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Committee of Experts
"Healthy Building and Housing"
with the
Federal Minister for Environmental Planning,
the Building and Construction Industry and
Urban Development

PVC Products in the Building and Construction Industry

Answers to Questions on Health and the Environment

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Committee of Experts "Healthy Building And Housing"
with The Federal Minister for Environmental Planning,
the Building and Construction Industry and Urban Development

P V C P R O D U C T S I N T H E B U I L D I N G
A N D C O N S T R U C T I O N I N D U S T R Y

Answers to Questions on Health and the Environment

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1. General Information

1.1 Reasons and Targets

The application of PVC (polyvinylchloride) is mentioned over and over again in the discussion about our environmental pollution, coupled with damage to people's health.

In order to be able to make statements on this, it is imperative to investigate all the health aspects, such as the manufacture, use and waste management of the material, in respect of the health hazard and environmental pollution.

In the following, however, only the area of the application of PVC in the building and construction industry will be singled out.

1.2 Application in the Building and Construction Industry and Production Quantities

In the Federal Republic of Germany around 8.0 million t plastic per year are manufactured currently; of that around 1.2 million t is PVC. About 50% of that, i.e. around 600,000 t PVC, is used for the building sector.

The reason for the versatile application of PVC in the building and construction industry lies in it's technical characteristics and in the fact that it is inexpensive. PVC is resistant to many chemicals, to weathering influences and to signs of corrosion. It has a low weight, is easy to process, can be welded, glued and dyed. In addition, it has low flammability and, owing to it's low conductivity of heat and noise, it has good performance characteristics.

A total of over 3,000 industrial and trade businesses, with more than 100,000 employees, deal with the manufacture and processing of PVC products in the Federal Republic of Germany.

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The following is an approximate division according to groups of products:

Window profiles	135,000 t/a	≡	22%
Pipes, formers	235,000 t/a	≡	38%
Building profiles, shutters	28,000 t/a	≡	5%
Films, wallpapers, sheets	65,000 t/a	≡	11%
Floor coverings	36,000 t/a	≡	9%
Cable insulation	60,000 t/a	≡	10%
Sealing compounds, glues,			
coatings, paints	5,000 t/a	≡	1%
Boards, others	26,000 t/a	≡	4%
	600,000 t/a	≡	100%

There are a large number of different PVC building materials in practical building applications. By adding different quantities of aids to the basic substance, material characteristics can be produced, which are particularly suitable for the respective application.

Rigid PVC (about 77% of the production quantity in the building sector) contains, above all, a higher addition of stabilizers. Because of this, the material is very resistant to mechanical demands and UV radiation, is resistant to aging in the open air, and can be welded easily at approx. 120°C. It has a resistance to compression of up to 100 N/mm².

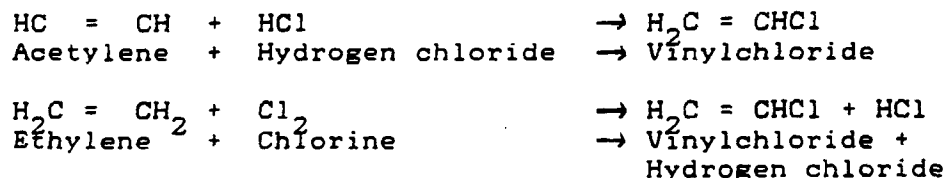
Flexible PVC (about 23% of the production quantity in the building sector) contains, above all, higher additions of plasticisers (10 -45%). Because of this, the material is highly elastic, can be easily welded, is waterproof and water vapour proof. It has a good electrical insulating ability.

1.3 Production Processes

The sources of raw materials for the base products of PVC are common salt (NaCl), from which the chlorine is obtained, as well as coal, petroleum and natural gas, from which acetylene and/or ethylene are manufactured.

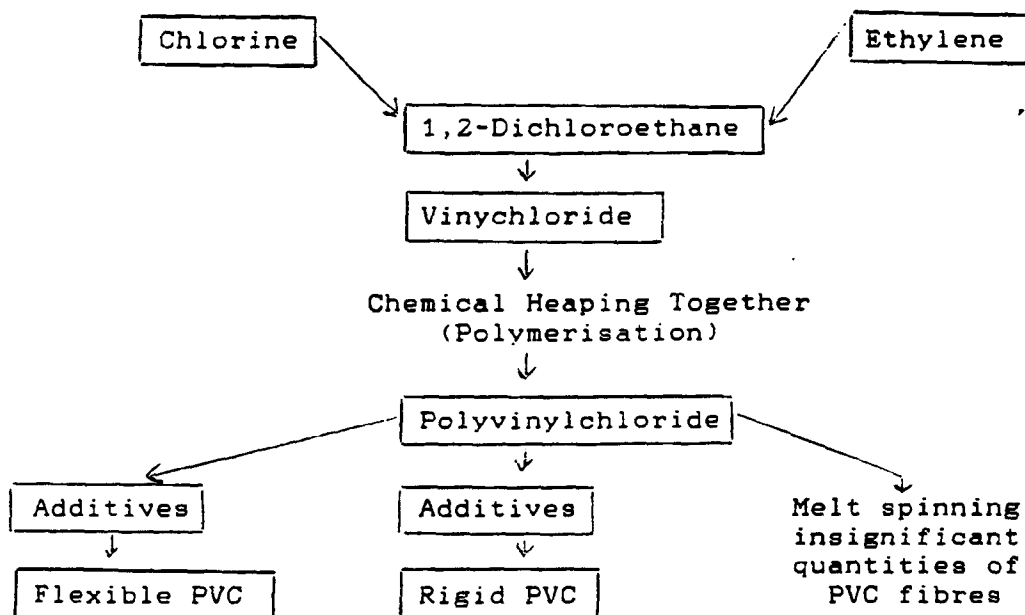
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The portion of PVC materials produced from coal (acetylene) amounts to about 15%, and the portion produced from petroleum and natural gas (ethylene) about 85%. The chemical action is represented as follows:



The monomer vinylchloride is a colourless gas, which, through polymerisation (= chemical heaping together/crosslinking), becomes polyvinylchloride = PVC.

Using the example of the application of ethylene, the following diagram occurs for the origination of PVC:



Depending on the application later, different additives are added to the white powder, which arises through the polymerisation of the vinylchloride.

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1.4 Additives

Stabilizers, dyestuffs (pigments), lubricants, plasticizers, flame retardants and fillers are used as additives.

Before processing, the primary plastic PVC is mixed through the use of various stabilizers, some of which contain metals, depending on the intended purpose of application, in order to prevent thermal damage during processing and use, as well as to prevent oxidation and degradation through the influences of weathering - in particular through UV irradiation. In the end, stabilizers are decisive for the resistance of products to aging.

The normal stabilizers in the manufacture of PVC are:

- Calcium, zinc, magnesium soaps
- Barium, cadmium soaps
- Tin octyl combinations
- Basic lead combinations
- Epoxidized soya bean oils
- Pentaerythritol ester
- Sorbitol

Sometimes, systems containing cadmium are used for PVC products, which are to be exposed to the weather, such as window profiles and shutters, for example. Interior products made from PVC, such as floor coverings, wallpapers, and also packaging materials, no longer contain cadmium stabilizers these days.

The PVC manufacturing and processing industry in the Federal Republic of Germany is striving to replace cadmium, step by step, with other stabilizers. Ten years ago, the cadmium consumption during the manufacture of PVC amounted to around 500 t per year. Despite a considerable increase in the overall production of PVC, it is currently only around 270 t per year.

Only lead compounds are used as stabilizers in pipe production these days. According to stipulations from the Federal Public Health Department, the lead content in PVC drinking water pipes must not exceed a value of two weight percent.

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In the Federal Republic the following combinations are normally used as dyestuffs (pigments) during the manufacture of PVC to colour the products:

- Titanium dioxide = white
- Iron oxide = yellow, black, brown, red
- Carbon black = black
- Cobalt = blue
- Organic pigments

There are no pigments containing cadmium in PVC products.

Lubricants reduce the viscosity of the moulding material for processing, or act as a lubricator between the melting plastic and the metal walls of the machines, tools and calibrator. They are processing aids.

The usual lubricants in the manufacture of PVC are:

- Metal soaps (stearates)
- Lignite wax and paraffin wax
- Types of polyethylene which are similar to wax
- Fatty alcohols and ester
- Silicons
- Glycerine ester

Plasticizers serve to make certain PVC products flexible (depending on the requirement) in broad ranges of temperatures.

Plasticizers are organic substances, which go into a physical interaction with high polymer materials, and form a homogeneous system with them. They are used to reduce the modulus of elasticity, the rigidity and the brittleness of thermoplastics (these soften in heat, in contrast with duroplastics, which remain stiff in heat).

The usual plasticizers in the manufacture of PVC are:

- Phthalates (among which is Diethylhexylphthalate DEHP, the most often used)
- Phosphates, epoxidized fatty acid ester
- Alkyl sulfonic acid ester
- Adipic - azelaic and sebacic acid ester
- Trimellite acid ester

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