it must be expected that vigilance will decline fairly soon.

PREVENTIVE MEASURES

The decline of vigilance may thus be caused by fatigue (due to overwork, an over-long working day, a working environment not adapted to physiological needs, or lack of training on the part of the worker); or, and this is a more frequent cause, by monotony of work.

The following are methods of countering this decline:

(*a*) anticipating fatigue by all possible means;
(*b*) ensuring that the intervals between stimuli are not excessively long and that the stimuli attain a minimum level;
(*c*) not giving a worker tasks which are too simple or devoid of interest;
(*d*) stimulating motivation;
(*e*) ensuring that the work is not carried out in an arid environment;
(*f*) leaving the worker a free choice as to his rhythm of work.

MACWORTH, N. H. (1950). *Researches on the measurement of human performance.* Special Report Series No. 268. Medical Research Council, London.

DEESE, J. (1955). Some problems in the theory of vigilance. *Psychological Review*, **62**, 359.

BROADBENT, D. E. (1957). The vigilant man and the active man. Symposium on Vigilance. *The advancement of science*, 339.

BAKER, C. H. (1963). Further towards a theory of vigilance. In: BUCKNER, D. N.; McGRATH, J. J. *Vigilance. A Symposium.* McGraw-Hill, New York, San Francisco, Toronto, London.

SCHMIDTKE, H.; MICKO, H. C. (1964). *Untersuchungen über die Reaktionszeit bei Dauerbeobachtung.* Westdeutscher Verlag, Köln, Opladen.

SCHMIDTKE, H. (1965). *Die Ermüdung.* Huber, Bern, Stuttgart.

*MOODY, J. A.; DUGGAR, B. C. (1966). Alertness management in industry. *American Industrial Hygiene Association Journal*, **27**, 17.

SCHMIDTKE, H.
Germany (Fed. Rep.).

Vinyl, polyvinyl chloride

Dahm

Vinyl chloride (CH_2:CHCl)
CHLOROETHYLENE

m.p. 160 °C
b.p. 13.9 °C
v.pr. 760 mmHg (13.8 °C)
v.d. 2.15
f.p. −78 °C (open cup)
slightly soluble in water; soluble in ethyl alcohol; very soluble in ethyl ether
flammable limits 4–21.7%
TLV ACGIH (ceiling) 500 ppm, 1 300 mg/m³
MAC USSR 30 mg/m³
a colourless gas with a mild, sweetish odour.

The monomer, vinylchloride, can be produced by adding hydrogen chloride to acetylene ($CH{:}CH + HCl \rightarrow CH_2{:}CHCl$) which is passed over a catalyst of activated charcoal impregnated with 10% mercuric chloride, or by the dehydrochlorination of 1,2 dichloroethane.

It is used mainly as an intermediate in the manufacture of plastics, as a refrigerant and in organic syntheses.

HAZARDS AND THEIR PREVENTION

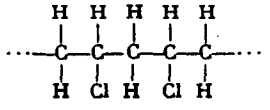
The inhalation of a 2.5% concentration of vinyl chloride may cause dizziness, disorientation, a burning sensation in the soles of the feet, followed by a headache, lasting about 30 min. These symptoms will disappear after removal from the exposure. The symptoms of workers exposed to concentrations ranging from 0.04 to 1.1 mg/l included headaches, neurotic disturbances, disturbances such as hyperhidrosis, dermatographia, light anaemia and possibly leucopenia. Sometimes paraesthesia was determined in the distal parts of limbs, occasional whitening of the palms of the hands, and a decrease of surface sensitivity.

Although the gas does not possess adequate warning properties, such as odour or irritant action, dizziness and disorientation should be considered as warnings of excessive atmospheric contamination. Extremely high concentrations will generally cause almost immediate helplessness and unconsciousness.

During the mixing of gases for the production of vinyl chloride, the environment may be contaminated by metallic mercury, which is reduced from the mercuric chloride in the catalyst and deposited on the walls of the reactor.

Sufficient ventilation is important during the production of vinyl chloride. Workers entering the reactors must comply with appropriate protective regulations.

Polyvinyl chloride
PVC



sp.gr. 1.41
MAC USSR (dust) 6 mg/m³

a white thermoplastic substance with good mechanical and electrical properties and a high resistance to chemicals. It can withstand temperatures of of 65–80 °C very well, but if heated to approximately 160 °C, it disintegrates with the release of hydrogen chloride. The properties of PVC can be altered according to the additives used and the desired molecular weight.

Production. PVC is produced by the polymerisation of vinyl chloride in the presence of initiators such as 0.1–0.5% benzoyl peroxide. Polymerisation is carried out continuously or intermittently in rotating autoclaves. The properties of commercial PVC products can be modified by the addition of stabilisers, plasticisers, filling agents and pigments, as well as by copolymerisation with other monomers.

Uses. If rolled into sheets, the plasticised PVC may be used as imitation leather or as a floor covering. It may also be moulded into electric insulators, water pipes, handles and various consumer goods. Further chlorination of PVC in a tetrachloroethane medium forms a product which is precipitated by the addition of an equal volume of methyl alcohol. After drying, a powder is obtained which is used in the manufacture of films or synthetic fibres. After immersion in acetone and carbon disulphide, it may be spun and used as a textile yarn.

HAZARDS AND THEIR PREVENTION

PVC is odourless and hygienically faultless. During polymerisation, however, an explosion hazard may exist and inhalation of vinyl chloride may also be a health hazard. Dust could be a problem for employees filling sacks with the dried polymer. Dioctylphthalate, the most important plasticiser, may escape into the air of the workroom in which the PVC is processed. This appears as a fog which consists of particles smaller than 5 μm. The dioctylphthalate content in the air of a PVC processing plant, measured at the point where the material left the machine, was 5.38 mg/m³ where the PVC was plasticised with up to 20% phthalate and 0.24 mg/m³ in the case of rigid PVC to which only up to 1.5% phthalate was added. An exposure to phthalate concentrations of approximately 5 mg/m³ caused an

BFG36097

2489904

irritation of the upper respiratory passages, while an exposure to approximately 40 mg/m³ at an air temperature of 30 °C, caused considerable irritation of the upper respiratory tract, of the conjunctivae and lacrimation. The formation of acne (chloracne) on the face and forearms of workers handling PVC products, has been reported; this was caused by the chloronaphthalene used as a mould release compound. Two cases of skin damage have been reported among persons working with PVC. From the results of skin tests it was assumed that complex toxic and allergenic mechanisms may be responsible for this. Thus, the emulsifier, with its strong degreasing properties, or the solvents may cause not only an irritation of the skin, but further sensitisation to PVC which is generally not considered to be a sensitiser.

Acro-osteolysis and disorders resembling Raynaud's phenomenon have been reported in workers employed on PVC polymerisation. Spinning entails exposure to acetone and carbon disulphide possibly leading to nervous and digestive disorders and an irritation of the mucous membranes.

Owing to the explosive hazard during polymerisation, the tanks should be guarded by wire netting. It is also advisable to install remote controls and to provide an alarm system in the plant to detect any leakage of vinyl chloride into the workroom air. The employees filling sacks with the dried polymer should wear respiratory protective equipment.

*SONNECK, H. J. (1962). Berufsbedingte Hautschäden durch Polyvinylchlorid. *Berufsdermatosen*, **10**, 38.

*WALLS, W. L. (1964). *Vinyl chloride explosion*. NFPA 57–13. National Fire Protection Association, Boston, Massachusetts.

*ZDRAŽIL, J.; PÍCHA, F. (1965). Estery kyseliny ftalové v ovzduší při zpracování polyvinylchloridu. *Pracovní lékařství*, **17**, 257.

*SUCIU, I.; DREJMAN, I.; VALASKAI, M. (1967). Etude des maladies dues au chlorure de vinyle. *Medicina del Lavoro*, **58**, 261.

*CORNISH, H. H.; ABAR, E. L. (1969). Toxicity of pyrolysis products of vinyl plastics. *Archives of Environmental Health*, **19**, 15.

*VIOLA, P. L. (1970). Pathology of vinyl chloride. *Medicina del Lavoro*, **61**, 174.

ROUBAL, J.
Czechoslovakia.

Vinylidene, polyvinylidene chloride

Daht, Dubz

Vinylidene chloride (CH_2:CCl_2)
1,1-DICHLOROETHYLENE

sp.gr. 1.22
m.p. −122.1 °C
b.p. 32 °C
v.pr. 591 mmHg (25 °C)
v.d. 3.3
f.p. 15 °C (open cup)
explosive limits 7–16%
MAC USSR 50 mg/m³
a colourless liquid with a chloroform-like odour.

It is prepared by the chlorination of ethane, or by additional chlorination of vinyl chloride, followed by thermal dehydrochlorination.

$$CH_2{:}CHCl + Cl_2 \rightarrow CH_2ClCHCl_2 \rightarrow CH_2{:}CCl_2 + HCl$$

Its main use is as a chemical intermediate in the production of vinylidene polymer plastics.

HAZARDS AND THEIR PREVENTION

If pure vinylidene chloride is kept between −40 °C and +25 °C in the presence of air or oxygen, a violently explosive peroxide compound of undertermined structure is formed, which can detonate from slight mechanical stimuli or from heat.

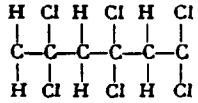
The vapours are moderately irritating to the eyes and exposures to high concentrations may cause effects similar to drunkenness, which may progress to unconsciousness. The liquid is an irritant to the skin which may be in part due to the phenolic inhibitor, added to prevent uncontrolled polymerisation and explosion.

White mice died after exposure to concentrations of 5–10 mg/l. A concentration of 8 mg/l caused irritation of the mucosa and death from respiratory failure within 24 h. In rabbits, an exposure of 0.2 to 2 mg/l slowed down the conditioned reflexes within 40 min. Chronic exposures to concentrations from 0.5–2 mg/l for 3 h daily, for 4 months, did not show any clear effects, but post mortem changes included bronchitis, slight dystrophic changes in the liver, swelling of the epithelium of the convoluted renal tubules, and an increase in spleen follicles. If the ear was immersed in liquid vinylidine chloride for 1 min, an inflammation resulted.

Owing to its explosive nature, this compound must not be handled or stored in the presence of oxygen or air.

Treatment. Removal from exposure of high vapour concentrations will usually ensure complete recovery from the anaesthetic effect. Spilled liquid should be washed off the skin and contaminated clothing removed immediately and thoroughly cleaned before re-use.

Polyvinylidene chloride



a white thermoplastic substance which is tasteless, odourless, and non-toxic.

It is made by the polymerisation of vinylidine chloride with peroxides or other free-radical catalysts. Suspension, emulsion and solution processes are used. The high temperature of softening (110–200 °C) and the relatively low temperature of disintegration (above 225 °C) make processing difficult. By copolymerisation with a compound such as vinyl chloride (usually 10 %), the chemical properties can be improved and the temperature of processing lowered.

Polyvinylidene chloride and its copolymers are made into boards, packaging film, pipes and mouldings. In an emulsion it is used for impregnation as a paint for paper, fabric, leather, etc. Since fabrics produced from polyvinylidene synthetic fibres are extremely strong and chemically stable, they are also used in the production of upholstery or as filtration materials in chemical industries.

ROUBAL, J.
Czechoslovakia.

Vinyls, polyvinyls

Dubj

Vinyls are chemical intermediates and are used primarily as monomers in the manufacture of plastics. Many of them can be prepared by the addition of the appropriate compound to acetylene. Examples of vinyl monomers include vinyl chloride, vinyl fluoride, vinyl acetate, vinyl ethers and vinyl esters. Polymers are high molecular-weight products formed by polymerisation which can be defined as a process involving the combination of similar monomers to produce another compound containing the same elements in the same proportions, but with a higher molecular weight and different physical characteristics.

Vinyl and polyvinyl chloride

See separate article.

Vinylidene and polyvinylidene chloride

See separate article.

24899002

BFG36098