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SHORT COMMUNICATION

SURVEY OF TOXIC HAZARDS DURING VAPOUR DEGREASING WITH TRICHLOROETHYLENE AND 1,1,1-TRICHLOROETHANE

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TRICHLOROETHYLENE is widely used in industry as a vapour degreasing agent and, at the present time, there are about ten thousand degreasing units in Britain based on this solvent. The toxic properties of trichloroethylene are well known and its Threshold Limit Value is 100 ppm. Special grades of trichloroethylene can also be used in the metal finishing industries as a drying agent and this process is similar to vapour degreasing. More recently another chlorinated solvent, 1,1,1-trichloroethane, has been introduced as a vapour degreasing agent. This has long been known as a cold cleaning solvent but new stabiliser systems have been developed to permit its use in vapour degreasing. It has the advantage that it is somewhat less toxic than trichloroethylene with a Threshold Limit Value of 350 ppm.

In a recent survey, atmospheric sampling was carried out in the vicinity of vapour degreasing plant in twenty-one factories in the South and Midlands of England. Workers wore personal samplers to measure their average exposure over most of a working day and other atmospheric samples were taken at selected points around the degreasing tanks.

Familiar problems were found at a number of tanks and, of the seventy-one workers who wore personal samplers, one quarter were receiving an average concentration of trichloroethylene in excess of the threshold limit value throughout their working day. Modern industry operates at an ever-increasing pace and many tanks are used to the limit of their capacity. The result is that short cuts may be taken and excessive quantities of trichloroethylene can enter the workroom air. Similar problems can exist with 1,1,1-trichloroethane but, during the survey, concentrations of this solvent in air were well below toxic levels during normal vapour degreasing.

The results of the survey can be summarised under two headings, "Ventilation" and "Method of operation".

VENTILATION

Lip exhaust ventilation was provided at three-quarters of the open-topped tanks of the survey. Standards varied widely and the extraction rates at tanks from velometer measurements varied from 0 to >100 ft³/min per square foot tank surface. At tanks at which operators were receiving average concentrations above the threshold limit value, the highest lip extraction rate was only 21 ft³/min per square foot. It was quite common to find the lip slots partially or even completely closed

where heavy objects had been dropped on the edge of tanks and in some cases the lips were blocked by deposits of dirt.

Conditions were generally much poorer at tanks without lip exhaust and over half the operators were receiving concentrations above the threshold limit value throughout the working day. The operation of a tank without lip extraction requires very deliberate procedures in a very well ventilated area and these conditions were not seen at most of the tanks. At semi-automatic units, a good standard of local exhaust ventilation was required where operators loaded and unloaded the units.

While exposure to solvent vapour is mainly a problem in the immediate area of the tank, poor conditions at some tanks were aggravated by a poor standard of general ventilation. Good general ventilation is always essential where a tank is situated in a small room. In some factories, draughts had a beneficial effect on the concentration of solvent vapour in air but, in other cases, downward draughts caused solvent vapour to be blown out of the tank and into the operator's breathing zone. The effects of draughts could be limited by the use of covers and screens at the tank.

METHOD OF OPERATION

The highest concentrations of solvent vapour in air usually occurred during unloading if an insufficient time had been allowed in the freeboard zone of the tank. Many operators whose long term samplers showed concentrations well below the threshold limit value were exposed to very unpleasant conditions during the short periods in which work was removed from the tank. Mechanical handling has the advantage that work can be suspended in the tank without any effort from the operator and he is not required to bend over the tank to load or unload work.

In many factories problems were caused by the way work was prepared before its insertion in the tank. Baskets, jigs and other workpieces were often too large to fit into the freeboard zone and few operators removed this work in stages from the tanks. During the degreasing of hollow articles, great care was taken in some factories to stack the articles in such a way that liquid trichloroethylene could drain easily but, in other factories, hollow articles were stacked at random with the result that hot solvent was always removed into the workroom air. Standards of maintenance were low at some tanks and this was reflected in an insufficient supply of water to the cooling coils, leaking gaskets and damaged and inefficient extraction systems.

The survey has confirmed that the vapour from degreasing solvents can be controlled below toxic levels if the following precautions are observed:

1. Degreasing tanks should be sited in well ventilated areas and particular attention should be given to general ventilation where a tank is placed in a confined work area. The effects of draughts can be minimised by the use of covers on the tank and the provision of draught screens.

2. Vapour degreasing tanks in regular use should be provided with an efficient lip exhaust system. An extraction rate of about 35 ft^3/min per square foot tank surface was found to give an adequate standard of protection. Where tanks are used at widely spaced intervals, lip extraction is still required if the operator is exposed to concentrations well in excess of the threshold limit value during work at the tank. Very small degreasing tanks may not require lip extraction but, in the survey, the

need for lip ventilation was apparent in small tanks with surface measurements of two feet by two feet.

3. Work should be arranged so that it can be contained in the freeboard zone of the tank during the removal of excess degreasing solvent.

4. Work should be stacked so that rapid and complete drainage of the degreasing solvent can take place.

5. Operators should allow sufficient time for the removal of excess degreasing solvent in the freeboard zone. Degreasing operations are much easier to control by mechanical handling and this system has the advantage that the operator is kept a few feet from the tank. With manual operations, the removal of liquid and vapour can be assisted if work is placed on shelves in the freeboard zone or suspended from hooks.

6. Degreasing tanks should be regularly maintained. Regular maintenance is particularly necessary for the condenser and extraction systems.

7. When tanks are entered for cleaning or maintenance, the requirements of Section 30 of the Factories Act, 1961 should be met.

8. Operations which require high temperatures, e.g. welding, should not be carried out in areas where solvent vapour may be present. Degreasing solvents can be decomposed to phosgene and other toxic breakdown products under these conditions.