

24.6.7.1.3 *Nucleophilic Substitution*

Rapid nucleophilic decontamination is efficient for decontamination but nonappropriate for skin (77). RSDL is based on a mechanism chemically similar to hydrolysis, but at a milder pH. The active ingredient, a nucleophilic compound (2,3 butanedione monoxime), also called diacetyl monoxime (DAM), is dissolved in a glycol solvent, which dissolves most agents and allows them to be rinsed off with water. Decontamination must be initiated within 5 to 10 minutes to be the most efficient (78). RSDL destroys CWAs without corrosive effects and counteracts the inflammatory process, especially against sulfur mustard (36). RSDL is a skin decontaminant that is FDA approved (2002) (79). This viscous yellow lotion impregnated in a polymer sponge (pH 10.5) is water soluble and therefore easy to eliminate after decontamination and presented in individual packets ready to use (five-year shelf-life). The sponge is applied in a overlapping circular motion to skin, requiring at least two minutes' contact to achieve neutralization of agents (nerve agents, pesticides). For safety DAM, the active ingredient of RSDL may be percutaneously absorbed (MW 101.10; log P [octanol-water] 1.740) (80). The acute toxic effects of DAM, observed after injection to rats and rabbits, appears due to the compound itself (81). RSDL is not approved for eyes or in wounds (79). Safety precautions are recommended for RSDL: short time application (less than 6 hours), rinsing after decontamination, and respect the incompatibility with solid bleaching.

24.6.7.1.4 *Neutralization by Oxidation*

Oxidation is a reaction of an agent with an oxidizing chemical, which breaks many types of bonds. The most common oxidizers used in decontamination processes are bleaches (hypochlorites) such as after World War II, bleaching powders, permanganate (KMnO_4), and peroxides (hydrogen peroxides and peroxy acids). By World War II, superchlorinated bleaches were the most common general-purpose decontaminants (18, 30). Oxidizers composed of hypochlorites proposed for skin decontamination are

- bleach 2% to 6wt % NaClO in water,
- dutch powder, $\text{Ca(OCl)}_2 + \text{MgO}$,
- activated solution of hypochlorite (ASH), 0.5% $\text{Ca(OCl)}_2 + 0.5\%$ sodium dihydrogen phosphate buffer + 0.05% detergent in water
- self-limiting activated solution of hypochlorite (SLASH) 0.5% $\text{Ca(OCl)}_2 + 1\%$ sodium citrate + 0.2% citrate acid + 0.05% detergent in water.

However, there are disadvantages to using bleach as a decontaminant, and the necessary extemporaneous preparation due to the active chlorine content of the bleach gradually decreases with storage and its corrosivity for the skin surface.

Sodium dichloroisocyanurate (NaDCC) is considered an alternative to hypochlorites, generating pH-neutral bleach when added to water (18). Fichlor (sodium N-N dichloroisocyanurate) detoxifies VX effectively by simple oxidation, but the pH influences the nerve agent's degradation kinetics. Tablets of NaDCC offer the advantage of stability (three-year storage) and is easily mixed with surfactants.

Hypochlorite solutions are efficacious when used to topically decontaminate intact skin. However, few studies examined the efficacy of decontamination of chemically contaminated wounds. Observations were performed after HD contamination. The lesions induced following decontamination are presumed due to the mechanical flushing of HD onto the perilesional skin, or by chemical damage induced by the solution, or HD-solution interaction. Comparing the decontamination efficacy of sodium hypochlorite (0.5% and 2.5% solutions) and calcium hypochlorite (0.5% and 2.5% solutions) is essential to manage skin decontamination with bleaching oxidizers (82). In skin decontamination by oxidizers, it is recommended to prepare the bleach solution 0.5% from certified lots of 5% household bleach diluted 1 to 10 (73). Nevertheless, bleaching is not universal in skin decontamination. Hypochlorite, diluted tenfold from a household bleach solution (0.5% concentration), is ineffective for agents such as VX, which require a significantly higher