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Review of the MDF-LSA 100 Spray Decontamination System

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Defence Science and Technology Organisation

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ABSTRACT

This report was prepared to provide a general overview of the history and performance of the Modec Decontamination Foam (MDF)-LSA 100 Spray Decontamination System as well as information regarding the decontamination systems which have since superseded it.

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Executive Summary

DSTO were given a sample of the Modec Decontamination Foam (MDF)-LSA 100 Spray Decontamination System and two Force 1 Decon™ products (surfactant and sodium hypochlorite) to evaluate and determine their effectiveness against chemical warfare agents (CWAs). However a laboratory-based evaluation was not undertaken due to the age of the MDF-LSA 100 sample and therefore the sample's integrity. As a result this report was prepared to provide a general overview of the history of the MDF-LSA 100 Spray Decontamination System as well as information regarding the decontamination systems which have since superseded it. This report also aims to provide brief information on the two Force 1 Decon™ products.

MDF-LSA 100, also referred to as DF-100 (Decontamination Foam -100), was the original decontamination formulation developed by Sandia National Laboratories (SNL) during the late 1990s, to provide the armed forces with a single decontaminant that would work effectively against all potential chemical and biological threats. However after testing, it became apparent that the original formulation was less than ideal as it required the pH to be adjusted for optimal decontamination of each specific chemical and biological agent and the formulation was found to degrade sulfur mustard at a relatively slow rate. In late 2000, an enhanced version of the DF-100 was developed, called DF-200 or MDF-LSA 200, which took into account the aforementioned problems.

The MDF-LSA 200 formulation was confirmed by SNL as effective on G agents, VX, sulfur mustard and anthrax simulants, however the EPA found that the formulation was ineffective against anthrax. As yet there have been no independent evaluations on the effectiveness of this new formulation to decontaminate CWAs. Furthermore an MDF 300 concentrate is currently under development.

The two Force 1 Decon™ products, provided to DSTO as refills for the MDF-LSA 100, were found not to be refills, rather they form part of a number of decontamination kits sold by Force 1 Decon™. These products were not evaluated.

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Rodi Sferopoulos graduated from Victoria University in 2004 with a BSc (Hons) in Forensic Chemistry. She is currently finalising her PhD which is being conducted at Victoria University. Her PhD work is in the area of fire investigation where she has developed a test method to analyse substrate comparison samples. Rodi commenced working at DSTO in June 2006 and is part of the Chemical Defence Branch. She contributes primarily to the CB Hazard Management area.

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1. Introduction

DSTO was given a sample of the Modec Decontamination Foam (MDF)-LSA 100 Spray Decontamination System and two Force 1 Decon™ products (surfactant and sodium hypochlorite) to test and determine their effectiveness against chemical warfare agents (CWAs). However a laboratory based evaluation was not undertaken due to uncertainties with the age and expiry date of the MDF-LSA 100 sample and therefore the sample's integrity. Furthermore, it was also discovered that the two Force 1 Decon™ products which were originally thought to be refills for the MDF-LSA 100, were not in fact refills, they are part of a separate decontamination kit. As a result this report was focussed on providing a historical overview and status of the MDF-LSA 100 Spray Decontamination System as well as information regarding the decontamination systems which have since superseded it. This report also aims to provide brief information on the two Force 1 Decon™ products.

2. MDF-LSA 100 Spray Decontamination System

MDF-LSA 100 is a dual cartridge decontamination system which contains hydrogen peroxide as the active ingredient (7.99%)[1, 2]. Modec Decon Formulations state that the MDF-LSA 100 is effective for chemical decontamination purposes and comes in a convenient, easy to use, specially designed dual-liquid sprayer (shown in Figure 1A with the refill shown in Figure 1B)[1]. Furthermore they claim that it is dispensed at a predetermined, fixed dilution ratio with the binary catalyst solution which makes it an excellent methodology for delivering the two-part reactive decontamination mixture[2].

Figure 1: A. MDF-LSA 100 Spray Decontamination System with Sprayer and B. Refill[2]

This spray decontamination system, also referred to as DF-100 (Decontamination Foam -100), was the original formulation developed by Sandia National Laboratories (SNL) between January 1997 and July 1999[1]. SNL originally developed this product to provide the armed forces with a single decontaminant to work effectively against all potential chemical and biological threats[2]. The manufacturer claimed that not only is MDF- LSA 100 effective against a wide range of chemical and biological agents, but it is also easy to use, able to decontaminate virtually any material exposed to chemical and biological agents and has a negligible impact on human health and the environment[2].

The original formulation was tested against live agents at Edgewood Chemical and Biological Centre (ECBC) and compared with DS-2 (Decontaminant Solution 2). DS-2 was originally introduced in 1960 and was shown to be a highly effective decontaminant for CWAs although it was found to attack paints, plastics and leather. Personnel were required to wear respirators with eye shields and chemically protective gloves whilst using it. Furthermore, it was found to be not very effective at killing spores[3]. The results of the tests conducted at ECBC were as follows[3]:

Table 1: Percent Destruction of Chemical Agents by DF-100[3]

	HD (pH 9.2)		GD (pH 9.2)		VX (pH10.5)	
	10 min	60 min	10 min	60 min	10 min	60 min
DS-2	100%	100%	100%	100%	100%	100%
DF-100	47%	100%	>99%	100%	100%	100%

Following on from this initial testing, it became apparent that two properties of the original formulation made its use less than optimal[1, 3]. These properties include:

The DF-100 formulation required the pH to be adjusted for optimal decontamination of each specific chemical and biological agent[1, 3].
The formulation was found to have a relatively slow reaction rate for HD[1, 3].

In July 2000, SNL issued a non-exclusion, all-field of use licence to Modec Inc for the manufacture and sales of this decontamination technology. In October 2000, SNL received funding from the U.S. Department of Energy's and National Nuclear Security Administration's Chemical and Biological National Security Program (CBNP) to develop an enhanced version of the DF-100[1]. Therefore, DF-200 was developed which is said to be an improvement on DF-100, taking into account the aforementioned issues. Modec Inc claim that this newer version destroys 99.84% of GD, VX and HD over a 60 minute time period[1].

3. MDF-LSA 200 Spray Decontamination System

The enhanced version of the decontamination foam is manufactured by EnviroFoam Technologies Inc (EFT) under the trade name EasyDECON®, and by Modec Inc under the trade name MDF-LSA 200®.[4]

The MDF-LSA 200 is supplied or created as a foam, liquid or aerosol. The foam can be sprayed from handheld canisters. When the foam is deployed it expands to approximately 100 times its liquid volume through a special nozzle that draws air into the spray. The foam fills the space and contacts the chemical and/or the biological agents in crevices and on open surfaces. In several hours it collapses back to compact liquid size[4].

Modec Inc, claim that this decontamination foam has a number of advantages over other decontamination systems, including[3]:

- It is a single decontaminant for chemical and biological warfare agents.
- It can be rapidly deployed.
- Mitigation of agents can be accomplished in bulk, in aerosol and vapour phases.
- It exhibits minimal health and collateral damage.
- It requires minimal logistics support.
- It has minimal run-off and no lasting environmental impact.
- It has a high expansion rate.
- Contact times can reasonably be determined.

Further claims include that the spray decontaminant is safe because the primary oxidisers decompose into oxygen and water. It is miscible with water, so it is safe to handle and apply to materials. It is versatile as it can kill vegetative biological agents as well as difficult to kill spores and it can be deployed as a liquid, foam and vapour and has no residual effect on the environment[3]. Furthermore they claim that the half lives for the decontamination of GD, VX and HD is in the order of 2-20 minutes and that it gives a 7 log kill (99.99999%) of anthrax spores after 10 min exposure to the foam[3].

According to a technical report prepared by Modec Inc, the results from live agent tests conducted at ECBC for the DF-200 formulations are as follows[3]:

Table 2: Percent Destruction of Chemical Agents by DF-200[3]

	1 min	**10 min**	**60 min**
HD	78.13% $\pm$ 10.53%	98.46% $\pm$ 1.43%	99.84% $\pm$ 0.32%
GD	99.98% $\pm$ 0.01%	99.99% $\pm$ 0.01%	99.98% $\pm$ 0.01%
VX	91.20% $\pm$ 8.56%	99.80% $\pm$ 0.08%	99.88% $\pm$ 0.04%

The MDF-LSA 200 formulation was independently confirmed by SNL in 2002 as effective on G, VX, HD and anthrax simulants[3] .

In November 2001, the Office of Solid Waste and Emergency Response (OSWER), Environmental Protection Agency (EPA) submitted a crisis exemption under Section 18 of the Federal Insecticide, Fungicide and Redenticide Act (FIFRA) for the use of EasyDECON® to decontaminate structures and other property contaminated or potentially contaminated with anthrax. The crisis exemption was granted based on existing data which provided presumptive evidence of efficacy. Later on the crisis exemption was amended to include the use of the MDF-LSA 200. These exemptions were later withdrawn when the EasyDECON®

product did not pass the Association of Analytical Communities (AOAC) Sporicidal test which was conducted under the conditions of use specified in the crisis exemption. The EPA's Office of Pesticide Programs applied the test results to the MDF-LSA 200 product because these two products, when mixed in accordance to the manufacturers instructions, result in the same decontamination product. Furthermore a number of application issues were also found including[4]:

- That bare steel objects are susceptible to rust after application, but the foam is safe on all other surfaces.
- The foam requires removal but may be contaminated.
- Field tests were needed to demonstrate the effectiveness of the technology and the stability of hydrogen peroxide in 'dirty' environments.

The EPA found that the formulation was ineffective against anthrax regardless of the vendors' claim[4].

The US Army Proving Ground at Dugway, Utah (Sandia 2003) also tested the effectiveness of one formulation in killing anthrax spores. Simulants were used and after 20 hours exposure to the formulation, the panels were tested and the results indicated that the spores were eliminated. MDF-LSA 200 was also tested against chemical agents (CAs) and toxic industrial chemicals (TICs) and SNL reports that after 1 hour contact, 100% of CAs and TICs were decontaminated. However no analytical methods, detection limits, analytical method descriptions, quality control data, nor test conditions were available to validate their results presented. The EPA testing using AOAC protocol disagrees with the SNL results[4].

4. Force 1 Decon™ Products

Force 1 Decon™ Surfactant and Force 1 Decon™ Sodium Hypochlorite were supplied as refills for the MDF-LSA 100 system. However it was discovered that theses two products are not intended to be refills as the MDF-LSA 100 contains hydrogen peroxide as its active ingredient whereas the Force 1 Decon™ products contain sodium hypochlorite.

Force 1 Decon™ market a product called HotShot™ which is the MDF-LSA 100 foam in a two part ratio spray dispenser (~119g). They also market a 5% sodium hypochlorite aerosol sprayer and a 0.5% sodium hypochlorite-surfactant aerosol sprayer (these decontamination solutions are part of the Individual Decon Kit™). Hence Force 1 Decon™ sell a number of decontamination kits which contains HotShot™ (MDF-LSA 100) and/or the sodium hypochlorite aerosol sprayer and sodium hypochlorite-surfactant aerosol sprayer. These kits include HotShot Plus™, Individual Sensitive Equipment Recovery System™ and the Modular Decon System™. There are no independent evaluations published in the open or classified literature to assess or verify the performance of the Force 1 Decon™ product range.

5. Summary

MDF-LSA 100 was original developed by SNL between 1997 and 1999. Due to some issues with the formulation it was later superseded with the MDF-LSA 200. The manufacturers of the MDF-LSA 200 claim that it is an effective decontaminant for chemical and biological warfare agents, however this has been disputed by the EPA, who found that this formulation was ineffective against anthrax. As yet there have been no independent evaluations on the effectiveness of this formulation to decontaminate CWAs. An MDF 300 concentrate is currently under development. The two Force 1 Decon™ products supplied were found not to be refills for the MDF-LSA 100, rather they form part of a number of decontamination kits sold by Force 1 Decon™.

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