The Future of Decontamination Operations—An Analysis of Decontamination Foam 200

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The use of bleach as a decontaminator dates back to 1917 (World War I) when the Germans discovered that bleaching powder neutralized mustard agent. Eventually, this evolved into a substance called supertropical bleach (STB), which is easier to spread and more stable in long-term storage than the old bleaching powder. In 1960, decontamination solution number 2 (DS2) was introduced. Both STB and DS2 are quite effective in decontamination operations and remain as the foundation from which the Army developed its doctrine for chemical decontamination. Unfortunately, there are significant problems with DS2 and STB that include training, environmental, and logistical concerns. A new solution called decontamination foam 200 (DF-200) has been developed for decontamination operations. This new decontaminating foam solution is superior to our current decontaminating solutions and could revolutionize the Army doctrine on decontamination operations.

The current threats to the United States are asymmetric means of attack on U.S. interests, both here and abroad. The 11 September 2001 events, the anthrax attacks, and recent captured documents from Afghanistan outlining the scope of terrorist chemical and biological (CB) weapons development are proof. Iraq used chemical weapons extensively during its war with Iran in the 1970s. There is also a great amount of credible evidence that Iraq stored chemical munitions in the bunkers along the allies' most likely avenue of approach in Operation Desert Storm. When the allies destroyed these bunkers, they inadvertently released chemical agents on themselves.

Most members of the U.S. Army Chemical Corps have never trained with the decontaminating solutions that we are supposed to use to counter these threats. Recently I talked to one of the rare soldiers who had trained with DS2, and he described the results this way: "I sprayed the DS2 on a small area of an armored personnel carrier (APC) with an M13 (a handheld pressurized liquid sprayer). After 15 minutes, the paint started peeling off. Then I rinsed the DS2 off and had to end the training." The Army's mantra is "Train as you fight," yet we cannot train with DS2 or STB. All chemical soldiers are required to go through the Chemical Defense Training Facility, which incorporates live nerve-agent training, allowing each soldier to gain complete confidence in his mission-orientated protective posture (MOPP) gear. However, no soldier has been able to gain this confidence while performing a decontamination operation.

The reason that soldiers do not train with DS2 is that it is dangerous to handle. DS2 is a suspected teratogen (causes birth defects). Both DS2 and STB can cause burns and respiratory hazards and may damage the nervous system and liver if exposed to them for long durations. When the two agents come in contact with each other, STB may ignite spontaneously. In a real-world situation, STB may also ignite with a liquid blister agent.

The reactions with DF-200 are significantly different because it essentially consists of the same ingredients that make up detergent and soap. The Environmental Protection Agency lists all ingredients that are either List 3 or 4 as "inert." Recent skin tests using DF-100 (a predecessor of DF-200) were performed on eleven people of varying ages and sexes. Four different tests were performed, with the longest allowing the foam to remain on the test subject's arm for 48 hours, unmolested. During these tests, four of the ten subjects experienced no side effects, while the other six experienced either slight or mild irritation. After 24 hours, all subjects had returned to normal. Environmental concerns involving DS2 and STB are just as extensive as the training and health concerns. While DF-200 resembles detergent, DS2 resembles paint remover, which explains the results that my friend received when he used DS2 on the APC.

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DS2 and STB are highly corrosive and incompatible with most metals, rubber sealants, plastics, fabrics, and electronics. They are also combustible in certain environments. During decontamination operations, gross amounts of hazardous waste from DS2 and STB are created. Additionally, since both agents will corrode rubber sealants and plastics, there is the possibility that various vehicle seals and hoses will deteriorate and spring leaks after contact with DS2 and STB. This increases the amount of waste and exacerbates the environmental damage. Both decontaminants have rigid storage restrictions and are prohibited for use on aircraft. The environmental considerations for DS2 are so great that most countries will not allow it inside their borders. The shelf life for DS2 is ten years and can be extended two more. DS2 has not been manufactured since 1992; therefore, by 2004 all existing DS2 will have passed its extended shelf life. In contrast, DF-200 is environmentally benign, meaning that it is nontoxic and noncorrosive. As with DS2, DF-200 has a ten-year shelf life, but it remains noncorrosive after the shelf life has expired. Because DS-200 is environmentally benign after it has exceeded its shelf life, it may be rotated into the training stock.

The logistics behind DS2 and STB are an S4's worst nightmare. Using FM 3-5 (*NBC Decontamination*) as a reference, a chemical unit that uses the M12 power-driven decontamination apparatus (PDDA) will use approximately 400 gallons of water at Station 1 (primary wash) for an M1 Abrams tank (this value is never stated, but may be extrapolated from planning values stated in the manual). Following in sequence, Station 2 (DS2 application) will require approximately 15 gallons of DS2 while Station 4 (rinse) will require 325 gallons of water. All together, this is 740 gallons of liquid weighing 6,100 pounds. (STB will be needed at the contact time and interior decontamination at Station 3, but not enough to greatly affect the weight.)

The other consideration with this setup is the engineer support needed. The current doctrine from FM 3-5 requires 35 cubic feet of space per 250 gallons of liquid runoff at Station 1. This would equate to 56 cubic feet per M1 tank. During training, chemical units rarely receive the engineer support they need because most nonchemical commanders do not understand the great amount of support needed to run a decontamination site to standard. Therefore, these commanders do not properly consider the chemical piece when they go through the military decision-making process.

A heavy decontamination company is equipped with nine tank and pump units for decontamination operations, giving the company a maximum water-carrying capacity of 10,800 gallons. This is enough water to decontaminate 15 tanks before needing to resupply. If an adequate water source is nearby, this may not be a problem. But in an arid environment, this becomes a critical issue.

A thorough decontamination site using the same equipment and DF-200 could operate in the following manner. The M12 PDDA already has a foaming apparatus; therefore, Station 1 and Station 2 would be combined. The chemical unit would wash down the vehicle at the same time that it applies the decontamination solution. The advantages of this method are threefold; it—

- Requires less manpower, as Station 2 is no longer needed.
- Needs no engineer support, as DF-200 is benign and does not create a hazardous runoff.
- Is less labor-intensive, as soldiers are no longer required to use mops to apply a decontamination solution.

At Station 3, DF-200 would replace STB but would be used in the same manner. Potentially, Station 4 would no longer be needed. DF-200 dries to a white powder within an hour and can simply be brushed off the vehicle. Knowing this fact, in arid environments, a vehicle rinse may not be necessary. However, it should be noted that DF-200 might give a false positive reading to an improved chemical agent monitor and an advanced chemical agent detection alarm. Therefore, not utilizing Station 4 becomes an assumed risk. In an environment where water is less of an issue, the vehicles may be rinsed.

Another advantage of DF-200 is that it is not corrosive. With DS2, all tarps are stripped off the vehicles and buried at Station 1 of the decontamination site. If they are contaminated, this process could include everything down to the vehicle's seats. Although the complete effectiveness of DF-200 is not known at this time, it is promising that the foam could decontaminate all surfaces it comes in contact with.

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A real world test of its capability occurred last year with the decontamination of anthrax spores from the Hart Building in Washington, D.C. For this operation, EasyDECON™ foam (a version of DF-200) was successfully used to sanitize the stairwells and elevators. It has been stated that this decontamination foam could be used to "wash clothes."

Chemical Agent	Percentage Destruction of Chemical Agent at Time Interval		
	1 minute	15 minutes	60 minutes
GD	99.98 +/- 0.01	99.97 +/- 0.01	99.98 +/- 0.01
VX	91.20 +/- 8.56	99.80 +/- 0.08	99.88 +/- 0.04
HD	78.13 +/- 10.53	98.46 +/- 1.43	99.84 +/- 0.32

The effectiveness of DF-200 for military use was proven in October 2000 when it was tested on three different chemical agents—soman (GD), VX, and mustard (HD). The foam was also tested against one biological agent, anthrax, which was chosen because it is considered to be the hardest biological agent to kill. The table at right shows the test results of these agents.

This chart shows that after 15 minutes of contact, the GD and VX have been destroyed, while only traces of HD remain. Therefore, if the agent is known not to be mustard, the contact time required at Station 3 may be reduced in half. After one hour, all three agents were neutralized.

With anthrax, the results were just as impressive. After 15 minutes of exposure, a seven-log kill (99.99999 percent) of all anthrax spores was recorded. This is in contrast to DS2, which only recorded a one-log kill with anthrax.

The above facts are critical, especially when it comes to aviation decontamination procedures. Currently, the only decontaminating agents approved for use on aircraft are soap and water, JP8, kerosene, and diesel fuels (FM 3-5). None of these agents are as effective as STB or DS2. Each aircraft also has certain sensitive areas that cannot be sprayed with a high-pressured hose, which makes the current decontamination methods using the M12 PDDA or M17A3 lightweight decontamination apparatus ineffective. With the use of specialized equipment, DF-200 may be produced as a fog, which is extremely effective in decontaminating these sensitive areas. The rest of the aircraft will be decontaminated in the same way as the detailed equipment decontamination, providing the Army with something it has never had before—an effective way of decontaminating aircraft.

Although a great improvement over STB and DS2, DF-200 is not without limitations. The most significant is that it has a freezing point of -7 degrees Celsius. In contrast, DS2 is effective down to -32 degrees Celsius. With the current equipment in the Army's inventory, this issue may remain unresolved. However, since water freezes at 0 degrees Celsius, using DS2 at low temperatures has its problems. An advantage of DF-200 is that if it is dry, it may be brushed off the vehicle. Spraying water over DS2 may freeze the DS2 as well as any contaminant that has not been neutralized. This will create a hazard when the water melts and the contaminant starts to desorb.

The current means of performing decontamination operations is outdated and impractical. Soldiers need to be able to train as they fight, something that they cannot do when it comes to decontamination operations. With the development of DF-200, the Chemical Corps is heading in the right direction. This new solution for decontamination operations must be adopted now to enable the Corps to go forward and protect our troops at home and abroad.

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