



## U.S. ARMY CHEMICAL MATERIALS AGENCY

### Sulfur mustard Bis (2-chloroethyl) sulfide

*Military designation: H, HS, HD*

**Description:** Sulfur mustard, a blister agent, is a colorless to light yellow to dark brown oily liquid, depending upon the age and relative purity of the material. Although sulfur mustard does not evaporate readily it may pose both a liquid contact hazard and a vapor hazard to the eyes, skin or respiratory tract, particularly at temperatures above its freezing point of 59 F (distilled mustard). Sulfur mustard has the odor of garlic or horseradish and its vapor is approximately 5.5 times heavier than air.

**Non-military uses:** Sulfur mustard has been used as a tool in medical research to study the basic biochemical mechanisms of DNA damage and to repair inside cells. The recognition that mustard kills rapidly growing cells led to the development of a new class of chemotherapeutic drugs. Some of the nitrogen mustards, such as mechloroethamine, alkeran, leukeran and cytoxan, are still used today for the treatment of certain types of cancer.

**Military uses:** Sulfur mustard was first introduced to the battlefield by the Germans against the British on July 12, 1917, and it was used most recently in 1986 by Iraq against Iran. A variety of munitions have been filled with sulfur mustard including projectiles, mortars and bombs. Mustard is also a component of chemical agent identification sets and is stockpiled in ton containers. This chemical agent may be dispersed from munitions as a vapor, aerosol, or in liquid droplets.

**Health effects:** High concentrations of mustard vapor may cause irritation and inflammation of the eyes, nose, throat, skin and respiratory tract. The first signs or symptoms of mustard exposure are usually delayed from four to six hours after initial contact, though this delay may vary from two

to 24 hours. The eyes may become gritty with itching or burning, followed by reddening of the conjunctivae, swelling of the eyelids and difficulty in keeping the eyes open in bright light. The skin may redden, with stinging pain, burning or itching, followed by blistering. The respiratory tract effects may include sneezing, hoarseness, coughing, and difficult breathing. Mustard may be absorbed into the bloodstream and affect the gastrointestinal tract, causing nausea, vomiting or diarrhea. Mustard can also be absorbed by the bone marrow and can destroy the stem cells that produce white blood cells, platelets and red blood cells. Human epidemiologic studies indicate that long-term inhalation exposures to sulfur mustard may cause cancer of the larynx, nasopharynx and lungs. Animal studies suggest that long-term mustard exposure may have developmental effects on the unborn fetus. Damage to the respiratory tract and eyes may persist following acute, high level exposures to mustard vapor.

**Environmental fate:** The persistence of sulfur mustard in soil will depend on the soil type, the amount of mustard in the soil, the depth of contaminated soil beneath the surface and the weather conditions. Sulfur mustard contamination of surface soil may persist for weeks, and deeper soil may remain contaminated from small pockets of liquid mustard for years. Mustard is relatively insoluble in water; however, once dissolved, it breaks down into less toxic degradation products such as thiodiglycol, hydrochloric acid and sulfonium salts. Because of its relatively rapid hydrolysis once in solution, mustard is not thought to be transported through the soil by groundwater. It is also unlikely that mustard is transported through the vascular system of plants, since it would undergo hydrolysis in the process.

For more information,  
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