

p. p. m. or more. Amor⁴ has reported similar eye injuries in workers exposed to monoethylamine, diethylamine and triethylamine. Watrous and Schulz⁵ described irritation of the mucous membranes as the chief toxic effect of cyclohexylamine in experimental animals; nausea and vomiting were caused in human beings by industrial exposure.

The studies reported in this paper were undertaken at the request of a manufacturer of ethylamines. Monoethylamine— $C_2H_5NH_2$ —is used in the manufacture of ethylammonium sulfamate, a softening agent and flame retarder for certain paper products; it is also used as a chemical intermediate. One of the most important uses for diethylamine— $(C_2H_5)_2NH$ —is that of an intermediate in the manufacture of diethyldithiocarbamic acid salts and tetraethylthiuram disulfide which are ultra-accelerators used in the vulcanization of natural and synthetic rubbers. Triethylamine— $(C_2H_5)_3N$ —is used as a solubilizer for 2,4-D acid. Table 1 shows some physical properties of the three compounds.

EXPERIMENTAL METHODS

Rabbits in groups of six were exposed to the amine vapors in a dynamic chamber constructed according to Silver's⁶ specifications. Dry air was passed into a bottle equipped with a fritted disk and containing the liquid amines. These were thus volatilized and dispersed into the chamber. The bottle was held in a refrigerated, constant temperature bath. The level of the liquid in the bottle was kept constant by means of a photoelectronic device which actuated a solenoid valve to admit the liquid amine into the bottle.

Air was sampled at approximately 1 L. of air per minute from the level of the animal's nose and mouth. The ethylamines in air were determined by the method used for ammonia in air.⁷ A measured volume of air containing the amine was drawn through a fritted gas-washing bottle containing 200 cc. of standardized 0.1 N sulfuric acid. An aliquot of this acid was titrated against repeatedly standardized 0.1 N sodium hydroxide solution, methyl red being used as indicator. One cubic centimeter of 0.1 N sulfuric acid is equivalent to 0.0014 Gm. of N, 0.0015 Gm. of NH and 0.0016 Gm. of NH_3 .

The experiments in which rabbits were exposed to 100 p.p.m. of diethylamine and triethylamine and to 50 p.p.m. of monoethylamine were performed twice.

RESULTS

All rabbits exposed to concentrations of these three amines of approximately 100 and 50 p.p.m. seven hours a day, five days a week, for six weeks, survived. The physiological response of the animals to these exposures is recorded in tables 2, 3 and 4. Pulmonary irritation, ascertained by histologic examination, was present in the animals exposed to both 100 and 50 p. p. m. of the three compounds with no uniform difference in degree between the effect of monoethylamine, diethylamine

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