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TYPES OF ACCIDENTS CAUSED BY EMISSIONS OF CHEMICALLY HAZARDOUS SUBSTANCES

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Annotation: Possibility of occurrence of accidents leading to the defeat of production personnel and the population located in the area of a chemically hazardous facility.

Key words: Emissions, chemicals, hazardous substances, chlorine, ammonia, phosgene, toxic effect.

An analysis of the causes of major accidents accompanied by releases of an emergency chemically hazardous substance (ACHS) shows that today it is impossible to exclude the possibility of accidents leading to the defeat of production personnel and the population located in the area of a chemically hazardous facility. Among the chemicals there are those that, in case of accidents at chemically hazardous facilities (CHOO), pose a danger to human life and health. This is a group of emergency chemically hazardous substances.

An emergency chemically hazardous substance is a hazardous chemical substance used in industry and agriculture, in the event of an emergency outflow or release of which environmental contamination can occur in concentrations (toxic doses) that affect a living organism. Among the chemicals there are those that, in case of accidents at chemically hazardous facilities (CHOO), pose a danger to human life and health. This is a group of emergency chemically hazardous substances.

Enterprises producing or consuming hazardous chemicals, as a rule, use a small amount of toxic compounds in production lines. A significantly larger amount of AHOV in terms of volume is contained in the warehouses of enterprises. This leads to the fact that in case of accidents in the working shops of the enterprise, local contamination of the air, equipment of the shops and the territory takes place. In this case, the defeat in such cases can be received mainly by production personnel.

In case of accidents at the warehouses of enterprises, when large-capacity containers are destroyed (damaged), hazardous chemicals spread outside the enterprise, leading to mass destruction not only of the enterprise's personnel, but also of the population living near chemically hazardous enterprises. The nature of the action of ACHS is determined by the degree of its physiological activity - toxicity. To characterize the toxicity of various hazardous substances, certain categories of toxic doses are used, taking into account the



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route of penetration of the substance into the body. A toxic dose is the amount of a substance that causes a certain toxic effect.

According to the degree of toxicity in the inhalation and oral routes of entry into the body, hazardous chemicals can be divided into the following 6 groups:

1. Extremely toxic $LC_{50} < 1 \text{ mg/l}$
2. Highly toxic $LC_{50} = 1 \div 5 \text{ mg/l}$
3. Severely toxic $LC_{50} = 6 \div 20 \text{ mg/l}$
4. Moderately toxic $LC_{50} = 20 \div 80 \text{ mg/l}$
5. Low-Toxic $LC_{50} = 80 \div 160 \text{ mg/l}$
6. Non-toxic $LC_{50} > 160 \text{ mg/l}$

Large variation in concentrations of AChS is explained by individual sensitivity of people to them.

Objects producing, using and storing chemical agents include chemical and oil-refining industry enterprises, enterprises with refrigeration units using ammonia as a refrigerant, water supply and treatment facilities where chlorine is used, railway stations with tracks for storage of rolling stock containing chemical agents, warehouses and bases with stockpiles of toxic chemicals.

A **chemically hazardous facility** is a facility where a hazardous chemical is stored, processed, used, or transported and where an accident or destruction of the facility could result in death or chemical contamination of people, farm animals, and plants, as well as chemical contamination of the natural environment.

Let us consider the physicochemical and toxic properties of some chemicals **Ammonia** (NH_3) – is a colorless gas with a characteristic suffocating pungent odor. It is classified as a highly toxic chemical.

At normal pressure the boiling point is $-33.4 \text{ }^\circ\text{C}$. Density of gaseous ammonia under normal conditions is 0.68 kg/m^3 , i.e. it is lighter than air. Combustible, explosive in mixture with air (forms explosive mixtures within 15-28 vol. % of ammonia). Its solubility in water is greater than that of all other gases: one volume of water absorbs about 700 volumes of ammonia at $20 \text{ }^\circ\text{C}$. Maximum allowable concentration in the air of settlements: daily average - 0.04 mg/m^3 and maximum one-time - 0.2 mg/m^3 , in the air of working area of industrial premises - 20 mg/m^3 . Threshold of sensation by sense of smell - 0.5 mg/m^3 . At concentrations of $40\text{-}80 \text{ mg/m}^3$ sharp irritation of eyes, upper respiratory tract, up to and including reflexive hold of breath and headache occurs. Concentrations of $1500\text{-}2700$



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mg/m³ in 0.5-1 h exposure are considered fatal. Ammonia is an asphyxiant and neurotropic chemical agent. Causes respiratory tract damage. Vapors strongly irritate mucous membranes and skin. In high concentrations excites central nervous system and causes convulsions. Death occurs hours or days after poisoning from pulmonary and laryngeal edema, cardiac weakness or respiratory arrest. In contact with skin, it may cause burns of varying degrees.

Acrylonitrile – colorless liquid with an unpleasant odor. At normal pressure melting point -83.5 °C, boiling point +77.3 °C. Lighter than water 42 (relative density 0.8). Heavier than air (relative density 1.83). Forms explosive mixtures with air within the range 3-17%. MAC in atmospheric air in populated areas (average daily) - 0.03 mg/m³, in work areas of production facilities - 0.5 mg/m³.

Its world production is about 2 million tons per year. Acrylonitrile poisoning is possible by inhalation of its vapors and contact of drops with mucous membranes and skin.

Chlorine – a greenish-yellow gas with a pungent, irritating odor. Chlorine is 2.5 times heavier than air, so the cloud of chlorine will move in the direction of the wind, clinging to the ground, it accumulates in basements, lowlands, but even in winter chlorine is in a gaseous state, liquefies at -34.6 °C, solidifies at -101 °C.

Cisterns and pressurized cylinders are used for transportation. Explosive in mixture with hydrogen. Non-combustible, but flammable, supports combustion of many organic substances. Tanks may explode when heated.

Chlorine is used for chlorination of drinking water and for obtaining organochlorine compounds (vinyl chloride, chloroprene rubber, dichloroethane, chlorobenzene, etc.).

The maximum allowable concentration (MAC) of chlorine in the atmospheric air in the working area of production facilities is 1 mg/m³, the minimum tangible concentration of chlorine is 2 mg/m³. Irritating effect occurs at a concentration of about 10 mg/m³. Lethal concentration of chlorine when exposed for 1 hour is 100-200 mg/m³. Chlorine refers to substances of suffocating effect. Chlorine irritates airways and causes pulmonary edema.

Hydrogen cyanide (hydrocyanic acid) is a colorless, mobile liquid with a smell of bitter almonds, freezing at -13 °C. Boiling point +27.5 °C, very volatile. Hydrocyanic acid and its salts are produced by chemical industry in large amounts. It is used in production of plastics and synthetic fibers, in electroplating, for gold extraction, as fighting agent in agriculture. It mixes with water, easily dissolves in alcohol, petrol. Mixture of vapors with air at 6-40 vol.% can explode.

Phosgene (COCl₂) is a colorless mobile liquid with a suffocating unpleasant odor of rotting fruit. Poorly soluble in water, well soluble in organic solvents (benzene, chloroform, toluene, xylene). At temperature above 8°C it transforms to gas. Solidification temperature is -118 °C. Phosgene is used in production of dyes and fertilizers, refers to substances of asphyxiant action. Gaseous phosgene is 3-4 times heavier than air, so phosgene vapours



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can accumulate in basements and low-lying areas. Ammonia is used for degassing phosgene vapors in closed spaces. Neutralization - interaction with aqueous solutions of ammonia and alkalis.

Sulfur dioxide (sulfur dioxide)– is colorless gas, which turns into a liquid at -75 °C; 2.2 times heavier than air.

Sulphurous anhydride is referred to as an asphyxiant and generally poisonous substance. Causes respiratory tract irritation, bronchial spasm, MAC in workplace - 10 mg/m³. At high concentrations in the air, death occurs from suffocation due to reflex spasm of the vocal chord, sudden pulmonary circulatory arrest or shock.

It is necessary for the protection of the respiratory organs every enterprise must have filtering and insulating gas masks, as well as industrial type "B", "M", "BKF" and make sure that employees must be able to use industrial gas masks.

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