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A Trip to Detox

Once contaminated with a chemically or biologically harmful agent, people and things need to be decontaminated. Decontamination is carried out through three principal methods: physical, chemical and thermal.

By Patrick Chisholm

Perish the thought that anyone would ever have the need to go to detox. And we're not talking places for alcoholics and drug addicts. While getting detoxified in a chemical/biological (CB) decontamination apparatus is no one's idea of Sunday fun, if a CB attack does occur, it is one place that will be in very high demand.

Decontamination—i.e., the removal or neutralization of hazards resulting from a chemical and/or biological (CB) attack—are carried out through three principal methods: physical, chemical and thermal.

Examples of physical decontamination processes include pressurized spray systems, sorbents (materials that absorb liquids such as soil or charcoal), and solvent washes, according to a report by the Law Enforcement and Corrections Standards and Testing Program, sponsored by the Office of Science and Technology of the National Institute of Justice, U.S. Department of Justice.

A natural clay known as Fuller's Earth, which contains aluminum-magnesium silicate, is the principal ingredient in some decontamination kits. Applying crushed Fuller's Earth to the skin is a method of removing personnel contaminants. (Common kitty litter consists of Fuller's Earth.)

Physical processes also involve washing away the contaminants with power washers or aerosol sprayers, using water, carbon dioxide, alcohol, diesel fuel or other solvents. High-pressure systems are used for objects and low-pressures systems, such as showers, for

personnel.

Water is often used in conjunction with detergents; soap can neutralize CB agents to some extent, but not detoxify them. Water in the form of steam can be used as well.

As physical decontamination processes typically involve removing the contaminants but not detoxifying them, the runoff must be collected and treated as hazardous waste in order prevent further contamination.

Chemical processes, by contrast, typically detoxify the contaminants. The latter are neutralized after reacting with an ingredient in the decontamination solution. Commonly available chemical decontaminants include bleach (sodium hypochlorite) and sodium hydroxide.

Thermal processes, meanwhile, involve vaporization in removing CB contaminants.

Decontamination equipment for personnel include portable decontamination showers equipped with recovery bladders and catch basins. Such shelters protect personnel from further CB contamination subsequent to the decontamination process.

The Law Enforcement and Corrections Standards and Testing Program recommends several factors to consider when purchasing CB decontamination solutions:

- The ability to decontaminate chemical agents consisting of nerve and blister agents.
- The ability to decontaminate biological agents including bacteria (e.g., Anthrax), rickettsia (e.g., Typhus), toxins (e.g., Botulinum Toxin), and viruses (e.g., Q Fever).
- The ability to decontaminate toxic industrial materials (TIMs).
- Functional application—the areas where a piece of equipment would best be employed in the event of a chemical agent, biological agent, or a TIM attack.
- Capacity/throughput, determined by the functional application of the decontamination equipment—that is, how many people (e.g., skin and protective equipment), large equipment (e.g., vehicles), small equipment (e.g., computers and communication equipment), and the areas within an infrastructure that a piece of decontamination equipment can clean in a specific time (e.g., per hour).
- Effectiveness of decontamination; the ability of the equipment to decontaminate chemical agents and biological agents. Some decontamination equipment may only be able to remove a surface hazard while other equipment may both remove and neutralize the hazard.
- Set-up time—the amount of time required to prepare the decontamination equipment for use.
- The type of power (e.g., AC or DC) required to operate the equipment.
- The operational environment best suited for the equipment, i.e., whether it is capable of all-weather conditions or controlled conditions.
- Durability—the ruggedness of the equipment.
- The manpower required to use the system.
- Equipment required to use the system, such as shower/dressing rooms with basins and bladders.

While several vendors of decontamination solutions were interviewed for this article, it does not imply an endorsement of these solutions over others solutions. Buyers of decontamination equipment should explore a variety of vendors, and carefully weigh the features of each product as they relate to the above factors. The report, "Guide for the Selection of Chemical and Biological Decontamination Equipment for Emergency First Responders," available at www.ncjrs.gov/pdffiles1/nij/189724.pdf, has a list of recommended questions to ask vendors before making a purchase.

That said, the below provides an indication of the types of products currently or soon-to-be

on the market.

Mass Decontamination System

Reeves EMS LLC, a wholly-owned subsidiary of DHS Technologies and a sister company to DRASH, provides several different models of decontamination systems, ranging from a single-patient decon system to a three-lane decontamination system. The latter is what Reeves EMS general manager Chuck Coughlin calls the Mass Decontamination System. It can be configured to simultaneously treat ambulatory and non-ambulatory patients or to treat solely ambulatory patients dependent on the situation. "End-users have slightly different visions as to the layout for conducting patient decontamination, but in general the process is very similar. The system would be divided into several stations with the first area allowing for patient undress. The patient would then enter the decon area where water injected with the decon solution is delivered to the patient. Although soapy water is the typical decon solution, it can range from diluted bleach to a number of other specific decontamination solutions. The next station is the rinse area prior to their entering the redress station. The patient is then taken to another shelter for monitoring purposes," commented Coughlin.

He said the Army is emphasizing the ability to decontaminate large numbers of people in a short period of time, with the fewest system operators. In that respect, Reeves EMS's systems are articulated frames that set up quickly and with no tools required. "Typically within 10 minutes, including system unloading and setup with berms and flooring laid out, you'd have a system ready to receive patients. The shelter has an integrated plumbing system so you don't have to pull in plumbing and attach it."

The system has a "smart" pump that automatically turns on and off based on berm water level to ensure that the water level remains below the grating on which patients stand to prevent them from standing in contaminated water. The water source may be a fire hydrant or water truck. The critical component in any system is the water heater and its ability to supply sufficient quantities of water to the system at the required temperature to ensure that patients do not suffer from hypothermia during the process and to effectively maximize throughput.

Ken Hall, military business development representative, added, "You can't put people through a system that delivers cold water as it will close the pores and trap the contaminant, as well as possibly cause hypothermia. You can't put them in water too hot either or else you open pores and allow contaminants that were on the surface of the skin to enter the skin. We have recently updated and adjusted our water heater to a point where we can provide the right amount of water at the right temperature to maximize the number of people through the system. The rule of thumb is a minimum of five gallons of decon solution injected water on an individual to get them cleaned; so we are able to put five gallons per minute in the system per station to clean a patient each minute."

Another factor is the distance that a given amount of water can be delivered. Coughlin said the Army wanted the water heater to be outside the hot (contaminated) area so that it doesn't get contaminated, and typically that means 100 feet of hose connected from the water heater to the shelter area. That poses a challenge in terms of how to maximize the water delivery rate with a 100 foot head. "So we've gotten our system to the point where, at a 35 degree temperature rise, we can supply a minimum of 21 gallons of water per minute from 100 feet away with an input pressure of about 90 pounds per square inch."

The three-lane Mass Decontamination System has a theoretical capacity of 180 patients per hour. Coughlin stresses theoretical because the patient through-put depends on variables outside the control of the system: the amount of contamination on specific individuals, their size and weight, a patient's age and/or ability to move through the system, or whether they are injured. "We continue to work with end-users to incorporate their feedback and requirements as improvements into our systems to facilitate their attaining all objectives."

MDF-200 WMD Foam

Developed by Sandia National Laboratories in 1999, MDF-200 WMD foam is designed to work against both biological and chemical agents. Modec is the manufacturer. "The technology development accomplished was coming up with non-toxic and environmentally friendly decontaminant," said Brian Kalamanka, president and CEO of Modec. "This is the first time they were able to get basically a single product that would work out both biological and chemical agents. It's unique to the extent that it actually neutralizes not only the microbial part of the mold but also the micro toxins."

The company states that in Sandia National Laboratory tests of the product against chemical warfare agent simulants, half-lives for the decontamination of the simulants were on the order of minutes. Also, nuclear magnetic resonance studies demonstrated that destruction of the CW simulants occurred without formation of potentially toxic by-products.

Originally developed as DF100, the SNL formulation was enhanced to achieve faster decontamination.

Ocular Scanning Device

Eye Marker Systems' Ocular Scanning Device is directed at determining if a person has been exposed to a toxicant, particularly to nerve gases and organic phosphates. "What we have done, which is fairly revolutionary, is to tie the imaging of the human eye to software to do the analysis and then give an output so that it requires no training on the part, or little training on the part of the user to take the device and screen a person to determine whether they have been exposed to toxins," noted Wes McGee, CEO of Eye Marker Systems. The handheld device will give a result between 1 and 2 minutes, he said.

The product was originally pitched and funded by the Defense Advanced Research Projects Agency. It was subsequently performed under a contract with the Chemical, Biological, Radiological and Nuclear Countermeasures Subgroup of the Technical Support Working Group (TSWG) with funding support from the Combating Terrorism Technology Support Office of DoD and the Department of State. It is currently still in the testing stage. "We're expecting to be testing the devices in the field with military units before the end of the year," he said. While the product is effective vis-à-vis Botulinum toxin and any of the nerve agents, so far there has not been a good result with detecting anthrax contamination, according to McGee.

Skin Decon

In the late 1980s, at the request of the U.S. Army under a series of research and development contracts, Rohm and Haas Company developed technology for the Army used in the M291 Skin Decontamination Kit (SDK). The M291 SDK is now standard issue equipment in the U.S. military for chemical defense.

Rohm and Haas's M291 SDK decontaminates skin from known nerve and blister agent threats without harming the skin and meets all of the DoD's operability and storage requirements.

The kit's active ingredient, Ambergard 555 decontaminating resin contains a mixture of synthetic adsorbent and reactive resins. The carbonaceous adsorbent, based in synthetically designed polymers has a bimodal pore system that promotes rapid adsorption of chemical agents from skin, effectively sequestering the agent in the micropores and preventing skin penetration. The synthetic, high surface area reactive resins, functionalized with strong acid and strong base, provide for chemical decontamination of an agent, rendering it impotent.

The company's ER M291 Chemical Skin Decontamination kits are also currently available for homeland security personnel such as first responders, EMS providers, firefighters and hazmat

teams.

Another skin decontaminate is E-Z-EM's RSDL (Reactive Skin Decontamination Lotion), a patented, broad spectrum skin decontamination product for personal use after exposure or suspected exposure to certain nerve agents, blister agents, and toxin. RSDL removes or neutralizes these agents from the skin, leaving a non-toxic residue that can be washed off when conditions permit.

In 2004 the DoD permitted sales of RSDL to police, fire departments, emergency medical teams, and the other organizations that form the first line of response to a terrorist attack. RSDL was developed by DRDC Suffield for the Canadian Department of National Defence. Part of the Joint Service Family of Decontamination Systems (JSFDS), RSDL is carried by individuals for immediate use on skin, individual equipment, and weapons to reduce morbidity and preserve combat effectiveness

U.S. Food and Drug Administration (FDA) approval for use was obtained in March 2003 with the sponsorship of the Office of the Army Surgeon General.

The Joint Program Executive Office for Chemical Biological Defense has determined that RSDL has satisfied all final configuration testing criteria, and is approved for initial procurements by the individual service branches. The decision, known as Milestone C, cleared the way for deployment of RSDL to warfighters as the DoD's next generation skin decontaminant for protection against chemical weapons agents. "Of course, we are extremely pleased that this long-anticipated decision has been made, said Anthony A. Lombardo, president and CEO of E-Z-EM. "With receipt of Milestone C approval, RSDL has now been evaluated and approved by three U.S. government entities, an intense level of scrutiny that we believe speaks to the importance of improving skin decontamination for war-fighters and first responders."

RSDL has also received designation and certification as a Qualified Anti-Terrorism Technology by the Department of Homeland Security, and was granted certification under the Support Anti-Terrorism by Fostering Effective Technologies (SAFETY) Act of 2002.