Appendix C

Physical Effects of Cold Weather on CW Agents

Northern regions are characterized by extreme cold and deep snow during winter months. Spring breakup and mud restricts mobility. Whiteout and greyout cause loss of depth perception, making vehicle movement hazardous. Ice fog (clouds of ice crystals) covers troops, vehicles, bivouac areas, and permanent facilities, marking their location.

Chemical agents become more persistent in low temperatures (see Chapter 6 and Table 6-2). As a result, some chemicals that normally are nonpersistent become persistent (GB nerve agent may remain a transfer hazard for up to 30 days in arctic climates). Although frozen agents do not present a significant problem in a solid state, they become hazards when they warm. Decon is a problem because low temperatures also reduce the effect of decontaminants.

Such situations present unique problems when you plan and conduct decon operations.

Effects

The freezing points of standard chemical agents are given in Table 6-2, Chapter 6.

The volatility of GA and GB is significantly reduced in the temperature range 0 to -55°C (+32 to -65°F). However, GA and GB present a liquid contact hazard and become moderately persistent agents in the cold. At normal temperatures, 10 to 25°C (50 to 77°F), these agents would persist in the target area 0.5 to 2 hours. However, at low temperatures, 0 to -43°C (+32 to -40°F), the agent may be present for 10 to 20 hours. The volatility of GB, for example, at 25°C (77°F) of 40,000 mg/m3 at 0°C (32°F) and at -40°C (-40°F) drops to 100 mg/m3. At that concentration it is still deadly enough to present a serious inhalation hazard. In addition, these agents can be aerosolized and would be deadly.

With the drop in temperature, the agent evaporates and hydrolysis much slower, posing a potential prolonged contact hazard for personnel. Agents such as GD and thickened GD (TGD) would be similarly affected by cold temperatures and the exact effects may depend upon additives used to thicken the agent. Thickeners increase the viscosity of liquids and generally retard their evaporation or adsorption. Thickening the agent also gives it an adhesive or sticky quality that increases the likehood to be picked by contact and presents difficulty in decontaminating personnel and equipment.

While V-type nerve agents have low volatility in the cold and would not present a vapor hazard they can present a percutaneous hazard. At low temperatures, the liquid agent would contaminate equipment and terrain but if personnel did not physically contact the agent, there would be minimal hazard. However, as forces maneuver through VX contaminated areas, extra care must be taken to thoroughly decontaminate skis, boots, outer clothing and equipment. Considerable attention must be given to vehicles, squad tents, etc. The agent will still be capable of producing casualties even after five months.

Note—nerve agents can also be dispersed as aerosols and as such, would present a serious inhalation hazard.

Hydrogen cyanide (AC) is sufficiently volatile to make it extremely hazardous even at temperatures as low as -55°C (-65°F). AC might be sprayed during ice-fog conditions and link onto water molecules suspended in the atmosphere. In either case, the agent would be readily inhaled by unprotected personnel. Even at -40°C (-40°F) the volatility of AC is high (36,000 mg/m3).

CK in liquid or solid form sprayed onto snow might become covered by either water or additional snow fall. Since CK is not readily soluble in water (only 5-10 percent) it will not be diluted and can still present a vapor hazard during melting and thawing.

A brief mention is made of arsine (SA). This very volatile arsenical may be a good blood agent candidate for use by an enemy for rapid casualty production in cold to extreme cold conditions.

Mustard agents are generally not very soluble in water and would not be diluted by melting snow and ice. Because blister agents in general achieve casualties by percutaneous (skin) penetration, few inhalation casualties are expected. These agents are mostly used to prevent, prohibit or exact a penalty for operating or occupying contaminated equipment and terrain. Blister agent contamination will require personnel to wear complete chemical protective ensembles and thoroughly decontaminate personal equipment and vehicles. This requires extensive time and resources, not to mention the extended performance degradation while in MOPP. Since

present aqueous decontamination methods in cold weather (below freezing) are severely limited, expect blister agents to be employed by an enemy to harass or restrict abilities to operate weapons and equipment.

Standard distilled mustard (HD) freezes at 14°C (58°F) and below this temperature will be found as a solid. Snow cover increases the persistency of the agent. The rate of evaporation is further reduced by the lack of sunshine in winter months. Nitrogen mustards have similar characteristics and field behavior as HD. By adding nitrogen, the freezing points are lowered to permit liquid agent use even at cold to extreme cold temperatures. Expect nitrogen mustards to remain liquids and to present both a contact and aerosol spray hazard to forces operating in the cold.

Lewisite (L) is an arsenical blister agent. Because hydrolyzed Lewisite contains arsenic, its effect on man in combination with body fluids is that of systemic poisoning. Furthermore, combining Lewisite with mustard increases agent persistency and provides a bonus effect of casualty production.

Phosgene oxime (CX) is solid at temperatures below 35°C (95°F). Information on this blister agent indicates it could be mixed with either G-nerve agents to increase percutaneous (skin) toxicity, or it could be used pure to cause severe eye damage. Even at -55°C (-65°F), concentrations of about 300 mg/m3 in air are obtainable, and eye exposure to CX at concentration of only 3 mg/m3 in air causes extreme pain. Furthermore, there is no decontamination procedure which is totally effective. Consequently, CX appears to be a good candidate for use to cause permanent eye damage or to increase skin penetration of other toxic chemical agents.

Note—Some countries have stockpiles of HL. This is an excellent agent for use in cold weather. The freezing point of HL ranges from -18°C to -42°C (-l°F to -44°F) depending on the agent purity.

Choking agents phosgene (CG) and diphosgene (DP) warrant consideration for use in low temperatures because of their extremely low freezing points (-128°C and -57°C (-198°F and -71°F) respectively). Under arctic conditions CG would be nonpersistent and DP moderately persistent, as an aerosol of inhalable vapor.