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ABSTRACT

This report contains information to assist organizations and personnel responsible for the quality and quantity of operators available for water quality control efforts. The text discusses in detail the current developments in operator instructional programs. Each of the seven sections of this report deals with a specific aspect of manpower planning, including: (1) model planning aids; (2) existing instructional programs; (3) roles and responsibilities of state and national coordinating committees; and (4) examples of delivery philosophies and programs operative in four states. (CS)

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ED174478

Water

# An Instructional Delivery System for Manpower Management

## A Report for Water Pollution Control Agencies

U.S. DEPARTMENT OF HEALTH,  
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## To the Reader

The key individual in ensuring that a state has the right numbers of the right kinds of personnel, doing the right things at the right times in water pollution control, is the director of that state's water quality control program. The strategies he devises and decisions he makes will directly affect the vast body of personnel who implement water pollution control not only at the treatment plant level, but also at the regulatory level, in the area of design by consultants, and in related operator training by education organizations.

This report on and reference document for developing an instructional delivery system for manpower management is thus intended primarily for the state director, the PL 92-500 program manager, and the appropriate manpower and training staff concerned with training operators for water quality control.

However, there are many other organizations and personnel in the environmental field who will find this guidance document useful; these are shown in Figure 1, page 8.

# **An Instructional Delivery System for Manpower Management**

Produced by Clemson University

In Cooperation with

Illinois Environmental Protection Agency  
New Mexico Environmental Improvement Agency  
New York Department of Environmental Conservation  
South Carolina Department of Health and Environmental Control

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## EPA Review Notice

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## Summary Recommendations

1. Each state should designate a *State Training Coordinating Committee* to coordinate operator training activities in the water quality control field.
2. A *National Training Coordinating Committee* should be designated to assist the state organizations.\*
3. These organizations should seek to channel funds from federal, state, local, educational and professional organizations into a master plan to meet operator training needs.
4. These organizations should establish standard procedures for:
  - a. Developing performance objectives
  - b. Developing instructional materials and methods
  - c. Developing an instructional delivery system
  - d. Information transfer.

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\*Such an organization was set up and, in fact, began work as this report was being written. The organization is a committee with representatives from four associations concerned with operator training: Association of Boards of Certification for Operating Personnel in Water and Wastewater Utilities (ABC); American Water Works Association (AWWA); Federation of Associations on the Canadian Environment (FACE); and Water Pollution Control Federation (WPCF). This committee is coordinating activities within the United States and Canada and is pooling information about operator training materials and programs. For more information about the committee, see page 40.

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(Ernest Bennett), New York (Dan Campbell), South Carolina (Cliff Hawkins), and New Mexico (John Wright, Jon Thompson and Richard Holland) and their staffs supplied invaluable time and materials.



## Who Should Read This Report

While this report is intended primarily for the director of a state water quality control program, his PL 92-500 program manager and manpower and training staff, it will also be useful as a planning and reference book to many others, because of the book's comprehensive discussions and examples of current developments in operator instructional programs. The chart on page 8 shows other organizations and personnel who will be concerned about the quality and quantity of operators available for water quality control efforts. Their roles are covered in this report.

Readers of this report should be familiar with another document which addresses the same subject areas and served as a valuable point of departure: *Roles and Responsibilities for Developing a Comprehensive State Water and Wastewater Operator Training Program*, developed by the Association of Boards of Certification (ABC, 1976a). The concrete recommendations, as well as conceptual considerations, outlined in *Roles and Responsibilities* provided the basis for this report on instructional programs.

This report, with its comprehensive set of appendices, is organized to enable you to tailor it to your own needs. The section summaries following will enable you to identify those portions of the report that are relevant for you.

SECTION 1 is a brief discussion of a crucial concept: that manpower management must be viewed as a continuous process, not simply an administrative tool. The development of an instructional delivery system for general use in operator training assumes that manpower management activities will be conducted in this manner.

SECTION 2 reviews several model planning aids relating to manpower management that will enable you to make the meaningful manpower forecasts that are a

prerequisite for use of the instructional delivery system proposed in this report.

SECTION 3 lists pertinent instructional programs that are already developed for water quality control personnel. It also introduces *IRIS -- Instructional Resources Information System* -- which is a comprehensive, computer-based compilation of instructional programs and materials that provides the technological means to developing a truly systematic, universal approach to operator training.

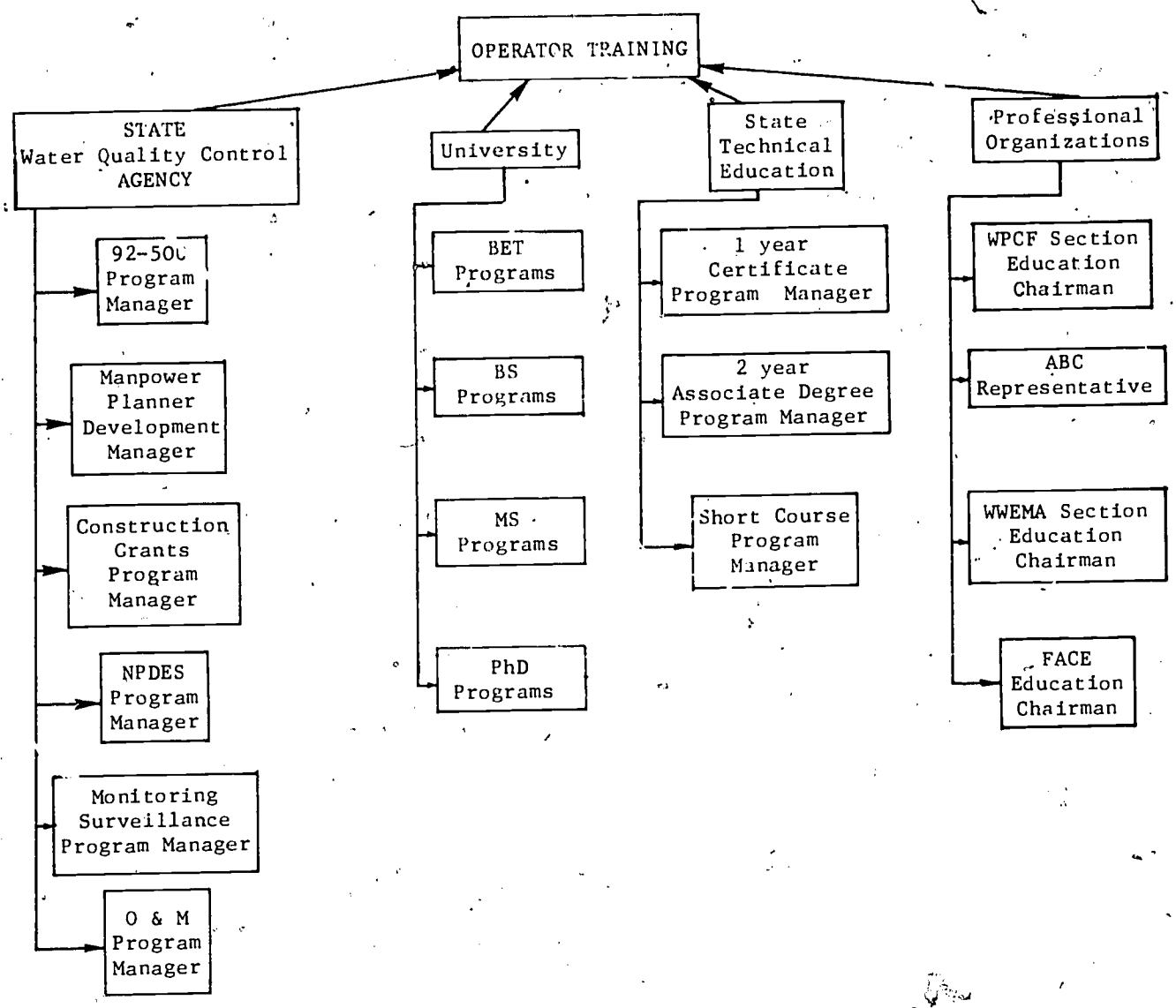
SECTION 4 presents a thorough analysis of the practical and theoretical considerations involved in developing an operator instructional delivery system for general use. The performance-oriented approach to training is explained, along with specific examples of its application. Modular learning and five instructional methods are discussed. Suggestions are made for the most effective and efficient procedures to coordinate the development of instructional materials.

SECTION 5 discusses the roles and responsibilities of suggested *State Training Coordinating Committees* and a *National Training Coordinating Committee*. It also provides an analysis of how these committees can cooperate in the development of an overall instructional delivery system for operator training.

SECTION 6 is a brief overview of recommendations concerning the establishment of a State Training Coordinating/National Training Coordinating effort for operator instruction.

SECTION 7 presents examples of instructional delivery philosophies and programs currently in use in the four states directly involved in producing this report.

Figure 1  
Organizations and Personnel Concerned with Operator Instructional Efforts



## Purpose

In recent years there have been several important studies concerning the ability of the water quality control profession to obtain optimum performance from the nation's water and wastewater treatment plants. The Association of Boards of Certification (ABC, 1976a) discusses shortcomings in recruitment, training and upgrading of operators. GAO (1976) and Gilbert (1976) review current operation and maintenance efforts at wastewater treatment facilities and suggest there is a great need for improvement.

Our own conclusion that many treatment facilities are not producing an effluent of the quality they might, because of deficiencies in operator performance, is thus not a particularly fresh insight. As far back as 1903 Anson Marston, a well-known design engineer, consultant, and professor at Iowa State University, wrote: "First the fact should be emphasized that any plant requires intelligent and diligent care. It will not run itself, no matter what the design. The plant should be placed by the city in charge of an intelligent and faithful man..." (Seidel, 1974). This realization of the need for high quality operation and maintenance personnel is now recognized not only by practitioners in the field, but also by the nation's decision makers, perhaps best stated by former Vice President Nelson A. Rockefeller: "I foresee situations in which even after billions of dollars are spent upgrading treatment, we will not have cleaner water because of ineffective operation and maintenance practices. There is already considerable evidence that some of the most modern of existing facilities are not being operated efficiently or are inadequately operated and maintained" (ABC, 1976a).

Educational and training programs have been available over the years to provide environmental manpower. Support has come from federal, state, local, professional

and educational organizations. For over a decade the Federal Government has appropriated large sums for training programs, which have offered considerable assistance. However, these training programs generally have not been as effective as they might be, as evidenced by the reports cited above from GAO (1976) and Gilbert (1976) and the statement by Mr. Rockefeller.

Further support of this is seen in the following summary comments from the state representatives involved in this report, along with comments from meetings of national, state, local, professional and training organizations concerned with manpower management and training of operators:

1. While many organizations and agencies are formally concerned with operator training;
2. While many persons at many levels in the water quality control field are similarly concerned;
3. While many types of instructional delivery systems are being used; and
4. While organizations and individuals in many locations are making strong and sometimes effective efforts in solving localized operator training needs;
5. There is much duplication of effort in the development of curricula, courses and instructional materials; and
6. There is an obvious lack of communication among the agencies, persons and other organizations involved.

During the past decade professionals in the water quality control field have explored a variety of instructional delivery methods which can be used in a systematic manpower management process to provide necessary personnel. This report, along

\*The term "operator" as used throughout this report includes all persons directly associated with management and operation of wastewater collection and treatment facilities.

with an extensive selection of relevant  
appendices, reviews possible approaches to  
consolidating these efforts and to devel-

oping an instructional delivery system for  
operator training that will be applicable  
statewide and nationally.

## Section 1: The Manpower Management Process

The extent to which comprehensive manpower management (as opposed to simple manpower "planning") is recognized by the state director as an essential activity -- and is made an identifiable and key element of the agency program -- can be an important measure of how effectively the agency itself will function and how well the state's water pollution control facilities will be staffed, operated and maintained.

The recent AWWA/WPCF/ABC/FACE annual joint project has produced a report entitled *Roles and Responsibilities for Developing a Comprehensive State Water and Wastewater Operator Training Program* (ABC, 1976a). The basic purpose of this project was to suggest ways to overcome some of the problems outlined in the previous section, by tying together the ABC certification process with training -- in such a way as to help make manpower management an "essential activity" on the state agency level. In particular, the report was intended to be used to:

1. Develop an outline for alternative methods for making operator training available statewide, and to identify a model program;
2. Describe methods that are needed to adequately meet the training needs established in certification programs; and
3. Establish guidelines for state boards for evaluating training courses and assigning training credits used in certification equivalencies.

It is no accident that in those states that are already thinking along these lines and that have systematic manpower planning, program development, and training of staff personnel and plant operators, significant gains have been made in achieving water quality objectives. Progress in proper staffing both within the agency and at the wastewater treatment level has

frequently been a reflection of how the state director perceives the manpower management function.

Where it ranks in importance and is coordinated with other functions like construction grants, monitoring and surveillance, enforcement and the other program areas under PL 92-500 requirements, the manpower management function directly influences the quality of agency activities that depend upon an adequate supply of qualified manpower.

Where it is relegated to minor status -- more as an afterthought than as a systematic management approach -- an agency frequently finds itself with problems at budget time resulting from confusion about the work to be done; with insufficient data to plan and coordinate training programs that correspond to the "real world" needs of the environmental workforce; and with an inability to identify clearly the new and changing skills required of personnel as program priorities are shifted.

Manpower management must be seen as a constant and top priority *process*, not simply a secondary administrative *tool*. Its operations should cover planning, training and recruitment, as well as certification, licensing and approval of operator qualifications. It is clear that trained and efficient manpower is the key to meeting responsibilities under PL 92-500 and to continuing environmental improvement, and this manpower simply cannot be developed haphazardly. A systematic process attacks head-on this most critical problem: How do you get effective measurements of the existing and projected environmental workforce so you can develop programs to insure that the right numbers of people with the right skills will be in the right places at the right time?

Applied properly in an environmental agency, the process will help assure that

these optimum manpower numbers and skills will be available to function not only in the agency, but in all elements of environmental control within the state -- educational institutions, consulting engineering firms, municipal and industrial

wastewater treatment plants, and the professional organizations.

It is within the framework of systematic manpower management that this report on instructional delivery methods has been prepared.

## Section 2: Manpower Management Tools

This report is not a how-to-do-it manual on the total manpower management process. It is, rather, one of a series of manpower documents developed jointly by EPA and the states that demonstrate step-by-step:

1. How you define work that must be done to achieve agency responsibilities, and relate that work to qualitative and quantitative manpower requirements.
2. How you determine the manpower resources available and required to carry out this work.
3. How you arrive at decisions concerning the work to be done and the resources to be made available if there is a workload-manpower imbalance.

This report, with its suggestions for developing instructional programs, is intended to be used in a fourth step: (a) how you can plan, along with personnel specialists, the kind of system necessary at the state level to develop the authorized manpower resources; and (b) how to develop the state's part in a national effort to coordinate the development and use of operator instructional resources.

These documents and their methodologies are designed and intended to be modified by state agencies to reflect conditions particular to their own situations. Below is a list of the primary manpower management aids that have been developed. For information on how to obtain these volumes and others noted, see page 6.

*Study of Manpower Needs for Implementation of the Water Pollution Control Act Amendments of 1972 - Report No. 1: Estimate of State Water Pollution Control Agency Manpower Needs.* U.S. Environmental Protection Agency, Washington, DC, 1975. 48 pages. Provides estimates of manpower needed for implementation of the Federal Water Pollution Control Act Amendments of 1972. Describes the methodology used for assessing the impact of the legislation on

state agency manpower requirements.

*Study of Manpower Needs for Implementation of the Water Pollution Control Act Amendments of 1972 - Report No. 2: Manpower Planning Criteria Manual for State Water Pollution Control Agencies.* U.S. Environmental Protection Agency, Washington, DC, 1975. 200 pages. A compilation of the manpower planning criteria used in *Report No. 1: Estimate of State Water Pollution Control Agency Manpower Needs*. Manpower planning criteria presented consist of function definitions, associated occupation definitions, staffing guides for estimating manpower requirements, productivity measures and rationale statements.

*Manpower Planning Methodology. Work and Manpower Planning for a State Water Pollution Control Agency.* (In draft form.) Manpower Planning and Training Branch, Municipal Operations and Training Division, Office of Water Program Operations, U.S. Environmental Protection Agency, 1976. 41 pages. Provides instructions that can be used by line managers and functional staffs of state water pollution control agencies to ensure that manpower factors are properly considered and provided for in their program planning process.

The following documents are also available from EPA. The details included in these documents are summarized in Table 1.

*Estimating Costs and Manpower Requirements for Conventional Wastewater Treatment Facilities.* Prepared by W. L. Patterson and R. F. Banker of Black & Veatch Consulting Engineers for the Office of Research and Monitoring, U.S. Environmental Protection Agency, Washington, DC, 1971. (Available at the U.S. Government Printing Office.) 251 pages. Contains occupational definitions, staffing guides and productivity measures, together with instructions for estimating costs and manpower requirements for conventional wastewater facilities (1-100 MGD).



*Estimating Staffing and Cost Factors for Small Wastewater Treatment Plants Less Than 1 MGD, Part 1 - Staffing Guidelines for Conventional Municipal Wastewater Treatment Plants Less Than 1 MGD.* Prepared by the Department of Industrial Engineering and Engineering Research Institute, Iowa State University, for the Manpower Development Staff, Office of Water Program Operations, U.S. Environmental Protection Agency, Washington, DC, 1973. 126 pages. Develops occupation descriptions and specifications for conventional waste treatment facilities having an average design flow of 0-1 MGD; provides time requirement estimates for job tasks in such a manner as to provide bases for staff planning.

*Estimating Staffing for Municipal Wastewater Treatment Facilities.* Prepared by the Office of Water Program Operations, U.S. Environmental Protection Agency, Washington, DC, 1973. (Available at the U.S. Government Printing Office.) 96 pages. Intended for use by consulting engineers, plant management personnel and state regulatory agencies. Provides productivity measures for various wastewater treatment plant processes and functions, and describes a four-step method for preparing staffing estimates for sewage treatment plants. Covers plants with capacities of from 0.5 to 25 MGD; sewage using primary, secondary and advanced treatment processes.

*Manpower Requirements for Wastewater Collection Systems in Cities of 150,000 to 500,000 in Population.* Prepared by Elie Namour of the Center for Manpower Research and Training, North Carolina A & T State University, Greensboro, NC, for the Manpower Development Staff, Office of Water Program Operations, U.S. Environmental Protection Agency, Washington, DC, 1974. 182 pages. Identifies specific manpower requirements in terms of types and numbers of personnel needed to operate and maintain wastewater collection systems efficiently in cities of from 150,000 to 500,000 in population. Provides occupational descriptions and descriptions of tasks.

*Research Report: Manpower Requirements for Wastewater Collection Systems in Cities and Towns Up to 150,000 in Population.* Prepared by Elie Namour of the Center for Manpower Research and Training, North Carolina A & T State University, Greensboro, NC, for the Manpower Development Staff, Office of Water Program Operations, U.S. Environmental Protection Agency, Washington, DC,

1973. 49 pages. Describes the methodology used in the development of the manpower planning criteria manual *Manpower Requirements for Wastewater Collection Systems in Cities and Towns Up to 150,000 in Population.*

*Dictionary of Water and Water Pollution Control Occupations.* Manpower Planning Branch, Manpower Development Staff, Office of Water Program Operations, U.S. Environmental Protection Agency, Washington, DC, 1972. 47 pages. Extracted from the U.S. Department of Labor's *Dictionary of Occupational Titles*; describes the duties peculiar to each occupational title.

*Micromanpower Planning in the Public Sector.* Prepared by J. Kenneth Davies and Colin Wright for the Office of Water Program Operations, U.S. Environmental Protection Agency, Washington, DC, 1975. 598 pages. Expands upon the publication *Manpower Planning for Wastewater Treatment Plants*, providing guidance on manpower planning methods, as well as conceptual information on labor economics, human engineering and institutional arrangements.

*Manpower Planning for Municipal Wastewater Treatment in Texas.* Prepared by the Environmental Education and Training Section, Texas Water Quality Board, to complete FY 76 "106" commitment to the U.S. Environmental Protection Agency, Region VI, Dallas, Texas. 151 pages. Describes the methods employed and results derived during a manpower forecast and analysis of training loads for wastewater treatment personnel in Texas. Provides age and educational characteristics of Texas municipal treatment plant certified personnel.

*Manpower Planning for Wastewater Treatment Plants.* Prepared by the Olympus Research Corporation for the Office of Water Program Operations, U.S. Environmental Protection Agency, Washington, DC, 1973. 212 pages. Provides methodologies and related guidance to state agency manpower planners.

*Manpower Analysis: Municipal Wastewater Treatment Facilities in New England.* Prepared by the New England Board of Higher Education's Student Internship in Economic Development Program, under a manpower planning grant from the U.S. Environmental Protection Agency, Waltham, Mass., 1972. 192 pages. Describes, on the basis of questionnaires and plant site visits, characteristics of the work force in wastewater



treatment plants in six New England States. Provides methodologies, and data on the number and type of training courses available to operators, as well as projections on future manpower needs of the industry.

*New York State Manpower Study for Municipal Wastewater Treatment.* Office of Environmental Manpower, New York State Department of Environmental Conservation, 1974. 85 pages. Provides the results of a survey of salary and staffing patterns studied in New York State (New York City excluded), and illustrates a model of manpower planning principles which were developed and could be applied in other states.

*Effectiveness Evaluation of Operator Training Conducted Under the PSC Program.* Prepared by J. Craig McLanahan and R. Clark Tefft for the Public Service Careers Section, State & Local Manpower Development Branch, Manpower Development Staff, U.S. Environmental Protection Agency, Washington, DC, 1972. 67 pages. Using (1) an analysis of the performance of a sample of wastewater treatment plants, (2) a survey of water quality board supervisors, and (3) a statistical correlation between operator training and plant performance, shows a favorable cost-benefit relationship between operator training and plant performance in Texas. Describes cost-benefit methodology that may be useful in other areas.

*Training Water Utility Employees Doesn't Cost ... It Pays.* Prepared by J. P. Reames, Water Distribution Division, Dallas Water Utilities Department, for the Public Service Careers Section, Office of Education and Manpower Planning, U.S. Environmental Protection Agency, Washington, DC, 1973. 13 pages. Describes the desirable effects of training on the retention of workers in entry jobs in the Water Distribution Division of the Dallas Water Utilities Department. Describes the methodology.

*Application of Selected Industrial Engineering Techniques to Wastewater Treatment Plants.* Prepared by Charles Mallory and Robert Waller for the Office of Research and Monitoring, U.S. Environmental Protection Agency, Washington, DC, 1973. 227 pages. A study performed to evaluate the

applicability of various industrial engineering techniques to operation and maintenance of secondary waste treatment plants. Conclusion reached is that industrial engineering techniques should be more universally applied in the planning, design, maintenance, operation and management of wastewater treatment plants.

*Handbook for Achieving Adequate Salaries for State Environmental Positions.* Prepared by Blazer, Zeni & Co. for the Water Planning Division, U.S. Environmental Protection Agency, Washington, DC, 1976. 74 pages. A handbook to assist state environmental administrators in achieving adequate salaries for environmental positions in order to improve recruitment and retention. Provides specific guidance on ensuring proper job structuring and classification.

*Methodology for Assessing the Demand and Supply of Manpower and Training Resources for Wastewater Treatment Plants.* (In draft form.) Prepared by the Manpower Planning and Training Branch, Office of Water Program Operations, U.S. Environmental Protection Agency, Washington, DC, 1977. 54 pages. Provides instructions and formats for (1) estimating current and future employment levels, new hire requirements and training needs of wastewater treatment facilities; (2) compiling data concerning training delivery resources; and (3) presenting analyses relating manpower and training needs relative to supply.

The 92-500 program manager and manpower and training officers will find many or all these sources useful in developing stronger manpower management capabilities within the agency. The methodologies adopted or devised by the agency will enable it to forecast, both internally and in the external environmental work force, how many personnel need to be developed or retrained; where and when they will be required; and what skills and abilities they will need. It is only after this kind of manpower needs assessment has been made that the state agency can develop the kind of instructional delivery system described in detail in the following sections.

**Table 1**  
**EPA Manpower Management Resources**

Manpower Management Resources	Classification Codes*												
	Planning Criteria				Methodologies								
	A	B	C	D	E	F	G	H	I	J	K	L	M
1. <i>Estimating Costs and Manpower Requirements for Conventional Wastewater Treatment Facilities</i> , 251 pages.	X	X	X	X									
2. <i>Estimating Staffing and Cost Factors for Small Wastewater Treatment Plants Less Than 1 MGD, Part I: Staffing Guidelines for Conventional Municipal Wastewater Treatment Plants Less Than 1 MGD</i> . 126 pages.	X	X	X	X									
3. <i>Estimating Staffing for Municipal Wastewater Treatment Facilities</i> , 96 pages.			X	X									
4. <i>Manpower Requirements for Wastewater Collection Systems in Cities of 150,000 to 500,000 in Population</i> , 182 pages.	X	X											X
5. <i>Research Report: Manpower Requirements for Wastewater Collection Systems in Cities and Towns Up to 150,000 in Population</i> , 49 pages.													X
6. <i>Study of Manpower Needs for Implementation of the Water Pollution Control Act Amendments of 1972, Report No. 2: Manpower Planning Criteria Manual for State Water Pollution Control Agencies</i> , 200 pages.	X	X	X	X									
7. <i>Dictionary of Water and Water Pollution Control Occupations</i> , 47 pages.	X												
8. <i>Micromanpower Planning in the Public Sector</i> , 598 pages.													X
9. <i>Manpower Planning for Municipal Wastewater Treatment in Texas</i> , 151 pages.													X
10. <i>Manpower Planning for Wastewater Treatment Plants</i> , 212 pages.													X
11. <i>Manpower Planning Methodology: Work and Manpower Planning for a State Water Pollution Control Agency</i> , 41 pages.													X
12. <i>Study of Manpower Needs for Implementation of the Water Pollution Control Act Amendments of 1972, Report No. 1: Estimate of State Water Pollution Control Agency Manpower Needs</i> , 48 pages.													X

Table 1 Cont.

Manpower Management Resources	Classification Codes*												
	Planning Criteria				Methodologies								
	A	B	C	D	E	F	G	H	I	J	K	L	M
13. <i>Manpower Analysis: Municipal Wastewater Treatment Facilities in New England</i> , 192 pages.					X						X		
14. <i>New York State Manpower Study for Municipal Wastewater Treatment</i> , 85 pages.					X						X		
15. <i>Effectiveness Evaluation of Operator Training Conducted Under the PSC Program</i> , 67 pages.													X
16. <i>Training Water Utility Employees Doesn't Cost ... It Pays</i> , 13 pages.													X
17. <i>Application of Selected Industrial Engineering Techniques to Wastewater Treatment Plants</i> , 227 pages.													X
18. <i>Handbook for Achieving Adequate Salaries for State Environmental Positions</i> , 74 pages.													X
<b>*Planning Criteria</b>													
A. Occupation Definitions													
B. Staffing Guides													
C. Productivity Measures													
D. Determining Manpower Requirements													
<b>Methodologies</b>													
E. State/Area Manpower Planning for Facilities													
F. Manpower Planning within Organizations													
G. Computerized Forecasting and Analysis													
H. Task/Occupational Analysis													
I. Analyzing Impact of New Legislation on Manpower and Training Needs													
J. Analyzing Impact of New Technology on Manpower and Training Needs													
K. Conduct of Manpower Surveys													
L. Cost-Benefit Analysis													
M. Improving Recruitment, Retention and Manpower Utilization Practices													

## Section 3: Public and Private Manpower Development Efforts

### INTRODUCTION

In order to determine systematically what instructional programs are needed to provide the required quantity and quality of operator personnel, you must first have a well-established methodology (see previous section on manpower management tools) that will indicate:

1. Numbers of operators needed
2. Types of operators needed
3. Levels of expertise in each level
4. Turnover (new entry)
5. Retraining (phasing in or out of activities)
6. Upgrading.

When this information is obtained, the next step in the manpower management process is to utilize an instructional delivery system that will provide the proper numbers of qualified persons at the correct time. This will require a supply of persons to move into the system, resources to support the system, and appropriate instructional methods to provide the training and education required.

### PRESENT STATUS OF EFFORT

A host of efforts at the federal, state, and local levels -- funded by federal, state, local, and private funds -- have developed instructional programs for water quality control personnel. The broad scope of these is indicated by Table 2, and many of the instructional products listed will provide valuable assistance in planning a statewide operator training system.

This list indicates the diversity of efforts and the many interested parties involved in them. The most comprehensive listing (EPA, 1976e) of all materials available for instructional programs in the water quality control field is to be found in the *Instructional Resources Information System* -- better known as *IRIS* -- which is available from:

National Technical and Operations  
Training Center  
Office of Water Programs/EPA  
Cincinnati, OH 45268

Over 2700 items are listed in the system and it is periodically updated. Anyone who is in any way involved in water quality control instructional programs should have a copy of the latest edition. (Appendix 1 gives more detail about *IRIS* and examples of its products.)

On a local scale, in some areas, coordination of effort has been attempted and occasionally achieved, but little has been done on the state or national basis. Illinois, New Mexico, New York and South Carolina have made efforts to do this, and their experiences have been reviewed and drawn upon in this report to discuss various approaches.

**Table 2**  
**Past and Existing Instructional Programs for Water Quality Control Personnel**

<u>PROGRAM OR PRODUCT</u>	<u>AUDIENCE DESIGNED FOR</u>	<u>FOR INFORMATION CONTACT*</u>
44-Week Training	New entries and persons with limited experience in wastewater field	A
Project Transition	Training of military personnel about to leave service for careers in wastewater	A
Public Service Careers	Training of disadvantaged persons for careers in water quality control	A
Correspondence Courses	Collection system and operational personnel at wastewater treatment plants	A
Criteria for the Establishment and Maintenance of Two-Year Post High School Wastewater Technology Programs. (Curriculum Outline and Instructor Guides.)	New entry for careers in wastewater treatment plant operations and maintenance	A
Standard Operating Job Procedures for Wastewater Treatment Plant Unit Operations	Wastewater treatment plant operating personnel	A
Development and Exchange of Instructional Resources in Water Quality Control Programs	Instructors and curricula development of water quality control instructional programs	A
A Two-Year Water Quality Monitoring Curriculum	New entry for careers in environmental monitoring and surveillance personnel	A
A Four-Year Wastewater Technology Program	New entry or continued study for two-year program graduates for careers in wastewater treatment plant design and operations and in regulatory agencies	A
Professional Training Grants	Graduate training in water quality control	A
Management Training for Water Quality Control	Upgrade training for persons moving into supervisory and management positions in water quality control facilities	A
Troubleshooting of Wastewater Treatment Facilities	Operating and regulatory agency personnel	A
Water Quality Instructional Resources Information System	Curriculum developers, instructors, water quality control personnel, librarians desiring information on instructional materials	B
NPDES Training Program for Basic Lab Skills, Municipal Parameters, Nutrients and Heavy Metals	Laboratory technicians involved in carrying out monitoring of NPDES permits	
Instructional Skills for Water Quality Instructors	Instructors in water quality control programs	A

Table 2 Cont.

<u>PROGRAM OR PRODUCT</u>	<u>AUDIENCE DESIGNED FOR</u>	<u>FOR INFORMATION CONTACT*</u>
Instructional Development Workshop	Instructors in water quality control programs	A
Instructors Guide for the Construction Grants Program for Municipal Wastewater Treatment Works	Instructors enrolled in training persons to fill out construction grant forms and work in construction grants program	A
Basic Laboratory Techniques for the National Pollution Discharge Elimination System	Laboratory and operating personnel involved in sample analysis for NPDES permits and process control	C
Procedural Manual for Evaluating the Performance of Wastewater Treatment Plants	Operators of wastewater treatment facilities	A
Operations Manual - Anaerobic Sludge Digestion (EPA 430/9-76-001)	Operators of anaerobic digestion systems	A

\*Addresses for contacts are as follows:

- A. Municipal Operations and Training Division  
Office of Water Program Operations  
U.S. EPA  
Washington, DC 20460
- B. National Technical and Operations Training Center  
Office of Water Programs  
U.S. EPA  
Cincinnati, OH 45268
- C. Dr. Joe F. Allen  
Chemistry Department  
Clemson University  
Clemson, SC 29631

## Section 4: Development of An Instructional Delivery System

### IDENTIFICATION OF DESIRED PERFORMANCE

Efforts to develop and implement operator training programs have usually been carried out on a local or state basis. While a number of useful individual results have been achieved, such as course outlines, sample curricula and actual instructional materials, little effort has been made to develop a truly comprehensive, systematic and universally applicable approach to operator training needs. And all too often the immediate objective of operator certification has guided these developmental efforts, rather than the long term goal of improved plant performance.

In order to provide such a systematic approach to training, a number of instructional schemes have been devised. One that shows great promise in the environmental field is the performance-oriented, or performance-objective approach, which is based on "job analysis." This approach is a consensus recommendation by the four states involved in this report, and it has the virtue of applicability nationwide.

With the use of the performance-oriented approach first to define work to be done and then to produce instructional materials, curricula can be developed which can be used virtually anywhere to bring operators up to the level of competence required to operate their plants according to accepted standards of performance.

Most conventional training programs contain few, if any, built-in techniques to measure their effectiveness, and training program certificates often attest merely to formal completion of courses, rather than actual learning achievement (i.e., the programs are not designed to systematically modify and measure desired performance changes in the operator). The performance-oriented approach, however, corrects these deficiencies.

This relatively new development in instructional technology is a branch on the same tree as the management by objectives concept employed by many of the world's largest business corporations. Both concepts have grown out of behavioral psychology and the techniques of operations research developed during World War II. All of these approaches have one thing in common: they enable you to break down any problem, plan of action or subject under study into specific, well-defined, simple parts in order to understand it fully. For a training program for operators, this means systematically breaking down the training into individual units of instruction arranged in logical sequence that let both instructor and operator trainee know:

1. Exactly what the operator must be able to do prior to beginning the unit of instruction (the *prerequisite* for the instruction, which determines at what entry level the operator can begin an instructional sequence).
2. What the operator must be able to do after instruction (his *terminal performance*) and under what conditions.
3. Whether the operator can demonstrate that he can, in fact, perform at the required level upon completion of the unit of instruction (this is determined by the evaluation instrument or test -- but test is not to be construed exclusively as conventional written answers to a quiz).

The units of instruction given to the operator are based *exclusively* on the performance objectives of a given task (what the operator must do, when and how well). A performance objective is defined as a goal for, or desired outcome of, learning, which is expressed in terms of observable behavior or performance of the learner (Montague and Koran, 1969). The emphasis on observable behavior or performance is most important. Only observable behavior can be evaluated quantitatively --



measured, in other words. You cannot measure what is inside the operator's mind, but you can readily measure what he does, and the only reliable way to determine the success of an instructional program for operators is to be able to measure how well they can perform the desired new tasks after completing the program. Expressing instructional objectives in terms of performance objectives provides the means for making that measurement, in addition to ensuring that the instruction is confined strictly to developing skill and increasing performance.

There is nothing magical about using performance objectives to develop instructional materials and procedures, but once the principle is seriously adopted, it gives an instructional program an internal logic and consistency that produce highly effective and practical teaching/learning results.

These straightforward statements of what the operator must be able to do at the end of a certain period of instruction will themselves strongly suggest the content and context of instruction (what methods and materials the instructor and operator must use). The instruction process is dynamic, not static, because it provides constant feedback for evaluating how well the instruction is going. If the operators are repeatedly unable to master the learning objectives, the instructor can and must alter his program to correct its faults. If the operators are having trouble, they will quickly discover it. When the continuous evaluation process indicates an operator has not mastered a particular skill, he can go through the instructional unit again until he can meet its performance requirements before progressing to the next level in the instructional sequence. This is a better and healthier learning environment than one in which the instruction focuses on general subject matter, rather than specific performance objectives, and the operator finds himself at the end of a long course of instruction realizing that he actually got lost back in the early stages.

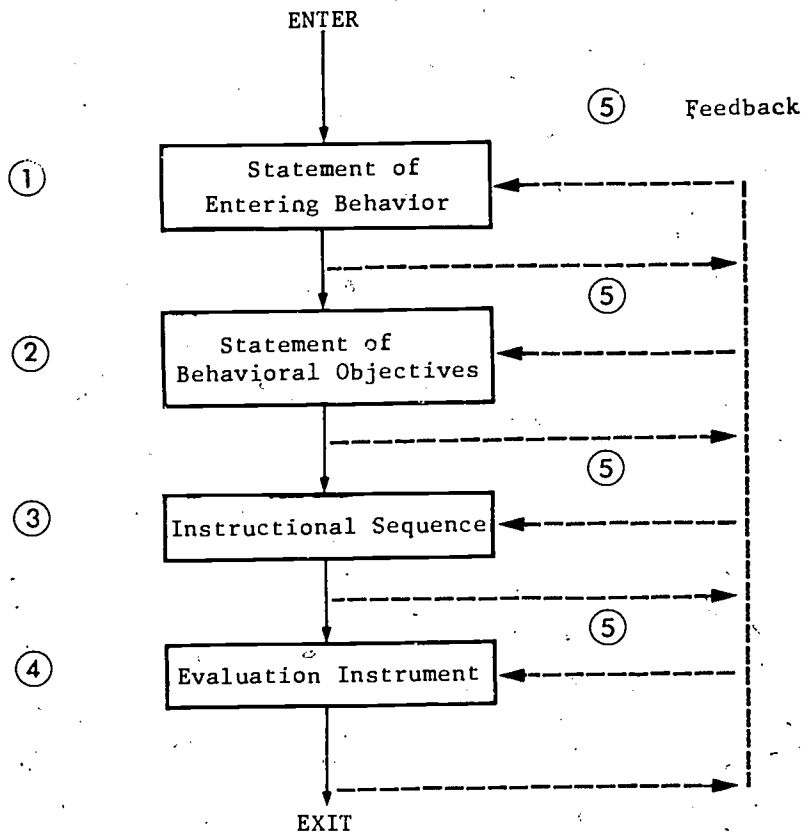
This whole approach to developing an instructional sequence is diagrammed in Figure 2. Initially, 1 the desired knowledge and skill level (entering behavior or prerequisites) of the operator must be determined. This indicates whether he is ready for the instructional sequence,

and if not, where his weaknesses lie and what remedial work he must undertake. Next, a statement of performance objectives ② indicates to the operator the new skills and knowledge he should have upon completion of the instructional sequence ③. These performance statements also guide the developer of the instructional sequence in limiting the instruction to only that material which is relevant to the performance objectives. The evaluation instrument ④, which is based solely on and must be consistent with the stated objectives, indicates to both the operator and the instructor and anyone else interested (e.g., potential employers) whether the objectives have been mastered. Feedback ⑤ from the operator, instructor and employer (indicated by the dotted lines), is an important aspect of the process, for it is the best way to determine at each step in the process whether the instructional sequence is working as it is designed to do.

The use of the performance objective approach to develop instructional sequences for operator training programs offers several advantages:

1. It requires that the curriculum developer be able to break down into specific, step-by-step performance components, each of the multitude of skills that various operators must have in order to perform their tasks at maximum effectiveness. Further, it forces the curriculum developer to produce performance-oriented instruction plans and materials that are based realistically on the specific performances that together define what the operator actually must do in his work.
2. It ensures that the stated performances will be achieved, but does not impose restrictions on the flexibility of instruction methods.
3. It is efficient. The ultimate goal is to provide the operator with the skills and knowledge required to perform specific tasks. There is no need for him to master more complex skills if they are not required in his work. The performance-objective approach ensures that the instructional program is relevant and that "nice to know" information is kept to a minimum.
4. It ensures that operators who graduate from the program achieve a standard level of competence, consistent with on-the-job needs.





**Figure 2**  
**Development of An Instruction Sequence**

5. It provides active and meaningful involvement of the operator in learning. By utilizing small, well-defined units of instruction, it lends itself to packaging in instructional modules that can employ a variety of learning aids. The learning modules are suitable not only for the classroom, but may also be developed for use in the plant for self-paced instruction and peer instruction.
6. It facilitates the evaluation of instructor performance and accreditation of the instructional programs.
7. It is a systematic and explicit approach not too dissimilar in principle and application from the precision that characterizes good engineering.

Applications in the Water Quality Control Field

The approach has been used in many instructional programs with great success (Table 2, page 20). It is the method advocated by the U.S. Environmental Protection Agency in the development of a national two-year post high school course for wastewater treatment operators, which has been initiated by three community colleges in the United States. (EPA, 1973, 1975a, 1976a, b, c, d, 1977; Reynolds and Austin, 1972; Lukc6 *et al.*, 1973; and Austin, 1974.)

The methods used in developing this course illustrate effectively the systematic approach to training recommended for

use in the water quality control field. Initially, a team of highly qualified individuals was assembled to work on the project. These included:

1. Practitioners in the field (operators, laboratory technicians, managers)
2. Water Quality control instructors
3. Two-year/curricula administrators
4. An instructional technologist.

The technical personnel on the project defined the type of equipment and process units to be included in the training program. Jointly the practitioners and the instructional technologist first defined broad categories of performance, then narrowed these down into detailed performance criteria. Each performance criterion was then matched with the appropriate equipment at each unit process until all conceivable performance requirements in the following seven areas were defined (see Table 3):

1. Normal operating procedures
2. Abnormal operating procedures
3. Preventive maintenance procedures
4. Corrective maintenance procedures
5. Laboratory Control procedures
6. Process interactions
7. Management/supervision procedures.

Breaking down the performance requirements into this amount of detail allows them to be resynthesized into a number of useful formats, such as all performance requirements for:

1. A particular process unit
2. A particular procedure (e.g., preventive maintenance) on all or selected process units
3. Selected tasks from a procedure (e.g., sampling and storage of samples from laboratory control procedures)
4. A complete two-year curriculum.

This approach provided a great deal of flexibility in developing not only the two-year wastewater technology program, but also courses on specific subjects for short schools and other types of instructional programs.

Other projects have used the same method:

A project sponsored by EPA produced a two-year water quality monitoring curriculum (Ulster County Community College and EPA, 1975). This program is now being implemented at Ulster County Community College.

Since graduates of the water quality monitoring program and the wastewater

treatment program may wish to continue their education in environmental technology, a four-year wastewater technology program has also been developed. Graduates of this program are trained for positions in treatment plant operations, regulatory agencies or with consulting firms (EPA, 1976f, g).

While the above programs were aimed at new entries into the field, operators already on the job needed a model to help them document the day-to-day normal and abnormal operating procedures for their own plants. Charles County Community College (1975) developed a series of *Standard Operating Job Procedures (SOJP)* (see Appendix 2) on a number of process units which serve as models to anyone wishing to develop performance-oriented guides for his own plant.

In addition to the development of guides and materials for instructors and trainee use, EPA has sponsored courses to help instructors in the water quality field learn how to apply the performance-oriented approach in their own instructional programs (see Table 2 for a list of instructional programs and Appendix 3 for an example of an application of the performance-oriented approach).

To assist water quality control personnel with the implementation of the NPDES Permit System, EPA has sponsored the development of a series of performance-oriented instructor guides (EPA, 1974a, b; 1976i, j, k). These detailed staff student guides give extensive detail on performance terms, on the organization and conduct of the instructional programs. One of these has been converted into a completely self-paced instructional sequence with detailed diagnostic tests for basic laboratory skills (Clemson University, 1976) (see Appendix 4).

Thus, the use of fairly standard, performance-oriented materials is already being promoted throughout the country, and many instructors are learning how to develop and use their own objectives (Charles County Community College, 1974). Compared to traditional methods of teaching, the performance-oriented approach might at first glance appear to be unwieldy, cumbersome and time consuming. However, the ultimate saving in time and money resulting from the use of a well organized instructional method that produces easily measured performance improvements, far outweighs its surface disadvantages.

**Table 3**  
**Definitions of Performance Categories**

PROCEDURE	DEFINITION
Normal Operations	These include routine operating activities that do not vary significantly from day to day and that are designed to keep the plant functioning within a normal range of values. For example, the operator conducts routine samplings of the primary sludge and inspects pumping equipment and the wastestream to verify that the process is functioning properly.
Abnormal Operation Procedures	These include activities of the operator that result from unusual and undesirable conditions of the wastestream. The abnormal procedures enable the operator to recognize when the wastestream is abnormal and to return it to an acceptable, normal condition. An abnormal wastestream results when a normal operation procedure is not properly applied, a corrective maintenance procedure is needed or management/supervisory procedures are poor. For example, the operator should recognize that a black septic primary sludge sample is an abnormal condition of the wastestream and take appropriate action.
Preventive Maintenance Procedures	These include routine maintenance activities of the operator which prevent major equipment breakdown and subsequent corrective maintenance. For example, the operator would lubricate bearings and other moving parts, replace worn components and adjust components of the primary sludge pumps.
Corrective Maintenance Procedures	These include maintenance activities of the operator that usually result from the breakdown or malfunction of a unit of equipment or a component. For example, the operator would notice whether the primary sludge pump is malfunctioning and know when and how to correct the disorder or when and how to refer the problem to plant maintenance personnel.
Laboratory Control Procedures	These include special and routine activities relating to laboratory analysis, the specification of sampling procedures and locations and the general management of the laboratory facilities. For example, the operator would collect primary sludge samples and conduct the analyses.
Systems Interaction Procedures	These include activities of the operator which relate the functioning of specific units of equipment to other process units and to the system as a whole. For example, the operator would determine how the effective functioning of the primary sludge pumps relates to digester performance.
Management/Supervisory Procedures	These include activities relating to employment practices, record keeping, plant operation policy and the establishment of a constructive and realistic rapport between the plant and the community it serves. For example, the operator would keep records on primary sludge pumping, keep an inventory of spare parts and evaluate the adequacy of maintenance procedures of shift personnel.

### Coordination of Efforts

Clearly, the performance-oriented approach is highly applicable to an instructional delivery system that is to be used in the manpower management process to develop resources. Most such efforts in applying performance objectives have been sponsored by EPA, or associated with persons working on EPA projects, and these projects have been coordinated. Most traditional operator training efforts (those that do not emphasize performance objectives) have not been well coordinated, however, resulting in much duplication of effort.

If all training were based on a systematic approach such as the one described, each funding organization could first investigate the status of other work before deciding to invest resources to develop new instructional materials. The approach would provide a much needed impetus for development of curricula, courses or materials by various organizations that will be compatible and interchangeable, with a minimum of alteration.

### DELIVERY METHODS

Overall training needs in the water quality control field may be characterized by the word "diversity," and an instructional delivery system to be developed for general use must take this into account. There are several factors to consider in designing an instructional system for the environmental field; these are listed in Table 4.

Location and the mobility of operators must be taken into account when deciding whether to take the operators to the training or the training to the operators. Prerequisites for particular instructional programs will be influenced by subject areas to be included, learning abilities of the operators and their level of experience. Remedial instructional programs may be needed. The specific instructional programs, or methods, selected for implementation will in part be dependent on how long operators can spend at the training site, as well as how much funding is available. (And, of course, one of the most important aspects of the entire training process is the attitude of management toward training -- encouraging

operators, allowing them to take training and rewarding them for completion of training.)

Using a modular approach to meet the "diversity requirement" for the training delivery system is a sound choice for many reasons. First, it allows great flexibility in developing courses to fit almost any kind of training need. Second, it provides for multiple instructional methods which can cater to any local constraints. Third, and perhaps most importantly, it enables the operator to divide his training into small units depending on his study habits. Also, in many training programs the operator is not evaluated until late in the training process. With the modular approach the operator is evaluated constantly and always knows just where he stands in the training process. The modular approach is applicable to any of the instructional methods which are discussed in this report.

One of the major administrative values of basing training on performance objectives and learning modules is that the objectives can be packaged in a great variety of ways to fit training requirements of different groups, yet contain comparable amounts of material so that Continuing Education Units (CEU's) can be assigned. This allows specialized training packages to be developed and their value assigned to fit the CEU system, assuring equal credit for training offered throughout the country.

At present, 10 hours of instruction is equated to one CEU. The approach of ABC in packaging instructional materials in several hour modules (an example of such a package is shown in Appendix 4 and is discussed in detail on pages 30-31) would readily fit the CEU system now used in the United States, which is based on hours of attendance in a training program. In the current CEU system, there may or may not be an evaluation of the operator to determine whether he has obtained some new knowledge or skill and can apply this in a working situation. With an instructional delivery system based on performance objectives, the units of CEU's earned by an operator would indicate that he had indeed reached the desired level of performance.

The selection of a training program and a subsequent evaluation to determine its applicability should be based on the improved performance of the facility where the operator works. Regular appraisals

**Table 4**  
**Factors to Consider When Selecting Delivery Methods for Operator Instructional Programs**

MAJOR FACTOR	VARIATION
Location	Geographical location of operators Accessibility of training site to operator Accessibility of operator to OJT instructor
Physical facilities, supplies and equipment available for training	At training site At operators' plant Need for specialized equipment Need for safety equipment Need for specialized conditions in a complete plant
Funds available	Support from level outside of operators' organization Operators' organization None -- on volunteer basis
Support of operators' superiors	Highly supportive -- will use organization's funds for training costs and pay operator during training Will pay training cost -- operator must take time off Will allow operator to be paid while training, but operator must pay for course and transportation Operator may go on leave time and pay all his own costs Operator must do on off hours
Attitude of superior	Encourages and actively seeks training for operator Will support operator if he finds opportunity Training OK on an occasional basis (once per year for 1 week) Will permit on leave time No interest -- waste of time Rewards operator for training (higher pay, more status, etc.) Does not acknowledge
Training resources availability	Instructional materials AV equipment Supplies Equipment Training treatment plant Transportation
Instructor availability	Technically competent Effective in communications and use of various media Motivates students Subscribes to performance-objective approach
Operator trainee prerequisites	Meets prerequisites of course a. reading level b. math level c. subject area background Remedial training available if does not meet prerequisites
Rewards available to operator	Increased pay Increased certification level or points toward Increased status a. more responsibility b. privileges Public recognition

should be made of each operator who passes through the program to determine whether the new knowledge and skills are improving his performance and that of his plant. For instance, some of the following measures might be used to evaluate an instructional program:

1. Meeting NPDES permit requirements
2. Meeting state regulatory requirements
3. Lower chemical costs
4. Less down time of equipment
5. Lower maintenance costs
6. Improved operator morale and work performance
7. Improved relations with public
8. Lower operator turnover
9. Faster progression through certification levels
10. Increased production of plant O and M manuals, etc.

There are many types of instructional delivery methods to be considered by an agency, but they will be classified into the following categories for discussion: self-paced, instructor-assisted-self-paced, short term, formal academic, and on-the-job.

#### Self-Paced

Self-paced materials are materials that have been developed and field-tested so that operators at the selected level of competence in the subject area can use the materials on an individual basis. After completion of the materials, a high percentage of the operators will have accomplished the performance objectives. All types of media can be used, such as printed materials, slides, audio tapes, slide/tapes, video tapes, overhead transparencies or motion pictures. Many different formats are possible and suitable for self-paced instruction. An example of a self-paced instruction module is given in Appendix 4. The essential features of a self-paced module are:

**WHAT IS THIS MODULE ABOUT?** -- A statement of the overall content of the module. (See page 97.)\*

**WHY DO I NEED TO LEARN THIS?** -- The reasons the material is important to the operator and where it will fit into his knowledge and skill requirements.

\*These page numbers refer to Appendix 4.

**WHAT DO I NEED TO KNOW BEFORE I BEGIN?** -- A list of the knowledge and skill the operator must have before attempting this new material. Often this is a list of prerequisite modules.

**WHAT EQUIPMENT AND SUPPLIES DO I NEED?** -- A list of materials needed to carry out the instruction. These are often listed by objective. This listing makes it easy for the operator to collect his materials before he begins the entire training process. (See pages 97-98.)

**WHAT SUPPLEMENTARY MATERIALS WILL HELP ME?** -- A listing of additional resource material which will offer different media and approaches to the instruction or go beyond what is in the module. (See page 98.)

**WHAT ARE MY OBJECTIVES?** -- A listing of the objectives the operator should have achieved upon completion of the module. (See page 99.)

Following the introductory material, the detailed instructional material is presented objective by objective. The objectives are separate units of instruction of appropriate length and content to be treated together. Each objective is composed of:

**ACTION** -- A statement of the performance required by the operator after completion of the material. Only action verbs are acceptable in these statements. (See page 100.)

**CONDITIONS** -- A statement of the conditions under which the operator will perform this action in practice. This would include what aids the operator would or would not have (e.g., a reference, calculator, etc.) or under what environmental conditions (e.g., working under 3 feet of water).

**PERFORMANCE** -- A statement of the quality of performance such as per cent correct or within a restricted tolerance or in conformance with a particular guide.

**INSTRUCTIONAL MATERIAL** -- This may take many forms; multimedia may be used. An example of a printed format is shown on pages 101 to 102 in Appendix 4. This may include text, pictures and exercises as in the example in the appendix or may include slides, tapes and other types of media.



**DIAGNOSTIC TEST** -- In order for the self-paced material to be complete, it is necessary to build operator self-assessment into the instruction. An evaluation instrument and answer sheet should be included with each module. (See page 104.) After meeting all the objectives of a module, the operator can complete the post-test to determine if he has mastered the material.

Often a series of modules can be combined in a unit of instruction. Operators may have some of the knowledge and skills required, yet be missing others. To minimize repetition of material already in the operator's repertoire, a comprehensive diagnostic test can be developed which will determine just what level of competence he has and, thus, which modules may be omitted and which should be studied.

A diagnostic test is often accompanied by a test "prescription." The prescription lists which module and objective relate to each test item. Thus, if an operator does not meet an objective, he on his own initiative can ascertain where the material is and go back and correct this deficiency in knowledge or skill. (See page 105.)

As will be seen in the subsequent discussion of other instructional methods, the self-paced modules can be readily adapted for use. Basing an instructional program on the development of self-paced materials adds a great deal of flexibility and economy of time for both operators and instructors.

#### Instructor-Assisted-Self-Paced

The remaining training methods all make use of an instructor in one way or another. In most cases the instructor is the focus for the information transfer. He controls the time, place, and content and methods used. Most of the decisions are based on the instructor's or his administrative system's preferences, rather than those of the operator. Many of these are valid because of considerations like persons' schedules and cost effectiveness or instruction given in large groups. However, all too often this kind of instructional program will be established and eventually becomes rigid, and thus does not allow better and more effective information transfer techniques to be used.

A person using the instructor-assisted-self-paced mode does not serve in the usual instructor role, but rather as a manager of the instructional process. The same instructional materials are used as discussed above. Whereas the operator working alone must repeat units of instruction one or more times or seek help when it becomes available on a particularly difficult point, the operator working on these materials in the presence of an instructor can get almost immediate assistance. An advantage this has over traditional instructor methods, where the same material is to be presented by a number of instructors at the same or different locations, is that subject matter is presented consistently and in a uniform format. This ensures that program graduates will exhibit "mastery" level performance of the knowledge and skills, rather than the usual bell-shaped curve distribution of performance.

In programs of this type, an information transfer method is used (Charles County Community College, 1974) which is economically and methodologically most efficient for the instruction intended, and which makes the instructor's role one of managing the instructional process by clarifying, motivating, encouraging and assisting the operator to extend himself to other training materials. An operator who learns quickly can complete more materials over a set time period because he is not in a lock-step program set by the instructor (or the slower student). On the other hand, the slower student can take additional time to study material and not hold up the class. The shy student can interact one-on-one with the instructor and receive assistance immediately and to the depth required, whereas in the normal class he may not seek assistance because of shyness or fear of appearing to be slow to learn. From an economic standpoint, operators may be working on different modules at different times, thus eliminating the necessity of having complete set-ups of equipment for each operator. Use of the diagnostic tests and prescription described in the previous section will assist in organizing an instructional effort in this way. An operator who masters the required objectives and modules can either go on to more advanced material or make use of supplementary materials to strengthen his grasp of the material or extend his knowledge and skills.

The instructor-assisted-self-paced method is used when:

1. Groups of operators in one location need similar instruction, supplies and equipment.
2. The instruction can be given at only one location.
3. Operators need an instructor because of deficiencies in prerequisites, lack of self-confidence (need constant reinforcement), lack of motivation (need frequent praise), and lack of good study habits.

The operator who moves quickly through the instructional sequence may serve as a peer instructor, helping those who need assistance. The operator acting as a peer instructor gains by reinforcing his knowledge and skill by having to work with someone else. He has an advantage over the instructor of having just gone through the learning process and can often diagnose another operator's problem faster. Also, the operator who needs help does not feel as "threatened" by his peer instructor, and a better line of communication is established.

#### Short Term

The most common form of short term training is the traditional short school held in many locations in the country. These vary from senior members of the operating profession lecturing on their experience, to classes on how to pass the certification exam, to performance-oriented instructional sessions.

The instructor-assisted-self-paced method discussed on pages 31-32 is highly applicable to short term training.

#### Formal Academic

Formal academic programs -- leading to associate of science (AS) (2-year), bachelor of technology (BET) (4-year nonengineering), bachelor of science in engineering (BS) and graduate work (MS, MEng or PhD) -- all have a place in providing manpower for plant operations. However, few persons of the total numbers needed will proceed into plant operations through a formal academic program. Persons qualified for the AS or BET programs often do not have the time or financial resources

or motivation to proceed through these programs. Persons graduating with BS, MS, MEng and PhD degrees seldom go into plant operations.

The self-paced and instructor-assisted-self-paced methods discussed earlier, however, do have definite application in formal academic programs just as they do in short term programs.

#### On-The-Job

On-the-job training usually consists of one-on-one interaction of an operator with an instructor utilizing verbal and hands-on techniques. It is effective for specialized techniques, but becomes very expensive if it is used for types of information transfer which can be handled in the classroom or, better yet, by self-paced materials. Most on-the-job instruction could be easily converted to instructor-assisted-self-paced instruction. Utilizing various forms of instructional media would cut down on the cost of the full-time interaction of the instructor and operator. The instructor would be used where needed as described above.

#### Coordination of Efforts

The above discussion on alternate instructional methods underscores the applicability and adaptability of the performance-oriented approach to operator training. Reviewing the points made in Table 4 (page 29) and the advantages of the various methods, it is possible for a state agency to match an instructional method with a particular training need. At present most agencies are geared for and are implementing short term, formal academic, or on-the-job instructional programs. As the performance approach gains momentum and more materials become available, they should be used not only by self-paced and instructor-assisted-self-paced programs, but also should be incorporated into the other types of programs throughout the country. This will necessitate close coordination to keep various agencies informed about what is being developed and is available and how to use it.



## INSTRUCTIONAL MATERIAL DEVELOPMENT

### Basic Considerations

As has been indicated, it is believed that state agencies can obtain optimum performance from operators, and thus from wastewater treatment plants, by the use of the performance-oriented approach to instruction (pages 23-26). During the past few years the Associated Boards of Certification (ABC) has suggested how the entire spectrum of plant operations should be broken into levels, and what knowledge and skills should be assigned to each of the four categories in each level (ABC, 1974 and 1975) (see Appendix 5). The performance objectives for each of the four ABC levels (ABC, 1974; 1975) in each of the four categories have been developed in a project conducted by Charles County Community College (CCCC, 1977) (see Appendix 6). These objectives provide a starting point for state agencies for the initial definitions of most of the performance required for operators in the water quality control field. (Slight modifications have been made in the system as proposed by ABC. Details of the present approach are given in the appendix.) A wide cross section of practitioners in the water quality control field have been selected to review these objectives to insure that they meet "need to know" criteria. Appendix 6 shows a sample of the performance objectives for a Level 1 operator in the category "process control for primary sedimentation."

Once these objectives have been developed, they will serve as a basis for both state agency sanctioned instructional programs and certification exam preparation. The translation of these objectives into a model certification exam with sample questions has been initiated, and an example of this effort may be found in *Model Certification Examination Procedures -- Operators of Wastewater Treatment Plants -- Process Control* (ABC, 1977). Appendix 5 shows several examples of the objective and its suggested corresponding certification exam question.

In addition, the objectives must be translated into instructional materials. The first step is to show the relationship or the sequences of the objectives in a matrix. A beginning of this matrix is available through a project at Charles County Community College (CCCC, 1978). Each of the performance objectives

identified for each ABC level has been coded and tracked through a training program. Instructor guides are now being developed based on these objectives. Table 5 summarizes the subject areas that will be available in 1978 in a format based on the worksheet shown in Appendix 14 (page 171).

Once the relationship of the objectives has been established, the production of instructional materials can begin. The basic step in the development of performance-oriented instruction is to lay out the instructional process on an instructional package worksheet. Appendix 14 shows examples of a worksheet and an explanation.

What is required of the operator can be spelled out clearly on the worksheet. The worksheet also provides space for suggestions for suitable instructional materials and an instructional approach. The instructor in planning can use these sheets to develop a number of different training delivery methods or modes of instruction.

If all development efforts will utilize the suggested Instructional Package Worksheet, or a modification of it, the water quality control profession -- on the state and national levels -- will be much closer to a uniform approach to solving the real need for high quality instructional materials, and to the development of an instructional delivery system for use nationwide.

### Efforts in the Water Quality Control Field

In recent years a number of instructional materials have been developed that allow use of multiple delivery methods. *Standard Operating Job Procedures* (Charles County Community College, 1975) for many unit processes in wastewater treatment plant operations can be used for classroom instruction as reference material, as a model for operators to develop their own O & M manuals in their plants, and as self-study materials. Appendix 2 shows a sample of an *SOJP*.

Another effort is the Basic Lab Skill self-paced modules described earlier (pages 30-31) (Clemson University, 1976). These have many applications in several instructional delivery methods of interest to a state agency. They can be used:

1. As a laboratory guide in a laboratory course on lab procedures.

**Table 5**  
**Summary of Instructor's Guide Being Prepared**

Subject	Level	Subject	Level
<b>INTRODUCTION TO WATER ENVIRONMENT</b>		RPM. . . . .	I
Natural Cycles . . . . .	I	Thermometer. . . . .	I
Properties of Water . . . . .	I	V Notch Weir . . . . .	I
Properties of Wastewater. . . . .	I	Venturi. . . . .	II
Major Wastewater Treatment Processes. I		Watt Meter . . . . .	I
<b>BASIC KNOWLEDGE</b>		Bubbler Controls . . . . .	II
Basic and Applied Math. . . . .	I	Counter Controls . . . . .	I
Safety. . . . .	I	Dials. . . . .	I
Communication . . . . .	I	Digital Control System . . . . .	I
Lab Skills. . . . .	I	Electric Control System. . . . .	II
<b>RECORDS AND REPORTING</b>		Floot Control System . . . . .	I
Preparing Purchase & Service Orders . I		Hand-off-auto Selector . . . . .	II
Ordering Consumable Supplies. . . . .	I	Hydraulic Controls . . . . .	I
Completing Report Forms . . . . .	I	Lead-follow Selectors. . . . .	II
Handling Emergencies. . . . .	I	Log Scales . . . . .	II
Maintaining Preventive & Corrective		Pneumatic Control System . . . . .	II
Maintenance Records . . . . .	I	Pressure Gage. . . . .	I
<b>HYDRAULIC EQUIPMENT</b>		Recorders. . . . .	II
Airlift Pump. . . . .	I,II,III	Time Controls. . . . .	II
Centrifugal Pump. . . . .	I,II,III	Totalizer. . . . .	II
Duplex Pump . . . . .	II,III	Vacuum . . . . .	I
Ejector Pump. . . . .	II,III	Valve Activators . . . . .	II
Positive Displacement Pump. . . . .	I,II,III	Dry Feed System. . . . .	II
Screw Lift Pump . . . . .	II,III	Pressurized Gas System . . . . .	II
Single Speed Pump . . . . .	II,III	Solution Feed System . . . . .	I
Two Speed Pump. . . . .	II,III	<b>ELECTRIC POWER EQUIPMENT</b>	
Variable Speed Pump . . . . .	II,III	Induction Motor. . . . .	II
Automatic Valves. . . . .	II	Small Motor. . . . .	I
Ball Valves . . . . .	I	Squirrel Cage Motor. . . . .	II
Check Valves. . . . .	I	Synchronous Motor. . . . .	II
Couplings . . . . .	I	Delta Transformer. . . . .	II
Dosing Siphons. . . . .	I	Y Transformer. . . . .	II
Fittings. . . . .	I	Electric Circuits. . . . .	I,II
Gate. . . . .	I	Manual Switch Gear . . . . .	II
Globe . . . . .	I	<b>SMALL GASOLINE POWER EQUIPMENT. . . . .</b>	
Petcocks. . . . .	I	<b>LARGE GASOLINE POWER EQUIPMENT. . . . .</b>	
Pipe. . . . .	I	<b>DIESEL POWER EQUIPMENT. . . . .</b>	
Plug Valves . . . . .	I	<b>AUXILIARY EQUIPMENT</b>	
Position Indicators . . . . .	I	Speed Reducers . . . . .	I,II
Pressure Control. . . . .	II	Centrifugal Blowers. . . . .	I,II
Vacuum Relief . . . . .	II	Reciprocating Compressors. . . . .	I,II
Valve Activators. . . . .	II	Rotary Positive Displacement	
Amp Meter . . . . .	I	Compressors. . . . .	I,II
Kennison Nozzle . . . . .	II	<b>PRE AND PRIMARY TREATMENT</b>	
Magnetic Flow Meter . . . . .	II	Screening & Grinding: Barminutor. . . . .	II
Parshall Flume. . . . .	II	Screening & Grinding: Hand	
Proportional Flow Weir. . . . .	II	Cleaned Bar Screen . . . . .	I
Rectangular Weir. . . . .	I		
Rotameter . . . . .	I		

Table 5 Cont.

Subject	Level	Subject	Level
<b>PRE AND PRIMARY TREATMENT</b> <i>continued</i>		Nitrite . . . . .	II
Grit Removal: Cyclone . . . . .	II	Specific Conductance . . . . .	II
Grit Removal: Hand Cleaned . . . . .	I	SVI-SDI - Sludge Age . . . . .	II
Primary Sedimentation: Combined Sedimentation/Digestion . . . . .	I	Total Dissolved Solids . . . . .	II
Primary Sedimentation: Rectangular . . . . .	II	Total Solids . . . . .	II
Pumping Station: Bubble Control Duplex, Two Speed . . . . .	II	Turbidity . . . . .	II
Pumping Station: Wet Well Mounted Lift Station . . . . .	I	Volatile Acids . . . . .	II
<b>SECONDARY TREATMENT</b>		<b>SUPERVISION</b>	
Trickling Filtration: Roughing, Rotary . . . . .	I	Planning . . . . .	IV
Trickling Filtration: Single Stage, Rotary . . . . .	II	Coordinating . . . . .	IV
Aeration: Aerobic Digestion Mechanical Propeller Aerator . . . . .	III	Directing . . . . .	IV
Aeration: Extended - Air . . . . .	I	Work Delegation . . . . .	IV
Secondary Sedimentation: Circular Center Feed, Suction . . . . .	II, III	Inspection . . . . .	IV
Package Plant: Under 25,000 gpd . . . . .	I	<b>PERSONNEL</b>	
Package Plant: Over 25,000 gpd . . . . .	II	Interviewing . . . . .	IV
Lagoons: Aerobic . . . . .	II	Orienting . . . . .	IV
Lagoons: Facultative . . . . .	I	Evaluating . . . . .	IV
Aeration: Mechanical, Fix Bridge, Surface . . . . .	II, III	Disciplining . . . . .	IV
<b>SOLIDS HANDLING</b>		Dismissing . . . . .	IV
Sludge Digestion: Fixed Cover, Gas Recirculation, Rotary Positive Displacement Compressor, External Heat Exchanger, Single Stage, Flame Arrestor & Gas Production . . . . .	II	Development . . . . .	IV
Sludge Conditioning & Dewatering: Single Stage Elutriation . . . . .	II	Staffing . . . . .	IV
Solids Disposal: Landfill . . . . .	I	Training . . . . .	IV
Solids Disposal: Multiple Hearth . . . . .	III	Safety . . . . .	IV
<b>DISINFECTION</b>		<b>REPORTING</b>	
Gas Chlorination, 150 lb. Cylinder Mounted . . . . .	I	Daily . . . . .	IV
Gas Chlorination, Ton Cylinder . . . . .	II	Weekly . . . . .	IV
Hypochlorination . . . . .	I	Monthly . . . . .	IV
<b>ADVANCED WASTE TREATMENT</b>		Annually . . . . .	IV
Intermittent Sand Filter . . . . .	II	Regulations . . . . .	IV
Precipitation . . . . .	II	<b>FINANCIAL</b>	
Rapid Sand Filter . . . . .	II	Purchasing . . . . .	IV
<b>LABORATORY</b>		Inventory Control . . . . .	IV
Acidity . . . . .	II	Budget Preparation . . . . .	IV
Alkalinity . . . . .	II	Budget Review . . . . .	IV
COD . . . . .	II	Bonding & Grant Procedure . . . . .	IV
F/M Ratio . . . . .	II	<b>PUBLIC RELATIONS</b>	
Kjeldahl Nitrogen . . . . .	II	Complaints . . . . .	IV
		Promotion . . . . .	IV
		Tours . . . . .	IV
		Seeking Support . . . . .	IV
		<b>EMERGENCY PROCEDURES</b>	
		Planning . . . . .	IV
		Coordinating . . . . .	IV
		Directing . . . . .	IV
		Work Delegation . . . . .	IV
		<b>LEGAL</b>	
		State & Local Regulations . . . . .	IV
		Federal Regulations . . . . .	IV
		Local Responsibility . . . . .	IV
		Contracts . . . . .	IV

2. As a workbook in self-paced laboratory courses.
3. By an operator in his own plant, along with a knowledgeable person in laboratory skills.
4. By an operator in his own plant on his own, with telephone contact to a training center to ask questions.
5. By an operator in his own plant on his own, with assistance received from an itinerant instructor during his periodic visits.

In addition to the *SOJP* and Basic Lab Skill projects, others are under way or planned, but it has been difficult for instructors in the water quality field to keep abreast of all the instructional materials available that might be used by operator trainees or by an instructor in preparing his own materials. The *IRIS* project discussed on page 19 has now developed a listing of instructional materials to solve this problem. The present listing has over 2700 items that are available in various forms such as printed matter, slides, audio tapes, motion pictures, overhead transparencies and video tapes. *IRIS* is available on microfiche (42x) with access available by ID number, title, author, source, type of material, category and subject. Appendix 1 gives more detail of the system and examples of its products.

#### Coordination of Efforts

The performance-oriented approach offers many advantages in the water quality control field, not the least of which is that the adoption of a standardized approach to operator training will bring about great savings in overall expenditures for training. The elimination of duplication of effort with the sharing of materials is a major feature of the approach.

A recommended first step in this coordination effort is the adoption of a standard methodology to develop performance objectives (as suggested in pages 33-36) and the establishment of a national clearinghouse (or committee) for instructional system development in the water quality control field. This would enable each state agency (and other interested organizations) to place instructional package worksheets on file and request ones in other subject areas to assist in curricula,

course and instructional material development.

Secondly, all states should make maximum use of *IRIS* to keep abreast of what is available for use in instructional programs. A system for entering new items, updating the listings, and transmitting the updated information to users, has already been designed, and only the administrative details remain to be worked out.

Thirdly, an information system should be established that will keep instructional material developers abreast of what is being developed around the country. This listing would indicate what is being developed, where, by whom, when expected to be ready and other details. A suggested format for this effort is given in Appendix 7. Note that an item entered into this system immediately moves into *IRIS* when it is completed. Most of the information is the same as that required by *IRIS*. Information of this type would help eliminate duplication of effort by two or more groups working independently on the same development project.

A fourth effort useful to state agencies would be a listing of water quality control courses being offered around the country. An example of a suggested mechanism for accomplishing this is shown in Appendix 8. A review of the information found on the form would indicate to an agency planner or other user:

1. Whether a course is available to fit the needs of operators he wishes to have trained.
2. Where, if a course is not available, he can get assistance in developing his own course from a person in charge of a related course.
3. If he wants to develop a course, who else has already done this and whether he can benefit from their experience by either bringing the instructors to his location to put on a course, or reviewing course materials while developing his own.
4. What information is available about instructional materials to use in a course he is considering.

The national clearinghouse, or committee, would have to maintain contact with each agency that sponsors courses to keep the listing updated, and then be able to transmit this information to interested parties.

## Section 5: Management Systems

### THE STATE INSTRUCTIONAL DELIVERY SYSTEM

#### Introduction

There is a clear need for each state to have its own distinct instructional system and mechanism to coordinate, guide or regulate the development and use of instructional programs and materials for operators in the state. The following discussion explores the essential points that should be considered in the establishment of the instructional delivery system and what this report will call a "State Training Coordinating Committee."

#### Program Management

Most states do have some mechanism for managing some aspects of water quality instructional programs. In some states, a governmental organization such as the state regulatory agency or an educational institution provides the leadership and directs a program for new entry and upgrade training for operators. In other states these efforts are directed by private organizations set up for this purpose or by some of the professional organizations.

In most cases the organization covers one or more aspects of the coordination and training need, but often does not include all aspects. Table 6 summarizes the major activities that should take place in the State Training Coordinating Committee. It may not be necessary for the organization to control the budgets and operation of these activities (usually it cannot because they are housed elsewhere in state government or private organizations), but it must coordinate all the activities for maximum effectiveness in providing the quantity and quality of manpower needed.

For maximum effectiveness, each state should work closely with a national effort. Such an effort has begun and is described

on page 40. The most important first effort is to open lines of communication between state coordinating committees and the national coordinating committee.

#### Program Area Definition

In developing a state instructional system for water quality control, one of the initial efforts of the State Training Coordinating Committee must be to define the types of treatment plants, the process units in these plants and each component of each process unit. This has been done in a number of efforts which can serve as models (EPA, 1973, and Charles County Community College, 1975).

In most states several branches of the educational system are involved in instructional programs of interest to the managers of the state's operator training program. The groups may include (1) universities which are preparing engineers, scientists, and managers; and (2) the community colleges or technical education centers providing technicians. Both groups provide short term courses on specialized topics. In addition, many state agencies supply funds for special courses, technology transfer seminars and the like. Funds from federal agencies often funnel through state agencies for manual development and courses. Coordination of these activities would not only allow for more efficient utilization of state controlled funds, but also allow for coordination with other states, federal agencies and other interested organizations.

Since most states have control of their instructional efforts, it is reasonable that they should also control the quality of the instructors used in these efforts. All too often someone is selected as an instructor because of time spent in a position where he has been exposed to the subject matter of the proposed course. This

**Table 6**  
**Water Quality Manpower Management Activities**

ACTIVITY	DESCRIPTION	SEE THESE PAGES FOR MORE DETAIL
Personnel categories	Names of personnel categories such as operators, shift foremen, chemists, managers, sample collectors, etc.	Pages 13-17
Performance definition	Description of performance required by each category listed above in each level.	Appendix 6
Manpower needs assessment	Numbers of persons needed, where and when.	Pages 13-17
Performance required	Detailed performance objectives for every aspect of each level and category defined above.	Appendix 6
Evaluation questions	Translation of performance objectives into evaluation questions to be used in training as well as certification.	Appendix 5
Instructional system development	Design of instructional delivery system to meet operators' needs.	Appendices 2, 4
Instructor development	Training of instructors to carry out various instructional delivery programs	Appendix 3
Instructional material development	Development of instructional materials for use in various delivery methods.	Pages 33-36 Appendices 2, 4
Coordination	Coordinating allocation of funds and activities by federal, state, local and private organizations.	Pages 37-41
Informing	Keeping all levels of persons engaged in instruction informed.	Appendices 1, 7, 8

experience, however, does not necessarily mean that he will be a successful instructor. An effective instructor must:

1. Have technical competence in the subject area.
2. Have the communication skills to transmit his knowledge to the operator.
3. Have the personality to motivate the operator so that he will be able to accomplish the stated performance objectives in the minimum time and most efficient manner.

If high quality, self-paced instructional materials are made available to operators, the materials themselves will communicate the subject matter, and all that is left is to motivate the operator. However, instructors will be needed in many

training situations, and a systematic approach should be used to prepare persons for this role. Appendix 3 contains a list of objectives developed for a series of training courses that prepare instructors for the water quality control field. Besides the technical competence the instructor brings to the course, the trained instructor will go away with expertise in communication skills and instructional systems development techniques as outlined in Appendix 3.

#### Performance Definition

The State Training Coordinating Committee must have some means for setting priorities



of training needs. With the performance objectives defined for all four levels of ABC grades (CCCC, 1977) in the wastewater field, it would be expeditious for the State Training Coordinating Committee to keep an up-to-date inventory of which performance categories most frequently are not being met in plant operations. This information, coupled with the numbers of persons involved with these operations, will set the training priority. Of course, there will be a base-line training effort for new entries into the field, upgrading of personnel, and the incorporation of new technology in the field. Several efforts have developed methods for estimating future manpower requirements (see pages 13-17).

ABC has reviewed existing certification practices (ABC, 1976b, 1977a). In addition, ABC has used the detailed objectives developed for the four levels of ABC (CCCC, 1977) (see Appendix 6), and has suggested procedures for converting these objectives into certification exam questions (ABC, 1977) (see Appendix 5). This material with its associated workshop will assist the states in developing not only performance-oriented certification exams, but also exams which will meet Equal Employment Opportunity Commission (EEOC) requirements. Appendix 5 gives an example of an objective from Level 1 for a primary sedimentation unit, the test item specification for generating a certification exam question, and the exam question.

#### EEOC Requirements

In recent years the relevancy of certification exams as a measure of on-the-job performance has been questioned and law suits have begun in two states (Texas and California). Recent federal regulations outlined by EEOC have spelled out requirements to be met (see Appendix 9). The important point here is that persons involved in training and certifying operators must consider the implications of these legislative and judicial acts. If they do not, the courts will set the basis on which operators are certified.

The Civil Rights Acts of 1964 (U.S. Government, 1964) included the first mention of what might be constructed as illegal selection procedures:

"...allows employers to give and to

act upon the results of any professionally developed ability test provided that such test, its administration or action upon the results, is not designed, intended or used to discriminate because of race, color, religion, sex or national origin."

Although this early law did not mention training and certification directly, a later administrative interpretation did. In 1970 the Equal Employment Opportunity Commission stated (Sharf, 1976):

"The term test is defined as any paper and pencil or performance measure used as a basis for employment decision. The guidelines in this part apply; for example, to ability tests which are designed to measure eligibility for hire, transfer, promotion, membership, training referral or retention."

Thus, it behooves training and certification authorities to be ready to demonstrate that selection procedures are job related. Two types of validation are required, content validity and criterion-related validity (see Appendix 9 for a discussion of these terms). A review of these topics will indicate the soundness of the performance-objective approach discussed earlier in this report and its applicability to the requirements of EEOC.

#### Manpower Instructional System Development and Delivery

Perhaps the greatest savings in time and money for any state effort will accrue from the willingness and ability of the State Training Coordinating Committee to coordinate its training effort with other public and private groups, both inside the state and with other state and national organizations. On pages 23-25, detailed approaches were described on the development of performance objectives and translating these into courses and curricula. In addition, schemes were proposed for listing instructional materials available (IRIS) (Appendix 1), instructional materials under development (Appendix 7), and courses available (Appendix 8). If the State Training Coordinating Committee actively participates in these activities, duplication of effort would be minimized, thus saving both time and money. Also, the standardization of production techniques would increase the

usefulness of each new item produced.

Efforts to provide this kind of cooperation are in effect in some areas, for example, in Maryland, which has a coordinating group made up of the organizations indicated in Table 7. This group meets periodically to exchange information about training activities and to plan additional cooperative efforts.

### Selling the Program

Traditionally, training has not been a high priority item with top managers and decision makers, and as a result several innovative efforts have been needed over the last few years in order to reach these personnel.

In South Carolina a series of 10 workshops was held to increase the awareness of elected and public officials to their obligations and responsibilities. These workshops, entitled "WHO IS RESPONSIBLE FOR CLEAN WATER?" stressed the need for training and assistance available to the community to obtain this training. Appendix 10 contains sample materials from this workshop.

In Texas, a slide-tape presentation was prepared to use at meetings where public officials learned about the roles they should play in improving facility operations. Public service announcements (PSA's) have also been used to alert public officials, as well as the general population, to the importance of their treatment facilities. (Federal regulations require TV and radio stations to include some public service announcements in their programming.) Appendix 11 reviews two of these public relations efforts.

Selling techniques are required not only with management, but also with those who will benefit from the training. Too frequently the operator receives little if any reward for the effort put into training, and the common rewards of increased pay or responsibility are not as widely practiced as they should be. For any instructional system to be effective it must clearly show the prospective trainee how he will be rewarded for the effort. Many rewards are common, such as increased pay, prestige, responsibility and privileges. Reports about the use of these various techniques should be widely disseminated. Keeping the operator aware of opportunities

can be handled by periodic newsletter. Appendix 12 gives an example of a newsletter used in South Carolina (the example shown is concerned with training opportunities).

One most important aspect of selling training to management is to collect hard facts of the costliness of *not* training and *not* having proper management systems for operational personnel -- information on such items as:

1. Capital cost of municipal treatment plant per operator (as compared with industry).
  2. Dollar value of savings to plant attributed to improved performance of staff.
- State training personnel should make collecting this kind of information a priority item so as to have some powerful facts to marshal when dealing with the setting of program priorities.

### NATIONAL TRAINING COORDINATING COMMITTEE

The effectiveness of the State Training Coordinating Committee suggested in the previous sections will be greatly enhanced if there is a National Training Coordinating Committee to serve as a clearinghouse for information. Such an organization is already in existence and has begun to coordinate activities within the United States and Canada and to pool information on operator training materials and activity. The organization is a Committee with key members from four associations concerned with operator training: ABC, AWWA, FACE, and WPCF.

Recommendations contained in the report *Roles and Responsibilities for Developing a Comprehensive State Water and Wastewater Operator Training Program* (ABC, 1976a) formed the basis for establishment of the Committee. The Committee will seek to accomplish two objectives in the near future. First is the establishment of an operator training communications system beginning with the identification of state and province training contacts. (Appendix 13). The next objective is a major project to complete a matrix to assess available training material. The matrix was begun as an appendix to the ABC report, which also presented criteria for new material development. Being aware of several ongoing projects which would provide useful information for the matrix, the Committee will seek to establish close coordination with them.



Table 7  
Maryland Advisory Committee for Training of Water and Wastewater Operators

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ORGANIZATION

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American Society of Civil Engineers  
Charles County Community College  
Chesapeake Section, American Water Works  
Association  
Chesapeake Water and Pollution Control Section  
Civil Engineering Department, University of  
Maryland  
Environmental Manpower and Education,  
Department of Natural Resources  
Maryland Board of Certification  
Maryland Environmental Services, Department  
of Natural Resources  
Maryland Municipal League  
Maryland Operators Association  
Office of Director, Environmental Health  
Administration, Department of Health and  
Mental Hygiene  
Operations Section, Division of Water and  
Sewerage, Department of Health and Mental  
Hygiene  
Public Water Supply Section, Environmental  
Health Administration, Department of Health  
and Mental Hygiene  
Washington Suburban Sanitation Commission  
Water Resources Administration, Department of  
Natural Resources

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## Section 6: Recommended Approaches to Management Organization Structure

In summary, each state should establish or designate an organization to coordinate operator training activities in the water quality control field. This State Training Coordinating Committee must have the authority, personnel and funds to do the job effectively. Tasks to be accomplished include the establishment of development standards for training materials, development of delivery methods and an overall instructional delivery system, maintaining information systems for materials and courses, and providing information services such as newsletters and workshops.

All this can be greatly facilitated if each state will keep the National Training Coordinating Committee appraised of its activities and is willing to share its information and efforts with this national group and other state committees. (This kind of effort has already been started, as discussed on page 40.)

To be effective, each State Training Coordinating Committee must make maximum use of funds and funding sources available

to it. The organization should develop plans to tap all possible sources, such as federal agencies, state legislatures, pay-as-you-go plans, etc., and information about successful, innovative funding strategies should be channeled through the national coordinating group.

The national organization should serve to bring tight focus to the development of new approaches to training. This might be accomplished by obtaining grant money itself to conduct efforts or by funneling funds to state organizations that have demonstrated competence in particular areas. The national organization should assist funding agencies in selecting contractors, evaluating quality of efforts on grants, setting standards for instructional material development, and evaluating graduates of programs for improved performance on the job.

## Section 7: Examples of Instructional Delivery Programs In Use

### INTRODUCTION

The four states -- Illinois, New Mexico, New York and South Carolina -- which provided much of the information, evaluations of the state of the art of operator training, and suggestions for future directions contained in this report, all have instructional delivery programs and philosophies that can be looked at as representative of many other states. In this section some of those specific ideas and programs are outlined as examples of current approaches to operator training. The discussions that follow were provided by the four states.

### ILLINOIS

Many wastewater treatment facilities in Illinois can achieve a higher degree of treatment than is presently being accomplished. A number of plants demonstrating less than optimum treatment are in fact hydraulically or organically underloaded. There are a number of reasons for such unsatisfactory performance. It may be due partially to improper assumptions in design, construction errors, to improperly evaluated industrial wastes or to unexpected infiltration/inflow. It is, however, generally agreed that the major deficiency in achieving optimum operation of Illinois wastewater treatment facilities is due to inadequate operation and maintenance procedures.

The primary objective of an effort called Project Optimize is to improve significantly the operation and maintenance of 150 specific Illinois wastewater treatment facilities through a multi-media, multi-technique approach, and to train or upgrade instruction capabilities of 24 operator-instructors, while concurrently improving the training and operator assistance capabilities in the state. The

operation and maintenance procedures of the plants included in the program are studied prior, during and following the actual training phases of the project in order to evaluate program effectiveness. As a result of this evaluation, it will be possible quantitatively to substantiate or reject the generally held opinion that operator training is a necessary antecedent to optimum operation and maintenance procedures, and that it results in a favorable cost-benefit ratio.

The cost-benefit ratio of operator training has been the subject of earlier studies. Most notable is the Harbridge House, Inc., study, "Effectiveness Evaluation of Operator Training Conducted Under the Public Service Careers Program," a study of experience in a selected number of Texas cities. While this study indicates a cost-benefit ratio of \$91 for every \$1 expended, several factors should be noted. The study relied heavily on data from treatment facility self-monitoring reports. The use of such report information must be placed in proper perspective. Where laboratory facilities are inadequate or improperly maintained and technical personnel inadequately trained, analytical results must be considered suspect. General experience in Illinois indicates such analytical data to be frequently invalid and misleading. The training of personnel to perform proper analysis and to evaluate results is, in fact, a recognized need in operator training. The Texas report attempts to show in a tangible way the benefits of training. While such tangible measure is most impressive to the budget-minded administrator, it is most often the difficult to measure, intangible factors that must be considered; namely, the commonweal of the people and their environment. It is reasonable to assume that in Illinois, as in Texas, many operators are responsible for waste treatment facilities valued at \$200,000 or more. The Texas studies showed

that the estimated capital investment per operator amounted to \$64,033, compared to a \$10,200 capital investment for the average production worker. It is reasonable to assume that the situation in Illinois is analogous.

It is not, however, the intention of Project Optimize to evaluate the effectiveness of training in dollars of return, but rather to demonstrate that optimum operation and maintenance can result from intensive training of facility operators. Some indication of the benefit of trained operators is contained in the "Statistical Summary of Preliminary Survey of Operator Training and Education," an unpublished report prepared by the Operator Certification and Training Unit of the Division of Water Pollution Control, Illinois Environmental Protection Agency. This study, covering 1,415 (59%) of the waste treatment facilities in Illinois, considers the adequacy of laboratory facilities and operator training as compared to plant effluent quality. The study, based on a survey of surveillance personnel, indicates a substantial improvement in operation and maintenance of waste treatment facilities as a result of operator training.

However, if optimum operation and maintenance are to result from operator training, two basic concepts must be recognized and achieved: (1) total involvement and (2) meaningful instruction.

There must be total involvement of appropriate state and federal agencies, as well as owners and operators of wastewater treatment facilities. Also involved should be operator organizations and professional groups such as the Illinois Association of Water Pollution Control Operators, the Illinois Society of Water Pollution Control Operators, and Central States Association of the Water Pollution Control Federation. The importance and impact of local operator groups on operator training and on operation and maintenance practices cannot be overemphasized. Involvement must include not only a consensus of plant owner, operator, government, and operator organizations that training should occur, but active support of such training, including provision of the necessary equipment, tools and supplies with which to utilize training received, and an on-going communication and the exchange of pertinent information among all involved parties.

To be meaningful, instruction in the operation of wastewater treatment facilities must be relevant, transferring usable knowledge and skills. The operator, equipped with new knowledge and provided with the necessary and appropriate tools and supplies, should be able to achieve the optimum level of operation and maintenance for the facilities under his control.

Recognition of operator training needs and accomplishments must be included in local, state and federal program plans, along with provision for appropriate operator incentives and rewards.

Project Optimize, then, addresses itself in a responsible manner to operation and maintenance deficiencies resulting from inadequately trained operators. For ease in reference, the overall program has been divided into five basic Elements:

#### Element I

Management Awareness: To increase substantially the awareness and support of municipal officials for the need for optimum operation and maintenance of wastewater treatment facilities through 24 seminars reaching 1,000 to 1,200 officials.

#### Element II

Instructor Development: To train or upgrade the level of 24 operator-instructors through the development and demonstration of innovative instructor development techniques. After development, these instructor techniques will be available to train additional instructors.

#### Element III

Operator Training Assistance: To optimize the operation and maintenance of 50 specific wastewater treatment facilities through intensive operator training and assistance, and to provide varying degrees of in-plant, in-depth, specialized assistance to an additional 100 facilities. This Element will also be utilized to improve operator assistance capabilities of agency staff, particularly staff not currently experienced in this area.

#### Element IV

Centralized Instructor Aids: To develop an inventory of training aids as an adjunct to improved operator training techniques.

#### Element V

Program Evaluation: To evaluate the activities of Elements I through IV and determine whether a significant improvement in wastewater treatment facility operation and maintenance has resulted.

Project Optimize is funded by the Illinois Environmental Protection Agency and the U.S. Environmental Protection Agency. Directly or indirectly, the program will ultimately affect nearly every facility in the state, (1) through substantially increasing the awareness of the need for optimum operation and maintenance of wastewater treatment facilities; (2) through improving the level of operator training, and (3) through enhancing agency staff operator assistance capabilities.

#### NEW MEXICO

##### Operator Training Approach

The proper operation and maintenance of municipal wastewater treatment facilities and the resultant improvement in water quality can only be accomplished with adequately trained utility operators. To provide these trained operators, the State of New Mexico, utilizing federal, state and local funding and services, supports several operator training programs. These programs vary from regional private training programs (local associations of utility operators) to an extensive two-year Associate of Arts Degree Program at New Mexico State University. Those programs presently in operation or proposed are as follows (see also Table 8 on page 48).

Utility Operators Vocational Education School - New Mexico State University: This Associate of Arts Degree Program consists of a carefully constructed curriculum having an average of 16 college credits per semester for freshmen and 18 college credits per semester for sophomores. The program divides its emphasis between operations type courses and lab courses. During

the year approximately 33% freshman and 25% sophomore instruction time is allocated to lab procedures. This training program was initiated using CETA, EPA and state funds, which were used for capital equipment and first-run support. The school is becoming self-supporting via university funding, tuitions, etc.

O.J.T. Program (Carlsbad Area): This program for training utility operators utilizes the "Sacramento Operators Course" as its basis for instruction and course construction. The program will provide training for the southeast area of the state, thus allowing a reduction in travel to and from classes by students and instructors.

Basic course structure consists of the students meeting for one day a week at a central location for classroom instruction and the instructor providing on-site instruction at the students' worksites on the remaining days of the week. Total enrollment is projected to be 22 students.

Texas A & M Short Schools: Modular instruction schools team-taught by professional instructors from Texas A & M, these provide fill-in coverage of subjects not presently taught or inadequately covered by existing instruction.

Lab Techniques and Procedures Course: This consists of three one-week courses which provide instruction and hands-on experience in lab procedures and techniques. Instruction will include NPDES Reporting Requirements.

N.M.S.U. Annual Short School: This program is a five-day technology transfer and training school for utility operators, conducted by New Mexico State University.

New Mexico Water Supply and Pollution Control Association: In addition to the above training courses and schools, the New Mexico Water Supply and Pollution Control Association holds short schools for training of utility operators. These consist primarily of four three-day schools and one five-day short school. Average attendance is approximately 80 students for the three-day schools and 200 students for the five-day schools, about 1,960 man days training a year. Because of widely varying subjects taught, it is impossible to allocate time spent between operations and lab instructions.

**Table 8**  
**New Mexico Training Programs**

Title	Purpose	Target Group	Level of Training
1. Circuit Rider	Improve selected operational materials	Plant operators	Operators and technicians
2. Entry Level Utility Operators Program	Provide basic skills to new operators	New municipal operators	Operators II - IV
3. Entry Level Utility Operators Program, Federal Manpower Programs	Train entry-level personnel	New and current operators	Operator I
4. Entry Level Utility Operators, New Employees	Improve operator skills and plant operation	Preoperation I	Operator I
5. Extension Outreach; Troubleshooting	Solve immediate operating problem through educational process	Plant operators and supervisors	Operators, technicians and engineers
6. Monthly Association Training Sessions	Continuing education for improved management, operator skills	Plant operators, supervisors and management	Operators I, II, III
7. Annual Short School	Continuing education for improved management, operator skills	Plant operators, supervisors and management	Operators I - IV, Supervisors
8. Short Courses, and Interim Short Courses	Continuing education for improved management, operator skills	Technicians, supervisors, management	Operator IV, college credit
9. Skill Improvement, Training Courses	Continuing education for improved management, operator skills	Operators II, III, IV	Operators and technicians
10. Utility Operators Associate Degree Program	Produce trained operators of potential managers	New, current and potential municipal management and operators	Utility operators II, IV
11. Training for Trainers	Produce skilled instructors	Educators in programs 1 - 13	Technicians, professionals, managers



In addition to these programs, the association also sponsors a 42-week training program. This is a series of programs at localized training centers, using the Sacramento State correspondence course manuals and the Texas A & M manuals as source materials.

#### State Agency Staff Training

Training for agency staff is provided through the use of both internal and external programs. One of the main methods of providing that needed training is by sponsoring individual staff members in their attendance at various training functions, such as the New Mexico Water Supply and Pollution Control Association Utility Operators Short Schools, EPA and locally funded short schools, and short courses sponsored by various municipalities, agencies or other state agencies.

**Field Personnel:** The major training program for field personnel is the New Mexico Water Supply and Pollution Control Association Short Schools. Of the six regional offices that make up the field staff, average attendance at the three-day schools is two persons from the region in which the school is held, comprising approximately 18 man-days of training. In addition, average field staff attendance at the five-day short schools is two persons from each of the regions, comprising approximately 60 man-days of training.

In addition, New Mexico State University has proposed a series of training programs for both new personnel and advanced personnel. This training would be aimed at providing the new, as well as the experienced, environmentalist with strong technical training in the wastewater field.

**Central Office Staff Training:** For Central Office personnel, as with field staff, the New Mexico Water Supply and Pollution Control Association Short Schools are also utilized as a training program. This is supplemented with in-house and EPA training programs. Projections for staff training consisted of approximately 12 staff members attending various training programs varying from four hours to five days, giving an estimated man-day training total of 45 man-days for FY 77.

## NEW YORK

### Introduction

There is a severe shortage of expertise in the operation of wastewater facilities which has the potential for causing deficient use of the massive investment government is making in such facilities. The problem is not one of inadequate numbers or basic capability of people in or entering the field, but of inadequate development of the knowledge, skills and abilities required after entry.

Regardless of whether entry-level requirements are maintained as is, or raised, the nature of municipal wastewater treatment plant operation is such that a means of developing operator capabilities is required once the operator has been employed. A total system of entry-level, on-the-job, upgrade and special purpose training is required and suggested in this analysis. This system is mandated by intelligent planning to make good use of the public investment in environmental improvement. Many elements of the system are now in place in New York, and most of the others are under development. Some may be "ideals" where full development is not totally achievable.

A brief review of the background to the current "state of the art" in New York should be helpful. During the Depression, many wastewater treatment plants were built for New York State communities under W.P.A. These were of simple design, generally providing for the settling out and removal of solids from the sewage, followed by disinfection. Operational control was limited primarily to ensuring regular sludge removal and control of disinfectant dosage. Yet, even then, it was recognized that operators of these facilities required certain basic qualifications if the public health was to be protected by sewage treatment. Consequently, in 1937 the Public Health Council set the minimum qualifications a person must have for "certification" as a wastewater treatment plant operator.

The wastewater treatment plant of today can best be compared to a chemical processing plant. Effective operational control demands that specialized technical capabilities be developed in operators beyond the



basic level which was previously satisfactory. However, the current operator manpower development system has not progressed significantly from that which was to prepare individuals to operate the relatively simple facilities of the past.

Before the entry level, a minimum basic educational level must be reached. Prior to certification (i.e., approval of the minimally required qualifications), an individual must acquire specified operational experience and satisfactorily complete an entry-level training program. The individual is then eligible for certification, and for all practical purposes, the state's impact on this individual's performance is nonexistent beyond this point.

Through continued experience and a scarcely available amount of on-the-job and classroom training opportunities, most of the state's 1,800 municipal operators attain what can be identified as the "journeyman" level. That is, they are considered competent to operate facilities under ordinary circumstances, but generally lack in-depth knowledge, skills and abilities which will enable them to adapt to conditions out of the ordinary. Unfortunately, the nature of municipal wastewater treatment is conducive to extraordinary conditions; this is reflected by the poor levels of performance at many new facilities. In addition, the majority of the new facilities being constructed are of such size and/or complexity that a "journeyman" level of competence is no longer adequate under ordinary circumstances.

A small percentage of the operating pool in the state currently progresses in capability to the "master" level. That is, they develop capabilities to cope with extraordinary circumstances and the complex problems associated with the advanced technology. The primary problem with the state's current capabilities is that the number progressing to the "master" level is inadequate.

This cannot be attributed to the aptitude of the operating pool. The minimum qualifications required of operators, while realistic, are high. The source of the problem is that the state has not taken measures to assure the availability of the resources necessary to develop the capabilities of the operating pool to the level required.

The problems which could potentially result from failing to provide these resources are substantial. In the period between 1965 through 1978, approximately \$20 billion will have been spent on construction of wastewater facilities in New York State. If the facilities are not operated properly, a large percentage of this investment will have achieved no benefit. Wastewater treatment plant operational staffs are the people ultimately responsible for the protection of this public investment and its efficient use, as well as the protection of the public health and the environment.

The only apparent alternatives to reducing the number of plants failing to meet permit conditions are assuring adequate manpower development, making capital improvements to the facilities, using enforcement action or accepting substandard effluents. Capital improvements will prove extremely costly and still may not achieve the desired results. Enforcement, while it will ultimately be required in a number of instances, may prove impractical for wide-scale application to municipalities on a significant basis and is not a solution in itself. Even if a municipality is subjected to penalties, it must then still solve the problem of substandard plant performance. Accepting the substandard performance cannot be considered, given the magnitude of the investment in water pollution control the public has made.

What is identified in the following analysis is a system which, while not the solution to all plant performance problems, can provide reasonable assurance that few such problems will be attributable to the manpower elements of operation. The cost of this assurance is small compared with that of the original investment and the other alternatives cited above.

#### System Elements - Conceptually

The system has been designed to assist in the major objective of New York's Pure Waters Program -- that is, the abatement of water pollution -- through operational manpower development. In order to accomplish this, it is necessary to provide broad training in the fundamental elements of plant operation to every individual in the state who will have operational

responsibility. This is being provided now and must be maintained. In addition, intensive training must be provided for a limited number of individuals for two interrelated purposes. First is the achievement of the "master" pool of operators referred to above. Second is the need to have the capability of assisting specific plants with manpower-related operational problems which cause deleterious impact on the environment. A conceptual description of each major element in the system is presented below. (See Table 9.)

**Entry-Level Training:** Since 1965 the state has supported this level of training by contracts with educational institutions. The three basic considerations behind this effort are:

1. The training is essential for assuring that those responsible for facility operation have the fundamental knowledge required to meet their responsibilities. Each and every certified operator in New York must have at least this level of training in order for the water pollution program to have any measure of success.
2. The Department should continue to meet a portion of the costs required for conducting this training. This is necessary to maintain the quality of the courses through use of the highest caliber instructors, updating curriculums, adding new courses to keep pace with changing technology, scheduling courses when and where needed, and other means. Such quality assurance is impossible to attain through a totally regulatory posture, which is the only alternative.
3. The contracting institutions can provide the necessary training more efficiently and effectively than any other resource. Over the past 10 years, these institutions have acquired the necessary expertise for conducting the entry-level training, as well as having the necessary laboratory facilities. More than 1½ times the present program cost amount would be required for the Department to conduct this training using its own staff and facilities.

**Upgrade and Special-Purpose Training:** Although different in objectives and scope, training at these two levels is similar in concept. Both levels of training build upon the entry-level, increasing the operator's knowledge and skills for better performance of the individual and, as a

result, the treatment plant. Upgrade training is broader and more general in nature and is offered to a larger target group. Special-purpose training is more specific in both nature and target group. It is intended either to eliminate specific problems or to develop specific capabilities. Both are required for a substantial percentage of the state's operators.

1. Upgrade Training in the proposed system would continue to be offered through existing mechanisms, but the capabilities of these mechanisms would be increased through the assistance of the system elements discussed in following sections. An additional stimulus to the improvement and increased utilization of upgrade training is the concept of renewal of treatment plant operators' certificates, with continued training as a requirement. This is an issue which remains to be dealt with.
2. Special-Purpose Training, to be conducted on an effective basis, requires a method of identifying both the subjects which need to be presented and the individuals who should attend. Needs for the courses will be identified by analysis of operating data on a statewide basis, field observations by the educational assistance teams, and recommendations of operators and Department field personnel. Participants will be selected in a similar manner. The focal point of the delivery mechanism will be the training facility, when established, and the educational assistance teams discussed in following sections. Selected participants would attend specific courses held at the training facility and at in-plant locations throughout the state, conducted by staff of the educational assistance teams.

**Project Aim:** As can be seen in this proposal, the training delivery mechanisms of the system range from broad programs for attendance by all operators to very specific programs for selected individuals. The subsystem which is being developed for identifying the individuals and subjects for the intensive levels of training, as well as having broader manpower planning capability, is given the name "Project Aim." This subsystem will have two elements: a data processing and analysis element and an element based on professional evaluation and judgment.

The data processing element will have as

**Table 9**  
**Comprehensive Wastewater Treatment Plant Operator**  
**Training and Development System — Conceptual Summary**

ELEMENT	SUMMARY DESCRIPTION	OBJECTIVE	METHOD OF PERFORMANCE	TARGET GROUP
ENTRY-LEVEL TRAINING	Classroom training - broad in nature	To provide fundamental knowledge required for plant operation	Primarily through contracts with educational institutions	Highly extensive - mandatory for all NYS operators - voluntarily attended by others involved in plant operations
UPGRADE TRAINING	Primarily classroom training; median in specificity between entry-level and special purpose	To improve knowledge and skills of operators beyond the minimum level required	Through educational institutions, supplemented by courses at treatment plants and at the training facility	Extensive - most NYS operators plus selected other individuals involved with plant operations
PROJECT AIM	Development and operation of a sub-system to assist in establishing training needs and priorities	To focus the intensive elements of the system's training delivery mechanisms for achievement of maximum pollution reduction	Automated data system supplemented by judgment of system personnel and others	All operators and treatment plants in the state
TRAINING FACILITY	An actual treatment facility with instructional capabilities built-in	To provide a base of operations for system implementation where "hands-on" instruction and practical demonstrations can be provided	To be constructed at the "head end" of a major treatment facility	Primarily for use in special-purpose and upgrade training and the practice and demonstration of operational techniques by the educational assistance teams
SPECIAL-PURPOSE TRAINING	A balanced mix of classroom and "hands-on" training. For specific trainees and/or on specific subjects	To develop full capabilities of selected operators and to overcome specific problems	By educational assistance teams at the training facility, supplemented at selected plants	Intensive - a limited number of selected operators from selected treatment plants
EDUCATIONAL ASSISTANCE	Total operational training to entire plant operating staffs at their own facilities	To eliminate operational deficiencies when due to manpower development causes at plants in NYS	By educational assistance teams at operating facilities experiencing operational difficulties	Highly intensive - selected operating staffs (anticipated maximum impact upon plants in S-25 MGD size range).

inputs the self-monitoring and regulatory surveillance data supplied in connection with the Permit System and the operation and maintenance data supplied in connection with the Department's program of operation and maintenance cost reimbursement. Also provided as input to the system will be data on experience and training of individual operators.

Supplementing this will be the judgment of needs as assessed by the educational assistance teams, Department field personnel and other reliable sources. Project Aim will serve to direct the resources of the system where they will achieve maximum results in improving water quality. To achieve the same results without this subsystem would require a considerably greater output of resources.

**The Training Facility:** Successful operation of the proposed system requires a training facility consisting of appropriate classroom(s) and other standard instructional necessities. More important, however, is a demonstration-scale wastewater treatment plant and ancillary equipment which can be used for instructional purposes. This requires that the effluent from the training facility be discharged into a large treatment plant, rather than a small plant or directly to a receiving water. This will permit operation of the facility to be determined strictly by training needs, without the added constraint of constant production of high quality effluent.

The training facility will be the base for the special-purpose training, giving the trainees the opportunity to obtain "hands-on" practice and to manipulate the treatment plant and equipment during training. It will also give the educational assistance teams and "master level" operators the opportunity to practice advanced operational techniques. The facility will be the center in the state for instructional materials in water pollution control.

**Educational Assistance Teams:** The key to successful implementation of any system is the personnel who operate the system. This is particularly true in the case of manpower development systems. The educational assistance teams will have three fundamental responsibilities:

1. Providing in-plant educational assistance to operating staffs at facilities

established as priorities through Project Aim.

2. Providing special purpose training at the training facility to those individuals and in those subject areas established as priorities through Project Aim.
3. Providing assistance and instruction to those involved in providing entry-level and upgrade training; preparing for this and the above assignments; developing training aids for this and the above assignments; operating the training facility treatment plant.

In order for effective performance of these functions, the educational assistance teams will need to maintain their own operational expertise, which is a major reason for assigning them the responsibility for operation of the training facility. There should be three teams alternating in the performance of each of the functions specified immediately above. Each team should consist of an operator-engineer-instructor and two operator-instructors. There should also be two scientists as resource persons, primarily for laboratory training and analyses, a project director, and a clerk-typist.

#### The System - Implementation Details

**Entry-Level Training:** This is currently the strongest element of New York State's water pollution control training effort. It is proposed to maintain the present capacity. This will provide training for approximately 300 operators per year.

**Upgrade Training:** It is proposed to improve the capabilities of the existing delivery system through development of staff of the Office of Environmental Manpower and other key Department personnel. The capability acquired will be disseminated to others involved in the upgrade training effort such as higher-level operators and academic instructors.

The means of staff development will be attendance at operational courses and direct involvement in facility operations. At full capability, training will be provided to approximately 400 operators per year, with the objective being to bring them to what has been previously referred to as the journeyman level. This figure is higher than that for the entry-level for a number of reasons. Individuals may

require training in several upgrade training sessions; there is a backlog of individuals requiring this training; and new technical and regulatory developments will require additional training of individuals to maintain current levels.

This level of training will be relatively broad-based and for the most part can be best provided locally at educational institutions such as the community college network. In certain instances, upgrade training at centrally located treatment plants and at the state training center will be most effective.

**Project Aim:** The development of Project Aim was initiated under an EPA grant, and remains in progress. Details regarding each individual plant's unit processes, the self-monitoring and regulatory surveillance data provided under permit conditions, training and experience records of operators and professional judgments will be integrated into a system. This system will be used to establish priorities in terms of upgrade and special-purpose training which should be provided operators with special needs for training or special talents to be developed, and plants at which manpower development will achieve significant operational improvement. For the total system to achieve its intended effect without Project Aim would require resources several orders of magnitude higher. Data concerning approximately 500 municipal wastewater treatment facilities and 2,000 operators will be analyzed in the system for the establishment of priorities.

**Training Facility:** The nature of wastewater treatment plant facility operation mandates that, in order to be effective, training and other facets of manpower development must include specialized and intensive elements. The specialized, intensive training can only be given effectively by individuals who are knowledgeable and proficient in both the practical and theoretical phases of operation. The advances which are being made in treatment technology also require that instructors keep themselves current.

Effective instruction in the specialized, intensive subjects which need to be taught can only be given where the trainees have the opportunity to actually observe and use, in a training environment, equipment of the nature they will be using

at their own facilities and observe as far as possible the effect of the techniques they will be learning.

All of the above point out the necessity for a training center consisting of a treatment plant and instructional facilities. Such a facility is proposed herein. A substantial amount of the capital costs required can be provided by the federal government under the authority of Section 109(b) of the Water Pollution Control Amendments of 1972 (P.L. 92-500).

The facility would be staffed by the Educational Assistance Teams, with support services provided by a stenographer and two laborers. Additional annual costs will be similar to those required for the operation of a small-scale treatment plant. Operation of the facility by the Educational Assistance Teams will enable them to test newly developing operational techniques for process optimization and to develop such techniques themselves. Such techniques, when proven effective, can be spread throughout the state through the various elements of the Comprehensive Operator Training and Development System.

It will also provide the opportunity for truly practical training. Approximately 300 operators will be trained at the facility each year. The majority of the trainees at the center will be receiving special-purpose training which can only be given at such a facility. The remainder will be receiving upgrade training, where it is evidenced that the specific upgrade training courses in question can be provided more effectively at the center than at educational institutions or at centralized wastewater treatment plants.

The center will also be the focal point for development of instructional materials and be important as a resource for the training of regulatory agency engineers in the operational aspects of water pollution control. A key additional use of the facility will be for the training of those in the state who are instructors in entry-level and upgrade training programs to assure the transfer of appropriate new developments at those levels.

**Special-Purpose Training:** Intensive instruction in the operational control and maintenance of many unit processes and the equipment required for these processes is necessary for their effective utilization.



and proper upkeep. As stated above, such instruction can only be given effectively by individuals thoroughly knowledgeable about the processes and equipment. The proposed system will develop the required expertise in the Educational Assistance Teams and enable the transfer of this expertise by means of special-purpose training conducted at the training facility and at treatment plants during on-site educational assistance projects. Approximately 200 operators per year will receive this training. The prorated cost of the special-purpose element of the system is \$100,000 per year, primarily in personnel costs.

**Educational Assistance:** The most intensive element of the system will be the Educational Assistance Projects (EAP). The Educational Assistance Teams will conduct total training programs at plants selected through Project Aim. The EAP will be tailored specifically to each plant at which it is conducted. The objective is not merely to overcome the specific operational problem or problems which may have caused Project Aim to focus on it. It is to adequately develop the plant staff so that while overcoming specific problems, future operational problems are avoided.

A minimum of 15 EAP's could be provided each year, resulting in the optimization of the operation of plants selected so that their improvement would have maximum benefit to the environment. The EAP's would also provide for maximum development of approximately 100 operators per year. In addition to developing fuller capabilities for the operation of the plants at which the EAP's were conducted, these operators will be the nucleus for upgrade and other local training efforts for operators of additional plants in their areas.

## SOUTH CAROLINA

### The Trainers

Training for operators of water and wastewater treatment plants in South Carolina is provided by two state institutions: Clemson University and the Technical and Comprehensive Education System (TEC). The university's training program is directed by the Office of Operator Training, a division of the Department of Environmental Systems Engineering, within the College

of Engineering. The TEC system includes 16 locally directed technical education centers and colleges around the state and a state-level Special Training Projects Office. Both the Office of Operator Training and TEC are funded by annual appropriations from the South Carolina General Assembly.

**Clemson University:** In the mid-1950's, influential members of the Water and Pollution Control Association of South Carolina (WPCASC), recognizing the need for well trained operators in the state, convinced the State Legislature to appropriate \$10,000 for operator training at Clemson University. Initial emphasis was placed on development and delivery of correspondence courses, but the program gradually expanded as annual appropriations gradually increased, and today administering correspondence courses is only one of the Office of Operator Training's activities.

One of Clemson Operator Training's most successful and well received projects is its Short School, an intensive three-to-four-day review session for operators held in the spring of each year. Short School uses performance-oriented instructional materials, developed at Clemson, to refresh the operator's knowledge of the practices and procedures of water/wastewater treatment. Classes for all certification levels in water and wastewater are offered, and certification examinations usually are administered on the day following the conclusion of the school. One-hundred-eighty-five persons attended the May 1977 Short School.

Short School has become a vital part of operator training in South Carolina, and operators, WPCASC and the South Carolina Board of Certification of Environmental Systems Operators have regularly requested Clemson to offer two schools per year. In response, Clemson has planned to sponsor a modified, two-day short school in the fall.

Approximately two years ago the Office of Operator Training began publishing a bimonthly newsletter, the *South Carolina Environmental Systems Operator*. The *Operator* is designed and written for in-plant operating personnel and attempts to be an informative, and entertaining, news medium, rather than a technical publication.

Specialized workshops are also a part of the Operator Training program. To date, in 1977, workshops in mathematics, operation and maintenance of "package" plants

and operation and maintenance of pumping stations have been held. An average of 17 persons attended each short course.

Instructional materials used in Short School and much of the material used in workshops are developed at Clemson by the Office of Operator Training. For example, work was completed recently on the second edition of *Math Problems for Water Quality Control Personnel*, a book of 77 problems presented as an operator would most likely encounter them in a treatment plant. The problems were selected from more than 1,500 submissions from active operators. The number of words in each problem statement is held to a minimum, and, to the extent possible, all data are shown in charts, on diagrams, on reports, etc. The book comes in two versions: as a student workbook and as an instructor's manual. The versatile instructor's manual contains only problem structures (without data), a format which allows a single problem to be used any number of times.

In addition to discharging their training duties, members of the Operator Training staff serve on the South Carolina Board of Certification of Environmental Systems Operators and the Board's Exam Development Committee. Until recently the project administrator of Clemson Operator Training chaired the Exam Committee and, in that capacity, did much to promote the performance-objective approach to exam writing.

An area in which the Office of Operator Training has potential to increase its service to the state involves extension activities. For example, a specialist to provide on-the-job training and direct technical assistance is needed in South Carolina, and plans are being made at Clemson to employ such a person sometime in the future.

TEC: Water/wastewater treatment being a technical field, participation in operator training by South Carolina's technical education centers has evolved naturally since the TEC system began taking shape in the early 1960s. Most of the training offered by TEC is limited to continuing education courses taught at night and designed to aid persons already in the water/wastewater field upgrade themselves with regard to certification levels. These courses usually last between 12 and 16 weeks and involve 96 to 100 class hours.

Between September 1976 and May 1977 approximately 500 persons were enrolled in such courses in South Carolina TECs. Each enrollee pays \$40 to \$60 to attend a course.

Two technical colleges offer two-year associate degree programs covering both water and wastewater. Greenville Technical College has a program in water and wastewater technology, and Sumter Area Technical College awards associate degrees in environmental systems engineering.

#### Other Principals

While Clemson's Office of Operator Training and the TEC system deliver most of the training operators in South Carolina receive, three other organizations play important roles in determining what that training will be. These organizations are the Water and Pollution Control Association of South Carolina (WPCASC), the South Carolina Department of Health and Environmental Control (DHEC) and the South Carolina Board of Certification of Environmental Systems Operators (the Board of Certification).

WPCASC: WPCASC is a voluntary association of operators, engineers, managers and other persons with interests in the water/wastewater field. Because it is recognized by most decision makers as the best medium through which operators can express collectively their views on issues relevant to the field, WPCASC can have a great deal of influence, formal and informal, on any subject associated with water/wastewater treatment.

Regarding operator training, WPCASC got involved at the very beginning of Clemson's program and, in fact, deserves much of the credit for the existence of a Clemson program. The initial state appropriation used to establish operator training at Clemson was granted in response to WPCASC lobbying efforts, and the Association has played an important role in the development of Clemson's correspondence course system. WPCASC has worked with Clemson in developing and choosing manuals for the courses, holds copyrights on many of the manuals and handles major portions of the financial matters associated with the courses. The direction WPCASC takes concerning operator training largely is determined by the actions and recommendations of the Association's Education Committee (formerly the



School Committee), which was a prime mover in getting the Clemson Short School started.

DHEC: DHEC is South Carolina's health and pollution control agency and performs enforcement and regulatory functions. Operator training is not a primary concern of DHEC, but the Department does employ a Manpower Planning, Development and Training Coordinator within its Environmental Quality Control Office. This officer serves as the state's official contact with Federal agencies, such as EPA, which promote programs and provide funding for training.

Board of Certification: South Carolina's 11-member Board of Certification has its origins in the 1966 mandatory certification law. The Board consists of four persons representing WPCASC, three representing DHEC, two representing Clemson, one representing the South Carolina Soil and Water Conservation Commission and one representing the South Carolina Municipal Association. The legal responsibility of the Board is that of certifying the qualifications of persons working in water quality and wastewater treatment plants, based on operating experience, education and examination requirements.

Additionally, the Board is charged in its enabling act with assisting and advising WPCASC and Clemson regarding educational programs for operators. This assistance and advice usually is given in two forms: recommendations from the Board and actions of the Board's Examination Development Committee. The Board, for example,

can indicate that a particular manual will be the primary reference for examinations for a given level of certification and suggest that trainers use that manual in short courses and classes. The Examination Development Committee, which does exactly what its name implies, affects operator training in that the information required of a person taking a certification exam is at least part of the information a trainer wants to impress upon his or her trainees.

### Conclusion

No single person, committee, association or agency is in charge of all operator training in South Carolina. Clemson's Office of Operator Training and the TEC system operate independently of each other, and any coordination of effort is the result of mutual goodwill and willingness to cooperate. The degree of cooperation between the two training systems has fluctuated considerably over the years, with the present trend appearing to be toward better communication and association.

Concerning the actions of WPCASC, DHEC and the Board of Certification, the importance of these influences is dependent upon how and to what extent the influences are exerted. Each of the three views training from a unique perspective and each is entitled to be listened to by trainers.

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## **Appendix 1 Features of *IRIS***

For more information contact:

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**NTOTC/EPA**  
**Cincinnati, OH 45628**  
**513-684-7501**

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## Appendix 1 Features of IRIS

### OBJECTIVES OF SYSTEM

IRIS has been developed with a number of different kinds of users in mind:

1. Instructors desiring knowledge of instructional materials.
2. Instructors, authors or publishers desiring to enter new instructional material into the system.
3. Developers, authors, publishers or funding agencies desiring information on the existence of material in a particular subject.

### IRIS PRODUCTS CATEGORIES AND RELATIONSHIPS

The principal concept of IRIS is to supply the user with a set of information products which provide efficient access to available training material. IRIS products fall into three major categories: Reports, Indexes and Tables. Each category meets a specific user requirement; namely:

- **REPORTS.** These products (*Title Master Report, Identification Number Master Report*) provide complete bibliographic information on each training material in IRIS. They are examined by the user in making a final judgment about whether the material meets a particular need.
- **INDEXES.** These products (*Subject, Type, Category, Author, Source*) do not provide complete bibliographic information on each training material. Rather, they provide key information (*Title, Author, Media Type, Date, Category and Educational Level*) to allow the user to rapidly browse through training materials

and make initial selections. To facilitate this browsing, each index is sorted appropriately. For example, the *Subject Index* allows you to determine what materials are available for a given subject, such as "Laboratory Skills."

• **TABLES.** These products (*Code Definition, Thesaurus, Source Name, Source Code*) assist the user in using the Indexes and Reports by providing definitions for special codes used in IRIS.

### TITLE MASTER REPORT

This product is one of the two master reports provided through IRIS. As a Master Report, it completely describes each training material in the system. Alphabetically arranged by the title of the material, all authors, sources, types, categories and subjects assigned to a particular training material are defined here. It also indicates educational level, rent or purchase requirements (cost), publication date and copyright. An objective and concise abstract describing the material and its use, and a "remarks field" describing special physical and bibliographic characteristics of the item, complete the record entry.

The user must know the title of a material before using this report. To facilitate this, several indexes (*Subject, Author, Source, Type, Category*) are provided which allow the user to browse the IRIS system and select potentially relevant training materials. During this browsing process, the user notes the titles of materials and then consults the *Title Master Report* to read the full bibliographic citation and abstract before making a final materials selection.

Title Master Report

PAGE 211

SEWAGE WORKS OPERATION UNIT I  
AUTHOR(S): ROMHOVE I N  
SOURCE(S): TEXAS AM

COST: 1.67 P

TYPE(S): PM  
LEVEL: 1

DATE: 68-00  
CATEGORIES: M O  
ID NUMBER: EPAW00535 COPYRIGHT:

SUBJECT AREAS:  
CHLORINATION  
DIGESTION

WASTEWATER CHARACTERISTICS  
TRICKLING FILTERS

COLLECTION SYSTEMS  
ACTIVATED SLUDGE

PRIMARY TREATMENT

REMARKS AND SUMMARY:

63PP

INTRODUCTORY TEXT DESIGNED TO COMPLEMENT CLASSROOM INSTRUCTION. CHARACTERISTICS AND METHODS OF COLLECTING WASTEWATERS ARE PRESENTED, FOLLOWED BY A DISCUSSION OF THE MORE COMMON UNIT PROCESSES EMPLOYED IN PRIMARY AND SECONDARY TREATMENT. ADDITIONALLY, SOME CONSIDERATIONS OF ROUTINE TESTING AND SAFETY ARE PRESENTED.

SEWER CONSTRUCTION

AUTHOR(S): PCA  
SOURCE(S): PCA  
SUBJECT AREAS:

COST: 8.00 R

TYPE(S): MP  
LEVEL: 3

DATE: 65-00  
CATEGORIES: D  
ID NUMBER: EPAW00788 COPYRIGHT:

SEWERS

CONCRETE PIPES

CONSTRUCTION

REMARKS AND SUMMARY:

16MM, 18 MIN., COLOR; PURCHASE PRICE \$110.

ILLUSTRATES PROPER PROCEDURES THROUGH EVERY PHASE OF A SEWER PROJECT, FROM STAKING-OUT BY THE ENGINEER THROUGH FINAL COMPACTION OF BACKFILL. MANY ALTERNATE METHODS OF CONSTRUCTION ARE SHOWN WITH CONCRETE PIPE AND SEVERAL TYPES OF CONCRETE UNITS FOR MANHOLES. INCLUDES BOTH NEW AND CLASSICAL BEDDING METHODS, AND THE USE OF CONCRETE PIPE IN SIZES FROM 8-TO 72 INCH DIAMETER.

SEWERS A HIDDEN COMMUNITY BENEFIT (OUT OF PRINT)

AUTHOR(S): PCA  
SOURCE(S): PCA  
SUBJECT AREAS:

COST: 0.00

TYPE(S): MP  
LEVEL:

DATE:  
CATEGORIES:  
ID NUMBER: EPAW00789 COPYRIGHT:

SEWERS

REMARKS AND SUMMARY:

16MM, 17 MIN., COLOR

SEWERS / GUARDIAN OF COMMUNITY HEALTH (OUT OF PRINT)

AUTHOR(S): CAN TEX  
SOURCE(S): CLAY PIPE  
SUBJECT AREAS:

COST: 0.00

TYPE(S): MP  
LEVEL:

DATE:  
CATEGORIES: M  
ID NUMBER: EPAW00790 COPYRIGHT:

SEWERS

REMARKS AND SUMMARY:

16MM, 26 MIN., COLOR

TO MASTER REPORT

70

EPAN01655

DATE: 72-00

FUNDAMENTAL ASPECTS OF WATER QUALITY MANAGEMENT

AUTHOR(S): HAAN R W  
SOURCE(S): TECHNOMIC

COST: 8.00 P

TYPE(S): PM  
LEVEL: 2

CATEGORIES: M O P S  
COPYRIGHT:

SUBJECT AREAS:  
BIOLOGICAL ANALYSIS      CHEMICAL ANALYSIS      WATER QUALITY  
CHEMICAL ANALYSIS

REMARKS AND ABSTRACT:  
158 PP.

TECHNIQUES FOR PLANNING, MANAGEMENT, ANALYSIS AND IMPROVEMENT OF WATER QUALITY.

EPAN01660

DATE: 72-00

DESIGN HANDBOOK OF WASTEWATER TREATMENT SYSTEMS

AUTHOR(S): GOODMAN B L  
SOURCE(S): TECHNOMIC

COST: 20.00 P

TYPE(S): PM  
LEVEL: 3

CATEGORIES: D  
COPYRIGHT:

SUBJECT AREAS:  
WASTEWATER TREATMENT PLANTS      PRETREATMENT      PRIMARY SEDIMENTATION      TRICKLING FILTERS  
AERATION      CHLORINATION      WASTEWATER TREATMENT DESIGN      INDUSTRIAL WASTES  
DOMESTIC WASTEWATERS

REMARKS AND ABSTRACT:  
125 PP.

GUIDE TO ADVANCED DESIGN OF DOMESTIC AND INDUSTRIAL WASTEWATER TREATMENT SYSTEMS.

EPAN01661

DATE: 76-99

HANDBOOK OF WATER RESOURCES AND POLLUTION CONTROL

AUTHOR(S): GEM  
SOURCE(S): VAN NOSTRA

BREGMAN  
COST: 39.50 P

TYPE(S): PM  
LEVEL: 3

CATEGORIES: L T  
COPYRIGHT:

SUBJECT AREAS:  
MANUALS      WATER QUALITY      DESALINATION      LAWS AND REGULATIONS  
WATER REUSE      TERTIARY TREATMENT

REMARKS AND ABSTRACT:

PROVIDES A SECTION-BY-SECTION ANALYSIS OF THE FEDERAL WATER POLLUTION CONTROL ACT, EXPLAINS THE TECHNOLOGY REQUIRED TO MEET THE LAWS REQUIREMENTS. DESCRIBES AREAS SUCH AS PRACTICAL, ECONOMIC DESALINATION; TERTIARY TREATMENT OF MUNICIPAL SEWAGE; TREATMENT AND DISTRIBUTION OF POTABLE WATER; DISPOSAL OF SLUDGE RESULTING FROM WASTE TREATMENT; BENEFICIAL USE OF WASTE HEAT FROM INDUSTRIAL FACILITIES; WATER RECLAMATION THROUGH ADVANCED TREATMENT OF MUNICIPAL AND INDUSTRIAL WASTEWATER.

EPAN01662

DATE: 74-00

NEW CONCEPTS IN WATER PURIFICATION

AUTHOR(S): CULP G L  
SOURCE(S): VAN NOSTRA

CULP R L  
COST: 16.95 P

TYPE(S): PM  
LEVEL: 3

CATEGORIES: T  
COPYRIGHT:

SUBJECT AREAS:  
WATER TREATMENT      PLANT CONSTRUCTION      OPERATIONS (WATER)      SEDIMENTATION  
FILTRATION      COAGULATION      RESOURCE RECOVERY      WATER TREATMENT PLANTS

REMARKS AND ABSTRACT:  
306PP., 103 ILLUS.

SHOWS HOW TO USE ADVANCED TECHNIQUES FOR DESIGNING NEW TREATMENT PLANTS OR INCREASING THE CAPACITY AND PERFORMANCE OF EXISTING ONES. EXAMPLES IN FULL-SCALE USE OF THESE PROCEDURES, ENGINEERING DESIGN INFORMATION, AND ACTUAL PLANT OPERATING EXPERIENCES BRING YOU VITAL INFORMATION IN AREAS SUCH AS HIGH RATE (TUBE) SETTLING; ADVANCES IN COARSE-TO-FINE IN-DEPTH FILTRATION; A FULLY AUTOMATIC METHOD FOR OPTIMIZING AND CONTROLLING COAGULANT DOSAGE; DISPOSING OR RECLAIMING OF WASTE WATER PLANT SLUDGES; ENSURING ADEQUATE & SUCCESSFUL DISINFECTION; REMOVING TOXIC HEAVY METALS FROM WATER SUPPLIES.

65

65



CODE DEFINITION TABLE

ITEM	DESCRIPTION	CODE DEFINITION
ID Number	unique 9-character field comprising a 4-digit agency/program identifier (EPAW) plus a 5-digit sequence number	
Copyright Code	indicates whether item is copyrighted	C copyright blank no copyright
Item Title	title of the material	
Publication Date	month and year	
Author	up to two	
Type	up to four	AC audio tape cassette AR audio tape reel FS 35mm filmstrip MP motion picture OT overhead transparency PM printed matter SL 35mm slide VC video tape cassette VR video tape reel
Category	up to 5 one-character codes broadly identifying the application area of the material	D design E explanatory L legal & regulatory M monitoring & surveillance O operations P planning S supervision T theory
Educational Level	defines educational use level of material	0 remedial 1 basic 2 intermediate 3 advanced
Originating Source	up to two; identifies organization responsible for the material	Consult Source Code Table
Cost	approximate dollar amount if item is available for purchase	
Purchase/Rent Code	indicates whether material can be rented or is available for purchase	R loan/rent/free P purchase
Subject	up to 16	Consult Thesaurus
Remarks	identifies special characteristics of the media that cannot be easily quantified	
Abstract	up to 5-120 character lines representing a professional summary of the material	

## Appendix 2 Sample *SOJP* — Activated Sludge

For more information contact:

Joe Bahnick  
MOTD/OWOP  
EPA  
Washington, DC 20460  
202-426-7887

---

# S.O.J.P.

## 5

SOJP NO 5  
ACTIVATED  
SLUDGE-AERATION  
AND  
SEDIMENTATION

A GUIDE FOR THE  
DEVELOPMENT OF

## STANDARD OPERATING JOB PROCEDURES

FOR  
WASTE WATER TREATMENT PLANT  
UNIT OPERATIONS

DEVELOPED BY  
CHARLES COUNTY COMMUNITY COLLEGE  
LA PLATA, MARYLAND

GRANT NO 900253  
MANPOWER DEVELOPMENT STAFF,  
ENVIRONMENTAL PROTECTION AGENCY.

(Document Cover)

Process Activated Sludge - Aeration & Sedimentation

1. Operation Objectives

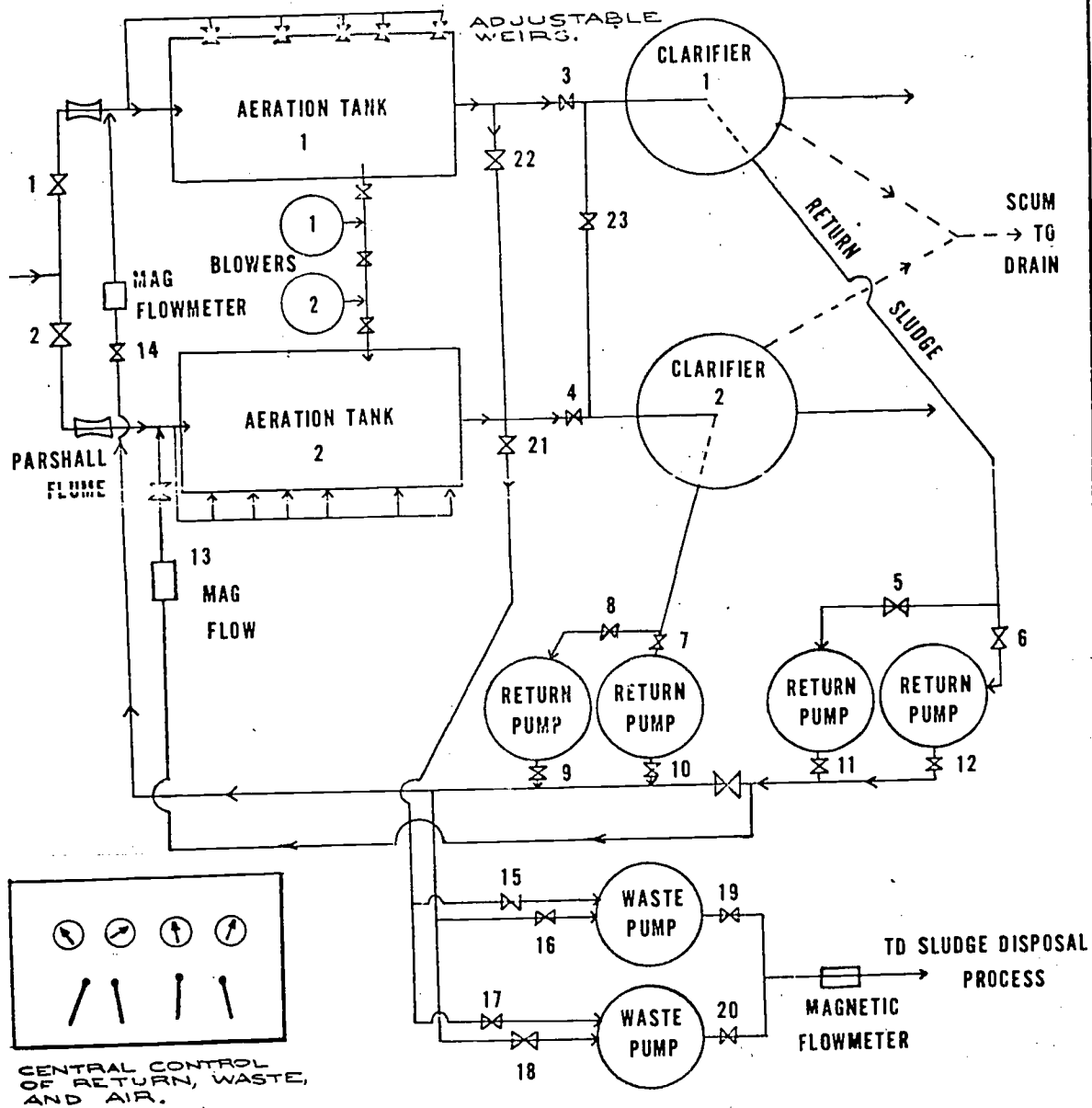
2. Brief Description of Process

1. Conversion of nonsettleable and nonfloatable materials in wastewater to settleable, flocculated biological groups and separation of the settleable solids from the water.
2. Wastewater enters the aeration unit where air is applied to mix the waste materials and biological organisms and to supply the organisms with oxygen to promote their growth. The organisms feed on the waste material converting it to water, carbon dioxide and more organisms. As the material is consumed or entrapped by the organisms, a floc, or grouping of organisms is formed. The water and floc flow to settling basins where quiet conditions allow the floc to separate from the water. The water flows from the surface of the tank to further processes or to a receiving stream and the settled organisms are returned to the aeration tank once again to be mixed with waste materials. The concentration of the organisms is controlled by wasting excess solids to disposal operations.



Process Activated Sludge - Aeration & Sedimentation

Flow Sheet



71



Process ACTIVATED SLUDGE - AERATION & SEDIMENTATION

General Description of Equipment Used in the Process

Flow Measurement

Influent - Parshall Flume - Bubbler Tube Level Sensor  
Return Activated Sludge - Magnetic Flow Meter  
Waste Activated Sludge - Magnetic Flow Meter  
Air Flow, Orifice Plates, Differential Tubes, Totalizer Integrators

Air Application

Common Header, Swing Type Diffuser Arms  
Sparger Diffuser - Coarse Bubble - 3/8" Orifice.  
Centrifugal Blower, Constant Speed Motor, Manual Valve Control for  
flow with Automatic Back Pressure Control  
Two Aeration Tanks - Width equal to Depth

Sedimentation

Center Feed Clarifiers with Skimming Device, Hydraulic Suction  
type Sludge Collectors, Notch Overflow Weirs

Sludge Pumping

Centrifugal, Varispeed Pump, Electric Drive

Control and Metering

Central Control Panel for Return Activated Sludge, Wasting and  
Blower Control

STANDARD OPERATING JOB PROCEDURES

SOJP NO 5

Prepared by George Mason Date 11-26-72

PROCESS Activated Sludge-Aeration & Sedimentation

Approved by \_\_\_\_\_

OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION/OPERATING GOALS/SPECIFICATIONS	TRAINING GUIDE NOTE
C. ROUTINE OPERATION			
1. Observation	1. Observe surface of aeration tank once every 2 hours	1. Good mixing, minimum of dead spots 2. Color-red brown to brown 3. Odor-like earth 4. Foam, color and amount 5. Foam control sprays on	VI-1 VI-2 VI-3 VI-4
	2. Observe surface of clarifiers once every 2 hours	1. Minimum of scum 2. Minimum rising sludge 3. Minimum suspended materials	VII-1,VI-5 VI-6 VI-7
	3. Check clarifier sludge blanket and record once every 2 hours	1. Level between 1/4-1/2 tank depth	VI-8
	4. Observe flow over clarifier weirs	1. Even flow 2. Weirs clean	VI-9 VI-9
	5. Observe return sludge flow	1. Color brown to red-brown 2. Odor-earthy 3. Even smooth flow	VI-2 VI-3 III-1
2. Equipment Checking (every 4 hrs)	1. Check blower and record readings	1. Suction gauge near zero 2. Oil temperature per mfg. specs. 3. Oil pressure per mfg. specs. 4. Cooling water flow at set point 5. Ammeters per mfg. spec. 6. Phase angle indicator greater than p.85 7. Bearing temperature per mfg. specs. 8. Vibration monitor within specs.	V-44 V-45 V-45 V-45 V-46 V-47 V-48 V-49

SOJP NO 5

PAGE NO 9

STANDARD OPERATING JOB PROCEDURES

SOJP NO 5

Prepared by George Mason Date 11-26-72

PROCESS Activated Sludge-Aeration & Sedimentation

Approved by \_\_\_\_\_

OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION/OPERATING GOALS/SPECIFICATIONS	TRAINING GUIDE NOTE
<b>C-I PROCESS CONTROL</b>			
1. Sampling	1. Collect a flow paced composite sample of influent wastewater	1. Daily 2. Refrigerate at 4°C after each sampling 3. Analyze for BOD, suspended solids, total phosphorus and COD and record	X-1
	2. Collect a flow paced composite sample of mixed liquor	1. Daily 2. Refrigerate at 4°C after each sampling 3. Analyze for suspended and volatile solids, and record	X-1
	3. Collect a flow paced composite sample of return activated sludge	1. Same as for mixed liquor	X-1
	4. Collect a flow paced composite sample of the clarifier overflow	1. Daily 2. Refrigerate at 4°C after each sample 3. Analyze for BOD, COD, turbidity, suspended solids and total phosphorus, and record	X-1
	5. Collect a grab sample of the influent	1. Daily 2. Determine and record Ammonia-N	X-2
	6. Collect a grab sample of the effluent	1. Daily 2. Determine and record Nitrate-N	X-2
2. Sampling for Control	1. Grab a sample of mixed liquor	1. As needed for control purposes-may be once/hour or once/4 hours 2. Perform settling rate test, 60 minutes in 5" drain settleometer	X-3 X-4

SOJP NO 5

PAGE NO 12

STANDARD OPERATING JOB PROCEDURES

SOJP NO 5

Prepared by George Mason Date 11-26-72

PROCESS Activated Sludge-Aeration & Sedimentation

Approved by \_\_\_\_\_

OPERATING PROCEDURES	STEP SEQUENCE	INFORMATION/OPERATING GOALS/SPECIFICATIONS	TRAINING GUIDE NOTE
D. ABNORMAL OPERATION			
1. Bulking Sludge	<ol style="list-style-type: none"> <li>1. Observe settleometer tests</li> <li>2. Observe clarifier</li> <li>3. Observe aeration tank</li> <li>4. Note oxygen demand ratio</li> <li>5. Correct sludge condition for long term operation</li> </ol>	<ol style="list-style-type: none"> <li>1. Note slowly settling sludge with extremely clear supernatant and lack of straggler floc. Sludge light brown to gray in color</li> <li>2. Plot settling and SSC curves</li> <li>1. Sludge blanket &gt; 1/2 of tank volume or sludge going over the weirs</li> <li>1. Note: may possibly have white foam over much of tank surface</li> <li>1. May be 2 or less</li> <li>1. Increase aeration rate as per oxygen demand test</li> <li>2. Aerator D.O. between 1 and 3 mg/l</li> <li>3. Adjust return rate to increase the sludge concentration ratio. This adjustment will be made by deciding what return sludge concentration is desired and the settled sludge concentration at time t.</li> <li>4. Adjust wasting - reduce the wasting rate to decrease the settling rate of the sludge in the system.</li> <li>5. Run settleometer and centrifuge test and perform calculations at least once per 4 hours until condition is corrected.</li> </ol>	<p>VIII-1 II-3 VI-10 VII-4 VII-4 VII-4</p>

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TRAINING GUIDE

SECTION II

EDUCATIONAL CONCEPTS -- MATHEMATICS

TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES
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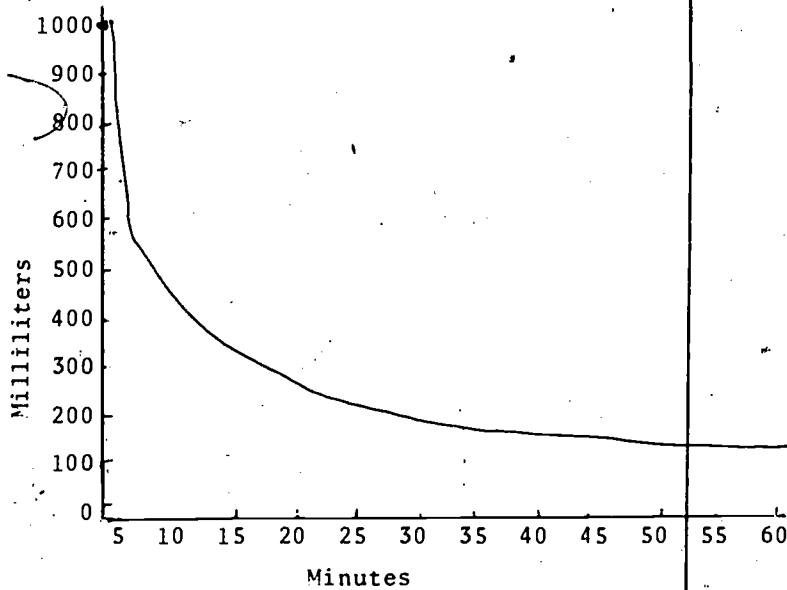
II-1  
 [C-1.3.1.5]  
 [C-1.4.1.1]  
 [D.2.3.1]

How to make a graph of volume of sludge versus time.

- (1) Mark a horizontal line in even intervals, each representing 5 minutes up to 60
- (2) Mark a vertical line in even intervals each representing 50 ml.
- (3) Place a dot at each point observed, at the intersection of the appropriate volume and time until the 60 minute period is up

Example:

Time	Volume
0 min.	1000 ml
5 "	580 "
10 "	430 "
15 "	310 "
20 "	270 "
30 "	200 "
40 "	180 "
50 "	150 "
60 "	140 "



## TRAINING GUIDE

## SECTION V

## PROCESS EQUIPMENT

TRAINING GUIDE NOTE	TRAINING INFO: THEORY/CONCEPTS/CALCULATIONS/TECHNIQUES	REFERENCES/INSTRUCTIONAL RESOURCES
V-1 [A.1.1.1]	Observe indicators on valve to ascertain valve position. If not marked, mark the fully open and fully closed positions with a permanent marker.	
V-2 [A.1.2.1]	Lock with bar provided on power switch-gear circuit breaker.	
V-3 [A.2.1.1]	Water stops are provided to keep water from leaking in or out of the tank at the joints. If water is leaking in, repairs should be made before putting the tank in service, as leaks going out could contaminate the surrounding ground water.	
V-4 [A.2.2.1]	An open drain could make the process inoperable since this is an uncontrolled wasting of sludge. Make sure drain operators are lubricated and operate freely since they will be needed next time you need to drain the tank and the mechanism may be inaccessible with the tank full.	
V-5 [A.2.3.1]	These valves are to keep the tank from floating when empty and their free operation is absolutely necessary. They may have to be pushed down before putting the tank into service, particularly if it has been out for a long period of time.	
V-6 [A.2.5.1]	Antifoam sprays should be operable and unplugged. They will probably be needed during start up of the process, as foam is common during the first weeks of operation.	
V-7 [A.2.6.1]	Absolutely clean sparger ports are necessary to insure adequate agitation and air supply.	
V-8 [A.2.7.1]	Mis-seated O-rings lead to air leakage and inefficiency, and lubrication is necessary to prevent O-ring cracking and to insure easy operation of the swing arms.	

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### **Appendix 3**

## **Performance Objectives for Instructor Training Courses**

For more information contact:

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**EPA**

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## Appendix 3 Performance Objectives for Instructor Training Courses

### BACKGROUND

The development of the following four-part unit of instruction from an Instructor's Guide was based upon the material presented by EPA's Instructor Technology Course-B, which was conducted extensively in the United States by Kenneth M. Hay. It reflects minor modifications and changes of emphasis that developed when Charles County Community College conducted the program under the direction of Carl Schwing. In addition, it has incorporated the comments and suggestions of a panel of reviewers, selected for their expertise in the various subject areas.

### PURPOSE

The Instructor's Guide establishes the qualitative requirements for the Basic Instructor Technology Course in terms of instructional objectives, which are presented in the preferred instructional sequence. The units of this instruction include both the prescribed subject matter and the recommended instructional media. Although the units and their component lessons outline the instructional content to be covered, additional background development is normally required of the instructor.

### COURSE DESCRIPTION

This course, from which the following units of instruction are taken, provides training in the styling or restyling of an instructor's approach to teaching, based upon the U.S. Environmental Protection Agency's Instructor Development Program. It is offered to supervisors, instructors and prospective instructors of environmental instructional programs and is designed

to insure successful performance through an increase of instructional knowledge and technology. Seventeen units of instruction, presented in an instructional sequence best for learning, are presented in this course. A minimum of 40 hours is required to complete this competency-based instructional program. A variety of instructional media is used throughout the course to provide continuous examples of their proper utilization in actual teaching/learning situations. There are no academic prerequisites for the course. However, one who enrolls must be directly involved in one or more elements within the training process.

### COURSE OBJECTIVES

Upon completion, the trainee will be able to:

- Write a clear, precise instructional objective (behavioral objective).
- Differentiate between acceptable and unacceptable instructional performance.
- Utilize effectively the information received regarding the principles of learning, communication, instructional media, instructional methods and evaluational procedures.
- Demonstrate those instructional techniques which are necessary to insure a successful instructional performance.
- Render a comprehensive and constructive evaluation on the mannerisms, techniques and methods demonstrated during an instructional presentation.

INSTRUCTOR DEVELOPMENT PROGRAM  
 COURSE: BASIC INSTRUCTOR TECHNOLOGY  
 SUBJECT MATTER: METHODOLOGY AND TECHNIQUE OF INSTRUCTING

UNIT OF INSTRUCTION 8: WRITING INSTRUCTIONAL OBJECTIVES  
 Lessons: Total of 4

ESTIMATED TIME: 3 hours

PREREQUISITES: Satisfactory completion of previous units of instruction or the equivalent.

INSTRUCTIONAL OBJECTIVE:

TERMINAL BEHAVIOR: To write a meaningfully stated instructional objective: one that succeeds in communicating to the reader the writer's instructional intent.

CONDITIONS: By recall.

ACCEPTABLE PERFORMANCE: As prescribed in individual lessons.

JUSTIFICATION: In order to prepare an effective instructional package worksheet (lesson plan), the instructor must be able to write meaningful instructional objectives.

INSTRUCTIONAL RESOURCES:

SELECTED: T8-1 through T8-23 Task Detailing (A2) Sheet

SUGGESTED FOR DEVELOPMENT: None

INSTRUCTIONAL ACTIVITIES:

- Lesson 1. Terminal Behavior
2. Conditions
3. Acceptable Performance
4. Checking Instructional Objectives

METHOD OF EVALUATION: Instructor will determine if the class has achieved an acceptable performance level by questioning several learners selected at random. (He will ensure equitable distribution of questions during the unit.)

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INSTRUCTOR DEVELOPMENT PROGRAM  
 COURSE: BASIC INSTRUCTOR TECHNOLOGY  
 SUBJECT MATTER: METHODOLOGY AND TECHNIQUE OF INSTRUCTING

UNIT OF INSTRUCTION 8: WRITING INSTRUCTIONAL OBJECTIVES  
 Lesson 1 of 4: Terminal Behavior

ESTIMATE: 15 minutes

PREREQUISITES: Satisfactory completion of previous units of instruction or the equivalent.

INSTRUCTIONAL OBJECTIVE:

TERMINAL BEHAVIOR: To write the terminal behavior portion of the instructional objective so that it clearly identifies what the learner will be DOING (stated in performance terms) when demonstrating his achievement of the objective.

CONDITIONS: By recall.

ACCEPTABLE PERFORMANCE: 80%

JUSTIFICATION: In order to write a meaningful instructional objective, the instructor must be able to state the terminal behavior in clearly defined terms.

INSTRUCTIONAL RESOURCES:

SELECTED: T8-1 through T8-11; Learner's previously completed Task Detailing (A2) Sheet (Unit 6)

SUGGESTED FOR DEVELOPMENT: None

INSTRUCTIONAL ACTIVITIES:

INSTRUCTOR ACTIVITY:

Review the previous unit, Instructional Objectives. Ensure that the material on Terminal Behavior, Conditions, and Criterion of Acceptable Performance is thoroughly understood.

Show transparencies T8-1 through T8-11 on instructional/behavioral objectives to reiterate and reinforce the background information which the class has been given. As each transparency is displayed, read and discuss it fully.

Refer the students to the A2 Task Detailing Sheets which they completed in Unit 6, Task Analysis. Ask them to write the terminal behavior portion of an instructional objective for one of the steps which they listed on the sheet. Provide any assistance which they might need. When they have finished, call on several to read their objectives aloud and offer a critique.

**LEARNER ACTIVITY:**

Learner writes the terminal behavior portion of an instructional objective for one step (procedure) listed on his Task Detailing (A2) Sheet.

**METHOD OF EVALUATION:** Instructor will call upon several learners to read the "terminal behavior" portion that each has prepared.

INSTRUCTOR DEVELOPMENT PROGRAM  
 COURSE: BASIC INSTRUCTOR TECHNOLOGY  
 SUBJECT MATTER: METHODOLOGY AND TECHNIQUE OF INSTRUCTING

UNIT OF INSTRUCTION 8: WRITING INSTRUCTIONAL OBJECTIVES  
 Lesson 2 of 4: Conditions

ESTIMATED TIME: 15 minutes

PREREQUISITES: Satisfactory completion of previous units of instruction as well as Lesson 1 or the equivalent.

INSTRUCTIONAL OBJECTIVE:

TERMINAL BEHAVIOR: To write the "conditions" portion of an instructional objective so that it clearly defines the qualifications which will be imposed upon the learner when he is demonstrating his mastery of the objective.

CONDITIONS: By recall.

ACCEPTABLE PERFORMANCE: 95%

JUSTIFICATION: In order to write a meaningful instructional objective, the instructor must be able to clearly define the conditions under which the terminal behavior is to occur.

INSTRUCTIONAL RESOURCES:

SELECTED: T8-12 through T8-15; A2 Sheet prepared by students during Unit 6.

SUGGESTED FOR DEVELOPMENT: None

INSTRUCTIONAL ACTIVITIES:

INSTRUCTOR ACTIVITY:

Review that portion of the previous unit on Instructional Objectives which deals with "conditions."

Show transparencies T8-12 through T8-15 on "conditions" to supplement the information the class has already received. As each transparency is displayed, read and discuss it fully.

Ask the students to add "conditions" to the instructional objectives they wrote in Lesson 1. Circulate among the class to provide assistance when needed. When they have finished, select several students to read aloud what they have written. Provide constructive criticism where necessary.

**LEARNER ACTIVITY:**

Learner writes the "conditions" portion of an instructional objective.

**METHOD OF EVALUATION:** Instructor will call upon learners to read the "conditions" they have written.



**INSTRUCTOR DEVELOPMENT PROGRAM**  
**COURSE: BASIC INSTRUCTOR TECHNOLOGY**  
**SUBJECT MATTER: METHODOLOGY AND TECHNIQUE OF INSTRUCTING**

**UNIT OF INSTRUCTION 8: WRITING INSTRUCTIONAL OBJECTIVES**  
**Lesson 3 of 4: Acceptable Performance**

**ESTIMATED TIME:** 15 minutes

**PREREQUISITES:** Satisfactory completion of previous units of instruction as well as Lesson 1 and 2 of this unit or the equivalent.

**INSTRUCTIONAL OBJECTIVE:**

**TERMINAL BEHAVIOR:** To write the "acceptable performance" portion of an instructional objective so that it clearly defines how well the learner must perform.

**CONDITIONS:** By recall.

**ACCEPTABLE PERFORMANCE:** 95%

**JUSTIFICATION:** In order to write a meaningful instructional objective, the instructor must be able to define the minimum acceptable performance he will accept.

**INSTRUCTIONAL RESOURCES:**

**SELECTED:** T8-17, T8-18; Learner's A2 Sheet

**SUGGESTED FOR DEVELOPMENT:** None

**INSTRUCTIONAL ACTIVITIES:**

**INSTRUCTOR ACTIVITY:**

Review that portion of the previous unit on Instructional Objectives which pertains to the criterion of acceptable performance. Emphasize that the establishment of such a criterion tells the student HOW WELL he must perform.

Show transparencies T8-17 and T8-18 to reinforce the class's understanding of "acceptable performance." As these transparencies are being discussed, point out that the term "performance level" is used synonymously with "acceptable performance."

Refer the students to the instructional objectives they have written in the previous two lessons. Ask them to now add a criterion of acceptable performance to these objectives. Assist them as necessary in this task. When they have finished, select several students to read aloud what they have written and provide whatever criticism is required.

**LEARNER ACTIVITY:**

Learner completes instructional objective by writing "acceptable performance" portion.

**METHOD OF EVALUATION:** Instructor will call upon several learners, selected at random to read aloud the "acceptable performance" portions which they have written.

INSTRUCTOR DEVELOPMENT PROGRAM  
 COURSE: BASIC INSTRUCTOR TECHNOLOGY  
 SUBJECT MATTER: METHODOLOGY AND TECHNIQUE OF INSTRUCTING

UNIT OF INSTRUCTION 8: WRITING INSTRUCTIONAL OBJECTIVES  
 Lesson 4 of 4: Checking Instructional Objectives.

ESTIMATED TIME: 2 hours, 15 minutes

PREREQUISITES: Satisfactory completion of previous units as well as Lesson 1 through 3 of this unit or the equivalent.

INSTRUCTIONAL OBJECTIVE:

TERMINAL BEHAVIOR: To perform the following:

- a. Identify the instructional objectives that successfully communicate an educational intent.
- b. Prepare an instructional objective for each step.

CONDITIONS:

- a. Given a list of instructional objectives.
- b. Using the steps itemized on the A2 Task Detailing Sheet.

ACCEPTABLE PERFORMANCE:

- a. 100%
- b. 80%

JUSTIFICATION: To ensure that the concept of instructional objectives has been thoroughly understood, it is necessary to have feedback from the students.

INSTRUCTIONAL RESOURCES:

SELECTED: T8-19 through T8-23; Learners' Task Detailing (A2) Sheets prepared during Unit 6

SUGGESTED FOR DEVELOPMENT: None

INSTRUCTIONAL ACTIVITIES:

INSTRUCTOR ACTIVITY:

Using transparencies T8-19 through T8-22, discuss the question posed by each transparency with the class. Ask various class members to provide reasons why the proposed answers or statements are correct or incorrect.

**INSTRUCTOR ACTIVITY (CONT'D.)**

Refer the students to the A2 Task Detailing Sheet which they have been using in this unit. Ask them to prepare an instructional objective for each step listed on the sheet using the lined yellow pads provided.

Circulate around the class, and along with the assistant instructors, offer any assistance that might be needed. Evaluate the students' work and where common problems or misunderstandings are identified, clarify them for the entire class.

**LEARNER ACTIVITY:**

Write instructional objectives for each step (procedure) listed on learners' A2 Sheets.

**METHOD OF EVALUATION:** Instructors and assistant instructors will circulate through the class and evaluate learners' work as they write instructional objectives.

**Appendix 4**  
**Example of a Self-Paced Module of Instruction**  
**Volumetric Analysis**

For more information contact:

**Joe F. Allen**

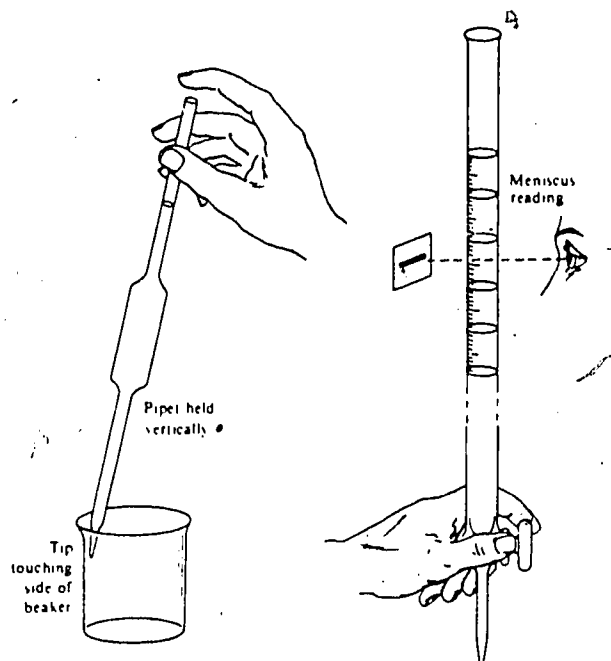
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**803-656-3276**

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VOLUMETRIC ANALYSIS  
(Draft 2)

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June 1976

## Volumetric Analysis

## WHAT IS THIS MODULE ABOUT?

The preparation and standardization of sodium thiosulfate,  $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$ , using primary standard potassium biiodate,  $\text{KH}(\text{IO}_3)_2$ , are discussed. Equations are given for the final calculation of the concentration of the  $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$  solution.

## WHY DO I NEED TO LEARN THIS?

In many chemical tests, a initial step in the analysis is a volumetric titration. For example, in a dissolved oxygen (D.O.) determination, the final step is a titration using sodium thiosulfate as the standard reagent. The general procedure described in this module is followed in the standardization of most chemicals used in volumetric analysis if the chemical of interest is substituted for the sodium thiosulfate.

## WHAT DO I NEED TO KNOW BEFORE I BEGIN?

Before beginning this module you should have completed all modules through 22, except numbers 16 and 21.

## WHAT EQUIPMENT AND SUPPLIES DO I NEED?

EQUIPMENT AND SUPPLIES	OBJECTIVE			
	1	2	3	4
Reagent grade $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$		X		
Chloroform		X		
(2) Storage bottle-dark glass		X		
25 ml volumetric pipet		X		
(3) 500 ml volumetric flask		X		
10 ml graduated cylinder		X	X	
Refrigerator		X		
Reagent grade $\text{KH}(\text{IO}_3)_2$		X		
(2) Weighing bottle		X		
Triple beam or centigram balance		X	X	
Drying oven		X		
2 l beaker		X		
Ring stand		X		
Iron ring		X		



EQUIPMENT AND SUPPLIES	OBJECTIVE			
	1	2	3	4
Forceps		X		
Desiccator	X			
Balance that weighs to 0.001 g		X		
100 ml volumetric pipet		X		
100 ml graduated cylinder		X		
250 ml Erlenmeyer flask		X		
250 ml glass-stoppered bottle		X		
250 ml beaker		X		
150 ml beaker		X		
Starch, 1 gram		X		
Bunsen burner		X		
150 ml storage bottle fitted with rubber stopper		X		
Potassium iodide, KI			X	
500 ml Erlenmeyer flask			X	
20 ml Volumetric pipet			X	
50 ml Buret			X	
Asbestos pad			X	

WHAT SUPPLEMENTARY MATERIALS WILL HELP ME?

1. "Part 2. Titration Techniques," #813 from Communication Skills Corporation, slide-tape presentation--OBJECTIVES 1, 2, 3.
2. "How to Titrate Using a Burette," #B8105 from Communication Skills Corporation, slide-tape presentation--OBJECTIVES 1, 3.
3. "Preparing Solutions," #813 from Communication Skills Corporation, slide-tape presentation--OBJECTIVE 2.
4. "Dilution and Titration Problems," #897 from Communication Skills Corporation, slide-tape presentation--OBJECTIVES 2, 3.
5. "Titration," #5400 from Kalmia Company, 16 mm motion picture--OBJECTIVES 1, 3.



**WHAT ARE MY OBJECTIVES?**

Upon completion of this module, you should be able to:

- 1: *Define the following terms commonly used in volumetric analysis:*
  - a. *volumetric analysis*
  - b. *indicator*
  - c. *standard solution*
  - d. *primary standard*
  - e. *standardization*
  - f. *titration*
  - g. *titrant*
  - h. *end-point*
- 2: *Prepare the reagents for a titration procedure.*
- 3: *Titrate a potassium biiodate solution with standard sodium thiosulfate solution.*
- 4: *Calculate the concentration of the sodium thiosulfate solution in normality units.*

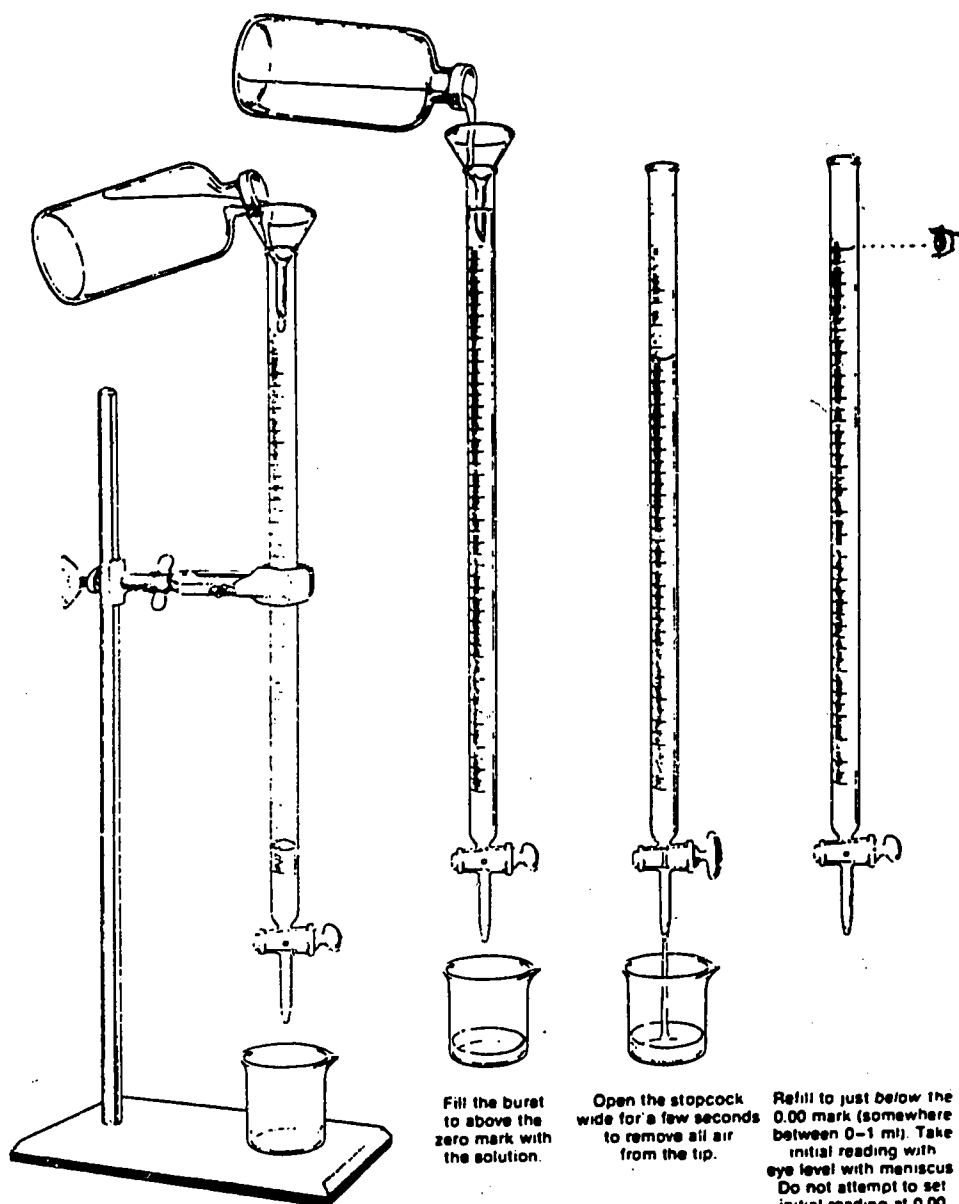
**OBJECTIVE 3:**

- ACTION**            *Titrate a potassium biiodate solution with standard sodium thiosulfate solution.*
- CONDITIONS:**    *Given a chemical laboratory containing the chemicals and equipment listed on Pages 1 and 2.*
- PERFORMANCE:**   *Titrate until addition of one drop of sodium thiosulfate changes the color. Three consecutive titrations should require the same volume to  $\pm 0.2$  ml of sodium thiosulfate.*

Before beginning this section review the module "Care and Use of Burets."

- Exercise 6:
- a. Roughly weigh out 1 to 3 g of potassium iodide, KI. (This need not be accurately weighed.)
  - b. Transfer the KI to a 500 ml Erlenmeyer flask and add about 100 ml of distilled water. Swirl the contents of the flask gently until all the KI dissolves.
  - c. Use a 10 or 25 ml graduated cylinder to transfer 10 ml of the previously prepared 10% sulfuric acid solution, then swirl the flask gently to mix the solutions.
  - d. Use a pipet to transfer 20.0 ml of the standard (0.0375N) potassium biiodate to the above solution. Mix thoroughly by swirling the flask for 30 seconds.
  - e. Place the above red to red-brown solution in the dark for 5 minutes. (Use the drawer or cabinet beneath your lab bench, if available).
  - f. To the contents of the above 500 ml flask, add enough distilled water to half fill the flask. Swirl the contents gently (be careful not to splash out any of the solution) to mix the solutions.
  - g. Fill a 50 ml buret with the standard sodium thiosulfate solution. See the figure on the next page to refresh your memory! Record the initial buret volume of the  $\text{Na}_2\text{S}_2\text{O}_3$  solution in your laboratory notebook.

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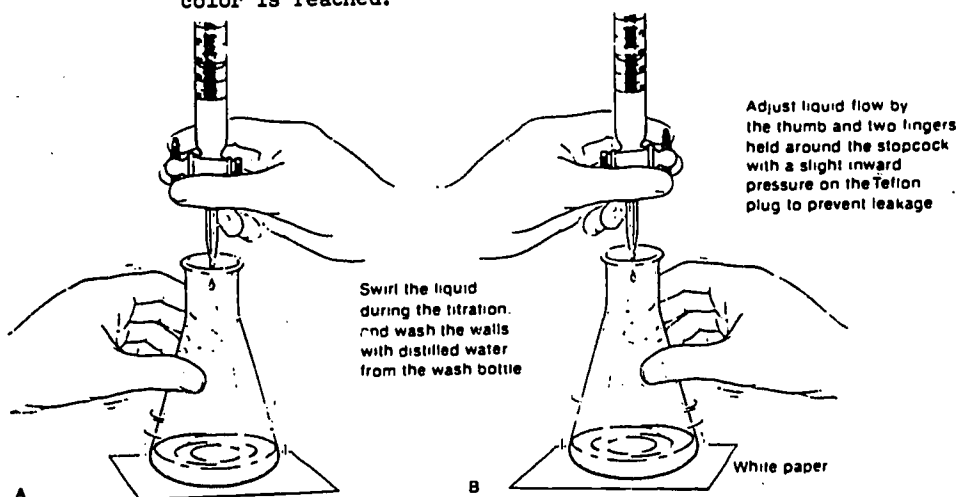
Using a small funnel, rinse a clean buret with a few milliliters of the solution. Allow the buret to drain.

Fill the buret to above the zero mark with the solution.

Open the stopcock wide for a few seconds to remove all air from the tip.

Refill to just below the 0.00 mark (somewhere between 0-1 ml). Take initial reading with eye level with meniscus. Do not attempt to set initial reading at 0.00 or 1.00 or any other specific reading.

- h. In most titrations you add titrant until the color changes. However, in the test you are now running, a two step color change is required to determine the end point. First, add the solution from the buret until the potassium biiodate solution in the Erlenmeyer flask changes to a pale yellow color. To accomplish this, add the solution from the buret at a fast dropwise rate (one drop every one or two seconds). See the figure below. Stop the addition of  $\text{Na}_2\text{S}_2\text{O}_3$  from the buret when the pale yellow color is reached.



Recommended technique for manipulation of a buret stopcock. Most left-handed students will manipulate the stopcock with the right hand (A), whereas most right-handed students will prefer to manipulate it with the left hand (B).

#### MANIPULATION OF A BURET STOPCOCK

1. Use a 10 ml graduated cylinder to measure 1 to 2 ml of the freshly prepared starch solution. Add the starch to the above solution and swirl to mix thoroughly. The solution in the flask should have changed colors from pale yellow to light or medium blue. Starch is the indicator which causes the blue color. Slowly add more sodium thiosulfate from the buret (dropwise with constant swirling of the flask) until the solution turns from blue to colorless. This is the end-point. Stop the addition of sodium thiosulfate. (The solution in the flask should still be cloudy due to the starch suspension.) Also, if this solution is allowed to stand open to air, the blue color gradually returns.

- j. Record the final volume of the sodium thiosulfate from the buret in your laboratory notebook. Subtract the initial volume from the final volume to find the amount of  $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$  added to the flask.

$$\begin{aligned} \text{Final volume of } \text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O} &= \underline{\hspace{2cm}} \text{ ml} \\ - \text{Initial volume of } \text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O} &= \underline{\hspace{2cm}} \text{ ml} \\ \text{Volume of } \text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O} \text{ added} & \\ \text{to the flask} &= \underline{\hspace{2cm}} \text{ ml} \end{aligned}$$

**OBJECTIVE 4:**

**ACTION:** Calculate the concentration of the sodium thiosulfate titrant in normality units.

**CONDITIONS:** Given the normality (or weight) and volume of the potassium biiodate and the volume of the sodium thiosulfate added to the flask.

**PERFORMANCE:** Normality calculations to  $\pm 0.0002$  of the true normality.

Of the following equations, 1 is general, but 2 applies only to the potassium biiodate titration with sodium thiosulfate. To find the normality of the  $\text{Na}_2\text{S}_2\text{O}_3$  solution use the equation:

$$\begin{array}{ccccccc} \text{Normality of} & \text{Volume of } \text{Na}_2\text{S}_2\text{O}_3 & \text{Normality of} & \text{Volume of} & N_A = & \frac{N_B V_B}{V_A} \\ \text{Na}_2\text{S}_2\text{O}_3 & \text{added to the flask} & \text{KH}(\text{IO}_3)_2 & \text{KH}(\text{IO}_3)_2 & & \\ N_A & V_A & N_B & V_B & & \end{array}$$

If exactly 2.4180 g of  $\text{KH}(\text{IO}_3)_2$  were used in Exercise 3 to prepare the standard biiodate solution, then the normality of  $\text{KH}(\text{IO}_3)_2$  used in equation above ( $N_B$ ) is 0.0375 N. If some other weight of  $\text{KH}(\text{IO}_3)_2$  was measured, use equation below to find  $N_B$ .

$$N_B = \frac{\text{weight KH}(\text{IO}_3)_2}{64.48}$$

Since the procedure calls for 20.0 ml of the  $\text{KH}(\text{IO}_3)_2$  to be added to the flask,  $V_B$  is 20.0 ml in Equation 1.

**Example:** A standard  $\text{KH}(\text{IO}_3)_2$  solution was prepared using 2.408 g  $\text{KH}(\text{IO}_3)_2$  as described in Exercise 3. This sample was titrated with a  $\text{Na}_2\text{S}_2\text{O}_3$  solution as described in Exercise 6. 18.52 ml of the  $\text{Na}_2\text{S}_2\text{O}_3$  solution were needed to turn the solution from blue to colorless. Calculate the normality of the  $\text{Na}_2\text{S}_2\text{O}_3$  solution.

## MODULE 23 DIAGNOSTIC TEST

## VOLUMETRIC ANALYSIS

If you can satisfactorily complete these exercises, you may omit this training module and proceed with the next module.

TIME LIMITATION: 1 hour

1. Define 6 of the following terms in your own words:
  - a. volumetric analysis
  - b. indicator
  - c. standard solution
  - d. primary standard
  - e. standardization
  - f. titration
  - g. titrant
  - h. end-point
2. Prepare the following reagents for a titration procedure when given the reagents and equipment and the preparation procedures:  
(Your supervisor may ask that you prepare only 1 or 2 of these solutions.)
  - a. 0.0375 N sodium thiosulfate standard titrant
  - b. 0.0375 N potassium biiodate solution
  - c. 10% by volume sulfuric acid
  - d. starch indicator solution
3. Label and store each of the solutions prepared in exercise 2.
4. Titrate three 20.0 ml samples of potassium biiodate solution with the prepared sodium thiosulfate titrant. These three titrations of the potassium biiodate samples must require the same volume to  $\pm 0.2$  ml of sodium thiosulfate to reach the end point.
5. Record all weight and volume data from the titrations properly in a laboratory notebook.
6. Calculate the volume of the prepared sodium thiosulfate solution, added to the potassium biiodate, from the initial and final volume readings.



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June 1976

## MODULE 23 PRESCRIPTION FOR DIAGNOSTIC TEST

## VOLUMETRIC ANALYSIS

Each exercise in the diagnostic test for Volumetric Analysis (module 23) refers directly to one of the objectives in this module. The test exercises are further divided into skills which must be mastered to perform the exercise satisfactorily. The particular Course I module objective(s) which taught this skill or concept, is listed beside each skill. If you have problems doing any of these steps within the test exercise, refer to the listed objective(s) for further study.

## Diagnostic Test

Exercise Number	Skills or Concepts	Module	Objective
1	Definitions	23	1
2	Equipment identification	7	1 *
	Use a Bunsen burner to boil distilled water	11 11 15 3	2 3 1 (Ex. c) 5
	* Weigh solid samples (single pan analytical balance)	20 20 6 5	2 3 1 3
	* Weigh solid samples (double pan analytical balance)	19 19 19 19 6 5	2 3 4 5 1 3
	* Weigh solid sample (toploading balance)	18 18 6 5	2 3 1 3
	Transfer solids with spatula	14 3 3	2 4 7 b
	Mix solution in volumetric flask	15 8 22	1 5 6 (ex. 11 e-k)

101

102

**Appendix 5**  
**Excerpts from Model Certification Examination Procedures**  
**For Process Control Operations of Wastewater Treatment Plants**

**A: Test Specification**

**B: Test Item**

For more information contact:

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**ABC**

**Municipal Building**

**Ames, IA 50010**

**515-232-6210**

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## TEST ITEM SPECIFICATION OBJ-7

<b>IDEN. NO.:</b>	OBJ-7
<b>TOPIC:</b>	Level I, II Process Units
<b>TERMINAL BEHAVIOR:</b>	Recognize process unit problems within a particular process system.
<b>GIVENS:</b>	<p><b>Directions:</b> CHECK the most likely process unit problem or problems requiring immediate attention.</p> <p><b>Content:</b> Diagram of a process system, <i>plus</i> Set of data reflecting one particular process unit problem, <i>plus</i> List of possible process unit problems</p>
<b>SCORING:</b>	Most likely process unit problem must be identified; penalize checking of unlikely process unit problems.

## NOTES:

- Alternative Directions (See Section VI, page 59.)
  - CHECK only the most likely process unit problem, IF complications expected from checking all most likely process unit problems.
  - WRITE the most likely process unit problems, IF recall more job-critical than recognition.
- Content (See Section VI, page 61.)
  - Diagrams for all process systems appear on pages 87 to 99.
  - Specific data for particular process unit problems *within* the following process systems begin on the next page:

PROCESS SYSTEM	PAGE
I-A	to be added
I-B	to be added
I-C	150
I-D	160
II-A	168
II-B	to be added
II-C	to be added

- Test Items Needed (See Section VI, page 62.)  
One per process unit problem to be diagnosed.
- Levels (See Section VI, page 62.)  
Use as recommended for Levels I, II; require writing for III, IV.
- Priority (See Section VI, page 63.)  
HIGH for Levels I, II; medium for Levels III, IV.
- Recommended Media (See Section VI, page 63.)  
Panel Book for process system diagrams; Test Book for set of process unit data and problems.
- Sample Test Items (See Section VI, page 64.)

**CONTENT – OBJ-7**  
**PROCESS SYSTEM I-C**  
**(Diagram on page 91)**

Beginning on the next page, problems with the following process units of Process System I-C are detailed.

- Lift Station (page
- Comminutor (stationary screen with oscillating cutter) (page
- Grit Chambers (hand-cleaned) (page
- Gas Chlorinator (page
- Sludge Drying Beds (page

PROCESS SYSTEM I-C

LIFT STATION PROBLEMS

GIVEN THIS SET OF DATA IN THE TEST BOOK TEST ITEM	THIS IS THE CORRECT ANSWER TO CHOOSE	THESE ANSWERS MAKE ACCEPTABLE DISTRACTORS
<ul style="list-style-type: none"> <li>● wet well inlet has normal dry weather flow</li> <li>● wet well empty with flow going directly to pump suction</li> <li>✓ lead pump is running</li> <li>● follow pump is running</li> <li>○ lead &amp; follow pump check valve lifting arms are slightly above closed position</li> <li>● force main pressure low and erratic</li> <li>● lead air compressor running</li> <li>● low level pressure switch is closed</li> <li>● electrical controls automatic mode</li> </ul>	<p>malfunctioning level control is causing pumps to run constantly</p>	<ul style="list-style-type: none"> <li>● malfunctioning level control is causing pumps to run out of phase</li> <li>● malfunctioning level control is causing pressure switches to open too soon</li> <li>● malfunctioning level control is causing high wet well level</li> </ul>
<ul style="list-style-type: none"> <li>● wet well inlet has normal dry weather flow</li> <li>● wet well is erratic with alternating excessively high and low levels</li> <li>● lead pump starts and stops erratically</li> <li>● follow pump starts and stops erratically</li> <li>● lead and follow pump both have normal discharge</li> <li>● force main pressure erratic with alternating high and low pressures</li> <li>● lead air compressor running</li> <li>● low level pressure switch is erratically opening and closing</li> <li>● high level pressure switch is erratically opening and closing</li> <li>● electric controls are on automatic</li> </ul>	<p>malfunctioning level control is causing pumps to run out of phase</p>	<ul style="list-style-type: none"> <li>● malfunctioning level control causing lead-follow sequence switch to be broken</li> <li>● malfunctioning level control is causing pumps to run constantly</li> <li>● air hubbler system causing erratic wet well influent flow</li> </ul>

PROCESS SYSTEM I-C

LIFT STATION PROBLEMS

GIVEN THIS SET OF DATA IN THE TEST BOOK TEST ITEM	THIS IS THE CORRECT ANSWER TO CHOOSE	THESE ANSWERS MAKE ACCEPTABLE DISTRACTORS
<ul style="list-style-type: none"> <li>● wet well inlet is normal for dry weather flow</li> <li>● wet well alternating excessively high and excessively low levels</li> <li>● lead pump starts at right level, level continues to rise, pump stops at right level</li> <li>● follow pump starts at right level, level drops, pump stops at right level</li> <li>● lead pump check valve lifting arm remains stationary in lowered position when pump starts and stops</li> <li>● follow pump check valve lifting arm rises when follow pump starts, goes to lowered position when it stops</li> <li>● force main pressure remains same when lead pump starts, increases when follow pump starts, drops to previous level when follow pump stops</li> <li>● low level pressure switch normal</li> <li>● high level pressure switch normal</li> <li>● electrical controls automatic</li> </ul>	<p>lead pump clogged</p>	<ul style="list-style-type: none"> <li>● follow pump clogged</li> <li>● lead pump check valve clogged</li> <li>● force main pressure too high</li> </ul>
<ul style="list-style-type: none"> <li>● wet well inlet increased flow because of rain</li> <li>● wet well unchanged at excessively high level</li> <li>● lead pump running</li> <li>● follow pump running</li> <li>● lead pump check valve lifting arm up</li> <li>● follow pump check valve lifting arm down</li> <li>● force main pressure remains at normal range for one pump</li> <li>● low level pressure switch normal</li> <li>● high level pressure switch normal</li> <li>● electrical controls automatic</li> </ul>	<p>follow pump clogged</p>	<ul style="list-style-type: none"> <li>● lead pump clogged</li> <li>● follow pump check valve clogged</li> <li>● force main pressure too high</li> </ul>

**SAMPLE TEST ITEM #2 FOR OBJ-7 (Recognize process unit problems within a particular process unit system)**

**REFER TO PANEL 4 IN THE PANEL BOOK.**

Below is a set of data, or events, that could happen if a process unit problem developed in Process System C.

**DATA**

- Lead pump does not start on rising level in lift station.
- Follow pump does not start on rising level in lift station.
- Mercury switches for lead and follow pumps remain open on rising level.
- Compressor remains running.
- Air flow from end of bubbler tube into wet well

Study the data carefully.

Decide the most likely process unit problem causing the results shown in the data.

Check below the most likely process unit problem requiring immediate attention.

- a. \_\_\_\_\_ Discharge valve clogged
- b. \_\_\_\_\_ Drain check valve malfunction
- c. \_\_\_\_\_ Malfunctioning level control (Lift Station)
- d. \_\_\_\_\_ Follow pump clogged (Lift Station)
- e. \_\_\_\_\_ Clogged check valve on follow pump (Lift Station)
- f. \_\_\_\_\_ Inlet pipe clogged
- g. \_\_\_\_\_ None of the above (If you checked this answer, enter the type of process unit problem you think most likely caused the results shown in the data.)

Enter here: \_\_\_\_\_

- NOTE:** In choosing the incorrect answers for the Test Item above:
- Avoid too obvious "distractors."
  - Include all reasonable "distractors."

**Appendix 6**  
**Excerpts from Performance Objectives**  
**For All ABC Levels of Certification**

**A: Background**

**B: Example for Level I, Primary**  
**Sedimentation Process Control Objectives**

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## Appendix 6 Excerpts from Performance Objectives For All ABC Levels of Certification

### A: Background

### B: Example for Level I, Primary Sedimentation Process Control Objectives

#### A. BACKGROUND

For some time instructional objectives have been developed by grantees of EPA and other agencies. In 1976 Charles County Community College began development of instructional objectives for entry-level and advanced-level treatment plant operators under Grant T900501-01. During the course of this grant, EPA awarded another grant to the Association of Boards of Certification (ABC) for the development of a uniform certification model. ABC based its system on four categories of certification:

1. Wastewater Collection System (WWC),
2. Wastewater Treatment Plant (WWT),
3. Water Distribution System (WD), and
4. Water Treatment Plant (WT).

Each of these levels had four classes ranging from I (the lowest) to IV, according to complexity and the management skills required.

The college has modified and adjusted its development of the instructional objectives to parallel the ABC subject category format. These instructional objectives were then reviewed on a nationwide

basis by representatives of ABC, the American Water Works Association (AWWA), Water Pollution Control Federation (WPCF), U.S. Environmental Protection Agency (EPA), state regulatory agencies, and operating agencies.

After a series of instructional objectives was prepared on any given subject, these objectives and evaluation sheets were sent out to the evaluators. Upon return of the evaluation sheets, an average of the evaluation values was placed on each objective, as well as a summary of the comments from the reviewers. Utilizing this information, some instructional objectives were added in various subject areas, some instructional objectives were moved from one module to another, and others were moved from one class to a higher or lower class.

Each grantee participating in this project will receive a summary of the evaluation for the instructional objectives on which he is working. This same review committee will be evaluating his product.

#### B. EXAMPLE FOR LEVEL I: PRIMARY SEDIMENTATION PROCESS CONTROL OBJECTIVES

##### 1. Identifying the Unit

- \*TER BEH - Identify the rectangular primary sedimentation tank.
- COND - Given a photograph of a rectangular primary sedimentation tank.
- AP - Indicate whether the unit in the photograph is a rectangular primary sedimentation tank.

##### 2. Process Description

- TER BEH - In technical and nontechnical terms describe the sedimentation process in a rectangular primary sedimentation tank.
- COND - Given photographs of a rectangular primary sedimentation tank.

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\*TER BEH = Terminal Behavior  
COND = Conditions of Performance  
AP = Acceptable Performance

B. EXAMPLE FOR LEVEL I *continued*

2. Process Description *continued*

- AP - The description must include:
- a. the name rectangular primary sedimentation tank.
  - b. the purpose of the primary sedimentation process in terms of how it affects the wastestream.
  - c. the effect of primary sedimentation on other process units including:
 

1. trickling filtration	7. aerobic digestion
2. aeration	8. sludge conditioning
3. secondary sedimentation	9. sludge dewatering
4. pond stabilization	10. solids disposal
5. thickening	11. effluent disposal
6. anaerobic digestion	

3. Identifying Components

TER BEH - Identify the components of a rectangular primary sedimentation tank.

COND - Given a photograph of a rectangular primary sedimentation tank.

- AP - The trainee must identify the following listed components and associated equipment:
- |                             |                                  |
|-----------------------------|----------------------------------|
| a. Influent channel         | n. Skimmer                       |
| b. Baffle                   | o. Longitudinal sludge collector |
| c. Drive unit               | p. Drive chain                   |
| d. Sludge pipe              | q. Scum box                      |
| e. Sludge hopper            | r. Scum pipe                     |
| f. Tee rail                 | s. Sludge cross collector        |
| g. Gear box                 | t. Drive sprockets               |
| h. Headshaft                | u. Wearing shoes                 |
| i. Bearings                 | v. Collector sprockets           |
| j. Revolving scum skimmer   | w. Angle tracks                  |
| k. Take up                  | x. Shearpin hub                  |
| l. Adjustable effluent weir | z. Chain guards                  |
| m. Effluent channel         |                                  |

4. Purpose of Components

TER BEH - Explain the purpose of each component, how each component works and why it is important to the operation of the rectangular primary sedimentation tank.

COND - Given a photograph of the rectangular primary sedimentation tank.

AP - The trainee must describe the function and importance of each of the components listed in lesson number 3 of this subject matter.

5. Locating Components

TER BEH - Name and locate the components of a rectangular primary sedimentation tank.

COND - Given a photograph of a rectangular primary sedimentation tank.

AP - The trainee must point out and name the components listed in lesson number 3 of this subject matter.

6. Safety

TER BEH - Describe safety procedures for a rectangular primary sedimentation tank.

COND - Given a photograph of a rectangular primary sedimentation tank.

AP - The trainee must comment on high risk activities, sources of danger and safety equipment, explaining how the procedures protect employees and visitors:

6. Safety *continued*

<u>High Risk Activities</u>	<u>Sources of Danger</u>	<u>Safety Equipment</u>
Lifting & lowering objects with ropes & pulleys	Waste characteristics	Barricades
Making adjustments with switches in automatic position	Falling objects	Ladders
Raking floating material from tank surface	Moving parts	Life preservers
Working inside tank without a buddy	Open pits & tanks	Lockout tags
Working near open pits & tanks	Slippery walks	Padlocks & keys
Unclogging pipes & pumps		Protective clothing

## 7. Normal Operation Procedures

- TER BEH - Describe the normal operation procedures for the components of a primary sedimentation tank listed in lesson number 3 of this subject matter.
- COND - Given a checklist of components to check, the characteristics of the components to check and a photograph of a primary sedimentation tank.
- AP - The trainee will:
- a. Describe the characteristics of each component which the operator checks to determine whether the component is functioning normally, commenting on:
    1. wastewater level
    2. flow distribution
    3. number of tanks in service
    4. scum accumulation
    5. sludge accumulation
    6. characteristics of floating material
    7. corrosion and deterioration
    8. smoothness of motion of moving parts
    9. shock & vibration
    10. sound
    11. temperature of motor & gear box
    12. raw sludge pumping system
  - b. Explain how often each component must be checked and why the component must be checked on this schedule.
  - c. Describe what an operator does if the characteristics of a component indicate that it is not functioning normally including:
    1. making adjustment
    2. deciding about corrective maintenance
    3. reporting to supervisors
    4. reporting in written records
  - d. Explain why a component's characteristics must be returned to normal.
  - e. Describe the routine sampling for a rectangular primary sedimentation tank.
  - f. Describe the routine calculations for a rectangular primary sedimentation tank.
  - g. Describe the routine procedures for a rectangular primary sedimentation tank.

## 8. Start-up and Shut-down Procedures

- TER BEH - Describe the start-up and shut-down procedures for rectangular primary sedimentation tanks.

## 8. Start-up and Shut-down Procedures *continued*

- COND - Given photographs of rectangular primary sedimentation tanks.  
 AP - The trainee will:
- a. Describe the start-up and shut-down procedures, commenting on:
    1. the number of tanks to put in service
    2. removing and installing inlet and outlet gates
    3. draining tanks for extended shut-down
    4. starting and stopping support systems
      - a. sludge pumping
      - b. sludge collection
      - c. skimming
    5. shutting down to remove objects dropped in tank
  - b. Evaluation of the operation of the rectangular primary sedimentation tank to determine whether correct start-up procedures have been used. Use the normal operation procedures described in lesson number 7 of this subject matter.
  - c. Evaluation of the operation of the rectangular primary sedimentation tank to determine if correct shut-down procedures have been used. Use the normal operation procedures described in lesson number 7 of this subject matter.

## 9. Abnormal Operation Procedures

- TER BEH - Describe the abnormal operation procedures for the rectangular primary sedimentation tank.  
 COND - Given photographs and descriptions of a wastestream flowing through a rectangular primary sedimentation tank.  
 AP - The trainee will:
- a. Evaluate the wastestream for abnormal conditions, commenting on:
 

1. color	9. oil
2. floating material	10. pH
3. flow	11. septic wastewater
4. foam	12. settleable matter
5. grease	13. suspended matter
6. industrial wastes	14. temperature
7. level	15. velocity
8. odor	
  - b. Explain how often the condition of the wastestream must be checked.
  - c. Describe what an operator does if he observes abnormal conditions, including:
    1. operational changes
    2. reporting to supervisors
    3. sampling procedures
  - d. Describe how the actions of the operator will improve the condition of the wastestream.

## 10. Preventive Maintenance

- TER BEH - Describe the preventive maintenance procedures for a rectangular primary sedimentation tank.  
 COND - Given photographs of a rectangular primary sedimentation tank and reference materials, including:
  - a. Inspection records
  - b. Manufacturer's maintenance guides
  - c. Plant drawings and specifications
  - d. Preventive maintenance schedule

10. Preventive Maintenance *continued*

- AP - The trainee will:
- a. Describe these procedures for the rectangular primary sedimentation tank:
    1. cleaning
      - a. channels and walls exposed to wastewater
      - b. skimming system and scum box
    2. painting
      - a. exposed metal surfaces
    3. lubrication
      - a. drive unit
      - b. sludge pump
      - c. scum skimmer
      - d. shearpin hubs
    4. mechanical adjustment
      - a. chain length
      - b. sprocket alignment
    5. replacement
      - a. worn wear shoes
      - b. chain links
      - c. shear pins
      - d. end squeegees on flights
    6. wear measurement
      - a. wearing shoes
      - b. chain links
      - c. sprockets
  - b. Name the reference materials and tools needed to perform the preventive maintenance.
  - c. Explain how often each preventive maintenance procedure must be performed.
  - d. Explain how an operator determines whether a component needs preventive maintenance.
  - e. Explain what an operator does if a component needs preventive maintenance.
  - f. Explain why each preventive maintenance procedure is important.

## 11. Corrective Maintenance

TER BEH - Describe the corrective maintenance procedures for a rectangular primary sedimentation tank.

COND - Given photographs of a rectangular primary sedimentation tank tools and reference materials, including:

- a. Catalog of replacement parts
- b. Equipment catalogs
- c. Manufacturer's maintenance guides

AP - The trainee will:

- a. Describe how an operator evaluates each component of a rectangular primary sedimentation tank for corrective maintenance, commenting on:
 

1. capacity	7. position
2. color	8. sound
3. corrosion	9. deterioration
4. depth	10. temperature
5. motion	11. flow
6. odor	12. vibration
- b. Explain why a component has malfunctioned.
- c. Name the reference materials and tools needed to perform the corrective maintenance.

**11. Corrective Maintenance *continued***

- d. Describe what an operator does when he discovers a malfunction, including:
  - 1. evaluation of capabilities of plant personnel to perform the procedures
  - 2. selection of replacement parts
  - 3. record keeping
- e. Describe how the operator corrects the malfunction.

**Appendix 7**  
**Proposed System for Water Quality Training Materials**  
**Under Development**

For more information contact:  
**John H. Austin**  
**Civil Engineering Department**  
**University of Maryland**  
**College Park, MD 20742**  
**301-454-2438**

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## Appendix 7 Proposed System for Water Quality Training Materials Under Development

### PROPOSED SYSTEM DESIGN

A necessary adjunct to *IRIS* is timely informational access to training materials which are currently being developed and are relevant to water and wastewater treatment. To meet this requirement, certain modifications to the *IRIS* record structure will allow the Office of Water Programs Operations to produce a separate series of reports and indexes covering training materials currently under development. Information about the developer, project cost, start date, projected end date, funding organization, funding authority code and field test code data are provided in lieu of the fifth line of the abstract as it is used in the *IRIS* record. The proposed information products would include an *ID Master Report* listing all information captured for any one training material being developed and indexes by Subject, Developer, Funding Organization, and Category. Additional indexes providing financial data for dollars expended by a funding organization, by a developer, by education level, by type, by a category (e.g., operations) or by a subject can be generated if required. The *IRIS* Thesaurus Table would meet the subject analysis

requirements for the proposed system. A Developer Name Table, Developer Code Table, Funding Organization Name Table, and Funding Organization Code Table would be developed, allowing users to obtain total address and code information for any given developer or funding organization.

Using the modified *IRIS* record approach, as training materials were completed, the "in process" record would be adjusted to include cost, source and author information. Funding organization and development cost data would be deleted. The record could then be moved from the master data file supporting materials under development to the master data file supporting *IRIS*. In this manner, rekeying is minimal, and the record flows from one information application to another.

Examples of sample products follow.



DATA INPUT FORM - IRIS

8/76

ID NUMBER 1/9 EPAW04300	C 10/1	ITEM TITLE PACKING A CENTRIFUGAL PUMP MECHANICAL SEAL					11/104	Date 11/74
AUTHOR ONE 1/24 DELVECCHIO F	AUTHOR TWO 26/24 LORD R	TYPE 52/11 PH SL AC	CATEGORIES 64/9 0	LVL 85/1 1	SOURCE 1 87/10	SOURCE 2 98/10	COST 110/8 01250 P	
SUBJECT ONE 1/29 CENTRIFUGAL PUMPS	SUBJECT TWO 31/29 MAINTENANCE	SUBJECT THREE 61/29 SELF PACED INSTRUCTION	SUBJECT FOUR 91/29					
SUBJECT FIVE 1/29	SUBJECT SIX 31/29	SUBJECT SEVEN 61/29	SUBJECT EIGHT 91/29					
SUBJECT NINE 1/29	SUBJECT TEN 31/29	SUBJECT ELEVEN 61/29	SUBJECT TWELVE 91/29					
SUBJECT THIRTEEN 1/29	SUBJECT FOURTEEN 31/29	SUBJECT FIFTEEN 61/29	SUBJECT SIXTEEN 91/29					
REMARKS (Rept. No.; No pages; No. slides; Film mm, Color, b/w, run time; Addl. authors and sources; Misc.)							1/120	
ABSTRACT LINE ONE DETAILED PROCEDURES FOR TROUBLE SHOOTING AND REPACKING A MECHANICAL SEAL ON A CENTRIFUGAL PUMP.							1/120	
ABSTRACT LINE TWO							1/120	
ABSTRACT LINE THREE							1/120	
ABSTRACT LINE FOUR							1/120	
DEVELOPER 1/24 CLEMSON	PROJ COST 26/6 5000	START DATE 33/4 7606	END DATE 38/4 7702	FUNDING ORG 43/20 CLEMSON	FUND AUTH CODE 64/20 TRNS 016	TEST 85/1 T		

SAMPLE LAYOUT OF IDENTIFICATION MASTER REPORT

EPAW04300

PACKING A CENTRIFUGAL PUMP MECHANICAL SEAL

DEVELOPER: CLEMSON EDUC LVL: 1 TYPE(S): PM SL AC

AUTHOR(S): DELVECCHIO F

SUBJECT(S):

CENTRIFUGAL PUMPS

MAINTENANCE

SELF PACED INSTRUCTION

DATES (START/END): 7602/7702

EST. PURCHASE COST: \$ 12.50 P

FUNDING ORG: CLEMSON

FUND CODE: TRWS 016

ABSTRACT AND REMARKS:

DETAILED PROCEDURES FOR TROUBLESHOOTING AND REPACKING A MECHANICAL SEAL ON A CENTRIFUGAL PUMP.

SAMPLE LAYOUT OF THE SUBJECT INDEX

CENTRIFUGAL PUMPS

PACKING A CENTRIFUGAL PUMP MECHANICAL SEAL

DEVELOPER: CLEMSON EDUC LVL: 1 TYPE(S): PM SL AC

CATEGORIES: 0

ID: EPAW04300

DATES (START/END): 7602/7702

MAINTENANCE

PACKING A CENTRIFUGAL PUMP MECHANICAL SEAL

DEVELOPER: CLEMSON EDUC LVL: 1 TYPE(S): PM SL AC

CATEGORIES: 0

ID: EPAW04300

DATES (START/END): 7602/7702

SELF PACED INSTRUCTION

PACKING A CENTRIFUGAL PUMP MECHANICAL SEAL

DEVELOPER: CLEMSON EDUC LVL: 1 TYPE(S): PM SL AC

CATEGORIES: 0

ID: EPAW04300

DATES (START/END): 7602/7702

SAMPLE LAYOUT OF THE CATEGORY INDEX

CATEGORY: 0

PACKING A CENTRIFUGAL PUMP MECHANICAL SEAL

DEVELOPER: CLEMSON EDUC LVL: 1 TYPE(S): PM SL AC

ID: EPAW04300

DATES (START/END): 7602/7702

SAMPLE LAYOUT OF THE FUNDING AGENCY INDEX

CLEMSON

PACKING A CENTRIFUGAL PUMP MECHANICAL SEAL

DEVELOPER: CLEMSON EDUC LVL: 1 TYPE(S): PM SL AC

CATEGORIES: 0

ID: EPAW04300

DATES (START/END): 7602/7702

SAMPLE LAYOUT OF THE DEVELOPER INDEX

CLEMSON

PACKING A CENTRIFUGAL PUMP MECHANICAL SEAL

EDUC LVL: 1

TYPE(S): PM SL AC

CATEGORIES: 0

ID: EPAW04300

DATES (START/END): 7602/7702

## **Appendix 8 Proposed System for Water Quality Control Courses**

For more information contact:  
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**University of Maryland**  
**College Park, MD 20742**  
**301-454-2438**

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## Appendix 8 Proposed System for Water Quality Control Courses

### PROPOSED SYSTEM DESIGN

The proposed Curriculum System will be designed to provide comprehensive control over courses offered by various sponsors (universities, associations, federal agencies, etc.) throughout the calendar year. The design concepts are similar to *IRIS*. Each course would be entered into a master data file as one record which would identify the sponsor, course title, costs, times offered during the year, prerequisites, and subject and abstract information, among other data. The resultant master data file would be used to generate a Master Report sorted by ID which would list all information gathered for the

various courses, and 3 indexes by Subject, Type, and Sponsor. The indexes would provide abridged information: ID, course title, type of course, sponsor, dates offered, times and cost. Additional indexes by date of course offerings and by education level could also be generated. The Thesaurus Table currently supporting *IRIS* would meet the subject analysis requirements for the Curriculum System. A Sponsor Name Table and a Sponsor Code Table would be developed allowing users to obtain total address and code information for any given sponsor.

Examples of sample products follow:

:ID NUMBER 1/9: COURSE TITLE 11/104: CRSE TYPE 116/5:  
 : : : :  
 : EPWC00001 : Pump Station Operation and Maintenance :O&M :

:SPONSOR 1/10: DATES/DEADLINE (1) (2) (3) (4) 12/16: TIME 50/7: COST 60/3: PREPAID 64/3:  
 : : : (0512) (0908) : : : : :  
 : Clemson : 0224/0228 (0210) : 0526/0530 : 0922/0926 : : 8/5/1 : 75 : 10 :

:EDUC LVL 1/2: CREDITS 4/6: CRSE FORMAT 12/8: CATEG 21/3: NO REGISTR 25/3: CRSE PREREQ 30/29: EMPLYMT PREREQ 60/29:  
 : : : : : : Introduction to : Water and Wastewater :  
 : 1 : CEU3.7 : WS SS : 0 : 15 : Pumps : Treatment Plant :

:SUBJECT ONE 1/29: SUBJECT TWO 31/29: SUBJECT THREE 61/29: SUBJECT FOUR 91/29:  
 : : : : :  
 : Pump Stations : : : :

:COURSE REFERENCES - LINE 1 1/120:  
 : : :  
 : Pump Station Modules from Clemson University. :

:COURSE REFERENCES - LINE 2 1/120:  
 : : :  
 : :

:ABSTRACT - LINE 1 1/120:  
 : : :  
 : Goes into the operations and maintenance procedures including troubleshooting for valves, centrifugal pumps, :

:ABSTRACT - LINE 2 1/120:  
 : : :  
 : Electric motors and electric controls for pump stations. :

:ABSTRACT - LINE 3 1/120:  
 : : :  
 : :

SAMPLE LAYOUT OF THE IDENTIFICATION MASTER REPORT

EPWC00001 COST: \$ 75 CRSE TYPE: O&M  
 PUMP STATION OPERATION AND MAINTENANCE  
 SPONSOR: CLEMSON DATES/REGIS DEADLINES: 02/24-02/28(02/10) 05/26-05/30(05/12) 09/22-09/26(09/08) TIME: 8H/5D/1W  
 PREPAY: \$ 10 NO REGISTRANTS: 15 CREDITS: CEU3.7 EDUC LVL: 1 CRSE FORMAT: WS SS CATEGORIES: 0  
 SUBJECT(S):  
 PUMP STATIONS  
 ABSTRACT:  
 GOES INTO THE OPERATIONS AND MAINTENANCE PROCEDURES INCLUDING TROUBLESHOOTING FOR VALVES, CENTRIFUGAL  
 PUMPS, ELECTRIC MOTORS AND ELECTRIC CONTROLS FOR PUMP STATIONS.  
 COURSE REFERENCES:  
 PUMP STATION MODULES FROM CLEMSON UNIVERSITY.  
 COURSE PREREQUISITES: INTRODUCTION TO PUMPS EMPLOYMENT PREREQUISITES: WATER AND WASTEWATER TREATMENT PLANT

SAMPLE LAYOUT OF SPONSOR INDEX

CLEMSON COST: \$ 75 CRSE TYPE: O&M  
 PUMP STATION OPERATION AND MAINTENANCE  
 DATES/REGIS DEADLINES: 02/24-02/28(02/10) 05/26-05/30(05/12) 09/22-09/26(09/08) TIME: 8H/5D/1W  
 ID: EPWC00001 EDUC LVL: 1 CATEGORIES: 0

SAMPLE LAYOUT OF SUBJECT INDEX

PUMP STATIONS COST: \$ 75 CRSE TYPE: O&M  
 PUMP STATION OPERATION AND MAINTENANCE  
 SPONSOR: CLEMSON DATES/REGIS DEADLINES: 02/24-02/28(02/10) 05/26-05/30(05/12) 09/22-09/26(09/08) TIME: 8H/5D/1W  
 ID: EPWC00001 EDUC LVL: 1 CATEGORIES: 0



**Appendix 9**  
**Equal Employment Opportunity Commission**  
**Employee Selection Procedures**

From *Federal Register* Wednesday, November 24, 1976 Volume 41, No. 228, p. 51984-51986

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**202-634-6460**

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## RULES AND REGULATIONS

**Title 29—Labor**  
**CHAPTER XIV—EQUAL EMPLOYMENT**  
**OPPORTUNITY COMMISSION**  
**PART 1607—GUIDELINES ON**  
**EMPLOYEE SELECTION PROCEDURES**  
 Republication of Guidelines

The Equal Employment Opportunity Commission hereby republishes its Guidelines on Employee Selection Procedures (originally published at 35 FR 12333, August 1, 1970). Notwithstanding the publication of "Federal Executive Agency Guidelines on Employee Selection Procedures," the Equal Employment Opportunity Commission Guidelines on Employee Selection Procedures remain applicable to all employers and other entities subject to the jurisdiction of this Commission under Title VII of the Civil Rights Act of 1964, as amended, 42 U.S.C. 2000e et seq.

Signed at Washington, D.C. this 13th day of November 1976.

KIRKEL BENT WALSH,  
 Vice Chairman.

29 CFR Part 1607 is revised as set forth below:

Sec.	
1607.1	Statement of purpose.
1607.2	"Test" defined.
1607.3	Discrimination defined.
1607.4	Evidence of validity.
1607.5	Minimum standards for validation.
1607.6	Presentation of validity evidence.
1607.7	Use of other validity studies.
1607.8	Assumption of validity.
1607.9	Continued use of tests.
1607.10	Employment agencies and employment services.
1607.11	Disparate treatment.
1607.12	Retesting.
1607.13	Other selection techniques.
1607.14	Affirmative action.

**AUTHORITY:** The provisions of this Part 1607 issued under Sec. 713, 78 Stat. 285, 42 U.S.C. sec. 2000e-12.

**§ 1607.1 Statement of purpose.**

(a) The guidelines in this part are based on the belief that properly validated and standardized employee selection procedures can significantly contribute to the implementation of non-discriminatory personnel policies, as required by title VII. It is also recognized that professionally developed tests, when used in conjunction with other tools of personnel assessment and complemented by sound programs of job design, may significantly aid in the development and maintenance of an efficient work force and, indeed, aid in the utilization and conservation of human resources generally.

(b) An examination of charges of discrimination filed with the Commission and an evaluation of the results of the Commission's compliance activities has revealed a decided increase in total test usage and a marked increase in doubtful testing practices which, based on our experience, tend to have discriminatory effects. In many cases, persons have come to rely almost exclusively on tests as the basis for making the decision to hire, transfer, promote, grant membership, train, refer or retain, with the result that

candidates are selected or rejected on the basis of a single test score. Where tests are so used, minority candidates frequently experience disproportionately high rates of rejection by failing to attain score levels that have been established as minimum standards for qualification. It has also become clear that in many instances persons are using tests as the basis for employment decisions without evidence that they are valid predictors of employee job performance. Where evidence in support of presumed relationships between test performance and job behavior is lacking, the possibility of discrimination in the application of test results must be recognized. A test lacking demonstrated validity (i.e., having no known significant relationship to job behavior) and yielding lower scores for classes protected by title VII may result in the rejection of many who have necessary qualifications for successful work performance.

(c) The guidelines in this part are designed to serve as a workable set of standards for employers, unions and employment agencies in determining whether their selection procedures conform with the obligations contained in title VII of the Civil Rights Act of 1964. Section 703 of title VII places an affirmative obligation upon employers, labor unions, and employment agencies, as defined in section 701 of the Act, not to discriminate because of race, color, religion, sex, or national origin. Subsection (h) of section 703 allows such persons " . . . to give and to act upon the results of any professionally developed ability test provided that such test, its administration or action upon the results is not designed, intended or used to discriminate because of race, color, religion, sex or national origin."

**§ 1607.2 "Test" defined.**

For the purpose of the guidelines in this part, the term "test" is defined as any paper-and-pencil or performance measure used as a basis for any employment decision. The guidelines in this part apply, for example, to ability tests which are designed to measure eligibility for hire, transfer, promotion, membership, training, referral or retention. This definition includes, but is not restricted to, measures of general intelligence, mental ability and learning ability; specific intellectual abilities; mechanical, clerical and other aptitudes; dexterity and coordination; knowledge and proficiency; occupational and other interests; and attitudes, personality or temperament. The term "test" includes all formal scored quantified or standardized techniques of assessing job suitability including, in addition to the above, specific qualifying or disqualifying personal history or background requirements, specific educational or work history requirements, scored interviews, biographical information blanks, interviewers' rating scales, scored application forms, etc.

**§ 1607.3 Discrimination defined.**

The use of any test which adversely affects hiring, promotion, transfer or any other employment or membership

opportunity of classes protected by title VII constitutes discrimination unless: (a) The test has been validated and evidences a high degree of utility as hereinafter described, and (b) The person giving or acting upon the results of the particular test can demonstrate that alternative suitable hiring, transfer or promotion procedures are unavailable for his use.

**§ 1607.4 Evidence of validity.**

(a) Each person using tests to select from among candidates for a position or for membership shall have available for inspection evidence that the tests are being used in a manner which does not violate § 1607.3. Such evidence shall be examined for indications of possible discrimination, such as instances of higher rejection rates for minority candidates than nonminority candidates. Furthermore, where technically feasible, a test should be validated for each minority group with which it is used; that is, any differential rejection rates that may exist, based on a test, must be relevant to performance on the jobs in question.

(b) The term "technically feasible" as used in these guidelines means having or obtaining a sufficient number of minority individuals to achieve findings of statistical and practical significance, the opportunity to obtain unbiased job performance criteria, etc. It is the responsibility of the person claiming absence of technical feasibility to positively demonstrate evidence of this absence.

(c) Evidence of a test's validity should consist of empirical data demonstrating that the test is predictive of or significantly correlated with important elements of work behavior which comprise or are relevant to the job or jobs for which candidates are being evaluated.

(1) If job progression structures and seniority provisions are so established that new employees will probably, within a reasonable period of time and in a great majority of cases, progress to a higher level, it may be considered that candidates are being evaluated for jobs at that higher level. However, where job progression is not so nearly automatic, or the time span is such that higher level jobs or employees' potential may be expected to change in significant ways, it shall be considered that candidates are being evaluated for a job at or near the entry level. This point is made to underscore the principle that attainment of or performance at a higher level job is a relevant criterion in validating employment tests only when there is a high probability that persons employed will in fact attain that higher level job within a reasonable period of time.

(2) Where a test is to be used in different units of a multiunit organization and no significant differences exist between units, jobs, and applicant populations, evidence obtained in one unit may suffice for the others. Similarly, where the validation process requires the collection of data throughout a multiunit organization, evidence of validity specific to each unit may not be required. There may also be instances where evidence of



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validity is appropriately obtained from more than one company in the same industry. Both in this instance and in the use of data collected throughout a multi-unit organization, evidence of validity specific to each unit may not be required. Provided, That no significant differences exist between units, jobs, and applicant populations.

**§ 1607.5 Minimum standards for validation.**

(a) For the purpose of satisfying the requirements of this part, empirical evidence in support of a test's validity must be based on studies employing generally accepted procedures for determining criterion-related validity, such as those described in "Standards for Educational and Psychological Tests and Manuals" published by American Psychological Association, 1200 17th Street, NW., Washington, D.C. 20036. Evidence of content or construct validity, as defined in that publication, may also be appropriate where criterion-related validity is not feasible. However, evidence for content or construct validity should be accompanied by sufficient information from job analyses to demonstrate the relevance of the content (in the case of job knowledge or proficiency tests) or the construct (in the case of trait measures). Evidence of content validity alone may be acceptable for well-developed tests that consist of suitable samples of the essential knowledge, skills or behaviors composing the job in question. The types of knowledge, skills or behaviors contemplated here do not include those which can be acquired in a brief orientation to the job.

(b) Although any appropriate validation strategy may be used to develop such empirical evidence, the following minimum standards, as applicable, must be met in the research approach and in the presentation of results which constitute evidence of validity:

(1) Where a validity study is conducted in which tests are administered to applicants, with criterion data collected later, the sample of subjects must be representative of the normal or typical candidate group for the job or jobs in question. This further assumes that the applicant sample is representative of the minority population available for the job or jobs in question in the local labor market. Where a validity study is conducted in which tests are administered to present employees, the sample must be representative of the minority groups currently included in the applicant population. If it is not technically feasible to include minority employees in validation studies conducted on the present work force, the conduct of a validation study without minority candidates does not relieve any person of his subsequent obligation for validation when inclusion of minority candidates becomes technically feasible.

(2) Tests must be administered and scored under controlled and standardized conditions, with proper safeguards to protect the security of tests scores and to insure that scores do not enter into any judgments of employee adequacy that

are to be used as criterion measures. Copies of tests and test manuals, including instructions for administration, scoring, and interpretation of test results, that are privately developed and/or are not available through normal commercial channels must be included as a part of the validation evidence.

(3) The work behaviors or other criteria of employee adequacy which the test is intended to predict or identify must be fully described; and, additionally, in the case of rating techniques, the appraisal form(s) and instructions to the rater(s) must be included as a part of the validation evidence. Such criteria may include measures other than actual work proficiency, such as training time, supervisory ratings, regularity of attendance and tenure. Whatever criteria are used they must represent major or critical work behaviors as revealed by careful job analyses.

(4) In view of the possibility of bias inherent in subjective evaluations, supervisory rating techniques should be carefully developed, and the ratings should be closely examined for evidence of bias. In addition, minorities might obtain unfairly low performance criterion scores for reasons other than supervisors' prejudice, as, when, as new employees, they have had less opportunity to learn job skills. The general point is that all criteria need to be examined to insure freedom from factors which would unfairly depress the scores of minority groups.

(5) Differential validity. Data must be generated and results separately reported for minority and nonminority groups wherever technically feasible. Where a minority group is sufficiently large to constitute an identifiable factor in the local labor market, but validation data have not been developed and presented separately for that group, evidence of satisfactory validity based on other groups will be regarded as only provisional compliance with these guidelines pending separate validation of the test for the minority group in question. (See § 1607.9). A test which is differentially valid may be used in groups for which it is valid but not for those in which it is not valid. In this regard, where a test is valid for two groups but one group characteristically obtains higher test scores than the other without a corresponding difference in job performance, cutoff scores must be set so as to predict the same probability of job success in both groups.

(c) In assessing the utility of a test the following considerations will be applicable:

(1) The relationship between the test and at least one relevant criterion must be statistically significant. This ordinarily means that the relationship should be sufficiently high as to have a probability of no more than 1 to 20 to have occurred by chance. However, the use of a single test as the sole selection device will be scrutinized closely when that test is valid against only one component of job performance.

(2) In addition to statistical significance, the relationship between the test and criterion should have practical significance. The magnitude of the relationship needed for practical significance or usefulness is affected by several factors, including:

(i) The larger the proportion of applicants who are hired for or placed on the job, the higher the relationship needs to be in order to be practically useful. Conversely, a relatively low relationship may prove useful when proportionately few job vacancies are available;

(ii) The larger the proportion of applicants who become satisfactory employees when not selected on the basis of the test, the higher the relationship needs to be between the test and a criterion of job success for the test to be practically useful. Conversely, a relatively low relationship may prove useful when proportionately few applicants turn out to be satisfactory;

(iii) The smaller the economic and human risks involved in hiring an unqualified applicant relative to the risks entailed in rejecting a qualified applicant, the greater the relationship needs to be in order to be practically useful. Conversely, a relatively low relationship may prove useful when the former risks are relatively high.

**§ 1607.6 Presentation of validity evidence.**

The presentation of the results of a validation study must include graphical and statistical representations of the relationships between the test and the criteria, permitting judgments of the test's utility in making predictions of future work behavior. (See § 1607.5(c) concerning assessing utility of a test.) Average scores for all tests and criteria must be reported for all relevant subgroups, including minority and nonminority groups where differential validation is required. Whenever statistical adjustments are made in validity results for less than perfect reliability or for restriction of score range in the test or the criterion, or both, the supporting evidence from the validation study must be presented in detail. Furthermore, for each test that is to be established or continued as an operational employee selection instrument, as a result of the validation study, the minimum acceptable cutoff (passing) score on the test must be reported. It is expected that each operational cutoff score will be reasonable and consistent with normal expectations of proficiency within the work force or group on which the study was conducted.

**§ 1607.7 Use of other validity studies.**

In cases where the validity of a test cannot be determined pursuant to § 1607.4 and § 1607.5 (e.g., the number of subjects is less than that required for a technically adequate validation study, or an appropriate criterion measure cannot be developed), evidence from validity studies conducted in other organizations, such as that reported in test man-

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uals and professional literature, may be considered acceptable when: (a) The studies pertain to jobs which are comparable (i.e., have basically the same task elements); and (b) There are no major differences in contextual variables or sample composition which are likely to significantly affect validity. Any person citing evidence from other validity studies as evidence of test validity for his own jobs must substantiate in detail job comparability and must demonstrate the absence of contextual or sample differences cited in paragraphs (a) and (b) of this section.

**§ 1607.8 Assumption of validity.**

(a) Under no circumstances will the general reputation of a test, its author or its publisher, or casual reports of test utility be accepted in lieu of evidence of validity. Specifically ruled out are: assumptions of validity based on test names or descriptive labels; all forms of promotional literature; data bearing on the frequency of a test's usage; testimonial statements of sellers, users, or consultants; and other nonempirical or anecdotal accounts of testing practices or testing outcomes.

(b) Although professional supervision of testing activities may help greatly to insure technically sound and nondiscriminatory test usage, such involvement alone shall not be regarded as constituting satisfactory evidence of test validity.

**§ 1607.9 Continued use of tests.**

Under certain conditions, a person may be permitted to continue the use of a test which is not at the moment fully supported by the required evidence of validity. If, for example, determination of criterion-related validity in a specific setting is practicable and required but not yet obtained, the use of the test may continue: *Provided:* (a) The person can cite substantial evidence of validity as described in § 1607.7 (a) and (b); and (b) He has in progress validation procedures which are designed to produce, within a reasonable time, the additional data required. It is expected also that the person may have to alter or suspend test cutoff scores so that score ranges broad enough to permit the identification of criterion-related validity will be obtained.

**§ 1607.10 Employment agencies and employment services.**

(a) An employment service, including private employment agencies, State employment agencies, and the U.S. Training and Employment Service, as defined in section 701(c), shall not make applicant

or employee appraisals or referrals based on the results obtained from any psychological test or other selection standard not validated in accordance with these guidelines.

(b) An employment agency or service which is requested by an employer or union to devise a testing program is required to follow the standards for test validation as set forth in these guidelines. An employment service is not relieved of its obligation herein because the test user did not request such validation or has requested the use of some lesser standard than is provided in these guidelines.

(c) Where an employment agency or service is requested only to administer a testing program which has been elsewhere devised, the employment agency or service shall request evidence of validation, as described in the guidelines in this part, before it administers the testing program and/or makes referral pursuant to the test results. The employment agency must furnish on request such evidence of validation. An employment agency or service will be expected to refuse to administer a test where the employer or union does not supply satisfactory evidence of validation. Reliance by the test user on the reputation of the test, its author, or the name of the test shall not be deemed sufficient evidence of validity (see § 1607.8(a)). An employment agency or service may administer a testing program where the evidence of validity comports with the standards provided in § 1607.7.

**§ 1607.11 Disparate treatment.**

The principle of disparate or unequal treatment must be distinguished from the concepts of test validation. A test or other employee selection standard—even though validated against job performance in accordance with the guidelines in this part—cannot be imposed upon any individual or class protected by title VII where other employees, applicants or members have not been subjected to that standard. Disparate treatment, for example, occurs where members of a minority or sex group have been denied the same employment, promotion, transfer or membership opportunities as have been made available to other employees or applicants. Those employees or applicants who have been denied equal treatment, because of prior discriminatory practices or policies, must at least be afforded the same opportunities as had existed for other employees or applicants during the period of discrimination. Thus, no new test or other employee selection standard can be imposed upon a class of individuals pro-

tected by title VII who, but for prior discrimination, would have been granted the opportunity to qualify under less stringent selection standards previously in force.

**§ 1607.12 Retesting.**

Employers, unions, and employment agencies should provide an opportunity for retesting and reconsideration to earlier "failure" candidates who have availed themselves of more training or experience. In particular, if any applicant or employee during the course of an interview or other employment procedure claims more education or experience, that individual should be retested.

**§ 1607.13 Other selection techniques.**

Selected techniques other than tests, as defined in § 1607.2, may be improperly used so as to have the effect of discriminating against minority groups. Such techniques include, but are not restricted to, unscored or casual interviews and unscored application forms. Where there are data suggesting employment discrimination, the person may be called upon to present evidence concerning the validity of his unscored procedures as well as of any tests which may be used, the evidence of validity being of the same types referred to in §§ 1607.4 and 1607.5. Data suggesting the possibility of discrimination exist, for example, when there are differential rates of applicant rejection from various minority and nonminority or sex groups for the same job or group of jobs or when there are disproportionate representations of minority and nonminority or sex groups among present employees in different types of jobs. If the person is unable or unwilling to perform such validation studies, he has the option of adjusting employment procedures so as to eliminate the conditions suggestive of employment discrimination.

**§ 1607.14 Affirmative action.**

Nothing in these guidelines shall be interpreted as diminishing a person's obligation under both title VII and Executive Order 11246 as amended by Executive Order 11375 to undertake affirmative action to ensure that applicants or employees are treated without regard to race, color, religion, sex, or national origin. Specifically, the use of tests which have been validated pursuant to these guidelines does not relieve employers, unions or employment agencies of their obligations to take positive action in affording employment and training to members of classes protected by title VII.

[FR Doc. 78-34640 Filed 11-19-78; 9:28 am]

## **Appendix 10**

### **Excerpts from Who Is Responsible for Clean Water?**

For more information contact:

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**College Park, MD 20742**  
**301-454-2438**

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*Who is  
Responsible for*

*Clean*



## WOULD I, AS A MUNICIPAL OFFICIAL, KNOW HOW TO HANDLE EACH OF THESE PROBLEMS?

-Do you feel that you would be qualified to handle all of these problems?

-Do you think it is unfair to have municipal officials blamed when

- (a) a fish kill results in the proximity of your wastewater plant?
- (b) if the complex machinery necessary to purify the water or process the waste malfunctions?
- (c) if the only qualified operator for one of the plants quits?
- (d) if no qualified operators can be hired to fill a vacancy?
- (e) if the community fails to plan for its future water needs, and subsequently loses new industry?
- (f) if the community and its waste products outgrow the capacity of the wastewater plant to treat the wastewater?
- (g) if an outdated plant allows untreated wastewater to contaminate a recreation area?
- (h) if a stranger to your community places a toxic substance in the water reservoir?

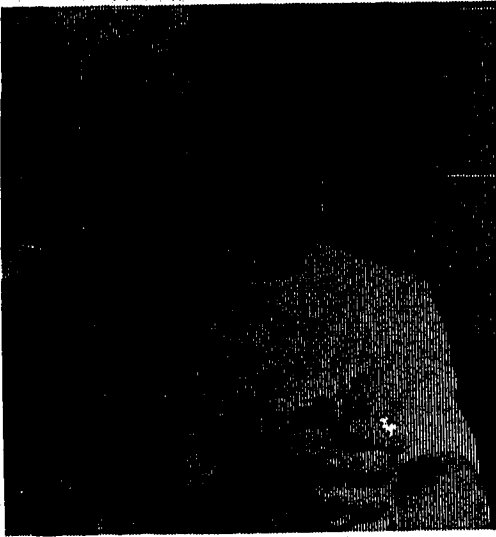
Qualified or not, fair or unfair, the municipal official will be required to respond to each of the above examples. It does not matter if the problem is complicated, or if technical competence is needed to propose solutions; the official is expected to find a satisfactory solution.

A real dilemma exists between what the citizens of the community expect from their municipal officials and what the officials are qualified and competent to handle.

One alternative would be to train all municipal officials to operate water purification plants, and wastewater treatment plants, and also the fire department, and the police department, and all other city services. Then they would be able to handle all related problems. This is not the solution we suggest.

If the municipal official is going to be held responsible for the correct operation of technical machinery and the health of the individual citizens, as well as for the future economic growth of the community, he must have competent employees. The town must hire and maintain qualified men, who are capable of handling efficiently and safely the types of problems mentioned earlier while operating the plants on a daily basis.

If the municipal official has a competent, qualified group of employees for all the town services, then the official has met the responsibilities of his office.



## HOW TO DETERMINE IF AN OPERATOR IS QUALIFIED

How do you know whether the man that is now working in the water or wastewater plants in your community, or the next man hired by the community is properly qualified? Is it possible for the municipal official to know that his employees are qualified?

### Hiring the Qualified Policeman

A comparison of the requirements and responsibilities of the policeman with those of the water and wastewater plant operators will serve as an illustration.

### Self Test:

What are the general responsibilities of a policeman?

**Answer:** To ensure the welfare and public safety of the residents of the community.

Which of the following requirements would you call essential qualifications when hiring a policeman? Circle the eight most important qualifications.

- |   |  |
|---|--|
| (1) be dedicated to the job                                 | (7) be on time                                       |
| (2) be 6'4" and 225 pounds                                  | (8) have the welfare of the community always in mind |
| (3) be able to follow orders and directions                 | (9) work really cheap                                |
| (4) have initiative   | (10) be willing to work hard                         |
| (5) be related to some friend or relative                   | (11) perform well in emergencies                     |
| (6) be interested in methods of becoming a better policeman |  |

Although some of the above characteristics are ridiculous, they help illustrate that in obtaining candidates for the important task of ensuring the welfare and public safety of a community, qualified personnel are needed. A policeman's actions during an emergency can be the difference between life and death. If a policeman is found to have performed poorly, and not to have been dedicated to his vocation, the whole community suffers.

What about the water treatment plant operator and the wastewater treatment plant operator? Is not their general responsibility to ensure the welfare and public safety of the residents of the community?

What could have been the results in the case discussed previously if the operators had not made the proper tests to discover the toxic substances in the reservoirs? How much damage could be done to a community if the wastewater plant operator is not interested in the community he serves?

Few people stop to consider how important the water and wastewater treatment plant operators are to a community. When a person locks his door at night to prevent intruders and gets a last drink of water, he never questions that the water is impure. He takes the operator for granted.

RETURN TO the list of essential qualifications when hiring a policeman. Check those essential qualifications for a water plant operator or a wastewater plant operator. How similar are the two lists?

One further point must be mentioned in comparing the policemen and the operators. Many more applicants presently prefer to become policemen because they have status. People identify the man by his uniform. They know the man that is attempting to protect their safety. The officials in municipal government also recognize the policemen and periodically cite the services performed by the policemen. The policemen STATUS is high.

The same is not true for the operators. The citizens of the community do not recognize them by sight. The municipality merely expects these men to do a job. Few communities provide their operators with uniforms. Few officials attempt to instill pride in a job well done. The status of the water treatment plant operator and/or wastewater treatment plant operator is low.

## SOME ADVANTAGES OF USING JOB DESCRIPTIONS

Up to this point, we have been discussing the fact that even though, as municipal officials, you are responsible for having clean water, due to the complexity of plant equipment and the technical skills required, you cannot operate or directly supervise plant operations yourself. It then follows, that in order to avoid problems similar to those discussed earlier, you must hire and depend upon qualified individuals to manage and operate your water or wastewater plant; a plant that concerns the safety and welfare of virtually everyone in the community. We would like to look at still another method of determining if your operator is qualified. While not the complete answer to the problem job descriptions can help. There are many advantages of having good job descriptions, advantages that can help you in the decision making process as a municipal official. We would now like to look at four of these advantages of job descriptions.

The first of these advantages is in recruitment. One survey shows that 43% of the operators today have more than 20 years experience in the field. Thus, the replacements for these people will be many. In addition, since water usage is increasing, more treatment facilities will be needed, and qualified operators will also be needed. Job descriptions and specifications can point out to the potential applicant the necessary education and skills required for the job. It will also outline some typical job duties, as well as other factors that relate to the job, such as working conditions. Possibly individuals that did not think they were qualified, can see these requirements and evaluate their own potential as an operator. They may discover that they do indeed have the beginning qualifications for the job. Also under recruitment, job descriptions can help the municipal official compete with industry when hiring water or wastewater operators. If descriptions are clear and accurate, the potential operator is not confused as to job duties, next promotion level, and responsibilities. He has a good mental picture of what is expected of him. Most industries use job descriptions, and to compete with them on an equal basis, job documentation is necessary. Finally, is the fact that job descriptions and specifications should eliminate favoritism hiring. Hiring is done for the job and not for the man. This is one of the best ways to assure yourself that you are hiring qualified individuals.

The second advantage is one of quality. If an operator can see where he fits in the organization or plant, and can see the next level of advancement, he must realize that to progress, he must perform at a high level in his present job. Therefore, the quality of his work should reflect this. Job descriptions and specifications point out to the operator exactly what the job requirements are for his present job, as well as designating what the next level of progress is. Unless each employee has a copy of his own particular job description, he is reduced to not knowing the full dimensions of his job, who in the plant can help him, how he will be evaluated, or what his opportunities for advancement are.

## **Appendix 11 Public Relations Programs**

**A: Improving the Operator's Image in Texas**

**B: Public Relations Efforts of the Water and Pollution Control  
Association of South Carolina**

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6521 Burnep Lane  
Austin, TX 78757**

**James L. Polk  
W & W Consultants, Inc.  
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Spartanburg, SC 29302**

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## Appendix 11 Public Relations Programs

### A: Improving the Operator's Image in Texas B: Public Relations Efforts of the Water and Pollution Control Association of South Carolina

#### IMPROVING THE OPERATOR'S IMAGE IN TEXAS

In an effort to enhance the professional image of persons in the water/wastewater treatment field, the Texas Water Utilities Association (TWUA) and the Texas Water Quality Board (TWQB) have cooperated to produce *The Good Life*, a 20-minute slide/cassette presentation about the importance and difficulty of the plant operator's job. The program is aimed at the general public and at management-level personnel with authority over operators' employment conditions. By emphasizing to these two audiences the demands a person must meet first to become an operator and then to keep a plant running as it should, TWUA and TWQB are trying to gain support for higher salaries and better benefits for operators.

Production work on the presentation was provided by the Training Division of TWQB. Distribution has been through a number of channels: TWUA districts, civic groups, television stations, etc. Copies of the materials are available on loan basis.

#### PUBLIC RELATIONS EFFORTS OF THE WATER AND POLLUTION CONTROL ASSOCIATION OF SOUTH CAROLINA

Two one-minute television spots (one each for water and wastewater) were

developed in 1976 by the Public Relations Committee of the Water and Pollution Control Association of South Carolina with the assistance of state Education Television personnel. According to the Committee, the commercials were designed to accomplish three goals: 1) to generate interest in the general public with regard to the importance of water and wastewater treatment; 2) to depict treatment plant operation and related work as worthy and rewarding careers for young men and women; 3) to publicize efforts by persons in the water/wastewater field to help clean up the environment.

The film segments were distributed to television stations across South Carolina, at no cost to the stations, for showing as public service announcements. General response from the television industry was good with stations in the midlands and low country sections of the state being most cooperative in airing the announcements. The Committee makes three recommendations to anyone wishing to engage in similar efforts: 1) the staff putting together the material should include experts both in the water/wastewater field and in the graphics business; 2) an outline of the objectives of the program should be developed in the initial stages; 3) the segments should be 30 seconds long, rather than 60 seconds, because television programmers tend to be more receptive to shorter announcements.

## **Appendix 12**

### **Sample Issue of the South Carolina Operator**

For more information contact:

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## Appendix 12

### Sample Issue of the South Carolina Operator

#### SOUTH CAROLINA ENVIRONMENTAL SYSTEMS OPERATOR

Since its birth in April 1975, the South Carolina Environmental Systems *Operator* has grown from a four-page, 8½" x 11" newsletter into a quarter-folded, eight- or twelve-page tabloid appearing approximately six times each year. The newspaper is prepared, published and circulated by Clemson University's Office of Operator Training, a division of the University's Department of Environmental Systems Engineering. The *Operator* is sent, at no cost to the subscribers, to over 3,000 persons (primarily treatment plant operators) with interests in the water/wastewater treatment field. Total cost of each issue is about \$600.00.

The *Operator* developers decided the publication should serve two purposes: 1) to inform and entertain operators by carrying news stories, feature articles, technical information and special columns written for, about and on the reading level of the "average" plant operator; and 2) to publicize and promote the activities and services of the Office of Operator Training. With the exception of providing sufficient technical information, the *Operator* has remained true to these purposes.

In the opinion of many, the best *Operator* published to date is the April-May 1976 issue. A copy of this issue appears in the appendix and is referred to in making the following comments on standard *Operator* features.

#### General

The standard *Operator* layout is three columns, each 18 picas (three inches) wide. Ten point type is used, as are large headlines and numerous pictures. The combination of these elements results in an easy-to-read, appealing-to-the-eye publication.

Writing in the *Operator* varies from informal to semi-formal, with accepted journalistic standards at times giving way to a less objective, more personal style. Attention is given to keeping the vocabulary of most articles at an eighth-grade reading level.

#### Major Story

Almost all of the April-May 1976 issue is devoted to operator training and education. The story beginning on page 1 and continuing on pages 3 and 11 is a factual accounting of the options to be considered by and the opportunities available to one who wishes to make plant operations a career. The article meets the two principal goals set for the *Operator* in that readers are both provided valuable information concerning training and education and made to realize the importance of operator training programs.

#### "Pipeline"

"Pipeline" is the *Operator's* editorial column, and the one in the sample issue (page 2) is a bit unusual in that the "editorial" is really a letter to the editor introduced by a long editor's note. This modification is successful in this instance, however, for it allows an operator to make the editor's point: "that no one in training or certification was really offering good solid advice to men and women in the field about the kinds of training best suited to their career goals."

Usually "Pipeline" is written as most newspaper editorials are written, and "Pipeline" authors tend to take a pro-operator point of view. Additionally, a standard "Letters to the Editor" column appears when appropriate letters are submitted.

### Feature Article

Regularly the *Operator* includes center-spread photo essays on subjects ranging from state and national conferences to new plants being built to old plants being closed. Such a feature was not included in the April-May 1976 issue in deference to "A Roundtable Talk" on pages 4, 5, 8, 9 and 11.

### "Operator News"

Pages 6 and 7 contain examples of articles usually found in the standard "Operator News" column, though in this particular issue that tag was not used. "Operator News" is a collection of short items of interest, such as course announcements, certification notices, meeting reports, etc.

### "Publications"

The "Publications" column (page 10 of sample issue) was begun as a means of keeping operators abreast of interesting books, magazines, pamphlets, etc. The

column no longer appears regularly, and appropriate items now usually are included in "Operator News."

### "Jobs"

As a service to job seekers and employers, the *Operator* lists in each issue qualifications of persons looking for work and details of positions available in the water/wastewater field. This information appears in the "Jobs" column (back page of sample issue).

The *Operator* staff will serve as a link between a would-be employee and a potential employer and will respond to inquiries. All information, however, is held in strict confidence.

### Exam Schedule

As a rule, the *Operator* usually includes a three-to-four-month schedule of when and where state certification examinations will be administered by the South Carolina Board of Certification of Environmental Systems Operators. Such information does not appear in the sample issue.



Apr.-May '76

# S. C. Environmental Systems OPERATOR

Special Careers Issue

## *Training and Education: How Much Do You Need?*

The big push is underway in South Carolina and across the country to interest recent high school graduates, and adults considering a career change, in entering the environmental technology field.

Recently, 30-second television spots were prepared by the Water and Pollution Control Association of South Carolina promoting water and wastewater treatment plant operations as attractive, challenging careers. Across the country, this same kind of promotional activity is going on; in Texas, the Texas Water Utilities Association has spent thousands of dollars in a recruitment and image-building campaign; a brochure from New Mexico State University advertising their two-year water utilities curriculum proclaims that "wages are skyrocketing in the water utility field... business, industry, federal, state and local agencies are expending huge sums of money and man-hours to meet ever higher standards of water purity... all major cities are undertaking major plant expansions. The need for qualified personnel... has created a large number of new positions for trained people."

The source of much of this recruitment energy, as the New Mexico brochure points out, is the escalating demand for cleaner water, accompanied by new state and federal regulations and the investment of millions of government dollars in improved treatment. The minimum qualifications necessary to be a "good" operator will continue to rise over the next five or ten years, as will the sheer number of operators needed. The present supply of qualified operators cannot meet the projected demands, so campaigns to recruit the new operator and upgrade current operator have been started in almost every state in hopes of meeting at least some of the estimated needs.

In the rush to recruit and upgrade, new training programs have been created at a steady clip, most notably two-year community and technical college programs offering a variety of degrees related to the field: en-

vironmental technology, wastewater technology, water utility operation, public health and sanitation technology, and so forth. In addition, many technical schools are offering shorter courses designed to upgrade the skills of existing operators or prepare them to meet certification and licensing requirements. At least one U.S. college (East Tennessee State University) is offering a four-year degree in environmental technology, and other schools, Clemson included, are considering similar programs.

As the education and training options increase, the individual considering a career in water and wastewater treatment and related fields is often faced with the problem of having to make choices among them without having a clear idea of the career options and opportunities available to him.

Should he or she go to college and major in environmental technology, public health, or some phase of engineering. Recent stories in *Time* and *Newsweek* magazines point out

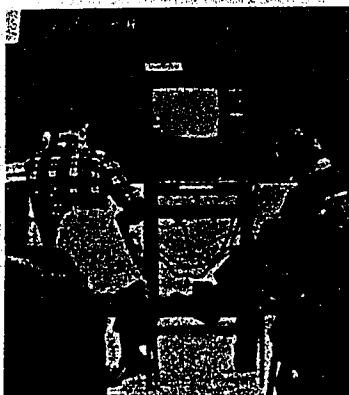
that individuals with college degrees, on the average, will make only about ten percent more during their careers than those without degrees. These articles add that recent surveys show only 30 percent of those attending college really want to be there — the rest go because of family pressure, indecision about a career, etc. And the cost of going to college is rising rapidly, averaging close to \$5000 per year at private colleges and about \$2800 at state-supported schools.

Community and technical colleges, on the other hand, cost on the average about \$300 per year, and an associate degree from one of these schools will often land you a job in the environmental field as readily as will a four-year degree. But do you really need even a two-year degree? It all depends. If the career you seek is in operations, the degree may help, but experience and training for specific skills related to operations will probably serve you as well or better, at least in the early stages of your career.

South Carolina's TEC centers offer 90-hour courses in water and wastewater treatment plant operation which are designed to teach you what you need to pass certification examinations. In addition, Clemson University and Sacramento State College in California offer water and wastewater correspondence courses at all certification levels which allow you to establish your own rate of study. Also, various states publish operations manuals — notably Texas and New York — which can be used for self-study. Both Clemson and the TEC system from time to time offer special courses in a variety of areas — lab procedures, basic management, activated sludge workshops — which can be used to upgrade skills; in addition, the Environmental Protection Agency offers three and five-day water pollution control courses throughout the year at their regional center in Atlanta.

(See pp. 10 & 11 for specific information about these different training opportunities.)

(Continued on Page 3)



(Sample Issue)

Operator, page 2



# Pipeline

The whole thing was a real coincidence. . . If you happen to believe in coincidence. The Clemson Operator training staff was locked up in a campus conference room with Steve Daniel, an operator from Greenville; Ernie Rowe, superintendent of Columbia Metro, and Jim Chocklett, head of Greenville TEC's wastewater technology program, participating in what I liked to call a "roundtable discussion."

The object of the roundtable (actually it was a rectangle) — a discussion of operator problems — more specifically, problems involved in deciding what kind of available training is best suited for careers in the water and wastewater treatment field.

The conversation, or dialogue if you like, rambled on for hours, touching on every conceivable subject, but concentrating on careers and training.

We kept coming back to the fact that no one in training or certification was really offering good solid advice to men and women in the field about the kinds of training best suited to their career goals. I for one wondered if there wasn't a need for this kind of advice — surely there were individuals "out there" who were at least vaguely interested in environmental technology, and water and wastewater in particular, but who weren't sure of the best approach to training for a career or even what careers were available.

Anyway, after three hours of this most of us were ready to wrap it up — several in hope of seeking out some liquid refreshment — when Delvecchio returned from an errand, dragging along a young man of 26 or 27. The young man seemed startled, confused, maybe terrified is the word. I could see Delvecchio was wearing one of his boy-have-I-got-a-but-one looks. He interrupted at the first possible moment. "Mee," he chuckled. "I've got an operator here, and he's got a few questions he'd like to ask you."

Steve Hopper introduced himself and began to pour out the sad tale of the problems he'd run into trying to make up his mind about a career in the water and wastewater treatment field. Should he go to school? How much school? What should he study? Was school more important than experience? These were the same questions we had worked to death during our discussion. Hopper was too good to be true. Frankly, I was suspicious. Some days before, Delvecchio and I had jokingly considered the possibility of introducing a "ringer" into the meeting — someone who would pose as an operator and personify all of the problems we imagined were the lot of the individual considering a career in the field. Had Delvecchio gone ahead with our proposed plan, keeping me in the dark?

Ernie, Steve Daniel, Jim and Bob — nobody's fools — were suspicious also. Hopper's clear and concise manner of speaking made us even more suspicious — he seemed to deliver his explanations from memory, as if someone had supplied a script. But after a hasty whisper or two in Delvecchio's direction, I decided he was the genuine article. I think our combined protests of innocence finally convinced the others.

Hopper told us he had more or less backed into the treatment field. He left college with a double-degree in English and psychology and stumbled into the real world to find himself overeducated and unemployed. In a move of sheer desperation . . . but why should I tell this story? He tells it very well:

Can you imagine what it feels like to be the one millionth paying customer in a store celebrating it's one millionth sale? Or can you imagine what it's like to be the one spectator in a crowd that gets knocked silly by a foul ball? Or, better yet, can you imagine stumbling into a director's office by accident only to be "discovered" as the ideal person to play the lead in his latest movie? Well, I re-



Steve Hopper

cently had that experience. My name is Steve Hopper and this is my story.

It all began back in December of 1977 when I graduated from college. An investment of X number of dollars and five years of my life earned a degree that has to this point proved useless. Subsequently, through a last ditch attempt or a stroke of luck, I landed a Public Service Employment job as lab technician and trainee for the city of Belton, S. C., where I perform and report all analyses on the city's three aerated lagoons.

After thirteen months at this capacity, I seriously entertained the idea of making a career of the water and wastewater field. But, even with my year's experience, I found I was in the dark about what my future could hold in store, and I was not about to offer another hunk of life to what might prove to be another futile effort. I had many questions. What requirements need to be met to enter wastewater technology at a state level? Which is better — an A.S. degree in wastewater technology or a "B" license which indicates more experience? Besides being an operator, what other careers are opening in this field? What careers are opening in the EPA? The WPCASC? The Board of Certification? What? How? Why? When? Where?

Living only a short distance from

Clemson University, I decided to pay a visit to Fred Delvecchio, Director of Operator Training, Department of Environmental Systems. Pat Phillips, Clemson operator training assistant, said he was at a meeting and would be returning shortly — quite shortly as a matter of fact, because no sooner had she uttered those words than the man himself appeared. My barrage of questions began immediately. Is the nonsequential system of certification still in effect? Will laboratory certification become a separate category unto itself? What does the WPCASC do anyway? So on and so on.

Now comes the interesting part of my story. As I proceeded to fire more questions to Fred, he proceeded to fire a larger, "Eureka, I've found it" — type smile at me.


"I don't believe it!" he said. "Did you hear this guy, Pat? He's just the one we've been looking for."

"Amazing!" she said. "A Godsend," she said. "The most exciting stroke of coincidental luck since the man eating chocolate collided with the man eating peanut butter and the peanut butter cup was born," she said.

My mind was spinning like a funnel of water trying to escape from an unplugged bathtub. I felt as if I'd won grand prize in a contest I hadn't entered. How about that. I sought answers and wound up a stereotype of the questions.

Fred asked me if I'd mind having all my inquiries answered by the group he'd been meeting with. I replied that six beats one any day and I'd be glad to get an expert opinion from any and all. I'd hit the jackpot.

(Continued on Page 11)



**S.C. Environmental Systems**  
**OPERATOR**

Fred Delvecchio  
Project Administrator

John Norton Editor	Robert Lord Photographer
John E. Smith Technical Advisor	

**Vol. 2, No. 2**

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## How Much Training?

(Continued from Page 1)

But let's suppose for a moment that you really aren't sure what you want to do about training or a career. You're interested in the general area of environmental quality control, possibly in some phase of water or wastewater treatment, but you're not sure exactly what it is you want to do, and therefore find it hard to make up your mind about school, training, and so forth.

Rather than force yourself into some decision you may not be happy with, why not take a year or two, find out whether the field is really for you, and keep bread on the table at the same time?

Here's a method that might work: take a job with a good-sized operation — a public water or wastewater treatment plant with a fairly complex treatment system, or perhaps an industry with a large flow and a sophisticated treatment operation. In South Carolina at present, real hands-on training in complex processes is not available through the education system — the best way to learn actual operations is still on-the-job.

If treatment plant operations are simply not for you, you'll find out pretty quickly and can turn to some other alternative. On the other hand, if you like the work well enough to stick it out for a year or two, your experience and two successful rounds of study for certification (on your own, at TEC, or through the Clemson short schools) will land you a "C" certificate in water or wastewater.

During your two years "apprenticeship," get to know people outside of your own operation. Attend district meetings of the state Water and Pollution Control Association (WPCASC) in your area, and try to make it to their semi-annual statewide meetings. By getting to know a variety of people in the field, you'll (1) learn about the different kinds of careers which people with backgrounds somewhat similar to yours have gotten into, and (2) you'll establish contacts which may help you later in landing a job.

With a "C" certificate and one or two years of experience, you'll be in a much better position to make up your mind about a specific career and its training requirements. You'll likely have some job security, and you'll be able to make decisions based on what you'd like to do, rather than what you have to do just to pay the bills. Also, you'll have an insider's knowledge of your own operation and the career opportunities available if you stay where you are. If you've taken the time to find out, by this time you'll have some familiarity with the treatment field as a whole and some idea of the different opportunities and careers available. Finally, you'll be in possession of a set of salable job skills which will help guarantee at least a minimum level of employment.

A number of options are now open to you. You may decide to stay where you are — perhaps you like the work and/or see possibilities for advancement within your present organization. Or you may have found that you like operations but feel you'd be better off in a different location. Start looking at the want ads in the trade publications (like the Operator, the WPCASC Journal, the



Water Pollution Control Federation's Needs and Data, or the American Water Works Association's Opflow. If you don't have access to some of these publications, write to us and we'll put you on our jobs mailing list.)

If you spot jobs that sound interesting, study the minimum requirements. Do you have them? You shouldn't be too discouraged if you don't meet all of the requirements listed in an ad. Remember, each ad specifies what a company or municipality would prefer. They might be willing to settle for less. (For example, supervisory or chief operator jobs are beginning to open up in many small towns and cities. Most ads for these jobs mention "A" or "B" certificates, but many employers will be satisfied if you have the ability to obtain these certification levels within a given time period.) On the other hand, don't take a lot of time preparing a resume; just write a simple, sincere letter outlining your experience and education and ask if the company might be interested in meeting with you to discuss the job.

As you look at the job ads, you may find that many list the same requirements — requirements which you don't have. In order to bolster your chances, you might now give some consideration to night classes at a nearby TEC center or community college — or daytime classes if you work the night shift. If you live near Greenville or Sumter, you might want to enter one of the two-year environmental technology programs — but other courses or curriculums might suit you just as well. How about industrial management, public administration, or a business curriculum? A degree in one of these fields, combined with your experience and licenses might improve your chances of landing a middle management or supervisory job.

If you should decide on more schooling, try to enroll in courses which will translate into college credits later. Many operators have a lot of experience and enough certificates and diplomas to paper the bathroom wall, but unless your certificates and diplomas are backed by an accredited institution, they're just so much paper. Keep your options open — you may be satisfied with a technical education now, but if you should decide later that a college degree is what you need to get the job you want, you'll have a headstart if you can transfer junior/technical/community college credits to a four-year college program.

If you decide you'd like to take a corres-

pondence course or attend short courses to upgrade your skills, make sure the courses are generally accepted as worthwhile. A national system has been set up whereby many such courses are accredited to offer "Continuing Education Units." Although these units are not transferable to college, CEU's are a recognized method of evaluating time spent in training on your own initiative.

After a couple of years' experience in operations, you may find that although you're still interested in the environmental quality field, you'd prefer something other than straight water and wastewater treatment operations. New jobs are opening up in industry, where the demands of new environmental legislation have made it necessary for companies to increase their involvement in pollution abatement. Industries are spending millions on treatment equipment, and personnel will be needed to operate it. Often, a treatment job in industry will call for a background in air pollution and solid waste disposal in addition to water and wastewater treatment. Here's where a two-year college program in environmental technology might be of real use to you. In some larger industries, management-level jobs are available as supervisor or manager of environmental systems. A two or perhaps even four-year degree in environmental technology will give you a working knowledge of air, water and waste treatment and industrial health problems — in other words, a background tailored for this type of job.

But perhaps you'd rather be out of operations altogether. A number of other opportunities are available, and in each one, your practical experience and certification should be a plus in trying to land the job. If you're interested in working for a regulatory agency — the state Department of Health and Environmental Control, the Environmental Protection Agency, etc. — a two or four-year degree will probably be a prerequisite for most jobs with a real future.

Teaching jobs in the field are opening up regularly, particularly on the technical school level. For a full-time teaching job, you'll probably need a four-year degree in environmental technology or perhaps industrial/vocational education. (There are many exceptions to this statement — non-degreed teachers still get jobs teaching full-time — but if you're planning on making teaching a career, a bachelor's and eventu-

(Continued on Page 11)

Operator, page 4

## A Roundtable Talk

# Training For Careers

In early April, the Operator invited a small group of people involved in water and wastewater treatment plant operations and training to come to Clemson for an afternoon of discussion. Although our roundtable talk covered many South Carolina operations issues — certification, salaries and wages, unionism, exam criteria, etc. — our main topic of conversation had to do with training and education for careers in the field.

Participants in the roundtable talk included an operator, a plant superintendent, a TEC program director, and three members of the Clemson staff.

Steve Daniel has worked for two years as an operator with the Western Carolina Regional Sewer Authority in Greenville. Before that, Steve served for a year as an industrial treatment plant operator with Olin Corporation. He holds a "B" certificate in wastewater and is a graduate of the two-year associate degree program in Wastewater Technology at Greenville Technical College.

Bob Lord is also a graduate of the two-year program at Greenville. Bob and Steve were members of the first graduating class at TEC, and both went to work for Olin after graduation. Bob is now a student at Clemson University, working on a Bachelor's degree in industrial education; he also works full-time developing training materials and certification exams for the Clemson operator training program. Bob holds a "B" certificate in wastewater and occasionally takes mediocre photos for the Operator.

Jim Checklett has been involved in some phase of waste treatment for eleven years — since he was 15. He worked at a commercial lab during high school, then went to college and received a four-year degree in chemistry. During his senior year, he worked as chief chemist and shift superintendent at a wastewater treatment plant in Wilson, N. C. He

then spent three years working for the State of North Carolina's Office of Air and Water Resources, first as a regional chemist and later as operator training coordinator. Two years as a field engineer for J. P. Stevens gave Jim experience in environmental analysis, wastewater treatment plant start-up, and environmental engineering. Jim is now project director and instructor for Greenville TEC's wastewater technology (now called environmental technology) program. He holds "A" certificates in water and wastewater in North and South Carolina and still operates a plant part-time.

Ernie Rowe has been familiar with the field since he was a kid; his father works for the state Department of Health and Environmental Control, and Ernie had the chance to travel with him. He's a graduate of the two-year associate degree program in environmental engineering technology at Sumter Technical College; after graduation, he spent two years with the old Pollution Control Authority (now part of DHEC) doing field evaluations for the compliance section and later working with the lab, legal and engineering sections. He ran the lab for the City of Columbia's wastewater facilities for six months, then spent another six months as the assistant superintendent of the Columbia Metro wastewater treatment facility. For the past two years or so, Ernie has served as superintendent of the Columbia treatment system. He is certified as an "A" wastewater operator in South Carolina.

Fred Delvecchio spent eight years with the Seattle Metro wastewater treatment system in Seattle, Washington, working his way up from maintenance man to a position as senior operator. During this period, Fred earned a two-year associate degree in wastewater technology at Shoreline Community College near Seattle. Fred taught wastewater

treatment courses at the New England Regional Wastewater Institute in Portland, Maine before coming to Clemson as director of the operator training program. Fred holds the "A" wastewater license in Washington State and is currently working on a Bachelor's degree in industrial education at Clemson University.

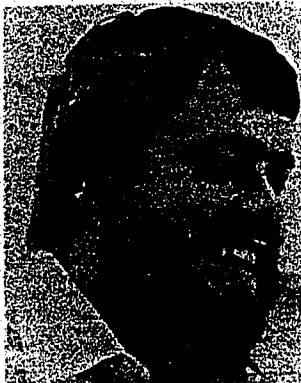
John Nerles knows practically nothing about water and wastewater treatment. He is editor of the S. C. Environmental Systems Operator and is working on a master's degree in history — mostly Southern history. John has edited the Operator for about a year and substitutes enthusiasm for his lack of knowledge and good sense.

What follows is a heavily-edited version of our three-hour discussion, which was taped and then laboriously transcribed by our office superperson, Linda Flagg. Although the conversation wanders some from time to time, we think operators will be interested in much of what is said — particularly those operators who have given some thought to college programs and similar training and education.

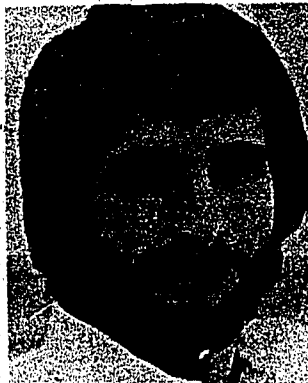
John: I'd like Ernie Rowe to start things off today. One of the reasons I asked Ernie to sit in on this meeting was that he told me not long ago that about two years ago he was attempting to hire some "B" level operators at the Columbia plant, and he experienced real problems finding qualified people. This situation, of course, won't come as any surprise to most of you. But Ernie added that he had interviewed a number of the graduates of Greenville TEC's wastewater technology program — individuals with two-year college degrees — and he was disappointed to find that their job expectations did not match

(Continued on Next Page)

Daniel



Lord



Checklett







Rowe

up with his employment situation. This struck me as significant — Ernie has one of the largest and most sophisticated plants in the state, and I couldn't help but wonder where the students could fulfill those job expectations. I finally began to wonder if the two-year program and other more or less intensive training programs were producing with too many expectations and too much education, given the low salary levels in many operations and the large value superintendents and managers place on hands-on operational experience.

I thought maybe we could begin by discussing this and see where things go. Ernie, would you begin by telling us something about your situation in Columbia and your manpower problems?

Ernie: The City of Columbia has one large industrial plant that was initially designed to handle 20 million gallons a day. We are in the upgrade process on that now. They also took over up to 15 other treatment plants and around 18-20 pumping stations. We've got some ready to start up and some under construction. This has basically taken place overnight. The city wound up with a new division created with no one to run it and too little background on the number of people and the type of people needed to run it. Plus the type of salary they would have to have to attract these people and hold these people.

Our problem when we started off (1973-74) is we were unable to find any licensed operators. This was during the big certification push when the people getting certified were already working in a plant and were strictly getting a license to hold a job. There weren't a whole lot of operators floating around. So we went out and hired people we felt were capable of passing the license and becoming good operators. In some cases it didn't work out fine and in other cases it didn't work out, because I think it's hard for an individual to realize exactly what he is getting into until he's actually worked on a shift for a while and realized what he's doing.

I think our major problem has been the inexperience factor. The people that we were getting that were going through six-month wastewater training at TEC were coming back to the plant having passed licenses with no practical experience — there was no way they could get



Delvecchio

that except on-the-job. They really hadn't covered what they actually needed to run the plant. I asked them very elementary questions regarding wastewater and they were lost. As far as doing any lab analysis such as running a BOD and doing a DO they couldn't do it.

Fred: Could you give an example? What you might ask them?

Ernie: Well, something like "pull me a settleable solids from the clarifier, and I've had people who did not know what a clarifier was. I know of one individual who is not working in this field now who passed his... I think it was a "C" but I'll say D. He didn't know where to get it from. He didn't know what it was. I asked him to run a DO in the aeration tanks, he couldn't do it.

John: Do you know what his training background was?

Ernie: The program at Tech. The 4-month or 6-month program they had, plus certification. As far as the people that went through the two-year program, some of them seemed more like the type of people we were looking for. The majority of them I talked with had apparently been sold on the idea that with all their background, they were overqualified to run a shift. They wanted administrative-type jobs. They were not willing to come in and work under anyone that had been there, they felt that they should walk into the plant and the lowest thing they would do is to take over a shift. This didn't work that way. You can't run a plant like that. That's the biggest thing we found wrong with the people who applied for jobs with this background. They didn't want to do the work.

John: Is there a problem then in there not being a middle job level where these people can come in?

Ernie: I don't think they should start out as a laborer.

John: But you say they have to have that practical experience first...

Ernie: I don't think they should come in and run a shift. Although, let's face it, there's an exception to anything, and you're gonna find people who are capable of doing it.

John: One of the things I've heard talk about is an internship program — having somebody come in and being designated as a trainee or intern.

Ernie: We have set up a training prog-



Norton

ram in the plant now. It's the same thing and pays the same as our utility workers. But "operator trainee" sounds better than "utility worker." It gives a guy a little pride, like he's going somewhere.

John: Is he?

Ernie: I certainly hope so.

John: Have you hired any Associate Degree students from TEC?

Ernie: Not as operators — let me take that back, I have too — I hired a girl who has an associates degree, and I moved her after a month into the lab where we could utilize her background a lot.

John: Suppose an associate degree holder came and agreed to take a job as more or less a lower level operator to gain experience. What would his career expectation be in the Metro-Columbia situation?

Ernie: If he does the job and gets the license, his position would improve and he would be moved up.

John: How does that work? How long would he be in this trainee situation?

Ernie: All right, the way we had it established, and some of this is being changed on the budget — we'll be setting up a new system, and it's kind of hard to go into, but anyway... A man came in as a trainee, he went to school and let's say he passed a D exam, but he didn't have the experience factor. We gave him a 5% raise for passing, then when he received his license we moved him to either an Operator 1, 2, or 3 depending on what grade his license was. We would up like I said with an awful lot of people getting their licenses, but there are few I call operators. Now, the way the new program will work — and I have no reason to believe that it won't go in effect like this — we're assigning each shift leader as mandatory to have a B license, he will have one man under him who is a C license operator and the others will either be trainees or utility workers.

The way that guy can go from there — basically the positions left are lab, or chain-of-command type set-up. If we've got a vacancy in the plant, instead of going outside and pulling someone in, we try to evaluate the people we have there and move any one of them up if we can. Sometimes this is not always possible.

John: Is there any advantage to coming in with a degree rather than going through

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## SOURCES: Training & Education

Training opportunities come in all kinds of different shapes and sizes. And this is probably a good place to distinguish between "training" and "education." Although it's not easy to draw the line, we can say that training prepares you for a fairly specific trade or occupation — or some particular skill associated with a trade or occupation. Education, on the other hand, provides you with a broader, though at times superficial, knowledge of some area of study, rather than providing you with specific skills for a specific job which can be identified at the outset of your training.

In this section of our training for careers issue of the Operator, we've listed a variety of information about available training and education. The list is far from complete, but it does include most of the opportunities in South Carolina related to the treatment field, as well as some of the more promising programs out-of-state. We've also included some information about financial aid.

Much of this information is general in nature; space limitations prevent us from going into each program in detail. We encourage you to write for more information if you think you might be interested in a particular program — it'll only cost you the price of a stamp. If you experience any difficulties obtaining information about any of these programs, please write and let us know. We'll try to get the information to you.

## Associate Degrees

Two of South Carolina's technical colleges are currently offering courses in the area of environmental technology; other schools are considering similar curriculums but have made no decisions as yet. If you are interested in seeing a curriculum established in your area, contact your local TEC by letter or in person and let them know of your interest. If you know of other people with the same interest, encourage them to do likewise. The technical colleges are always interested in establishing new programs where a demand has been demonstrated.

**GREENVILLE TECHNICAL COLLEGE**, Greenville, S. C. — Greenville TEC offers a two-year associate degree in environmental technology (formerly designated Wastewater Technology). The TEC program is being expanded next year to include more emphasis on the whole environmental quality field. In addition to the established water and wastewater technology courses, attention will be given to air pollution, solid waste disposal, industrial treatment operations, etc. The idea, according to program director Jim Chocklett, is to provide the graduate with a broader background in environmental technology and thereby increase his employment potential.

Although it is by no means definite, some monies may be available to students entering the program next year. For more information on the program, contact Jim Chocklett, Environmental Technology program, Greenville Technical College, Greenville, S. C. 29608.

**SUMTER TECHNICAL COLLEGE**, Sumter, S. C. — Graduates of the two-year environmental engineering technology program at Sumter TEC receive an associate degree in applied science. Dr. Robert Chen, the program director, informs us that the program is designed to train individuals to be engineers and technicians, as well as environmental technologists. Dr. Chen adds that the program is accredited by the Engineers Council of Professional Development (ECPD).

According to the college handbook, the graduate will "have a knowledge of principles and laboratory procedures necessary to perform tests on solid and liquid wastes, water, foods, and air contaminants to determine their suitability for man to release into the environment." Degree holders will be qualified "to enter a variety of positions such as environmental engineer, industrial waste technician, municipal water and sewage treatment plant operator, water pollution control technician, sanitary technician, sales and service of equipment and chemicals, and engineering technician positions with governmental or private organizations."

Courses include basic math and English, advanced math, chemistry and biology, water and wastewater engineering, hydraulics, physics, statistics, and so forth.

For complete information on Sumter TEC programs, including the environmental engineering technology curriculum, write for a catalogue to Sumter Technical College, 506 Guignard Drive, Sumter, S. C. 29150, (803) 773-9371.

## SHORTCUTS

Clemson University's water and wastewater treatment plant operations training program sponsors short schools periodically during the year. The schools provide a three-day basic operations review designed to prepare water and wastewater treatment plant operators for state certification examinations at the "A," "B," "C," "E," and "D" levels. Exams are given at the end of each short school. In 1975, two short schools were held: one on the Clemson campus in May, the other on the campus of Orangeburg Calhoun Technical College in August.

For information about training opportunities available through the Clemson program, write Director of Operator Training, 420 Rhodes Center, Clemson University, Clemson, S. C. 29631.

## BS. & M.S.

Currently, no South Carolina school or college offers a four-year degree in environmental technology. Clemson University is considering such a program but no definite plans have been made as yet. Several degrees are offered in areas related to environmental technology and health, however, and we have briefly mentioned some of them here.

**CLEMSON UNIVERSITY** — Clemson currently offers a number of Bachelor of Science degrees in engineering, including engineering analysis. On the master's degree level, Clemson has degrees in Environmental Systems Engineering and Water Resources Engineering. For complete information about

Water and wastewater treatment correspondence courses are available from two primary sources: Clemson University in Clemson, S.C. and Sacramento State College in Sacramento, California.

**CLEMSON COURSES** — The Clemson courses cover South Carolina certification levels A-D in both water and wastewater and have been used by more than 10,000 individuals since they were written. The courses offer basic training in operations, maintenance, lab procedures, etc. Tests are included in the course to help the student and the Clemson staff determine the student's progress. South Carolina certification examinations are currently drawn primarily from these materials, with the exception of the "B"-level wastewater examination, which uses the Sacramento State College "B" wastewater course as the primary reference.

More information about the Clemson courses may be obtained by writing to Clemson Correspondence, 401 Rhodes Center, Clemson University, Clemson, S. C. 29631.

**SACRAMENTO COURSES** — Sacramento State College offers correspondence or "home study" courses only in wastewater. The course is broken down into four levels, equivalent to South Carolina's grades A-D. The courses operate in much the same fashion as those at Clemson — students complete assignments and tests which are mailed to staff instructors in Sacramento. The Sacramento "B" wastewater course is recommended by the S. C. Board of Certification for study leading to certification at that level. Students who complete the Sacramento courses receive Continuing Education Units, which are not transferable as college credit, but which are a recognized national method of measuring self-study efforts.

The Sacramento program is now preparing a home-study course on wastewater collection systems.

For more information about the Sacramento courses, write Dr. Kenneth D. Kerri, Sacramento State College, 6000 Jay Street, Sacramento, California 95819.

Clemson's engineering programs, write the College of Engineering, Riggs Hall, Clemson University, Clemson, S. C. 29631.

**UNIVERSITY OF SOUTH CAROLINA** — The School of Public Health was established at USC in 1974. The University offers a Bachelor's degree in Public Health and Masters' degrees in Public Health, Public Health Education, and Environmental Health Staff. "The School's programs are designed for public health workers already committed to improving public health in the State. A high proportion of students are part-time, combining work in their regular jobs and graduate study."

For more information, write the School of Public Health, Williams-Brice Nursing Center, University of South Carolina, Columbia, S. C. 29208.

CORRESPONDENCE

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## TEC Upgrade

Each school or college has a financial aid office or financial counselor from whom you can obtain information about possible financial assistance to help pay your way through school. Many schools offer special scholarships based on ability and/or need.

In addition, certain types of financial assistance are available at all accredited colleges and universities. Veterans may take advantage of the special educational benefits provided by the federal government, including payment of tuition and fees, living expenses, special letters, etc. To find out more about this, veterans should contact their local Veterans Affairs office or write to the Director of Veterans Affairs at the school or college which interests them.

## Financial Aid

One of the best sources of financial aid available now is the federal government's Basic Educational Opportunity Grant Program. The BEOG is designed to provide financial assistance to individuals in need who wish to attend post-high school educational institutions. According to government literature, "Basic Grants are intended to be the 'floor' of a financial aid package and may be combined with other forms of aid in order to meet the full costs of education." The grant amount is determined on the basis of personal family resources. Awards average between \$50 and \$1,500 per year.

Grant eligibility is limited to students in undergraduate programs who have never received a Bachelor's degree from any institution. Students are required to enroll on at least a half-time basis. Accredited institutions include colleges, universities, vocational, technical, and career training schools, and community colleges.

To obtain a Basic Grant application form, write to the Basic Educational Opportunity Grant Program, P.O. Box A, Iowa City, Iowa 52242, or contact the financial aid office at the nearest college, university, or TEC center. You will file your application directly with the Basic Grants program, and you will be notified within six weeks of your eligibility. If you are eligible, the grant may be used at any accredited school.

**UPGRADE FOR CERTIFICATION** — Many of the technical colleges around the state regularly offer upgrade courses which average about 30 hours and are designed to prepare operators for state certification. Course schedules and contents vary from one center to another; on the average, however, 80 hours of basic instruction are offered, followed by 16 hours of certification examination review. Although all certification levels of water and wastewater are generally offered in these courses, the number of enrollees in the total program usually determines the course groupings. For example, if enrollment is small, two or more levels of instruction (e.g., "C," and "D") may be taught together. Wastewater courses are generally more in demand, but if sufficient interest is shown, water courses are held as well. A minimum class size of 12 is generally required.

Average tuition for the upgrade courses is \$30-\$35, plus references; in most instances, TEC students are required to purchase the TEC training manuals; the two-volume set sells for \$16.50.

Check with your local technical college to find out when courses are being held; if no courses have been planned in your area for the immediate future, write to the Dean of Continuing Education at your local TEC and ask to be informed when an upgrade course is offered. If you know of other operators in your area interested in such a course, you might try to come up with 12 students; if you do, provide your TEC center with their names and addresses and a course will be set up for you.

**NPDES LAB TRAINING** — In February, 1976, the state technical education system began offering special training in NPDES lab procedures. The courses are currently being offered at Greenville, Sumter, Trident and York Technical Colleges.

Interest in the courses has been great and TEC coordinator Earl Eagle said recently that there is currently a backlog of applicants. Part of the course's popularity stems from the flexible schedule — there is no set pattern for completion; students with varying degrees of background knowledge and skill combine home study with hands-on lab training at the TEC centers until they reach a level of competency sufficient to perform the NPDES monitoring procedures. Labs are open and instructors are present at the centers 12 hours each week during the evening, and students may attend during any of these periods.

At present, no tuition is being asked for the course; EPA student reference manuals are being provided free of charge; there is a \$10 registration fee to cover incidental costs to the centers. Tuition may be charged after June 30, 1976, if federal funding is not continued; students interested in the course should register as soon as possible to avoid tuition charges.

## Out-of-State

### 4-Yr. Environmental Health Degree

East Tennessee State University in Johnson City, Tenn. offers a bachelor of science degree in Environmental Health which will prepare the graduate for a career in a variety of environmental health and technology areas. The curriculum includes courses in water and wastewater treatment, air pollution, food sanitation, radiological health, insect control, disease control, occupational health, solid waste management, environmental health equipment, and more.

East Tennessee accepts credits from the two-year programs at Greenville and Sumter Technical Colleges. A work-study program is available, as well as the usual federal student grants (see section on financial aid).

For a school catalog and complete information, write Director of Admissions, East Tennessee State University, Johnson City, Tenn. 37601.

### Public Health Sanitation Certificate With College Credit

East Tennessee State University, in cooperation with the Tennessee Department of Public Health, conducts a sanitation school on the University campus which is available to both in-state and out-of-state students.

The school offers five courses, granting a total of 18½ hours of college credit. The courses provide basic training for "public health sanitationists" and topics for study

include the biological and physical sciences, public health problems related to the field of environmental sanitation, preparation of official reports and journalistic releases, public speaking, sanitation planning, etc.

For complete information about the sanitation school, write the Director of Admissions, East Tennessee State University, Johnson City, Tenn. 37601.

### 2-Yr. Degree in Water Quality Monitoring

Ulster County Community College in New York State is offering the first associate degree in water quality monitoring in the nation. The new program, which is co-sponsored by the U. S. Environmental Protection Agency and the New York State Department of Environmental Conservation, will train water quality monitors "to perform process control laboratory procedures for water and wastewater treatment plant operations, and to perform a variety of procedures required by water quality regulatory agencies." Graduates will find jobs in government regulatory agencies, and with municipalities, industries, and engineering and planning firms.

Present plans provide for the selection of 20 students each year. Of this 20, ten will come from states other than New York. Students, when accepted, will have their tuition, books and fees paid in full through a government grant. Students will have to bear the cost of room and board. Other financial aid is also available.

Individuals will be selected for the program on the basis of recommendations, personal achievement and geographical distribution. For more information about the program and to obtain an application blank, write to Richard B. Glaser, project director, Water Quality Monitoring Training Program, Ulster County Community College, Stone Ridge, N. Y. 12484.

### Short Courses in Tennessee

The State of Tennessee has established an operator training center in Murfreesboro, Tennessee which offers short courses lasting from three days to three weeks; the courses are free of charge, according to instructor James O. Sweeney, Jr., and trainees from all over the southeast and midwest have attended classes at the center.

Each trainee or his employer is responsible for travel, food, and lodging expenses — but when you figure in free tuition, the costs of obtaining the training is comparable to costs in-state.

The center offers courses in both water and wastewater; some course titles include "Theory and Practice of Wastewater Operations" (two weeks), "Advanced Waterworks (or Wastewater) Technology" (four days), "Reduced Pressure Backflow Preventer Workshop" (three days), "Pump and Valve Maintenance Workshop" (unscheduled as yet), and more.

For more information and a complete course list and class schedule, write to Operator Training Center, Route No. 4, Blanton Drive, Murfreesboro, Tennessee 37130, (615) 636-3727. ☐

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# Careers Talk

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another kind of training — correspondence or whatever — and getting the certification?

**Ernie:** That's hard to answer yes or no. Sure, I think an employer will look at the guy's background. You got a guy that's gone through a 2 year program, and let's say he's got his A, but I've got a guy who's gone through short school and has his B and has been working in the field for six years and does a genuine good job. He can run circles around the other guy. I'm going to go with the guy who can do the best job.

One thing I would say: some of these people I talked to with two-year degrees — and I'm not cutting them down. I think they're good — but when guys come in and say, well, I expect to be taking readings and doing all the lab work, but I have no intentions of shutting down a pump and pulling the sludge out, or I have no intentions of bosing the basins down or stuff like this, then someone needs to sit down with them and have a heart-to-heart talk. I do it now. You need to do it because the wastewater is not going to stop coming because you get a new guy in there. The guy has to do certain things, and he shouldn't have any qualms about it.

This is something I've heard a lot of talk about from an engineering firm. They made the statement that they feel possibly we may be getting too much training, too many people in the plant with too much training. We've got too many chiefs in there and it's creating a problem. I think we possibly have this problem in our plant right now.

**John:** Overeducation?

**Ernie:** That's right.

**John:** Why is it a problem? Because there are not enough upper level places for these people to move into?

**Ernie:** For one thing there's not enough jobs open. Whether it's municipal, state, or industry you can only pay so much money for so many people, and everyone is clamoring for more money. The people I've got don't mind getting in and doing whatever work needs to be done. But sometimes you find people questioning whether this actually their job: you know "I'm a B-licensed operator; this isn't my job." Who's the laborer and who's the actual utility worker? That attitude ridiculous if you've got to call a laborer at home and bring him in everytime you need to clean up.

**John:** So sometimes the certification law — the divisions created by our certification system — is translated to a kind of job structure in the plant.

**Ernie:** I think it is.

**Jim:** Ernie's hit on some of the basic areas. I think they reoccur everytime we have a discussion about Operator Training. The problem about the job status is an obvious problem. It's evident in my second year students at TEC. They expect top-notch salaries, a top position immediately upon graduation. Some think that if that they can go through the two-year program, they're automatically assured of employment at a certain salary. Somehow or another along the road they were led to believe that if they

complete the degree, they can demand certain salaries and demand certain jobs. This is the problem I've been fighting for a full year, to let the student know now before he gets out that that's not the way it is outside. That he is going to have to obtain some experience if he's going to continue in an operations capacity.

There are some jobs he can go right into and take over, such as in the laboratory. There are some jobs he can do like that. But in terms of going in and becoming a shift supervisor without any additional experience — that's nearly impossible. I'm not short changing the student, and in fact, some of our students who are presently employed at the Western Carolina Regional Sewer Authority while they're in school may have a year of experience when they graduate, but they could go down to your plant and it would take them another year before they fully learn your plant. This is one of the problems that keeps reoccurring. They have to obtain a year or a couple of years experience.

One alternative to obtaining the experience after they have completed the program is to give them the experience while they're in the program. I don't know if you're aware or not but we do have a summer training program. The student goes out, supposedly operates or assists the operator, maintains the plant, and so forth. In years past, our students ended up doing nothing more than mowing grass. So they've wasted three months. A student could have perhaps worked somewhere obtaining good experience, but all he's done is mow grass. The student then does not obtain the experience during that 3-month period, so he has nothing else to offer other than his degree.

I've gotten the impression that sometimes the student is at a disadvantage. Operators expect them to know more after they have completed one year at TEC than say an operator that's already been on the job for two or three years. There has been this problem. I won't say it's been a major problem. Our students now really don't want to get involved in the summer program.

One thing I also do is I encourage students to pick up small jobs on the side operating package plants. I've got one of my students that's doing that at this time. Or trying to become employed at some of the local treatment plants. Of my second year students, I've got one that's a shift supervisor at Greer Waterworks, one that's an operator on 3rd shift at Mauldin's plant. In my first year class, I have two students that are presently employed as operators.

These are some of the alternatives that we have tried. But I recognize that there is a problem when the student does come out thinking that somebody owes him something for completing the 2-year degree. After completing two years of formalized education, they are still not prepared technically. This has been an obvious problem that I've recognized, having employed TEC students when I was in industry. The student comes out sometimes with less actual education than the guy that has two years of practical experience. This is making me start to wonder what is going on if our program is turning out two year students that can't perform technically. But all you need is one student, one bad apple, and it affects the whole program.

**John:** Which raises the question again, do they need the two year associate degree? Or are they better off with this other kind of practical experience?

**Jim:** Things are stacked right now toward the student getting some practical experience and completing the certification course. You hit it right on the head earlier — most operator training salary scales and promotions are centered around the license. A student can come out with a four-year degree in environmental engineering or wastewater engineering, and if he doesn't have an "A" certification, he is going to limit himself in employment opportunities.

**Ernie:** I got people right now that are college graduates working for me that are paid because of their license, not their degree. If they can get a degree, that's great as far as I'm concerned because later on if they progress and stay in the field — let's say a magical type position opens up — this is going to be great background and experience, and it might be the little extra they need. This may push him into a good job over the guy that's been there for 15 years and had this "A" license but doesn't have a formal type education. I think possibly for a management position this guy with a degree would be better.

**John:** All right. Is it the technical part of that degree that serves the graduate best, or is it his other studies — management, supervision and those kinds of skills that you can supposedly acquire in college?

**Fred:** Or could it just be the fact that man attended school for two years? He's got a piece of paper that says, "I went to school for two years?"

**Ernie:** I would prefer to have someone with that college background, because he can go from there. But it depends on the guy, because I think you've got so many people who come right out of a school who think they know everything.

**John:** Steve, you came out of the two-year associate degree program in Greenville. Let's talk about that.

**Steve:** This problem of high expectations was probably more of a problem with us than it was with most of the other classes. We were the first class. We were the first group of operators coming out of the wastewater course with a two-year degree. We all went down and passed most of our certification exams, and we thought we knew it all and everything. Then we got in the field and found out how much experience means. It's really that experience that counts. But the education helped us get the licenses, and I think the education may not mean as much right away as soon as you get out of school as later on — if you look at a lot of ads for high positions, they require something other than just a high school diploma, some two years and some even four years. When we first got out we were thinking that we were supposed to get the higher salaries, but we found out different. You need experience also.

**Ernie:** I think this is a fallacy of a TEC student. They're great for doing that. I was a graduate from the two year program at Sumter. The first evaluation I ever received when I went to work, well, the guy was a straight shooter, and he put on it that he thought I felt that I knew more than I did. It made me mad.

**John:** How did you guys who went to TEC get the idea that you would take the field by storm when you got out? When Jim Chocklett took over the TEC program last year, he found this attitude was still held by the students. Where did the idea originate?

**Bob:** The recruiters. They give you this great big gold god outside there sitting waiting on you once you got your degree. When

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## More Career Talk

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they recruited me, they painted this beautiful picture and it was like the man said about having this black limousine waiting on you. They really go with that, and they tell you when you get out of here, you're gonna have Ernie Rowe's job and have a good time.

**Ernie:** Let's face it — at Tech schools, unless the program is really very much in demand, it lasts for several years and slowly fades out. To get this new one going they've got to do a good selling job. I was in the same boat, because my degree is in environmental engineering technology and I think at the time I went to Sumter TEC, there were 15 places across the nation where that course was offered. It was the only place in the state where you could get it. They really sold it big, and they got people in it too that weren't even interested, because we started out with something like 23 people in the class and three of us graduated after two years. I couldn't find a job when I graduated, to be honest with you.

**John:** Do you think that by creating these kinds of curriculums, TEC is projecting the state's future needs and trying to meet them, rather than doing what's best — giving the best advice to the individual student — being honest about the career potential in a particular degree area? There is going to be a need for operators. To serve the state we produce a lot of people who have this background, and then when the jobs come along hope the people will be there? Is the student being served when you allow him to spend two years preparing for a job that is just not there, or is not what he thinks it will be?

**Bob:** The jobs are there, if you want to work for dirt and then stay there for 20 years. The jobs are there, but the money is not.

**Fred:** Another view point here is that many — not just TEC but many — educational institutions just find students for their own programs, for their own self-perpetuation, regardless of whether there are jobs or not. They're not serving the objective of providing people for jobs that are available, but just trying to continue on their program so the department head can keep his job.

**John:** So it's self-justifying. You create your own student demand.

**Jim:** We keep going around in the circle of education and careers. There is the education factor; you can obtain all the education you want and never decide upon a field. But you can also at the same time develop a career and then obtain the education that you need and this is what most operators are doing. They are not getting the education first. They are going into the field and then obtaining the training, so our objectives are going to have to change from trying to provide this glorified curriculum that's going to provide the student with this education, and then let him pick a career. We're going to have to take the student or the individual that is already a practicing operator and provide the training that he needs from that point.

This is some of the emphasis that I'm putting on the program at TEC; I'm trying to

recruit as many students that are presently operators in the Greenville area as possible.

**John:** Then the recruitment is going to have to shift to the plant, rather than to the TEC center. The plant management will have to recruit raw people, then TEC can come in and train these people.

**Jim:** Well, if it's not going to work the other way, where TEC is doing the recruiting, then we have to look somewhere else.

**John:** I wrote down a couple of things here just in case it got real quiet. "I'm a high school graduate, I've seen some ads on TV which talk about the career potential in water and wastewater treatment" — (This is realistic because these ads are getting ready to go on TV here in this state). "I'm ambitious, I want to go far, I want to get to the top of my career ladder — what's your advice?" Fresh out of high school, what's the smartest thing he can do? He's just been told about this great career while he's watching a western on the late movie. It's a very positive ad.

**Ernie:** The first thing he ought to do is investigate — go to a water or wastewater plant and ask to be shown around. And I don't think the people at the plant should pull any punches with him. Tell him the bad side of it too. Tell him what he's going to be doing, exactly what he's dealing with in no uncertain terms, so he'll know exactly where he stands. I think his best bet if he goes to work is to get into an on-the-job training program or self-study. Why go directly into school?

**John:** So you think it would be smart to get to work first. Then what?

**Ernie:** Let him get his license. We've had several go into the 2-year programs while they've been working out there at the plant. After they've gotten their two-year degree, the only thing I can suggest if they don't want to go into a 4-year program somewhere is not to just let it stop there; get a hold of those correspondence courses. I don't care if it's going back over the same thing. If he's gone through Clemons's courses, get Sacramento's and go through theirs. Go through Texas. Don't stop. Try to learn the government agencies, your state agencies. Find out what will work for you and what you can do.

**Jim:** Say you have the ambitious individual — I'm in a little bit different situation. I may have a gung-ho individual who comes in and says I want to get a degree; I want to go out — you know, I want to burn the world. I want to really make a name for myself. I can fiddle with him a little bit and say well maybe you ought to get some experience first. The guy says, I don't want that, I want some education today. I want to study this curriculum right now, I want to know where it's going to take me. I want to know what's going to come out of it. What's there, what can I expect when I get into this field?

I could take him down to Mauldin Road treatment plant and he's probably get just about into the gate, and he's probably hop out of the car and run away. But if I take him to an industrial operation where it's nice, with all the panels and the blinking lights — if nothing else he's just gonna stand there and gaze for a while and say, well now, this is more like it. This is the exact response I've gotten from my students this year. All of them were under the impression for the first quarters that wastewater technology had nothing to do with anything but sewage. And of course, they say, well, sewage stinks and I don't want to be associated with sewage; I don't want my friends to know that I work in a sewage treatment plant.

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We're changing our program name from wastewater to environmental technology. The change is only academic. I take the student out, and I show him a municipal treatment plant and an industrial situation and say if you are interested in municipal operation this is pretty indicative of what you are going to have to deal with. If you're interested in industrial operations, this is what you will have to deal with. Again, I'm not trying to say that industry is better than municipality. I've been on both sides of the fence, so I can point out to the student what the good sides are to both areas and what the bad sides are to both areas.

I try if at all possible to eliminate any of this rosy picture approach. "You're gonna make \$15,000 when you get out." Mostly what he's going to be concerned with is making a decision between going to work in a utility position or going to work in a technical position, and where his future would lie in both these areas. If he's going into utilities, he would have this path that he would follow. If he is going into a technical area, which would most likely indicate industrial operation or consulting, he would have these possible paths. There is a big money differential between industry and municipality.

**John:** Industries can pay more?

**Jim:** Exactly.

**John:** Is the career potential in industry as good as in utilities?

**Jim:** It appeared to be, yes. I'm sure a lot of municipalities would throw sticks at me, but there can be a career in either one. This depends upon the individual.

**Steve:** Well what you've got in industry is this — they're going to try to spend as little money as possible for pollution control, because that's not their product, that's not what they are worried about. The least amount of money they can spend on this, the better they like it. I would rather work for a municipality myself, because treatment's their business. But it would depend upon the type of industry you're talking about. How much waste they treat . . .

**Jim:** We need to look at something else also. An industrial operation is looking for a guy who can perform that one job. But, if a student is prepared say in other areas of environmental technology, then eventually he stands a chance of taking over technical services of that industry. The water and wastewater treatment and disposal, air pollution monitoring, industrial health and hygiene. This is one reason why these subjects are brought into the curriculum.

**John:** Should an operator who's interested in becoming a chief operator or superintendent take some engineering courses?

**Jim:** Ok. The key to good operations is that an operator should be able to know the basic function of his plant. How the function of one unit intermeshes with the function of another unit.

An operator really needs to know his plant inside and out. Maybe he doesn't need to know everybody else's plant, but the basic fundamentals are at each plant and he needs to understand those. So that when something is going to be changed, or a new plant is going to be designed, this operator has the input. How often have you heard an operator complain that the design engineers built it and they sure fouled it up. Put the blame on the design engineer's back. But where was that operator when they were designing the plant? Nine times out of ten he was there, but he didn't say a word — it's not because he

(Continued on Page 11)

Operator, page 10



## Publications

### Some Unusual Books For the Go-Getter

Let's suppose you're one of those individuals who's determined to get to the top in your chosen field. You're young, energetic, perhaps even clever and shrewd. What you lack most is that often-talked about, seldom-defined "practical education" which any successful man and woman over forty will tell you "only comes with experience." Well, to some extent that's true, but there are ways to get a jump on that long apprenticeship in the "real world." How, you ask? Like this, we answer: turn to the experts, those same successful men and women we've already mentioned, who have lived in that dog-eat-dog real world and have survived, more or less, to tell about it.

Listed below you'll find books written by successful veterans of the struggle to make it in today's highly competitive, ulcer-ridden business and professional world. They offer a kind of practical education you'll seldom find in textbooks or classrooms. What you learn from them may give you that extra boost you'll need to get to the top of the heap.

**Power! How to Get It. How to Use It,** by Michael Korda, Random House, New York, 1975. \$9.95 hardback.

If you're an ambitious individual, you may have already heard something about Power!, which has been on the best seller lists for six months or more. If you're going to succeed, Korda says, you've got to learn how power works and how to use it to your advantage. "Style is the key to power," he observes. Appearance is important; highly-shined shoes, expensive suits, assertive statements spoken with complete confidence. Korda's view of the business and professional world is not particularly original—it's a jungle where the fittest survive by wielding power without much concern for the rightness and wrongness of their actions. If you want to make it, you must expect to climb over the corpses of those who stand between you and success.

Suppose, for example, you want the job of a superior who's getting on in years but appears uninterested in retirement. Korda suggests you work on his weaknesses. Psyche him out. Place him in situations where he is constantly reminded of his decreased vitality. Speak softly to make him think he's going deaf.

During a visit to another power figure's office, contrive some method to remove him from behind his desk, then ask to use the phone. Sit in his chair, violate his territory. When you finish with your call, remain behind his desk, talking to him from his position of authority. Finger the phone with confidence (the phone is a strong male power symbol).

Korda's suggestions are cold and calculated, his methods ruthless. Nevertheless, they will probably work and will be used, if book sales are any indication. In fact, so many people are reading his work, you may find yourself at a disadvantage if you haven't read it.

**Winning Through Intimidation,** by Robert J. Ringer, Funk & Wagnells, New York, 1975. \$9.95 hardback.

Winning Through Intimidation is another big best seller—apparently hacking one's way through the business and professional jungle is a popular sport. Ringer is a big-time real estate broker, and his book is basically an autobiography telling how he got rich in a hurry by bullying people into believing he was an important and powerful figure. Time magazine calls his message "tough-guy ethics," which is a pretty good description: "the main reason I wrote the book," he says, "was to make money, not to help people."

Although he applies his techniques to the real estate business, he says they'll work in any business or profession. He depends primarily on the psyche-out, over-awing the individuals he's trying to impress with symbols of power and influence. His business cards are 10-inch by 10-inch full-color photographs of the Earth taken from an Apollo moon rocket. If he's going to Cleveland to negotiate a big business deal, he ranges to be met at the airport, then lands in a private Lear Jet, accompanied by a dozen or more lawyers, assistants, and secretaries carrying portable office equipment. Impressive.

If you happen to be one of those who believe good impressions are important, here's a book you don't want to miss. The author's not saying it won't help you — it probably will — he's simply saying he doesn't care. But then that's what it's all about, right?

So far we've half-seriously reviewed a handful of books which might help a young career climber develop a more realistic ap-

proach to the many problems he'll encounter on that long haul up the mountain to success. But there are those who finally get to the top of that mountain, look around, and discover the top isn't all they supposed it would be. Somewhere along the way, they've lost their grip on the essential meaning of things — on what was important about getting to the top. If you'd like to insure that this won't happen to you, we offer a final book.

**Zen and the Art of Motorcycle Maintenance,** by Robert M. Pirsig, 9th printing, Bantam paperback, New York, 1975. \$2.25.

This strangely-titled book is definitely an O&M manual, but not for motorcycles. Zen offers operation and maintenance tips on life in general, on establishing values and living up to them. One reviewer called it "a journey toward awareness and appreciation of the world and of one's special place in it... A valuable how-to-do-your-life almanac." The New York Times said the book is "profoundly important... full of insights into our most perplexing contemporary dilemmas... It is intellectual entertainment of the highest order." What? "Intellectual?" Don't be put off by such high-sounding phrases. The book's author is a highly-skilled, easy-to-read-and-understand writer; the book is "intellectual" only in the sense that Pirsig tries to understand what is important and valuable about life. And the desire to understand life is not the special property of intellectuals.

If you like to sit around, drink a beer, talk about things like motorcycles and what life means, you'll enjoy this book. And if you're a real go-getter, maybe you'll come away with a better understanding of what it is you're going to get.

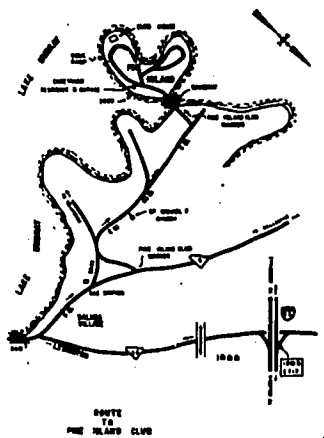
### WPCASC Spring Meeting

The Water and Pollution Control Association of South Carolina will hold its annual business meeting May 21 at the S.C.E. & G. Pine Island recreation center on Lake Murray near Columbia.

Arrangements committee chairman Dana Love says the Association will provide free beer to accompany the big barbecue lunch. Meal tickets are \$3 each.

Love adds that no speeches will be made — members and their guests will have an hour or so to be sociable, then a short business meeting will precede the barbecue.

Everyone is welcome; the Association is hoping for a big turnout, and operators are especially invited to come.



## Making Career Decisions

(Continued from Page 3)

ally even a master's degree will help secure your chances for continued employment.) By the way, don't overlook part-time teaching opportunities. With enough experience or education, you may be able to find a temporary or permanent part-time job teaching certification classes. Many of those teaching in TEC's 90-hour certification courses are hired with a two-year degree or an "A" certificate. Your local TEC center is the place to inquire about this kind of part-time job.

States, counties, large cities, even some large industries, are establishing their own training systems for environmental workers, and opportunities are available for persons with practical backgrounds and varying educational levels. While a four-year degree is most often required for a job as a training coordinator, intangible qualities like initiative, personality, ability to think creatively, combined with experience, may be the ticket to a good job in this area. (Clemson's own training director is currently earning a four-year degree in industrial education. He landed the job with a two-year degree in wastewater technology and eight years experience in a large municipal treatment system. Len Wrigley, the new director of the S.C. Board of Certification, has a two-year degree in applied science and 20 years experience. It's possible.)

And it's possible that after a year or two working in the field, you still won't be sure about a career. If you're happy where you are, or at least satisfied for the time being, keep looking around, continue up the certification ladder, and keep logging in that valuable experience. Give yourself plenty of options — the more you know how to do, the more education and experience you have, the more likely you are to find that job which fits your credentials exactly. A great many people eventually find themselves in jobs they'd never even heard of or thought of — jobs which simply didn't exist when they started out in a particular career. By keeping up with new developments in the treatment field, you'll be versatile enough to adapt to the changing scene. Look upon training and education as a career long process, not just a short term thing that ends with just one or two years of training.

Finally, be honest with yourself. Do you really want to get to the top? Is the long flight up the career rope, jockeying constantly for position, worth it to you? If not, then why do it? Remember, satisfaction counts for a hell of a lot. If you're happy where you are, satisfied with the work you're doing, and you don't see any need to change jobs or get more education, then stay put and be happy. That's what matters most.

If you'd like more information about a specific career or career area, write to the Operator, mentioning your educational background, your present work situation and the career area which interests you.



## Roundtable

(Continued from Page 9)

was shy, it's because he didn't know.

Steve: I don't have a lot of engineering background, but I feel sure that the engineering will benefit. Because if you rely on the engineer alone, and you've got this engineer that designed something for you and he's always thinking on paper and he's never operated, it makes a difference. You're in trouble if you can't communicate.

John: Is it the operator that should have the engineering experience or is it the engineer who should come the other way?

Ernie: I think it would be ideal if an engineering firm would have an operator on their staff. I know one firm had this for a

## Pipeline

(Continued from Page 2)

Upon arriving at the conference room (what am I doing in a conference?) Ernie Rowe, Steve Daniel, Jim Chocklett, Bob Lord, and John Norton introduced themselves. Apparently, they had been discussing me, or at least what I typified. They all felt that the operator was still in the dark about his job requirements, licensing, career diversification and advancement, and the correct path (e.g. experience vs. further schooling) that would be of the most benefit to the individual.

The field of water and wastewater technology has experienced a large focusing of attention upon itself and, confronted with greater federal and state regulation and its own rapid expansion in scope and importance, everybody from operator to instructor to frog in the lagoon is walking around in a daze wondering, "What am I? Where am I? Will the real system and guidelines please stand up?"

All on the panel were sympathetic to my needs and they conveyed to me an acute awareness of the problems at hand. Many questions were answered and I was assured that those deeply ingrained in the field are hard at work to remedy the problems that have yet to be solved. They tend to agree with Jim Polk, former president of the WPCASC, that reorganization and greater delegation of responsibility and definition is needed in certification, instruction, public relations, and informa-

tion dissemination. It is not only a matter of the old pants (system) not fitting the larger body (the field itself), but also a matter of the hands (officials) coordinating themselves to don a new pair. Overpopulation and ecological concerns have done to environmental control and protection what electricity has done to music. Perhaps there is no immediate answer — only a continuing evolutionary process.

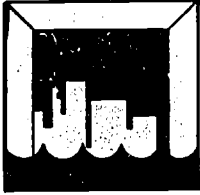
That's Steve Hopper's own account of his discussion with the group. He left out one thing though — he didn't mention the advice we gave him. To boil it all down, the group of "experts" suggested that he attend the Clemson short school in May and take his "C" exam in wastewater. If he passed, then he might look into some of the training opportunities available — the 90-hour TEC course, for example; or possibly the two-year associate degree program at Greenville Technical College. Everyone at the meeting agreed, however, that certification and experience were of most practical use to someone starting out. And the most direct method of obtaining certification, we agreed, is still a combination of on-the-job training, self-study with manuals or through a correspondence course, attendance at a TEC certification review course and attendance at the three-day Clemson exam review.

Jim: I think a job offer came across my desk last week from a North Carolina consulting engineering firm looking for a 2-year graduate to deal with operations problems.

Jim: I have something I would like to say — we, again, knocked around the same thing, reoccurring problems, over and over again, and I'm afraid that they're going to continue to be there for quite some time. I think what we've been talking about is two different types of operators — the ones who are education-oriented, that develop a career out of their education; and the other operators who choose this as their career and then obtain their training after they have chosen this field. Our education has got to be split, or our educational institutions have got to be split, in order to handle this type of division among the operators.

Leta take the careers for instance. My idea would be simply to continue along the line of certification. After an operator has obtained his A certificate quite often he will just dwindle away and just become a treatment plant operator and never be heard from again. If you expose him to additional education, upgrading education, maybe he's not gonna pass another certification, but he'll still be gaining new knowledge about his profession. It's something I'd like to try at TEC. Maybe summer training programs. Subject areas that operators are always bringing up in questions they ask me — like courses on activated sludge, courses on lab procedures, of course we fixed that with the NFDES lab course now, which is real good. We're getting excellent response. To me that indicates that we need this continuing education for operators.

Operator, page 11



# Jobs

## **Berkeley County**

The Berkeley County Water and Sewer Authority is looking for an individual to fill a supervisory position in both water and wastewater. This "manager-operator" should have five years of business experience with a background in fiscal, office and personnel management. The Authority prefers someone with experience in construction and/or utilities-related business. All applicants must hold a "B" certificate in both water and wastewater with the ability to obtain "A" certification in both within six years of employment.

Applicants must also have the ability to

assume complete responsibility for management, maintenance and repairs of equipment and plants, and installation of new connections. The applicant will have to be able to "deal successfully with customers, local officials, and state and federal agencies."

Fringe benefits include insurance program, paid vacation and sick leave. The salary is negotiable according to experience and ability. If you are interested and think you may qualify, contact Andrew J. Combs, chairman, Berkeley County Water and Sewer Authority, Suite 101, 8740 Northpark Blvd., Charleston Heights, S. C. 29405.

**OPERATOR**  
**401 Rhodes Center**  
**Clemson University**  
**Clemson, S.C. 29631**

Non-Profit Organization  
 U.S. POSTAGE  
 PAID  
 Clemson, S.C. 29631  
 Permit No. 31



**Appendix 13**  
**State and Provincial Training and Certification Contacts**  
**For the Water Quality Control Field**

For more information contact:

**Harris Seidel**  
**ABC**  
**Municipal Building**  
**Ames, IA 50010**  
**515-232-6210**

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(FACT SHEET)  
MOST CURRENT 3/26/79

1979 Certification Board Contacts' Names and Addresses

June 12, 1978 (last printed) Sept. 23, 1977  
 \* ABC Member      J Joint Board  
 O ABC Affiliate Member      X No Established Program  
 V Voluntary Program  
 M Mandatory Program

ASSOCIATION OF BOARDS OF CERTIFICATION  
FOR OPERATING PERSONNEL IN  
WATER & WASTEWATER UTILITIES

ORGANIZATION

ORGANIZATION	Program	Water	Wastewater	Contact Name	Address
ALABAMA	J	Water	M	W. T. WILLIS, Board of Certification	328 State Office Bldg., Montgomery, AL 36104
		Wastewater	M	SAME	
ALASKA	J	Water	M	TOM McCARTY, Div. of Environmental Conservation,	Pouch O, Juneau, AK 99801
		Wastewater	M	CONRAD CHRISTIANSON, Hyrdo-Tech., 1117 Phillips Field	Road, Fairbanks, Alaska 99701
ALBERTA	J	Water	V	G. SAMUEL, Alberta Dept. of Environment, Div. of P. C.	9820-106 Street, Edmonton, Alberta, TSK 2J6 Canada
		Wastewater	V	SAME	
ARIZONA	J	Water	M	MILDRED MATTERS, Bureau of Water Quality Control	1740 West Adams Street, Phoenix, AZ 85007
		Wastewater	M	SAME	
ARKANSAS	O	Water	M	TOM SKINNER, Bur. of Public Health Eng'g., Donaghey Bldg.,	13th Floor, 7th & Main, Little Rock, AR 72201
	*	Wastewater	M	JARRELL E. SOUTHWELL, Department of Pollution Control	& Ecology, 8001 National Drive, Little Rock, AR 72209
BRITISH COLUMBIA	J	Water	X	SAME	
		Wastewater	V	BERT CAINE, B. C. Ministry of Environment,	1515 Blanshard St., Victoria, B. C. V8W 3C8 Canada
CALIFORNIA	*	Water	M	CLARENCE L. YOUNG, Sanitary Engineering Section	2151 Berkeley Way, Berkeley, CA 94704
	*	Wastewater	M	R. V. DAIGH, State Water Resources Control Board,	2014 T Street, Sacramento, CA 95818
CALIFORNIA		Water Distribution	V	STEPHEN STOCKTON, 726 Nottingham Drive,	Redlands, California 92373
		Wastewater Collection	V	ROBERT REED, Ventura Res'l. Co. San. Dist.,	P. O. Box 88, Ventura, CA 93001
COLORADO	J	Water	M	RALPH W. LEIDHOLDT, Colorado Department of Health,	Room 320, 4210 East 11th Avenue, Denver, Colorado 80220
		Wastewater	M	SAME	
CONNECTICUT	(1)	Water	N	RICHARD WOODHULL, Environmental Health Services Div.	79 Elm Street, Hartford, CT 06115
	*	Wastewater	M	ROY T. FREDRICKSEN, Dept. of Environmental Protection,	State Office Bldg., Hartford, CT 06115
DELAWARE	*	Water	V		
		Wastewater	M	ROBERT J. TOUHEY, Dept. of Natural Resources & Environ-	mental Control, P. O. Box 1401, Dover, DE 19901
FLORIDA	O	Water	M	BOB HALL, Dept. of Env'l. Regulation, Twin Towers Office	Bldg., 2600 Blairstone Rd., Tallahassee, Florida 32301
		Wastewater	M	SAME	
GEORGIA	J	Water	M	JAMES E. SKRINE, Joint Secretary, State Examining Boards	166 Pryor Street, S.W., Atlanta, GE 30303
		Wastewater	M	SAME	
GUAM	O	Water	M	O. V. NATARAJAN, Administrator, Guam EPA,	P. O. Box 2999, Agana, Guam 96910
		Wastewater	M	SAME	
HAWAII	*	Water	V	RODNEY INCIONG, Board of Water Supply,	Wailuku Maui, HI 96793
		Wastewater	M	FRANK STONE, Jr.	16-1 Sand Island, Honolulu, HI 96819
IDAHO	J	Water	V	MICHAEL J. McMASTERS, Idaho Dept. of Health & Welfare,	Div. of Environment, Statehouse Mall, Boise, ID 83720
		Wastewater	V	SAME	
ILLINOIS	*	Water	M	DAVID OEHMKE, Illinois Environmental Protection Agency	2200 Churchill Road, Springfield, IL 62706
	*	Wastewater	M	ERNEST BENNETT, Illinois Environmental Protection Agency	2200 Churchill Road, Springfield, IL 62706

FACT SHEET

ORGANIZATION		Program		
INDIANA	Water	M	C. NEIL OTT, Indiana State Board of Health 1330 West Michigan Street, Indianapolis, IN 46206	
	Wastewater	M	ORAL H. HERT, Stream Pollution Control Board 1330 West Michigan Street, Indianapolis, IN 46206	
IOWA	Water	M	JOSEPH OBR, Department of Environmental Quality, 900 E. Grand, Des Moines, Iowa 50319	
	Wastewater	M	SAME	
KANSAS	Water	M	JAMES L. CURRENT, Division of Environment, Dept. of Health & Environment, Topeka, KS 66620	
	Wastewater	M	SAME	
KENTUCKY	Water	M	JACK LINDER, KY Dept. of Nat'l. Resources & Env'l. Pro., Highway 127 South, Century Plaza, Frankfort, KY 40601	
	Wastewater	M	SAME	
LOUISIANA	Water	M	RAUL M. BUSQUET, JR., LHRRA-Div. of Health P. O. Box 60630, New Orleans, LA 70160	
	Wastewater	M	SAME	
MAINE	Water	M	GERALD M. BATES, Division of Health Engineering Dept. of Health & Welfare, Augusta, ME 04333	
	Wastewater	M	KENNETH W. SHIRKEY, Div. of Municipal Services, Bur. of Water Quality Control, Augusta, Maine 04330	
MANITOBA	Water	V	G. D. BALACKO, Dept. of Mines, Resources & Env. Mgmt. Box 7, Bldg. 2, 139 Tuxedo Ave., Winnipeg, Manitoba R3N 0H6	
	Wastewater	V	SAME	
MARYLAND	Water	M	RICHARD B. SELLARS, JR., Env. Health Admin. P.O. Box 13387, 201 W. Preston St., Baltimore, Maryland 21203	
	Wastewater	M	SAME	
MASSACHUSETTS	Water	M	ROBERT A. McCRACKEN, Division of Environmental Health Room 320, 600 Washington Street, Boston, MA 02111	
	Wastewater	M	ROBERT McANESPIE, Massachusetts Division of WPC, 110 Tremont Street, Boston, MA 02108	
MEXICO	Water	X		
	Wastewater	X		
MICHIGAN	Water	M	WILLIAM A. KELLEY, Div. of Water Supply, Dept. of Health 3500 North Logan Street, Lansing, MI 48909	
	Wastewater	M	HOWARD B. SELOVER, Dept. of Natural Resources Stevens T. Mason Building, Lansing, MI 48926	
MINNESOTA	Water	M	PAUL JOHNSON, Chief, Water Supply & General Engineering 717 Delaware Street, S. E., Minneapolis, MN 55440	
	Wastewater	M	WILLARD N. SEXAUEK, Minnesota Pollution Control Agency, 1935 W. County Road B2, Roseville, MN 55113	
MISSISSIPPI	Water	V	HOWARD K. WILLIFORD, Assoc. Head, Dept. of Civil Engineering MSU, P. O. Drawer 111, Mississippi State, MS 39762	
	Wastewater	V	SAME	
MISSOURI	Water	V	FRANK W. POGGE, Kansas City Water Dept., 1 N.W. Briarcliff Road, Kansas City, MO 64116	
	Wastewater	M	GERALD FIELDS, State Dept. of Natural Resources, P.O. Box 1368, Jefferson City, MO 65101	
MONTANA	Water	M	ROSMARY FOSSUM, Water & Wastewater Op. Cert. Board, Capitol Post Office, Helena, MT 59601	
	Wastewater	M	SAME	
NEBRASKA	Water	M	CLIFFORD L. SUMMERS, Environmental Engr'g. Div., State Health Dept., 301 Centennial Mall So., Lincoln, NE 68509	
	Wastewater	V	JOSEPH R. DABBS, Dept. of Environmental Control, P. O. Box 94877, State House Station, Lincoln, NE 68509	
NEVADA	Water	V	JOSEPH T. MONSCVITZ, Las Vegas Valley Water District 243 Lakeshore Road, Boulder City, NV 89005	
	Wastewater	V	FRANK LUCHETTI, Dept. of Conservation & Natural Resources 201 So. Fall St., Capitol Complex, Carson City, NV 89710	
NEW BRUNSWICK	Water	X	W. J. SHAFFNER, Dept. of Environment, P. O. Box 6000, Fredericton, New Brunswick E3B 5H1	
	Wastewater	X	SAME	
NEWFOUNDLAND	Water	X	K. DOMINIE, Dept. of Consumer Affairs & Environment Elizabeth Tower, St. Johns, Newfoundland	
	Wastewater	X	SAME	

ORGANIZATION	Program		
NEW HAMPSHIRE *	Water	X	
	Wastewater	M	GORDON L. PAGE, Assoc. Sanitary Engineer P. O. Box 95, 105 Loudon Road, Concord, NH 03301
NEW JERSEY *J	Water	M	O. DOC GIBBONS, State Dept. of Environmental Protection, P. O. Box 1390, Trenton, NJ 08625
	Wastewater	M	SAME
NEW MEXICO *J	Water	M	HAYWOOD MARTIN, Environmental Improvement Agency, P.O. Box 968, Crown Bldg., Santa Fe, NM 87503
	Wastewater	M	SAME
NEW YORK *	Water	M	SAMUEL SYROTYNSKI, NYS Dept. of Health, Public Water Supply, Empire State Plaza, Tower Bldg., 4th Floor, Albany, NY 12257
	Wastewater	M	DANIEL J. CAMPBELL, Dir., Office of Environmental Manpower 50 Wolf Road, Albany, NY 12233
NORTH CAROLINA *G	Water	M	CHARLES E. RUNDGREN, Sanitary Engineering Section, P. O. Box 2091, Raleigh, NC 27602
	Wastewater	M	D. L. COBURN P. O. Box 27687, Raleigh, NC 27611
NORTH CAROLINA *GJ	Water Distribution	V	DONALD KNIBB, City Hall, Drawer C-1, Water & Sewer Department, Greensboro, North Carolina 27402
	Wastewater Collection	V	SAME
NORTH DAKOTA *J	Water	M	NORMAN L. PETERSON, Dir., Division of Water Supply & Pol. State Department of Health, Bismarck, ND 58501
	Wastewater	M	SAME
NOVA SCOTIA *	Water	X	A. J. CROUSE, Department of the Environment P. O. Box 2107, Halifax, Nova Scotia B3J 3B7
	Wastewater	X	SAME
OHIO *J	Water	M	PAUL FLANIGAN, Ohio Environmental Protection Agency, P. O. Box 1049, Columbus, OH 43216
	Wastewater	M	SAME
OKLAHOMA *J	Water	M	DEMPEY HALL, Water Quality Control Division, P. O. Box 53551, Oklahoma City, OK 73105
	Wastewater	M	SAME
ONTARIO *J	Water	X	ROBERT R. DODDRIDGE, Ministry of the Environment 135 St. Claire Ave., West, Toronto, Ontario M4V 1P5
	Wastewater	X	SAME
OREGON *G	Water	V	MARTIN E. NORTHGRAFT, Oregon State University Dept. of Civil Engineering, Corvallis, OR 97331
	Wastewater	V	SAME
PENNSYLVANIA *J	Water	M	ROBERT J. SLATICK, Dept. of Environmental Resources P. O. Box 2063, Harrisburg, PA 17120
	Wastewater	M	SAME
PRINCE EDWARD ISL. *J	Water	X	PAUL ROSE, Department of the Environment, P. O. Box 2000, Charlottetown, P. E. I. CIA 7N3
	Wastewater	X	SAME
PUERTO RICO *J	Water	X	JOSE R. GOITIA, Puerto Rico Aqueduct & Sewer Authority P. O. Box 7066, Barrio Obrero Station, Santurce, P.R. 00916
	Wastewater	X	SAME
QUEBEC *J	Water	X	RAYMOND LARIVEE, Assoc. Québécoise des Techniques de l'eau, 6290 Périnault, Bureau 2, Montreal, Quebec H4K 1K5
	Wastewater	X	ROLLAND MERCIER, Control Dir., Envir. Protection Service 2360, chemin Sainte-Foy, Sainte-Foy, QUEBEC G1V 4H2
RHODE ISLAND *J	Water	X	
	Wastewater	V	EDWARD S. SZYMANSKI, Principal Sanitary Engr., Room 209, Cannon Bldg., Davis St., Providence, RI 02908
SASKATCHEWAN *J	Water	X	RODGER McDONALD, Dir., WPC Branch, Dept. of the Environment 5th Floor, 1855 Victoria Ave., Regina, Sask. S4P 3V5
	Wastewater	X	SAME
SOUTH CAROLINA *J	Water	M	JACK A. MCKENZIE, SC Board of Cert. of Environmental Systems Opr., 2600 Bull St., Columbia, SC 29201
	Wastewater	M	SAME

ORGANIZATION		Program	
*J	Water	M	RAYMOND F. BIRCIEM, Dept. of Environmental Protection Foss Building, Pierre, SD 57501
SOUTH DAKOTA	Wastewater	N	SAME
*J	Water	M	D. ELMO LUNN, Dir., Div. of Water Quality Control, 621 Cordell Hull Building, Nashville, TN 37219
TENNESSEE	Wastewater	M	SAME
*J	Water	M	DAVID COCHRAN, Texas State Department of Health 1100 West 49th Street, Austin, TX 78756
TEXAS	Wastewater	N	SAME
*J	Water	V	LYLA RAY, Recording Secretary 468 Second Avenue, Salt Lake City, UT 84103
UTAH	Wastewater	V	GRANT BORG, Professor of Civil Engineering University of Utah, Salt Lake City, UT 84112
⊙	Water	M	KENNETH STONE, Department of Health, 60 Main Street Burlington, VT 05401
VERMONT	Wastewater	M	FRANCIS S. FYLES, Operations & Maintenance Section, Agency of Envir. Conservation, Montpelier, VT 05602
*J	Water	M	GERALDE W. MORGAN, St. Bd. for Cert. of Oper. of Water & Wastewater Works, 2 South 9th St., Richmond, VA 23219
VIRGINIA	Wastewater	M	SAME
	Water	X	PEDRITO FRANCOIS, Dept. of Conservation & Cultural Affairs Charlotte Amalie, P.O. Box 4340, St. Thomas, U.S.V.I. 00801
U.S. VIRGIN ISL.	Wastewater	X	SAME
*J	Water	V	BILL LIECHTY, DSHS-Water Supply & Waste Section, Airport Complex, Bldg. #4, MS 4-1, Olympia, WA 98504
WASHINGTON	Wastewater	N	NORMAN O. THOMAS, Dept. of Ecology, Olympia Airport, 7272 Cleanwater Lane, Olympia, Washington 98504
J	Water	X	
WASHINGTON, D. C.	Wastewater	X	SYLVIN BELKOV, Gov't. of D. C., Dept. of Envir. Services Environmental Health Admin., Washington, D. C. 20002
*J	Water	M	R. G. McCALL Div. of Sanitary Engineering, Dept. of Health 1800 Washington St. E., Charlestown, WV 25305
WEST VIRGINIA	Wastewater	M	SAME
*	Water	M	RALPH O'CONNOR, Department of Natural Resources P. O. Box 7921, Madison, WI 53701
WISCONSIN	Wastewater	M	SAME
*J	Water	M	DEBORAH HORTON, Dept. of Environmental Quality, Hathaway Building, Cheyenne, WY 82002
WYOMING	Wastewater	M	SAME

- (1) NEW ENGLAND WATER POLLUTION CONTROL ASSOCIATION  
New England Voluntary Program  
Edward Szymanski  
Davis St., Cannon Bldg., Room 209  
Providence, Rhode Island 02908
- (2) Howard Selover (Industrial Operators Program)  
Dept. of Natural Resources  
Stevens T. Mason Building  
Lansing, Michigan 48926

STATE TRAINING CONTACT PERSONS

Y/N Coordinated Program    
 Y/N Chart Provided

⊙ Mandatory Training Required for Certification  
 \* Use CEU's

ALABAMA	Water	Y	BOB FOWLER, Water Operator Instructor, Adult Vocational Education, 5th Floor, State Office Building, Montgomery, AL 36130
		Y	
ALABAMA	Wastewater	Y	CHARLES FAULK, Waste Water Instructor, Adult Vocational Education, 5th Floor, State Office Building, Montgomery, AL 36130
		Y	
ALASKA	Water	N	TOM MC CARTY, Certification and Training Engineer, Department of Environmental Conservation, Pouch 0, Juneau, AK 99811
		Y	
ALASKA	Wastewater	N	SAME
		Y	
ALBERTA	Water	Y	G. B. SAMUEL, Alberta Department of Environment, Division of P. C. 9280-106 Street, Edmonton, Alberta T5K 2J6 Canada
		Y	
ALBERTA	Wastewater	Y	SAME
		Y	
ARIZONA	Water		MILDRED MATTERS, Arizona Department of Health Services, Bureau of Water Quality Control, 1740 West Adams Street, Phoenix, AZ 85007
ARIZONA	Wastewater		SAME
ARKANSAS	Water	N	T. A. SKINNER, Acting Director, Bureau of Public Health Engineering, 4815 West Markham, Little Rock, AR 72205
		N	
ARKANSAS	Wastewater		JOE SHAW, Training Officer, Dept. of Pollution Control and Ecology, 8001 National Drive, Little Rock, AR 77209

STATE TRAINING CONTACT PERSONS

BRITISH COLUMBIA	Water	Y	SAME
		Y	
BRITISH COLUMBIA	Wastewater	Y	BERT D. CAINE, Assistant Director, Environmental Engineering Division, 1515 Blanshard Street - 5th Floor, Victoria, British Columbia V8W 3C8 Canada
		Y	
CALIFORNIA**	Water	N	CLARENCE L. YOUNG, Senior Sanitary Engineer, 2151 Berkeley Way, Berkeley, CA 94704
		N	
CALIFORNIA**	Wastewater	N	DALE DE LANEY, Water Quality Control Institute, 2310 Rancho Sante Fe Road, San Marcos, CA 92069
		N	
COLORADO	Water		RALPH LEIDHOLDT, State Health Department, 4210 East 11th Avenue, Denver, CO 80220
COLORADO	Wastewater		OTTO HAVENS, Wastewater Training Officer, State Health Department, 4210 East 11th Avenue, Denver, CO 80220
CONNECTICUT	Water		ROY FREDRICKSEN, Principal Sanitary Engineer, Water Compliance, Department of Environmental Protection, State Office Building, Hartford, CT 06115
CONNECTICUT	Wastewater		ROY FREDRICKSEN, Principal Sanitary Engineer, Water Compliance, Department of Environmental Protection, State Office Building, Hartford, CT 06115
DELAWARE	Water	N	MRS. BETTY HELLER, Training Officer, Office of Sanitary Engineering, B.E.H., Division of Public Health, Cooper Building, Capitol Square, Dover, DE 19901
		N	
DELAWARE	Wastewater	N	ROBERT J. TOUHEY, Manager, Water Resources Section, Division of Environmental Control, P.O. Box 1401, Dover, DE 19901
		N	

\*\*See additional names at end of contact list.

## STATE TRAINING CONTACT PERSONS

FLORIDA	Water	N	BILLY R. BLAIR, Treed Center, University of Florida, 2012 West University Avenue, Gainesville, FL 32603
		Y	
FLORIDA	Wastewater	N	SAME
		Y	
GEORGIA	Water		CALVIN SIMMONS, President, G.W. & P.C.A., P.O. Box Drawer 540, Acworth, GA 30101
GEORGIA	Wastewater		DR. T. F. CRAFT, Research Chemist, 116 Ridley Circle, Decatur, GA 30030
IDAHO	Water	Y	MICHAEL J. MC MASTERS, Coordinator, Certification and Training, Idaho Department of Health and Welfare, STATEHOUSE, Boise, ID 83720
		Y	
IDAHO	Wastewater	Y	SAME
		Y	
ILLINOIS	Water		DAVID W. OEHMKE, Manager, Operator Certification and Training Section, IEPA, Division of Public Water Supplies, 2200 Churchill Road, Springfield, IL 62706
ILLINOIS	Wastewater	N	JAMES O. BRYANT, Director, Environmental Resources Training Center, Campus Box 75, Southern Illinois University, Edwardsville, IL 62026
		N	
INDIANA	Water	N	C. NEIL OTT, Water Supply Section, Indiana State Board of Health, 1330 West Michigan Street, Indianapolis, IN 46206
		N	
INDIANA	Wastewater	N	JOSEPH LIPPS, Manpower Planner, Indiana State Board of Health, 1330 West Michigan Street, Indianapolis, IN 46206
		N	

\*\*See additional names at end of contact list.



STATE TRAINING CONTACT PERSONS

IOWA	Water	Y	LAVOY HAAGE Henry A. Wallace Building, 900 East Grand, Des Moines, IA 50316
		Y	
IOWA	Wastewater	Y	SAME
		Y	
KANSAS	Water	N	JAMES L. CURRENT, Training Officer, Division of Environment, State Department of Health and Environment, Forbes AFB, Building 740, Topeka, KS 66620
		N	
KANSAS	Wastewater	N	SAME
		N	
KENTUCKY	Water	Y	D. J. LINDER, Manager, Technical Services Branch, Division of Sanitary Engineering Kentucky Department for Natural Resources & Environmental Protection, Century Plaza Shopping Center, Frankfort, KY 40601
		Y	
KENTUCKY	Wastewater	Y	SAME
		Y	
LOUISIANA	Water		DR. CLARENCE LEDOUX, Louisiana Department of Education, P.O. Box 44064, Baton Rouge, LA 70804
LOUISIANA	Wastewater		SAME
MAINE	Water	N	GERALD BATES, Secretary, Board of Certification, Department of Human Services, Augusta, ME 04333
		N	
MAINE	Wastewater		

\*See additional names at end of contact list.

## STATE TRAINING CONTACT PERSONS

MANITOBA	Water	Y	G. O. BALACKO, P.E. Manitoba Department of Mines, Resources & Environmental Management, Box 7, Building 2, 139 Tuxedo Avenue, Winnipeg, Manitoba R3N 0H6 Canada
		Y	
MANITOBA	Wastewater	Y	SAME
		Y	
MARYLAND**	Water	Y	ANDREW A. HOLTAN, Training Manager, Environmental Health, P.O. Box 13387, 201 West Preston Street, Baltimore, MD 21203
		Y	
MARYLAND**	Wastewater	Y	SAME
		Y	
MASSACHUSETTS**	Water	N	ROBERT A. MC CROEKEN, Board of Certification of Operators, Room 1520 Leverett Saltonstall Building, 100 Cambridge Street, Boston, MA 02202
		N	
MASSACHUSETTS**	Wastewater	N	ROBERT C. MC ANESPIE, Massachusetts Div. of Water Pollution Control, 110 Tremont Street, Boston, MA 02108
		N	
MICHIGAN	Water		WILLIAM J. REOMAN, Training Officer, Michigan Department of Public Health, Division of Water Supply, 3500 North Logan Street, P.O. Box 30035, Lansing, MI 48909
MICHIGAN	Wastewater		HOWARD B. SELOVER, Chief, Training and Certification Section, Michigan Department of Natural Resources, Water Quality Division, P.O. Box 30028, Lansing, MI 48909

\*\*See additional names at end of contact list.

STATE TRAINING CONTACT PERSONS

MINNESOTA	Water	N	GUNILLA MONTGOMERY, Training Coordinator, Section of Water Supply and General Engineering, Minnesota Health Department, 717 Delaware Street SE, Minneapolis, MN 55440
		Y	
MINNESOTA	Wastewater	N	WILLARD N. SEXAUER, Supervisor, Training Unit, Minnesota Pollution Control Agency 1935 West County Road B-2, Roseville, MN 55113
		Y	
MISSISSIPPI	Water	N	HOWARD K. WILLIFORD, Secretary, Mississippi Water and Pollution Control Operators Association, Drawer HW, Mississippi State, MS 39762
		N	
MISSISSIPPI	Wastewater	N	SAME
		N	
MISSOURI	Water		DON R. SISSON, Dept. of Natural Resources, Water Supply Program, 2010 Missouri Boulevard, P.O. Box 1368, Jefferson City, MO 65101
MISSOURI	Wastewater		GERALD FIELDS, Operator Certification Program, Department of Natural Resources, 2010 Missouri Boulevard, P.O. Box 1368, Jefferson City, MO 65101
MONTANA	Water	N	CHARLES HARPER, Training Officer, Water Quality Bureau, State Department of Health and Environmental Sciences, 555 Fuller Avenue, Capitol Post Office, Helena, MT 59601
		N	
MONTANA	Wastewater	N	SAME
		N	

## STATE TRAINING CONTACT PERSONS

NEBRASKA	Water		STEVE MASTERS, Engineer II, Nebraska Department of Health, 301 Centennial Mall South, P.O. Box 95007, Lincoln, NB 68510
	Wastewater	N	RUSS IRWIN, Department of Environmental Control, 301 Centennial Mall South, P.O. Box 94877, Lincoln, NB 68509
NEVADA**	Water	N	FRANK WILLERS, Production Superintendent, Las Vegas Valley Water District, 3700 West Charleston, P.O. Box 4427, Las Vegas, NV 89106
	Wastewater	N	WENDELL D. MC CURRY, Water Quality Officer, Environmental Health, Environmental Protection Services, Capitol Complex, Carson City, NV 89710
NEW BRUNSWICK	Water	Y	JAMES SHAFFNER, Ph.D., P.E., Training Officer, P.O. Box 6000, Centennial Building, Fredericton, New Brunswick E3B 5H1 Canada
	Wastewater	Y	SAME
NEW HAMPSHIRE	Water		BERNARD LUCEY, Assistant Sanitary Engineer, NHWS & PCC, P.O. Box 95, Concord, NH 03301
	Wastewater	Y	GORDON L. PAGE, Associate Sanitary Engineer, NHWS & PCC, P.O. Box 95, Concord, NH 03301
NEW JERSEY	Water	Y	ROBERT LIPPINCOTT, Chief, Bureau of Manpower Planning and Staff Development, Department of Environmental Protection, P.O. Box 1390, Trenton, NJ 08625
	Wastewater	Y	SAME

\*\*See additional names at end of contact list.

## STATE TRAINING CONTACT PERSONS

NEW MEXICO**	Water	Y	PATRICK HANSON, Coordinator, New Mexico State University Water & Wastewater Operator Training Program, P.O. Box 968, Santa Fe, NM 87503
		Y	
NEW MEXICO**	Wastewater	Y	SAME
		Y	
NEW YORK	Water	Y	MICHAEL E. BURKE, P.E., Bureau of Public Water Supply, Room 478, Fourth Floor, Tower Building, Empire State Plaza, Albany, NY 12237
		Y	
NEW YORK	Wastewater		DAN CAMPBELL, Director, Environmental Manpower, Department of Environmental Conservation, 50 Wolf Road, Albany, NY 12233
NEWFOUNDLAND	Water	N	KEN DOMINIE, P.E., Civil/Sanitary Engineer, Department of Consumer Affairs and Environment, Elizabeth Towers, St. Johns, Newfoundland, Canada
		N	
NEWFOUNDLAND	Wastewater	N	SAME
		N	
NORTH CAROLINA	Water	Y	CHARLES E. RUNDGREN, Chairman, North Carolina Water Treatment Facilities Operator Certification Bd., P.O. Box 2091, Raleigh, NC 27602
		Y	
NORTH CAROLINA	Wastewater		D. L. COBURN, Head, Operator Training and Certification Branch Water Quality Section, DEM, P.O. Box 27687, Raleigh, NC 27611

\*\*See additional names at end of contact list.

STATE TRAINING CONTACT PERSONS

NORTH DAKOTA	Water	N	HENRY FLOHR, Public Health Executive, North Dakota State Department of Health, 1200 Missouri Avenue, Bismarck, ND 58505
		N	
NORTH DAKOTA	Wastewater	N	SAME
		N	
NOVA SCOTIA	Water		PETER J. CASEY, P.E., Director, Division of Public Health Engineering, P.O. Box 488, Halifax, Nova Scotia B3J 2R8 Canada
NOVA SCOTIA	Wastewater	N	T. D. RYAN, Regional Supervisor, Nova Scotia Environment, P.O. Box 2107, Halifax, Nova Scotia B3J 3NT Canada
		N	
OHIO	Water	Y	RICHARD F. MELICK, Administrator, Operator Training Committee of Ohio, Inc., P.O. Box 626, Worthington, OH 43085
		Y	
OHIO	Wastewater	Y	SAME
		Y	
OKLAHOMA	Water		DEMPSEY H. HALL Director, Training, Certification and Research Division Oklahoma State Department of Health, Box 53551, Oklahoma City, OK 73105
OKLAHOMA	Wastewater		SAME

STATE TRAINING CONTACT PERSONS

ONTARIO	Water	N	R. R. DODDRIDGE, Manager, Training and Certification Section, Personnel Services Branch, M.O.E., 135 St. Clair Avenue, W-7th Floor, Toronto, Ontario M4V 1P5 Canada
		N	
ONTARIO	Wastewater	N	SAME
		N	
OREGON	Water		MARTIN E. NORTHCRAFT, Associate Professor, Department of Civil Engineering, Oregon State University, Corvallis, OR 97331
OREGON	Wastewater		SAME
PENNSYLVANIA	Water	N	ANTHONY J. ZIGMENT, Director, Environmental Training Coordinator, Municipal Training Division, Pennsylvania Department of Community Affairs, Harrisburg, PA 17120
		Y	
PENNSYLVANIA	Wastewater	N	SAME
		Y	
PRINCE EDWARD ISLAND	Water		PAUL ROSE, Director, Pollution Control Division, P.O. Box 2000, Charlottetown, Prince Edward Island C1A 7N8 Canada
PRINCE EDWARD ISLAND	Wastewater		SAME
QUEBEC	Water	N	DANIELE MENARD MORIN ING., Coordinatrice Des Cours De Formation S.P.E.Q., Centre Experimental De Vaudreuil, 400 Blvd. Roche, Vaudreuil, Quebec, Canada
		N	
QUEBEC	Wastewater	N	SAME
		N	

STATE TRAINING CONTACT PERSONS

RHODE ISLAND	Water	N	JOHN HAGOPIAN, Principal Sanitary Engineer, Division of Water Supply, Room 209, Health Building, Davis Street, Providence, RI 02908
		N	
RHODE ISLAND	Wastewater	N	EDWARD SAYMASKI, Senior Sanitary Engineer Department of Environmental Management, Division of Water Resources, 209 Cannon Building, Providence, RI 02906
		N	
SASKATCHEWAN	Water		JOHN J. CRONE, Water and Sewage Works Division, Water Pollution Control Branch, Saskatchewan Department of the Environment, 1855 Victoria Avenue, Regina, Saskatchewan S4P 3T1 Canada
SASKATCHEWAN	Wastewater		SAME
SOUTH CAROLINA**	Water	Y	JAMES HINDMAN, Project Administrator, Office of Operator Training, 401 Rhodes Research Center, Clemson University, Clemson, SC 29631
		Y	
SOUTH CAROLINA**	Wastewater	Y	SAME
		Y	
SOUTH DAKOTA	Water	N	WILLIAM E. AISENBREY, Training Specialist III, SD/DEP Room 422-Foss Building, Pierre, SD 57501
		N	
SOUTH DAKOTA	Wastewater	N	SAME
		N	
TENNESSEE	Water	Y	MARION E. CASTO, Instructor, Operator Training Center, Route 4, Blanton Drive, Murfreesboro, TN 37130
		Y	
TENNESSEE	Wastewater	Y	JACK L. HUGHES, Director, Operator Training Center, Route 4, Blanton Drive, Murfreesboro, TN 37130
		Y	

\*\*See additional names at end of contact list.



STATE TRAINING CONTACT PERSONS

TEXAS	Water	Y	LESTER E. BLASCHKE, Professional Engineer, State Department of Health, 1100 West 49th Street, Austin, TX 78756
		Y	
TEXAS	Wastewater	Y	SAME
		Y	
UTAH	Water	Y	DR. NORMAN B. JONES, Division of Environmental Engineering, Utah State University, U.M.C. 41, Logan, UT 84322
		Y	
UTAH	Wastewater	Y	SAME
		Y	
VERMONT	Water	N	KENNETH STONE, P.E., Sanitary Engineer, Department of Health, 60 Main Street, Burlington, VT 05401
		N	
VERMONT	Wastewater	N	JAMES F. AGAN, P.E., Environmental Engineer, Agency of Environmental Conservation, Division of Environmental Engineering, State Office Building, Montpelier, VT 05602
		N	
VIRGINIA	Water	Y	ROBERT B. TAYLOR, P.E., Director of Training and Certification, Bureau of Water Supply Engr., Virginia Department of Health, 109 Governor Street, Richmond, VA 23219
		Y	
VIRGINIA	Wastewater	Y	JOHN W. VANDERLAND, Training Supervisor, State Water Control Board, P.O. Box 11143, Richmond, VA 23230
		Y	
WASHINGTON	Water	Y	FRED DELVECCHIO, State Coordinator for Water/Wastewater Training, Green River Community College, 12401 SE 320th Street, Auburn, WA 98002
		Y	
WASHINGTON	Wastewater	Y	SAME
		Y	

\*See additional names at end of contact list.

## STATE TRAINING CONTACT PERSONS

WEST VIRGINIA	Water		DAVID BALL, Engineer I, West Virginia State Health Department, 1800 Washington Street East, Charleston, WV 25305
	Wastewater	Y	JOHN BROWN, Sanitarian, Sewage Program, Division of Sanitary Engineering, State Department of Health, 1800 Washington Street East, Charleston, WV 25305
WISCONSIN	Water		RALPH O'CONNOR, Coordinator, Certification and Training, Department of Natural Resources, Box 7921, Madison, WI 53707
	Wastewater		SAME
WYOMING	Water		DEBORAH HORTON, Environmental Specialist, Water Quality Division, Hathaway Building, Cheyenne, WY 82002
	Wastewater		SAME
GUAM	Water	N	GUAM ENVIRONMENTAL PROTECTION AGENCY, P.O. Box 2999, Agana, Guam 96910
	Wastewater	N	SAME

ADDITIONAL STATE TRAINING CONTACT PERSONS

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CALIFORNIA

Water: MIKE YOUNG  
Metropolitan Water District of Southern California  
Box 54153, Los Angeles, CA 90054

FLORIDA

Water: MS. JUDY SEARS, Certification & Manpower Development  
Department of Environmental Regulation  
2600 Blairstone Road, Tallahassee, FL 32301

KENTUCKY

Wastewater: KERMIT MILLS, Training Officer  
Division of Water Quality  
Kentucky Dept. for Natural Resources & Env. Protection  
Century Plaza Shopping Center, Frankfort, KY 40601

MASSACHUSETTS

Water: MRS. ALICE I. HATHAWAY, Secretary  
New England Water Works Association  
990 Washington Street, Dedham, MA 02026

NEVADA

Water: J. T. MONSCVITZ, Manager, SNWS  
Southern Nevada Water System  
243 Lakeshore Road, Boulder City, NV 89005

NEW MEXICO

Wastewater: HAYWOOD MARTIN, Training and Certification Officer  
Water Quality Division  
N. M. Environmental Improvement Agency  
Box 2348, Santa Fe, NM 87503

SOUTH CAROLINA

Water: L. H. LOCKHART  
Coordinator, Manpower Development and Training, SCDHEC  
2600 Bull Street, Columbia, SC 29201

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VIRGINIA

Water:

ERIC H. BARTSCH, P.E., Director  
Bureau of Sanitary Engineering  
109 Governor Street, Richmond, VA 23219

Wastewater:

KENNETH F. SPEAR, Infilco Degremont, Inc.  
Box K-7, Richmond, VA 23288

WYOMING

Water:

DON ARMSTRONG, Environmental Engineer  
Water Quality Division  
Hathaway Building, Cheyenne, WY 82002

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## **Appendix 14 Instructional Package Worksheet**

For more information contact:

**Joe Bahnick**  
**MOTD/OWOP**  
**EPA**  
**Washington, DC 20460**  
**202-426-7887**

or

**John H. Austin**  
**Civil Engineering Department**  
**University of Maryland**  
**College Park, MD 20742**  
**301-454-2438**

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PERFORMANCE-ORIENTED INSTRUCTIONAL WORKSHEET

CURRICULUM: WATER QUALITY CONTROL PROGRAM
COURSE: GENERAL SECTION I
SUBJECT MATTER: INTRODUCTION TO WATER ENVIRONMENT

MODULE 4: MAJOR WASTEWATER TREATMENT PROCESSES
Lesson

ESTIMATED TIME FOR THIS LESSON:
PREREQUISITES FOR THIS LESSON:

PERFORMANCE OBJECTIVE (3 PARTS):
Action/Terminal Behavior: The learner will

[Blank lines for performance objective details]

Conditions:

[Blank lines for conditions]

Acceptable Performance:

[Blank lines for acceptable performance]

JUSTIFICATION OF OBJECTIVE:

[Blank lines for justification]

INSTRUCTIONAL RESOURCES:

Selected:

[Blank lines for selected resources]

Suggested for Development:

[Blank lines for suggested resources]

INSTRUCTIONAL ACTIVITIES:

Instructor Activity:

[Blank lines for instructor activity]

Learner Activity:

[Blank lines for learner activity]

METHOD OF EVALUATION:

SAMPLE TEST ITEM provided? [ ] yes [ ] no

EPA-MOTD/CCCC Date

PREPARED BY: (grantee) (person)

When you have filled in your worksheets, they will be reviewed and edited by Charles County Community College staff members. This review and editing is done to ensure accuracy and consistency in all the worksheets written by the different subject matter experts involved in this project. You will have an opportunity to react to any changes made during this review on the worksheets which you wrote.

After being written and reviewed, the worksheets will be printed and bound together to form instructor's guide books. These guide books should prove very useful to instructors in wastewater technology training programs. A typical page from one of these guidebooks will look something like this:

(See following page.)

CURRICULUM: WATER QUALITY CONTROL PROGRAM  
 COURSE: General Section I  
 SUBJECT MATTER: Introduction to Water Environment




---

MODULE 4: MAJOR WASTEWATER TREATMENT PROCESSES

Lesson 3 of 6: Identifying Treatment Process Units

ESTIMATED TIME FOR THIS LESSON: 6 hours

PREREQUISITES FOR THIS LESSON: Lesson 3 in this module

---

PERFORMANCE OBJECTIVE (3 PARTS):

Action/Terminal Behavior: The learner will name the treatment process unit shown in an unlabelled photograph or sketch.

Conditions: Given unlabelled photographs or sketches of the following process units: screening, grit removal, primary sedimentation, secondary sedimentation, trickling filter, activated sludge, disinfection.

Acceptable Performance: At least 5 of the 7 process units must be accurately identified.

---

JUSTIFICATION OF OBJECTIVE: Graduates of this program may be employed in wastewater treatment plants where they will need to distinguish between process units.

INSTRUCTIONAL RESOURCES:

Selected: IRIS 511,2381,2419

Suggested for Development: Slide-tape production illustrating and naming treatment process units.

INSTRUCTIONAL ACTIVITIES:

Instructor Activity: Points out distinguishing physical features of process units.

Learner Activity: Practices identifying process units from observation of physical features.

METHOD OF EVALUATION: Oral or written test.

SAMPLE TEST ITEM PROVIDED (See appendix)

Date: 8/78

EPA-MOTD/CCCC



## STEP BY STEP THROUGH THE WORKSHEET

**CURRICULUM:** This section is already filled in on the worksheet.

**CURRICULUM:** WATER QUALITY CONTROL PROGRAM

**COURSE:** This section is already filled in on the worksheet. Course titles are taken from Table I (see page 4) where they are numbered, I, II, III, etc.

e.g. **COURSE:** GENERAL SECTION I

**COURSE:** SUPPORT SYSTEMS II

**SUBJECT MATTER:** This section is already filled in on the worksheet. Subject matter titles are taken from Table I (see page 4) where they are lettered A, B, C, etc.

e.g. **SUBJECT MATTER:** Introduction to Water Environment

**SUBJECT MATTER:** Records and Reporting

**SUBJECT MATTER:** Hydraulic Equipment

**MODULE:** This section is already filled in on the worksheet. Module titles are taken from Table I (see page 4) where they are numbered 1, 2, 3, etc.

e.g. **MODULE 1:** Natural Cycles

**MODULE 2:** Properties of Water

**MODULE 3:** Properties of Wastewater

**MODULE 4:** Major Wastewater Treatment Processes

**LESSON:**

Your entries on the worksheet begin with this section. Here you must write the number and title of the lesson being described on the particular worksheet. Note carefully -- each worksheet describes one lesson in a module. At the beginning of this project, you were given a set of performance objectives. You must turn each of these objectives into a lesson and therefore into a worksheet. If you think that one of these original objectives covers too large an amount of information, then you may subdivide it and make two or more lessons out of it. Lessons are numbered 1 of 6, 2 of 6 or 1 of 3, 2 of 3, etc., depending on their position in a module. The only lesson in a module is numbered 1 of 1.

e.g. MODULE 4: Major Wastewater Treatment Processes  
Lesson 2 of 4: Identifying Treatment Process Units

MODULE 2: Safety  
Lesson 1 of 6: Safety Hazards

MODULE 2: Safety  
Lesson 2 of 6: Safety Equipment

**ESTIMATED TIME FOR THIS LESSON:**

Write here the amount of time you estimate the learner will need to spend in class in working through this lesson. It is a good idea to fill in this section only after you have filled in all other sections on the worksheet.

e.g. ESTIMATED TIME FOR THIS LESSON: 1 hour

ESTIMATED TIME FOR THIS LESSON: 30 minutes

**PREREQUISITES FOR  
THIS LESSON:**

In this section, make reference to the skills and knowledge the learner must possess before she/he will be able to profit from the lesson described on the worksheet. For example, a learner must know how to perform titrations before she/he is able to perform many of the laboratory tests of wastewater. In this case, an ability to perform titrations is a prerequisite for the lessons on performing wastewater laboratory tests and should be listed as such. In listing prerequisites, you may refer directly to the skill, or (better) refer to the lesson or module in this curriculum in which the skill was taught.

e.g. **PREREQUISITES FOR  
THIS LESSON:** Ability to perform  
titrations.

**PREREQUISITES FOR  
THIS LESSON:** Lesson 2 in this module

**PREREQUISITES FOR  
THIS LESSON:** Module 4 in SUPPORT  
SYSTEMS I.

**PREREQUISITE FOR  
THIS LESSON:** None

**PERFORMANCE OBJECTIVE (3 PARTS):**

The performance objective section is the core of each instructional worksheet. In most cases, you will copy it word for word onto the worksheet from the set of objectives which were given to you at the start of this project. Occasionally, you will need or want to rewrite one of these original performance objectives. With this possibility in view, here is a description of what should be written on the worksheet for each of the three parts of the performance objective:

**ACTION/TERMINAL  
BEHAVIOR:**

Write here a statement of what you want the learner to do as a result of taking this lesson. This learner behavior will be evaluated. In writing the statement, use ACTION VERBS which describe overt, observable behavior.

More than one sentence may be used to state the terminal behavior.

e.g. ACTION/TERMINAL  
BEHAVIOR:

The learner will name each of the process units shown in a set of photographs.

ACTION/TERMINAL  
BEHAVIOR:

The learner will perform the pH test on samples of wastewater.

CONDITIONS:

The "conditions" section describes the situation the learner will be in when she/he is asked to perform the terminal behavior for evaluation. In this section should be written a complete list of all the tools, equipment, books, and other resources to which the learner will have access while performing the terminal behavior. Whenever possible, the learner should be allowed access to a performance aid (a written reminder of the steps in a procedure) while performing, rather than be required to memorize complex procedures.

e.g. ACTION/TERMINAL  
BEHAVIOR:

The learner will name each of the process units shown in a set of photographs.

CONDITIONS:

Given unlabelled photographs of twelve plant process units.

ACTION/TERMINAL  
BEHAVIOR:

The learner will perform the pH test.

CONDITIONS:

Given laboratory glassware, samples of wastewater, indicator solutions, and a performance aid (instructions for performing the pH test).

**ACCEPTABLE  
PERFORMANCE:**

This section must state the minimum level of competency which the learner must achieve when performing the terminal behavior. Acceptable performance may be expressed as a percentage of correct responses, as a time limit, or as a degree of accuracy, and so on.

e.g. **ACCEPTABLE  
PERFORMANCE:** At least 80% of the problems must be solved.

**ACCEPTABLE  
PERFORMANCE:** At least 10 of the twelve process units must be correctly identified.

**ACCEPTABLE  
PERFORMANCE:** The test must be performed within 20 minutes.

**JUSTIFICATION  
OF OBJECTIVE:**

This section is to be used for a brief explanation of why the learner needs to achieve the performance objective written above. The objective should be justified chiefly on the basis of how achieving it will help the learner after she/he leaves the training program and goes on the job.

e.g. **JUSTIFICATION  
OF OBJECTIVE:** Graduates of this training program who work with municipal agencies may be involved in inspection of collection systems.

**JUSTIFICATION  
OF OBJECTIVE:** Many graduates of this training program will work in laboratories where they will be required to perform chemical analyses of wastewater.

**INSTRUCTIONAL  
RESOURCES:**

Use this section for recommending books, booklets, self-instructional packages, slides, tapes, films, filmstrips, and other instructional materials for use during the class session by the learner. The recommended materials must help the learner to achieve the performance objective.

Selected resources are ones taken from the IRIS system. Search the system for the code numbers of resources which you want to recommend. Then list these code numbers in this section. If the resource you wish to recommend is not yet in IRIS, then use one of the special IRIS sheets you were given to assign a code number to it and add it to the IRIS system.

Suggested for development resources are those which you recommend that the instructor develop or put together for use in class with the learner. Some types of resources which are easily and quickly put together by an instructor include: charts displaying information, posters, sample designs and drawings, and "ideal" test answers for use as models. If you cannot think of any resources to suggest for development, write NONE in this section.

e.g. INSTRUCTIONAL RESOURCES

Selected: IRIS 2705, 2803, 2911

Suggested for development: File of well-done designs drawn by past students.

**INSTRUCTIONAL  
ACTIVITIES:**

This section should be used to suggest what the instructor and learner can do during the class session to enable the learner to achieve the performance objective. In filling in this section, draw upon your own teaching experience. Whenever possible, suggest learning experiences which will be enriching for the learner.

## e.g. INSTRUCTIONAL ACTIVITIES:

Instructor Activity: Demonstrates how to do the pH test.

Learner Activity: Practices doing the pH test.

## INSTRUCTIONAL ACTIVITIES:

Instructor Activity: Describes effects of pollution on the environment. Takes learner on field trip to observe examples of environmental degradation caused by pollution.

Learner Activity: Designs a chart showing pollutants and their effects on the environment. Goes on field trips to observe examples of environmental degradation caused by pollution.

## METHOD OF EVALUATION:

This section must state the appropriate method of testing whether or not the learner has achieved the performance objective. For example, if the terminal behavior states that "the learner will perform the pH test on samples of wastewater" then the learner does not satisfy the objective by merely describing how she/he would perform that test. Nothing less than a demonstration will do: the instructor must watch as the learner performs the pH test and evaluate him or her on how well she/he performs. If the required behavior is that a learner "draw" or "design" something, then the method of evaluation is a "written test." If the required behavior is that a learner perform a chemical test, start up a pump, or adjust a piece of equipment, then a "demonstration" is the only possible method of evaluation. For some behaviors, the learner may demonstrate competence either orally (e.g. by answering questions), or in writing (e.g. writing a number of paragraphs or a list). The method of evaluation must be appropriate to the terminal behavior required of the student.

e.g. METHOD OF  
EVALUATION: Oral or written test.

METHOD OF  
EVALUATION: Written test plus demonstration.

METHOD OF  
EVALUATION: Demonstration.

SAMPLE TEST  
ITEM PROVIDED?

The more conventional name for a test item is a test question. These are the problems, questions, etc. given to a learner on the typical written examination. The learner's response to the test item shows whether or not she/he has indeed learned what she/he should have learned. You must provide sample test items for all terminal behaviors for which they are relevant.

Here is an example of a terminal behavior which SHOULD NOT have an accompanying test item:

ACTION/TERMINAL  
BEHAVIOR: The learner will name three major pieces of legislation on the environment.

The only possible test item for this behavior would be:

"Name three major pieces of legislation on the environment."

There is little need to write a test item as obvious as this. Here are two examples of terminal behaviors which SHOULD have accompanying sample test items:

e.g. ACTION/TERMINAL  
BEHAVIOR: The learner will solve word problems involving division of fractions.



ACCOMPANYING SAMPLE TEST ITEM: If a pump empties 5/12th of a tank in 3 hours, how much of the tank will it empty in 1 hour?

ACTION/TERMINAL BEHAVIOR: The learner will state whether treatment plant process units are operating normally or abnormally by evaluating values of characteristics of the effluent from each of the units.

ACCOMPANYING SAMPLE TEST ITEM:

For each process unit named below, check the appropriate box to indicate normal or abnormal operation of the unit:

Process Unit	Effluent Characteristic	Value of Characteristic	<input type="checkbox"/> normal operation	<input type="checkbox"/> abnormal operation
1. activated-sludge tank	BOD	10 mg/l	<input type="checkbox"/> normal operation	<input type="checkbox"/> abnormal operation
2. trickling filter	BOD	15 mg/l	<input type="checkbox"/> normal operation	<input type="checkbox"/> abnormal operation
3. grit chamber	flow	10 mgd	<input type="checkbox"/> normal operation	<input type="checkbox"/> abnormal operation

Sample test items like these are extremely useful to the instructor. They help clarify for him/her exactly what kind of learner behavior is called for. They also help the busy instructor prepare examinations and tests for learners more quickly and easily.

Write a test item on the blank sheet provided and staple this sheet to the accompanying worksheet.

see following page

**SAMPLE TEST ITEM SHEET**  
(Staple to Accompanying Worksheet)

This test item accompanies:

Course: \_\_\_\_\_

Module: \_\_\_\_\_

Lesson: \_\_\_\_\_

PLACE TEST ITEM HERE:

EPA-MOTD

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Then check the YES box at the bottom right hand corner of the worksheet.

FINALLY...

When you have filled in all sections of the instructional worksheet, write your name and the date at the bottom of the sheet.

REMEMBER - PLEASE TYPE ALL ENTRIES ON THE WORKSHEET.