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ABSTRACT

Awareness in Europe of the possible health hazards of certain building materials has increased. Many new building products have had no long-term testing, and competition leads to constant product changes. For example, asbestos-laden materials were used widely in schools, and now they must be removed or treated at great cost. Scientists and politicians have attempted to respond to the problem of health-threatening building materials. Germany's Federal Office for the Environment has created a guide describing substitutes that can be used in place of asbestos. Government civil-engineering departments also have released a planning aid on building materials. Other recommendations concerning harmful building materials and equipment have been made in operational instructions, circular orders, and building regulations. These regulations range from providing builders with a greater awareness of the dangers of some materials to refusal to provide financial backing for building projects using hazardous materials. The European Directive on Construction Products has been adopted and requires buildings to be constructed so as not to be dangerous and to meet certain standards. (JPT)

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HEALTH-THREATENING BUILDING MATERIALS IN SCHOOL CONSTRUCTION AND EQUIPMENT

Rudolf Wolf

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Health-threatening building materials in school construction and equipment

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ZNWB - Berlin

Health-threatening building materials in school construction and equipment

Introduction

One of humanity's great civilising and cultural achievements lies in the use of housing to afford protection against such external hazards as cold and heat, hail and storms, rain and fire.

The materials for this purpose were supplied by nature, and the art of the builder rested on inherited knowledge. The life of the buildings erected on these principles encompassed several generations, unless wars or natural catastrophes brought about their premature destruction.

It ist the last decade which has made us aware of the healthy atmospheric conditions in old buildings, which offer a cool interior in the hot seasons, while retaining heat for a lengthy period in winter.

The endeavour at present is to impose an economic view of the world, which does not hesitate to give theory precedence over traditional wisdom. This has given rise to a dilemma. The building now affords only qualified protection, and itself constitutes a source of danger.

The apparently limitless scope of new developments has engendered a multiplicity of novel buildings materials which are being introduced to the market in quantity. Non long-term experience is acquired with the new building products, as the force of competition causes constant modifications to be made, leading to changes of product which can no longer be monitored.

Cement-bonded asbestos, for instance, which for decades was used in large quantities in the building industry, has found further applications, with low-strength bonding, in plasters and insulating strips and as spray-applied coatings on steel girders, as well as in carpet underlays, electrical storage heaters, overhead projectors, hair-driers and so on. Negligent use of the material has sometimes caused contamination of adjacent building materials. The disposal of asbestos poses problems of the greatest difficulty, and now costs more than the erection of a new building. In Berlin in 1989, 12 intermediate-grade and 2 higher educational establishments were affected. Since then, 6 of the intermediate-grade buildings have been demolished, 2 buildings are standing empty, and the remainder are being rehabilitated. Replacement building costs amount to DM 20-40 million per building. Another rehabilitation project is concerned with 40 PCB-contaminated day nurseries, sports halls and schools.

Activities

In order to set limits to this process, scientists and politicians, too, have over the last ten years addressed the problem of health-threatening building materials.

Since 1985 the Umweltbundesamt[1] (Federal Office for the Environment) has been

[1] Umweltbundesamt, Bismarckplatz 1, D-1000 Berlin 33

issuing a multi-volume catalogue of asbestos substitutes compiled by the Batelle-Institute e.V. in Frankfurt am Main. This catalogue contains all the current substitutes for fibrous asbestos arranged according to the following criteria:

- composition and manufacture of the building material,
- physical, mechanical, thermal and electrical characteristics,
- combustion behaviour,
- chemical stability,
- implications for health,
- fields of application, and
- cost comparisons with asbestos.

A list of manufacturers of the substitute materials ist appended to the inventory.

In 1990, a nunber of civil-engineering departments in the old Länder of the Federal Republic of Germany issued a planning-aid entitled Umweltschutz im Bauwesen (Environmental Protection in the Construction Industry) prepared by the Standardisation and Rationalisation Subcommittee of the ARGEBAU Committee on Building Construction[2].

The subjects covered by this loose-leaf compilation extend from the planning of buildings, considered under the following heads:

- ecological principles
- ecological principles in design and construction,
- building materials,

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2) Landesinstitut für Bauwesen und angewandte Bauschadensforschung (LBB), Theaterplatz 14, D-5100 Aachen

- harmful substances, and

- recycling

to "green" planning, the technical equipment of buildings and the relevant regulations at national and European level.

Significant to our present theme are the inventories of building materials and harmful substances, and from these I extract the insulating materials and man-made mineral fibres for your attention.

HARMFUL SUBSTANCES A 4[2)]

HARMFUL SUBSTANCE	MAN-MADE MINERAL FIBRES
CHARACTERISTICS	EFFECT
Non-combustible fibres, classified as: - textile, i.e. spinnable fibres: A-, C-, D-, R- (=S) and Z-fibres - non-textile fibres: slag, rock and glass wool.	When the materials are used, small fibre particles become detached and cause irritation to the skin, eyes and mucous membranes. With resin-bonded materials, there is also the possibility of gas liberation with substance-specific effects.
An advantage over asbestos fibres is the apparent inability of textile fibres, generally with a diameter of 3 µm, to split lengthwise. On the other hand, with non-textile fibres, a considerable proportion may lie in the < 1 µm diameter range.	Findings relate essentially to animal and cell tests (employing fine-dust injections). These indicate that the biologically relevant diameter range of the fibres lies well below 3 µm, the maximum effect being attained below 0.5 µm.
With resin bonding agents, the fibres can be moulded. Depending on the base material, the fibres may be slightly radioactive.	In view of the carcinogenic effects of asbestos fibres, a similar suspicion also attaches to mineral fibres with the same latency period. Especially when these are inhaled over a lengthy period, damage to the respiratory organs (pneumonia, asthma, bronchitis) is a possibility.

USES	SUBSTITUTES
Textile fibres chiefly used in woven materials (glass-fibre wall coverings) and for reinforcements, e.g. as roofing material inlays, carpet backings, and in concrete and polyesters. Also on occasion for heat insulation and noise absorption in mats, with fibre diameters of 5-7 µm.	Recourse, wherever feasible, to natural insulating materials such as cork, perlite and foam glass. For the silencing of ventilation ducts, soft and as far as possible pollutant-free plastic foams may be used as substitutes.
Non-textile fibres are used almost exclusively in mats and panels for purposes of heat and sound insulation. They are also sometimes spray-applied for filling voids and in heat-insulating plasters.	
Critical are those applications in which air turbulence, for example, can cause fibres with a diameter of < 1 µm to find their way into living quarters, for instance, through ventilation ducts provided with non-textile fibre mats for noise absorption.	

Regulations in the "old" Länder of the Federal Republic of Germany

Acting on behalf oft the Conference of Education Ministers, the ZNWB (Central Office for Standardization and Economic Efficiency in Education) issued a questionnaire to the Länder to establish the position of environmentally harmful building materials, as defined in the relevant rules and regulations.[3)]

I should like to take this opportunity of advising you of the results of this enquiry:

All 11 of the old Länder stipulate that harmful substances should be reduced

- when using chipboard, so as to "avoid unreasonable concentrations of formaldehyde in the internal atmosphere",

- by limiting emissions of formaldehyde into the internal atmosphere "when using in-situ urea formaldehyde resin foam",

- when "assessing and dealing with loosely bonded asbestos products in buildings" (Asbestos Regulations), and

- in the use of "wood-preservatives in buildings" (wood preservatives containing PCP).

This is also reflected in Federal statutory and administrative regulations, such as the Regulations on Hazardous Materials, the Regulations prohibiting the use of PCBs and PCPs and the Asbestos Regulations.

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3) ZNWB - Zentralstelle für Normungsfragen und Wirtschaftlichkeit im Bildungswesen, Schillstraße 9-10, D-1000 Berlin 30

In addition, some Federal Länder have issued further recommendations contained in operational instructions, circular orders and Land building regulations, which relate to the following harmful materials in building construction and equipment.

Harmful substances	Range of applications
Aluminium (high energy consumption in case of manufacture	Window, metal mounts, facade
Asbestos (loosely bonded)	Fire-cover, plaster, electrical storage heater, overhead projector
Formaldehyde	Chipboard, furniture, wallpape carpet, adhesive
CFC - PUR - PUR - XPS	Refrigerator, pump for getting heat out of the ground - foaming agent for soft elastic foam - foaming agent for hard elastic foam - foaming agent for hard elastic foam and heat insulating-panel
In-situ urea formaldehyde resin foam	Heat insulating-panel, foam
Hydrazin	Corrosion-inhibiting for heating installation, pre-product for plastic, dyestuff, adhesive, foaming agent for foam
Isozyanat	Chipboard (adhesive)
Levoxin	Corrosion inhibiting matter for oxygen in vapour for humidi fiering

Lindan	Wood preservaties, lacques, dyestuff (since 1984 no more allowed in Germany)
PCB (polychlorinated biphenyls)	Condensor of neon tube, wood preservatives, collour, lacques, dye wood, spattle and packing materials, adhesive
PCP (pentachlorphenol)	Wood preservatives (since 1985 no more produced in Germany), dispersion-oil paint, oil-and nitro-lacque, adhesive and glue, cooling plant-system
Perchlorethylen	Cleaning agent
PUR (polyurethan	Floor-underlay, wall-unterlay, window section, cable covering
PVC (polyvinylchlorid)	Floor-underlay, wall-underlay, window section, cable covering
Coaltar-oil	Wood preservation (known as Karbiloneum)

No downright prohibition is placed on the use of construction products containing harmful substances.

However, Land Berlin, in its Regulations in Support of the Modernisation and Renovation of Residential Buildings (ModInst.RI 90), has, for instance, refused as a matter of principle to give financial backing to building projects involving the use of:

- building materials containing asbestos,
- building components made of tropical timbers,
- foam insulating panels and in-situ foam products based on polyurethane (PUR) and chlorofluorocarbons (CFCs),

- extruded polystyrene panels,
- PVC or aluminium door and window sections,
- floor and wall coverings and small building components made of PVC,
- waste-water downpipes, collecting pipes and mains made of PVC.

The right is retained to make further exclusions in future in respect of building materials shown to be undesirable by current ecological knowledge.

The Land government of Hesse has followed a different course. In a general circular order dated 10.10.1985 it made known its decision "in all future contracts and procurements, having regard to the issues of the environment and public health, to lay greater stress on the environmental compatibility and acceptability of products and processes ... even if these should be more costly than other alternatives and services". New economic considerations are brought to bear on this issue, including the possibility of re-using building materials (recyclable products).

To give appeal to the use of environmentally friendly products, a scale of price increments is proposed, which runs until 31.12.1993.

Products presenting a threat to the environment may, on principle, no longer be procured or used, where equivalent substitutes are available.

The following are affected by this ruling:

- transformers and capacitors (including fluorescent tubes), if filled with polychlorinated biphenyls (PCBs),

- corrosion-inhibiting chemical bonding agents, such as hydrazine, in heating installations (unless their use is technically unavoidable),

- materials containing asbestos,

- construction materials without adequate limitation of formaldehyde emissions used in buildings, extensions or furnishings (e.g. no E-2 or E-3 chipboards, or in-situ foam based on urea formaldehyde resin),

- Wood preservatives containing PCPs, and wood preservatives not covered by a test certificate for inside/outside use,

- coaltar oil as a wood preservative (not even for outside use),

- sprays and refrigerators using CFC propellants,

- cleaning agents containing perchloroethylene.

Federal Public Health Department (BGA)[4)]

The two sets of regulations referred to above go well beyond the painstaking and detailed work performed by the toxicologists acting on behalf of the Federal Public Health Department. Their job is to provide scientific proof of the health-threatening emissions of construction materials in enclosed spaces; to establish corresponding threshold values for environmental compatibility, and thereby equip the legislator with fundamental data on which decisions may be based.

The Federal Public Health Department has set up a committee on air-quality in enclosed spaces with this purpose in mind.

Pollutant emissions in enclosed spaces are difficult to measure, as they provide no indication of specific materials, but occur in the form of a "mixture". In some cases we lack the formulations of construction products which would be needed for an evaluation of individual materials.

Directive relating to Construction Products

The European Directive relating to Construction Products has now been adopted and can no longer be changed in substance. The preamble to this directive includes the following considerations of major importance:

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4) Bundesgesundheitsamt, Postbox 33 00 13, D-1000 Berlin 33

"Whereas Member States are responsible for ensuring that building and civil engineering works on their territoy are designed and executed in a way that does not endanger the safety of persons, domestic animals and property, while respecting other essential requirements in the interests of general well-being;

Whereas Member States have provisions, including requirements, relating not only to building safety but also to health, durability, energy economy, protection of the environment, aspects of economy, and other aspects important in the public interest;

Whereas these requirements, which are often the subject of national provisions laid down by law, regulation or administrative action, have a direct influence on the nature of construction products employed and are reflected in national product standards, technical approvals and other technical specifications and provisions which, by their disparity, hinder trade within the Community."

In order to reduce the obstructions to trade, Annex 1, para 3 of the Directive relating to Construction Products lays down only in quite general terms the essential requirements with regard to hygiene, health and the protection of the environment:

"The construction work must be designed and built in such a way it will not be a threat to the hygiene or health oft the occupants or neighbours, in particular as a result of any of the following:

- the giving-off of toxic gas,
- the presence of dangerous particles or gases in the air,
- the emission of dangerous radiation,
- pollution or poisoning of the water or soil,
- faulty elimination of waste water, smoke, solid or liquid wastes,
- the presence of damp in parts of the works or on surfaces within the works."

It is therefore left to individual Member States to determine the extent to which they will work towards the further harmonization of particular buildings standards in the interests of healthy and environmentally benign buildng materials, or whether they will focus their main attention on the sales prospects for their construction products.