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Chlorine: Its Products and Uses

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Since it is impossible in a brief paper to cover the entire field suggested by the above title, attention will be concentrated on liquid chlorine itself and trichloro-ethylene, one of its major products, with special reference to their safe use by customers of Imperial Chemical Industries Ltd., and the efforts made by the firm to minimize the work of factory medical officers. Reference will also be made to the scheme of the Association of British Chemical Manufacturers (A.B.C.M.) for warning labels for hazardous chemicals.

Liquid Chlorine.—Chlorine was first transported in the form of bleaching powder, invented by McIntosh at St. Rollox, and in 1890 as much as 85,000 tons was exported. Commercial development of liquid chlorine did not come until after its use as a war gas in 1915.

Chlorine is now produced by the electrolysis of brine or fused salt. A proportion is used in the producing works in the preparation of (a) old established inorganic derivatives, chloride of lime, chlorinated soda, muriatic acid, and (b) a wide and increasing range of organic products. The balance is liquefied by cold compression and packed into special steel containers. Today many tens of thousands of tons per year of liquid chlorine are transported about this country, the bulk by road and rail tank, but a substantial tonnage in drums and cylinders.

Many users have no experience in handling chemicals and safety problems arise, for example, in the case of waterworks operators or bath superintendents. To meet this obligation the following rules are observed:

1. Liquid chlorine must be dry and the packages and valves must be foolproof. Filling ratios must be observed and containers have to be serviced and tested regularly.
2. The customer should know how to use the product and to handle the packages safely. His drum and tank installations require initial inspection, and instructions and precaution cards are issued.
3. The customer should know what to do in the event of an accident. A Chlorine Emergency Service is available to deal rapidly with trouble at the premises of any user.
4. Regular visits are made to ensure that the necessary precautions are being taken.

A similar system is in operation for all liquefied gases presenting a toxic hazard, such as phosgene and methyl chloride.

Trichloro-ethylene.—This is one of the oldest of the commercially available chlorinated organics and the one now made on the largest scale. Its essential properties are low toxicity, non-inflammability, and high solvent power for fats and waxes. It has many uses, including degreasing and dry cleaning, and trichloro-ethylene sales are a good index of industrial activity.

There is still much confusion about the physiological properties of trichloro-ethylene. It is a good anaesthetic ("trilene"), but unlike some other chlorinated hydrocarbons, it has no known chronic effects. This fact is shown by the safe working limits: trichloroethylene 2,100 mg./m³, carbon tetrachloride 320, chloroform 250, tetrachloro-ethane 70. Trichloro-ethylene can, therefore, be used safely provided simple precautions are taken. Chronic poisons like tetrachloro-ethane are more dangerous, since in practice it is very much more difficult to avoid repeated exposure to low concentrations of a vapour.

The attitude adopted to users of trichloro-ethylene is similar in principle to that outlined above for chlorine. We do our best to ensure that before using the product customers are fully conversant with its properties, the methods of use, and the simple precautions which should be taken. Whenever possible we ensure that similar precautions are taken by merchants or others who resell the material. Precaution cards are provided. Plants are regularly inspected by technical service representatives. An enquirer may frequently be persuaded to use a less hazardous product, such as trichloro-ethylene, in place of tetrachloro-ethane.

A.B.C.M. Labels.—The policy outlined above is designed to protect the users of liquid chlorine and trichloro-ethylene from the results of their lack of knowledge or carelessness. To protect the transporters of hazardous chemicals (railway employees, lorry drivers, etc.) the A.B.C.M. has devised a labelling scheme for hazardous products, which is now widely used by the chemical industry in this country. The label has been designed with four main objects in view:

1. It should be distinctive and easily recognizable so that everyone concerned with the transport and storage of chemicals recognizes immediately that a particular package contains a potentially harmful substance.
2. A signal word indicates the degree of hazard.
3. The nature of the hazard is defined.
4. The label also states the simple precautions necessary to avoid injury and what to do in cases of spillage or in cases of fire, etc.

The hazards and the precautions are given in simple standard phrases which can be understood by the layman or by fire brigade personnel. At first sight this scheme might appear to involve additional labels and additional costs, but composite labels can be evolved incorporating the actual warning label and such an integration can, in fact, reduce costs.

The A.B.C.M. scheme does not apply to liquefied gas cylinders which are already distinguished by colour markings, or to small, retail-size packs.

The scheme has been adopted by the great majority of the A.B.C.M., and the General Chemicals Division of I.C.I. Ltd. was among the first to adopt it.

There was some discussion, after Mr. Pirie's paper, on trichloro-ethylene and it was questioned whether the figure of 400 parts per million was low enough for the probable safe concentration. Ninety parts per million had been suggested in the United States and 30 in Switzerland, on account of its cumulative effect. Arrangements to secure an air current across the top of the liquid were recommended and should include both blowing and suction.
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