



## PORTABLE DESTRUCTION

The CRAcANS is a highly portable chemical agent destruction system designed by DEVCOM CBC to fit inside military aircraft, on a small flatbed truck or suspended from a helicopter. (Photo by Michael Marinelli, DEVCOM CBC)

# MINIATURE BUT MIGHTY

DEVCOM Chemical Biological Center continues miniaturizing chemical agent destruction technology.

*by Brian B. Feeney, Ph.D.*

**W**hen chemical agents are found in the field, either as legacy waste from prior conflicts or recently produced by bad actors, there are advantages to destroying them at or near the place of discovery rather than packing them up and transporting them to a brick-and-mortar destruction facility. The U.S. Army Combat Capabilities Development Command Chemical Biological Center (DEVCOM CBC) has been steadily miniaturizing destruction technology to make that increasingly possible.

According to DEVCOM CBC's Field Response Team Operations Director Timothy Blades, chemical agents found in the field present unique challenges to warfighters and commanders. "Because of the risk of transport and mission timelines, it's almost always better to destroy these items on site," Blades said. "Part of our mission at DEVCOM CBC is to identify and develop technologies that make that possible."

## **A BIG START IN MINIATURIZATION MAKES HISTORY**

DEVCOM CBC's effort began in 2012 when the U.S. Defense Threat Reduction Agency (DTRA) and National Security Staff approached DEVCOM CBC's field response team, the Chemical Biological Application and Risk Reduction (CBARR) business unit, with an urgent need to destroy Syria's chemical warfare agent stockpile. The national team was considering incineration of the stockpile in or near Syria as a possible solution. Based on decades of experience, Blades told them that destruction using hot water, a method known as neutralization, would be a much better solution. An incinerator would take too long to build, require too many people to operate and involve too large a logistics train.

Until then, neutralization had only been used to destroy the U.S. chemical agent stockpile in the early 2000s in large factory buildings covering acres of land. Blades and



his team got to work and came up with a modularized system called the field deployable hydrolysis system (FDHS) that could be disassembled and fitted into standard shipping containers. It was designed for ease of maintenance and came with a portable laboratory for testing batches to ensure complete agent destruction. The rest is history. The FDHS was placed inside a Maritime Administration Ready Reserve Fleet roll-on/roll-off ship and was used to destroy 600 metric tons of mustard agent and 130 metric tons of sarin precursor chemicals in the international waters of the Mediterranean Sea in just 42 days.

### **MAKING HISTORY IS GOOD, MAKING IT SMALLER IS BETTER**

While that was a great triumph receiving world recognition, it was only a start. The scientists and engineers at DEVCOM CBC were intent on further miniaturizing chemical agent destruction technology so that it could be used by CBARR operators and warfighters alike to destroy

caches of agent encountered in austere environments around the globe. They began this effort by shrinking the FDHS, which filled several 8-by-20-foot shipping containers for transport and took up over a 20,000-square-foot area once assembled.

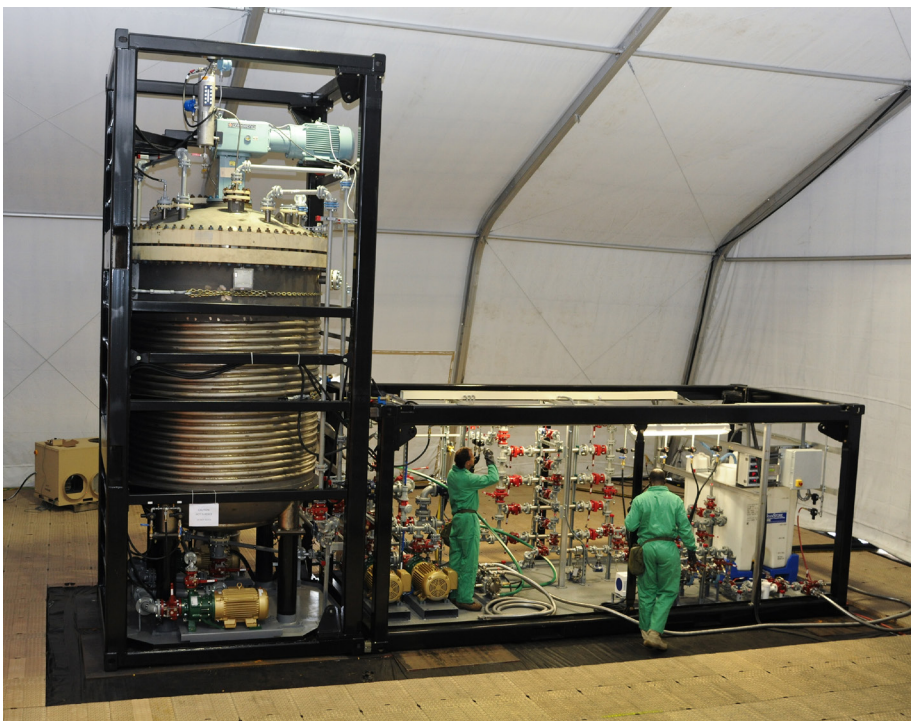
DEVCOM CBC further miniaturized the FDHS with a system called the Compact Rapid Chemical Agent Neutralization System, or CRaCANS, for short. Its dimensions are 88 inches by 108 inches by 80 inches and it fits on a standard NATO military aircraft shipping pallet. It can also be placed on a small flatbed truck or suspended from a helicopter. It can destroy two tons of bulk agent or agent from more than 48 projectiles and mortars in 24 hours when paired with an access system. It contains its own generator, compressor, heaters and waste storage. As a result, the CRaCANS only requires reagent plus diesel fuel to run.

A transportable laboratory that accompanies it confirms greater than

99.9% destruction as required by the Organisation for the Prohibition of Chemical Weapons (OPCW) and greater than 99.99% destruction required by the U.S. Environmental Protection Agency for each batch of agent. The process renders the agent a conventional industrial waste that is stored in bulk containers for disposal at a commercial hazardous waste disposal facility.

CRaCANS development is funded by DTRA and DEVCOM CBC and has already proven its effectiveness with agent simulant testing. It is currently undergoing live agent testing and DEVCOM CBC plans to field it for CBARR, making it available to operate in austere environments in 2025. It could be available to warfighters as early as 2026.

CRaCANS opens entirely new field response capabilities according to Michael Marinelli, DEVCOM CBC environmental scientist and CBARR project manager. “Once the CRaCANS is ready to deploy with us in the field, we will be able to quickly go to locations around the world where chemical agents are found, arrive with all the equipment we need, set it up within hours, and within days have the threat eliminated and be gone.”



### **COMPACT DEPLOYABLE**

The field-deployable hydrolysis system destroys chemical agent by mixing it with hot water and a caustic compound to render it a conventional industrial waste. It's even compact enough to fit into tight spaces like the hold of a ship. (Photo by Jack Bunja, DEVCOM CBC)

### STILL GOING SMALLER

All too regularly, a chemical munition will be unearthed during construction at a current or former military site, or warfighters will encounter one while forward deployed. There needs to be a simpler, less expensive way to deal with these situations than having to ship and set up the CRaCANS in a location that may be on the other side of the country or the other side of the world. That capability, now under development, is called Blackdog. It has two components. The first is a mechanism called Viper, which drills into the munition and drains out the chemical agent for neutralization. The second is the Polycat system, which neutralizes the drained agent in a bag. Each system can fit inside a single backpack and can be man-carried to the discovered munition.

The Viper consists of mechanical drill with a vacuum-attached self-sealing probe that punctures the munition and enters the chamber containing the agent. The drill is controlled by a sophisticated mechanical control unit (MCU), which is wirelessly attached to a display tablet and a camera to allow for the process to be conducted by field operators at a safe distance. The MCU monitors the depth of the drill and operates the drill through a cable link. Once inside the munition, it draws a sample of the liquid for testing through a small pipe attached to the probe. If the sample tests positive as a chemical agent, it is time to pull the Polycat system out of its backpack.

While still under development, Polycat will be combined with the Viper, which is already used in the field, to form the combined Blackdog chemical agent destruction system. The hose used for sampling the munition will be attached to a 15 kilogram “kill bag” containing an absorbent powder that neutralizes the agent. The bag can neutralize up to six kilograms of agent. Alternatively, responders can use a 14.5 kilogram “kill drum” that also neutralizes up to six kilograms of agent. Complete neutralization takes seven days, although most of the agent is neutralized in the first hour, making it safe for warfighters or a field response team to place the container in the back of a truck.

Working in tandem, Viper and Polycat give warfighters and field response teams the ability to carry the system to a remote location in the back of a vehicle or on their backs, set it up in minutes, sample the contents of the munition and, if positive, have the agent in a bag or barrel being neutralized in an hour, then move on.

Blackdog is the result of a joint industry call from the U.K. Ministry of Defence and the U.S. Department of Defense in 2018. With most of the world’s stockpiles of chemical agents

eliminated under the Chemical Weapons Convention, they focused on the need to respond to small caches of chemical agent found in munitions or in illicit laboratories and production facilities. The U.K. companies, Polycat, Ltd. and Valent Applications Ltd., were selected to collaborate on a solution. They teamed up with DEVCOM CBC to take advantage of the center’s 100+ years of chemical agent experience and live agent testing facilities.

In July 2024, DEVCOM CBC scientists concluded a successful initial round of bench scale testing with live agent at the milligram level. Polycat, Ltd. and DEVCOM CBC plan to soon scale up to testing in three-liter quantities to further prove the concept.

For DEVCOM CBC lead project manager Laura Graham, this is an exciting development project. “Nothing in this niche exists, and it will be a valuable new tool for our field response teams,” she said. “The spirit of collaboration with the Polycat and Valent teams has been terrific, and we are all very excited about it.”

### AND SMALLER YET

Still smaller is the thermite bag system. It can fit into a single pelican case and weighs 85 pounds. The concept behind it is simple; place a chemical munition found in the field inside a double bag with thermite grenades, fire them and the thermal reaction destroys the agent in the munition. DEVCOM CBC is performing advanced development and testing on the prototype originally developed by Southwest Research Institute, a non-profit research and development organization in San Antonio, Texas.

The double bag arrangement safely contains the temperature and expanding gases because the outer bag is reinforced with aluminum sheeting similar to a fire suit. The heat and pressure of the detonation decomposes the molecular structure of the agent, leaving inert remains that can be disposed of at a commercial disposal facility.

Once fielded, the thermite bag system will provide commanders in the field with a simple and effective option for field destruction of individual chemical munitions and small chemical agent caches with a minimal logistics burden. After destruction, the intact bags can be placed in a container and then into the back of a vehicle for disposal. The threat is disabled and the unit can keep moving.

DEVCOM CBC began advanced development in 2023, and it is currently at the testing stage. The development team is ensuring that the thermite bag can fully contain the thermal reaction. The next steps are to test the effectiveness of agent destruction, starting

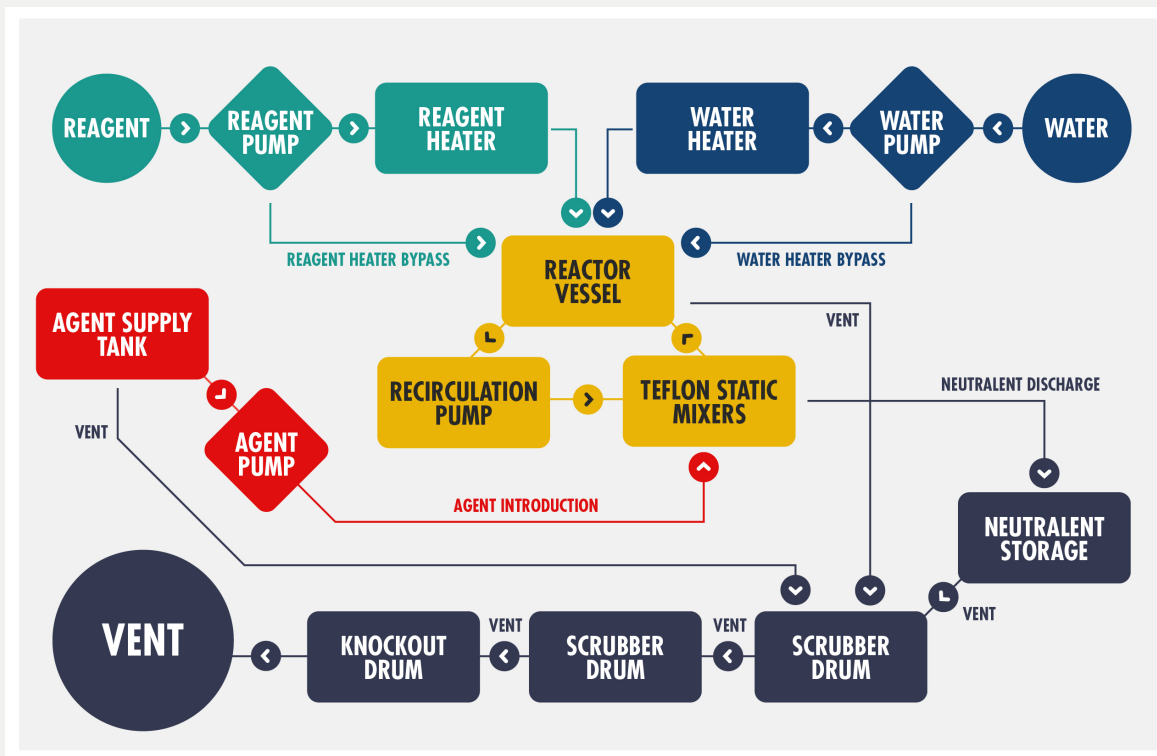
### How Neutralization Works

Neutralization is a method of chemical agent destruction that uses water to break apart the chemical agent molecules. Agitating a mix of water and agent alone is often enough to destroy the agent because of the kinetic energy generated by the baffles in the system. The destruction byproduct the process produces is highly acidic. Typically, a second reagent is added, commonly sodium hydroxide, to reduce the acidity. That makes the byproduct less corrosive to the pipes and valves in the destruction system and makes it more suitable for disposal as a conventional hazardous waste.

The tricky part is coming up with the right quantities of water, agent and second reagent in the recipe. DEVCOM CBC has more than 100 years of experience with chemical agents and is a recognized world authority on how to achieve optimum destruction.

Marinelli compares it to finding the best recipe for baking a cake. “You have to look at the batch size you want, the temperature and the amount of agitation you want to maintain in the reaction vessel, plus the optimum time to agitate each batch. On top of that, you have to consider the ratio of agent and reagents for each batch.”

The recipe varies by chemical agent. For example, the VX nerve agent destroyed at the U.S. Army Chemical Materials Agency’s Newport, Indiana, stockpile site in the early 2000s used 20% sodium hydroxide at 90 degrees and a two-hour period of agitation to achieve destruction. Other U.S. stockpile destruction facilities made minor variations to best meet the characteristics of the chemical agents in each stockpile.



#### REAGENT AND WATER FLOW

A specific chemical substance, called a reagent, is mixed with water to neutralize toxins. (Graphic by USAASC and Michael Marinelli, DEVCOM CBC)



### ONSITE OPS

A mobile laboratory on a field mission at Dugway Proving Ground, Utah, in support of a U.S. Army Corps of Engineers field response operation. Having the laboratory onsite accelerates the confirmation testing process during chemical agent destruction operations. (Photo by Dennis Dickson, DEVCOM CBC)

with simulants and, ultimately, live agent in a specially designed DEVCOM CBC testing chamber. The development team hopes to see it available for use by warfighters in 2026. The project is being funded by the Office of the Deputy Assistant Secretary of Defense for Threat Reduction and Arms Control.

DEVCOM CBC's program manager for the system, Janson Stoltzfus, sees this as a big benefit to the warfighter. "A thermite bag reduces the logistical burden on Soldiers when compared with current destruction methods. It is much lighter, more compact and easier to deploy. It will be a powerful tool in the commander's suite of chemical agent defeat capabilities."

### CONCLUSION

The greatest success of the Chemical Weapons Convention (CWC) of 1993, signed by 193 nations, is that it led to the destruction of the world's large stockpiles by those signatory nations. They were destroyed under the direction of the OPCW, which was created by the CWC. It performed regular inspections during

destruction and confirmed final destruction. What the world faces now is the illicit production of chemical agent by rogue nations and non-state actors.

DEVCOM CBC is addressing the new threat by making agent destruction technology smaller and thereby easier to transport, set up, operate and remove. By replacing the large brick and mortar destruction facilities of the 1990s and early 2000s with highly portable destruction systems, field response teams such as CBARR can, in effect, make house calls. Some of those house calls are to harsh and barren locations where providing the logistics for a larger system would be impossible.

The scientists and engineers of DEVCOM CBC who are advancing and operating this technology are proud of the contribution they are making to the world. DEVCOM CBC Director Michael Bailey shares in that pride. "The men and women who design, construct and operate these miniature agent destruction systems are making the world a safer place and demonstrating

that the United States is a force for good in the world."

For more information, go to <https://www.cbc.devcom.army.mil>.

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