



# Solutions

U.S. Army Research, Development and Engineering Command  
Chemical & Biological Center

**NEWSLETTER**  
Summer 2018

50-year-old toxic lab  
undergoing remediation,  
demolition

**Page 22**

Sprayable slurry can  
be used on equipment,  
vehicles

**Page 6**

Metal-organic frameworks  
use sunlight to neutralize  
chemical warfare agents

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## Director's Message

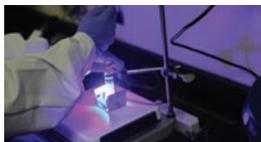
Welcome to the U.S. Army Research Development and Engineering Command Edgewood Chemical & Biological Center's quarterly publication, *Solutions*. Within the pages of *Solutions*, we tell the stories of how our scientists and engineers enhance our warfighters' ability to defend themselves against chemical and biological warfare agents. In 2018, international news outlets have reported on several uses of chemical warfare agents, including an assassination attempt on a former spy and his daughter using nerve agent and fatal chemical attacks on civilians, including children, in Syria.

The U.S. Army announced on March 26 that it will activate the Army Futures Command (AFC), a new unit, "to focus on future capabilities to allow our warfighters and units to be more lethal to win our nation's wars, then come home safely." The RDECOM C&B Center will realign under the AFC as a part of the U.S. Army Research, Development and Engineering Command. The AFC mission is to identify and develop new prototypes and technologies, and deliver them to Soldiers faster than ever. In support of this mission, the RDECOM C&B Center will continue to provide chemical and biological defense solutions ensuring warfighter readiness in unique and unpredictable environments.

In this issue of *Solutions*, you will learn more about how we are enhancing chemical and biological defense readiness. On page 11, see how Soldiers operated our ACORNS technology for the first time at a recent demonstration with the U.S. Army CBRN School; on page 4, read about the work being done in pursuit of a self-decontaminating combat uniform, where scientists utilized metal-organic frameworks to neutralize chemical warfare agents; and throughout the publication, learn about our employees' accomplishments at work and in the community.

If you have any questions or want to get in touch with us, please contact our Communications Office at [usarmy.apg.rdecom-ecbc.mbx.communications-office@mail.mil](mailto:usarmy.apg.rdecom-ecbc.mbx.communications-office@mail.mil). I hope you enjoy reading about the work being done at the RDECOM C&B Center.

Army Strong!  
Eric L. Moore, Ph.D.  
Director, U.S. Army Research, Development and Engineering Command Chemical & Biological Center



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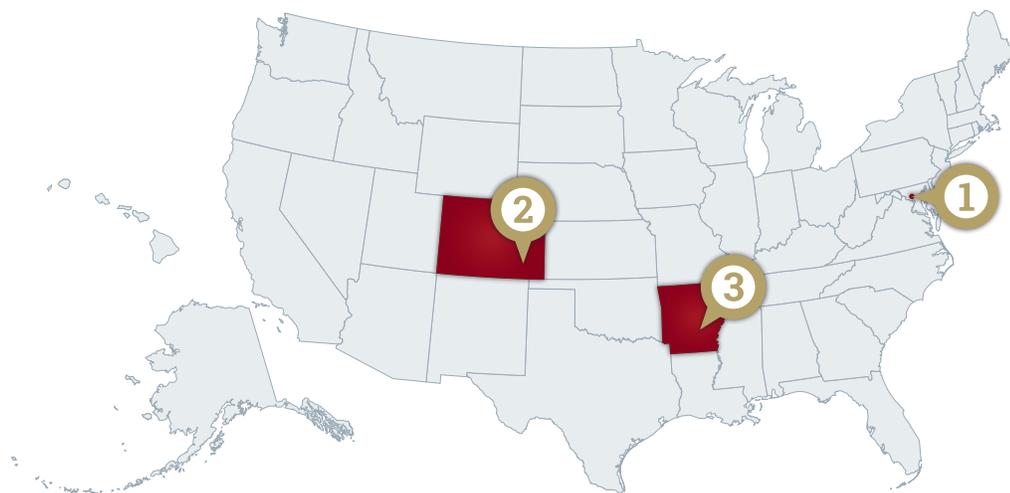
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## RDECOM C&B Center News from the Field

The RDECOM C&B Center Chemical Biological Application and Risk Reduction (CBARR) Business Unit performs global CB response operations in a safe, secure and environmentally sound manner by providing a broad range of field deployable operations for the remediation and destruction of chemical and biological agents, and other sensitive materials. CBARR is currently operating on seven active sites across the United States and in Australia, but here's a closer look at three projects being completed in partnership with the U.S. Army Corps of Engineers:

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1

**Spring Valley, Washington D.C.** – The Spring Valley Formerly Used Defense Site is a 650-acre plot in northwest Washington D.C. that used to be the site of United States government chemical agent testing. Today, the site encompasses 1,600 private properties, including several embassies and foreign properties, as well as the American University and Wesley Seminary. CBARR has been involved in destruction and remediation efforts at this site since chemical agent was discovered under a residential property in 1996. This year, CBARR completed intrusive sampling in one residence to determine whether chemical agent, chemical agent breakdown products or volatile organic compounds existed below the home's foundation. The project team collected more than 100 samples from the residence for analysis.

2

**U.S. Army Pueblo Chemical Depot, Colorado** – The U.S. Army Pueblo Chemical Depot (PCD) in Colorado spans 23,000 acres and has a primary mission of storing one of the last two remaining chemical weapons stockpiles in the United States. CBARR has provided a range of capabilities to PCD and the chemical weapons destruction pilot plant which has been constructed to destroy the stockpile. As part of a Resource Conservation and Recovery Act facility investigation, CBARR is actively supporting operations in two solid waste management units that are suspected of containing potential chemical warfare material. The team provides automated continuous air monitoring systems that ensure the safety of personnel and the environment. Additionally, CBARR's fixed and mobile laboratories are providing critical analysis of air, water and soil samples to determine the presence of chemical agent and agent breakdown products.

3

**Pine Bluff Arsenal, Arkansas** – CBARR operators are conducting air monitoring and on-site soil sampling at Pine Bluff Arsenal in Arkansas. Review of historical photographs and records show that the two locations have a high probability of containing chemical warfare material. Intrusive operations to date have uncovered numerous mortar rounds, projectiles and chemical agent identification sets that are being stored in an interim holding facility for future assessment. ▲

### Digital Version

For the digital version of  
this newsletter, please visit:

<http://www.ecbc.army.mil/solutions>

# Research Could Lead to Self-Decontaminating Combat Uniform

Metal-organic frameworks use sunlight to neutralize chemical warfare agents

By Bradley Kroner

New research being conducted at the U.S. Army Research, Development and Engineering Command Chemical & Biological (RDECOM C&B) Center is exploring whether chemical weapon-neutralizing substances can be incorporated into equipment worn by warfighters.

Discovered in 2000, metal-organic frameworks, commonly called MOFs, are a relatively new research area – their ability to neutralize chemical warfare agents was just discovered five years ago. A team of RDECOM C&B Center researchers is determining how to incorporate MOFs into fabrics and textiles to give decontamination capabilities to materials worn by warfighters.

energy to convert oxygen into a more active state called the singlet state.

“The light comes in and interacts with the MOF, and it takes that light and converts the oxygen in the air into an active oxygen species,” Decoste explained. “This is all based around finding the easiest way to create singlet oxygen.”

Composed of metal ions and organic compounds, MOFs take the form of powder. Decoste, along with Hui Wang, a National Research Council postdoctoral associate, and Ann Ploskonka, a contractor chemist working at the Center, are in the process of determining whether that powder could be infused within fabrics and textiles.

**“The oxygen from the atmosphere is excited into a higher energy state by the MOF to make an active species that can then react with mustard (agent) and neutralize it.”**

*Jared DeCoste, Ph.D. | RDECOM C&B Center chemist*

Essentially, certain forms of MOFs catalyze the oxidation of chemical warfare agents, thereby neutralizing toxic substances. When exposed to light, these MOFs react with and excite oxygen. In turn, oxygen reacts with and combines with agent, effectively neutralizing the threat. While there are thousands of different MOFs, RDECOM C&B Center researchers have identified fewer than 10 with this capability.

“This is a catalytic method that uses oxygen from the atmosphere as a reactant,” said RDECOM C&B Center chemist Jared DeCoste, Ph.D., who leads the Center’s photocatalytic oxidation study. “The oxygen from the atmosphere is excited into a higher energy state by the MOF to make an active species that can then react with mustard (agent) and neutralize it.”

Normally, oxygen does not react with chemical warfare agents. However, when MOFs absorb visible light, they can use this

Specifically, Wang is researching whether other photosensitizers, such as boron-dipyromethene analogs, can be incorporated into fabrics to improve the photooxidation process. While MOFs offer some advantages over other materials in that they are highly porous and can adsorb and potentially sequester large amounts of chemical warfare agents, the use of dyes has the potential of being a much simpler and cost-effective process.

Ploskonka is working on synthesizing and creating novel MOF structures that can increase the efficiency of the mustard agent photocatalysis degradation process. There are thousands of MOFs that have been reported to date, and they can be modified in many ways, so determining the optimal pore structure and density of functional features within the structure can be quite the laborious task.

When the capability is developed, the MOF-enhanced materials could be used



Inside the test tube, RDECOM C&B Center researchers mix agent with MOFs and oxygen. Exposure to light starts the MOFs’ oxidation process, which neutralizes the agent.

for clothing or even as filters for gas masks, Decoste said. The next steps are determining that right combination of MOF and fiber to maintain optimum flexibility while retaining decontamination ability.

As this is a relatively new area of research, the capability is at a basic level.

“There is no self-decontaminating fabric that’s fielded or anything along those lines at this point,” DeCoste said. “This is really basic research at this point. We’re trying to determine the best nanomaterials to achieve decontamination, while in parallel, working on methods to integrate these materials into textiles that can be fielded.”

This research was prompted by a need to identify field-deployable methods of mustard agent decontamination. While some types of agent can be decontaminated using water from the atmosphere, mustard agent is less susceptible to that method.

Currently, this decontamination capability is only being tested for mustard agent. Some other types of agents, like VX, may be susceptible to this method. Others, like Sarin, are not.

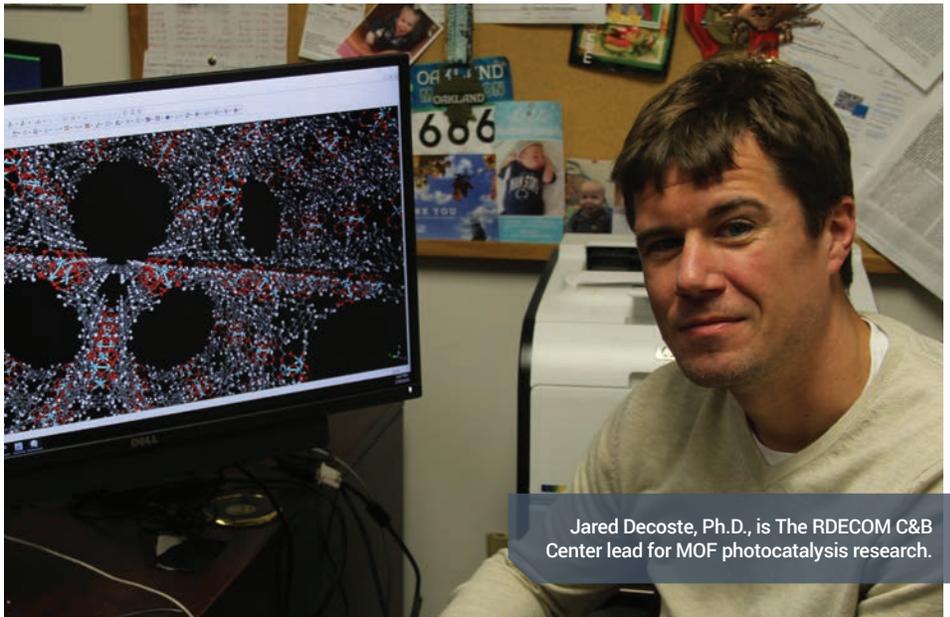
“It’s something that we plan on looking at,” DeCoste said. “In a lot of these basic studies, we try to study one reaction as best we can. Once we can fully understand the process well, we can move faster later on.”

As the technology is still in development, it’s unclear when it will be completed, tested, and deployed in the field.

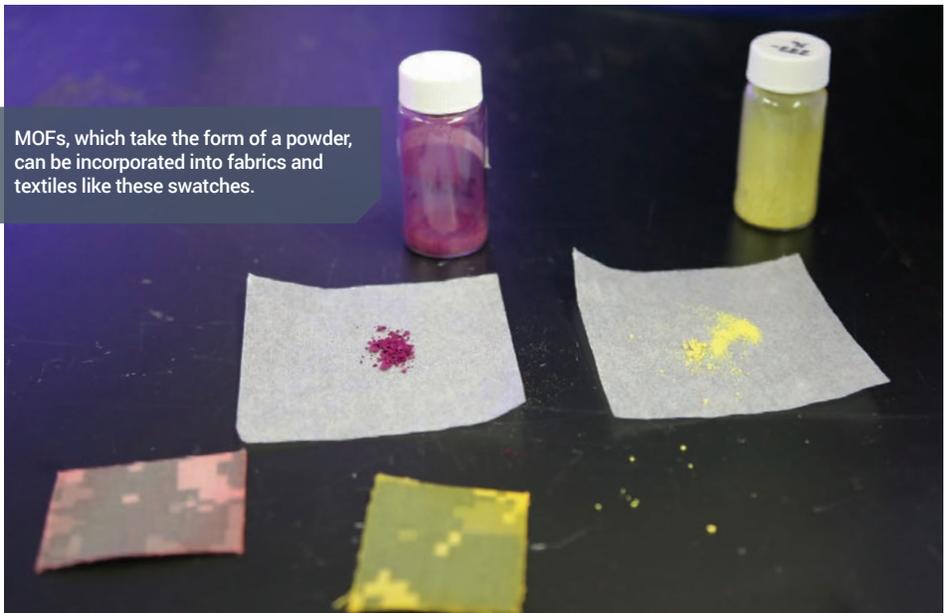
“When you hear about using sunlight to decontaminate, that sounds like a futuristic application, and it is,” Decoste said. “It’s one of those applications where the materials are really novel and require development.”

The Defense Threat Reduction Agency (DTRA) is interested in the technology and has funded a program focused on up-scaling the production of MOF materials.

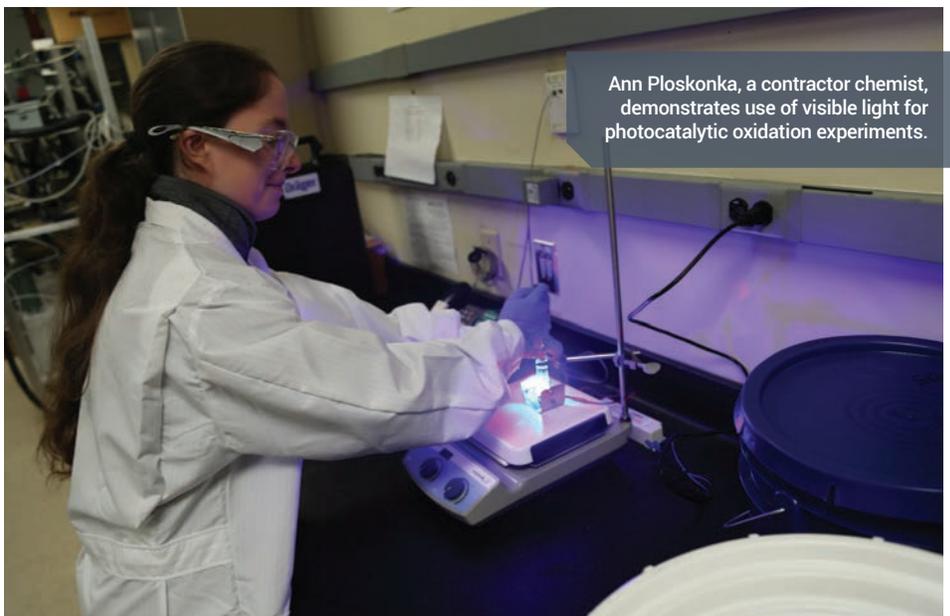
“We’re working with a pretty substantial program from DTRA to incorporate these active materials into more functional forms, such as textiles,” DeCoste said. “We have been talking to DTRA about getting these types of materials into the next generation of combat uniforms that are going out to warfighters.” 🚩



Jared Decoste, Ph.D., is The RDECOM C&B Center lead for MOF photocatalysis research.



MOFs, which take the form of a powder, can be incorporated into fabrics and textiles like these swatches.



Ann Ploskonka, a contractor chemist, demonstrates use of visible light for photocatalytic oxidation experiments.



The decontamination slurry, which is in development for material decontamination, is sprayed during a test.

# New Decontamination Technology Slated for Field Testing

Sprayable slurry can be used on equipment, vehicles

*By Bradley Kroner*

A sprayable decontamination slurry developed by scientists at the U.S. Army Research, Development and Engineering Command Chemical & Biological (RDECOM C&B) Center is entering the next stage of its development and will soon be tested on a larger scale beyond the laboratory.

The slurry is a highly effective decontaminant and works through two mechanisms: hydrolysis and oxidation. The slurry is designed for decontamination of equipment and vehicles – like the fender of a Humvee – but not skin.

“This is designed for immediate, material decontamination,” said Joseph Myers, an RDECOM C&B Center research chemist.

“Theoretically, let’s say there are Soldiers in the field and their Humvee is contaminated with chemical warfare agent. After getting to safety, they can mix up the decontaminant slurry, spray it on the vehicle, and drive back to the base.”

Under the current methods of material decontamination, platforms and personnel would have to leave the fight and use vast amounts of water and resources to be rendered safe. When deployed, the decontamination slurry will provide more efficient and effective decontamination for vehicles and equipment on the battlefield.

“This new technology will decrease the time

and resources needed to respond to an attack, allowing units to maintain their momentum and increase their effectiveness on the battlefield,” explained Maj. John Williams, assistant product manager for science & technology portfolio integration. “Because of the versatility of the slurry and its effectiveness on multiple surfaces, this new technology could enable all future Army systems to operate in a contaminated environment, including new ground and air platforms.”

In the coming months, the capability will be rigorously vetted to confirm that its laboratory-level efficacy is retained in the field. In May, the slurry underwent large-scale testing in

RDECOM C&B Center's chemical agent and explosives test chambers. Then, in September, Myers is taking the slurry to Joint Base Lewis McChord for a demonstration in which scientists will put emerging technologies like the slurry directly in the hands of warfighters.

"They provide feedback, to say what they liked and what they didn't like," Myers said. "We're going to get actual end-user feedback, and then we'll be able to re-optimize what we're doing to better fit the needs of the warfighter."

Resembling a thick paint, the slurry is a solid-liquid hybrid and may require a special sprayer. Myers thinks the sprayer could resemble a pump-action pesticide sprayer or maybe a backpack sprayer similar to a fire extinguisher.

Thus far, the U.S. Army Research Laboratory has assisted by providing insight into paint formulation ingredients that would make the slurry more paint-like. RDECOM C&B Center's Advanced Design and Manufacturing Division was recently able to take the slurry into its automotive spray booth and conduct a successful spray demonstration.

Myers is confident in the slurry's effectiveness.

"If you were to apply this as an immediate decon – within 15 to 30 minutes – you let it sit on the material for four hours, you get 99.9 percent removal for blister and nerve agent," he

said. "The slurry achieves this efficacy through its combination of hydrolysis and oxidation."

Some agent can be decontaminated through hydrolysis but not oxidation and vice versa, but by combining the processes, the slurry is more universally effective.

"Zirconium hydroxide works by a process

***“If you were to apply this as an immediate decon – within 15 to 30 minutes – you let it sit on the material for four hours, you get 99.9 percent removal for blister and nerve agent”***

*Joseph Myers | RDECOM C&B Center Chemist*

called hydrolysis," Myers said. "Through the optimization process, we've added another chemical into the mix that promotes oxidation. With a blend of hydrolytic and oxidative chemistries, the slurry has the ability to detoxify a wide range of chemical warfare agents."

This blend was identified by experimenting with different ingredients to determine which would be most effective in the laboratory.

"The primary component of this slurry is called zirconium hydroxide," Myers said. "We took this substance, which is like a fluffy, white powder, and we mixed it with kerosene, with the

assumption that kerosene would be available in the field. Mixed together, the components made a decontamination slurry."

Myers later found that sulfolane, a solvent, would make a better carrier liquid than kerosene, because it promotes the extraction of agent from materials, which allows, the slurry's other ingredients, like zirconium hydroxide, begin to hydrolyze or oxidize with the agent. "We swapped out the kerosene for a new solvent, sulfolane, and that did a better job of removing agent that soaked into materials," Myers explained. Sulfolane has a high flashpoint, which makes it logistically favorable for transport, Myers said.

Funded by the Defense Threat Reduction Agency, the capability is a year or two away from being deployed, Myers said. "This has a high probability of being provided to the warfighter," he said. "It's highly effective, it's easy to use, and none of the ingredients are particularly hazardous." ⚠



The slurry, a solid-liquid hybrid, resembles a thick paint.

# As Threats Change, the Reliable Joint Chemical Agent Detector Adapts

Longtime chemical agent detector in development for explosives detection

By Bradley Kroner

In use for more than 10 years, and with tens of thousands in service, the Joint Chemical Agent Detector (JCAD) has been a critical aid to the warfighter for detecting chemical warfare agents.

For the first years of its use, the portable JCAD was used exclusively for real-time, automatic chemical warfare agent vapor detection, using ion-mobility spectrometry, which identifies ionized molecules in the gas phase based on their mobility in a carrier buffer gas.

However, as chemical biological threats evolve, the warfighter's tools must evolve too. Six years ago, the original M4 JCAD was improved with better electronics and a built-in pre-concentrator, which better concentrates the sample for detection. This model is called the M4A1 JCAD.

Now, the M4A1 JCAD is under further development.

In 2010, the U.S. Army identified a need to determine whether any of its existing, fielded chemical agent detectors could be modified to detect homemade explosives and unknown bulk explosives — an increasing priority for land operations.

With funding from the Army Technology Objective Program, the U.S. Army Research, Development and Engineering Command Chemical & Biological (RDECOM C&B) Center found a solution: the JCAD. Used widely and well-known by the armed service branches, the JCAD was already in the hands of warfighters, making it a top choice for the project.

“Currently, distributing explosive detectors to warfighters would require them to carry an additional piece of equipment,” said Vincent McHugh, an RDECOM C&B Center research chemist. “The objective was to use fielded equipment, like the JCAD, with a couple of modifications to prevent the warfighter from having to carry a second detector.”

Designed to detect the vapors emitted by chemical warfare agents, the JCAD had to be modified so that it could detect explosives — which have low vapor pressures — without losing its original functionality.

JCAD accessory which consisted of add-on pieces: a cradle with a probe swab, and an inlet. When inserted into the cradle, the JCAD is considered an M4A1 JCAD Chemical Explosives Detector (CED). Upon removal, it's simply the M4A1 JCAD model.

While in the field, the cradle's probe swab heats and vaporizes explosive material. The JCAD CED can then detect the vapor emitted from the material to identify the explosive.

When the JCAD CED is fielded, its software will include a library of known explosives so that the device can identify the specific type of explosive encountered in the field. RDECOM C&B Center will complete this explosives library in a couple of months, which point the new JCAD's explosive detection capability will be fully functional.

Not only can the M4A1 JCAD CED detect explosives, it will also be able to detect nonexplosive compounds and pharmaceutical-based analogs — including illegal and dangerous drugs.

“If a warfighter goes into a site for a sensitive site assessment or site exploitation and doesn't know if he's going into a lab where these compounds were used or stored, this detector can identify those compounds,” McHugh said.

For now, the M4A1 JCAD CED is a prototype, with the design still not finalized. Development is ongoing with additional funding from the Joint Project Manager for Nuclear, Biological and Chemical Contamination Avoidance. It's expected to be fielded on a limited



Inside this white casing, referred to as a cradle, the M4A1 JCAD can detect explosives in addition to chemical agent.

“One of our mandates going into this was that we couldn't change any of the hardware on the M4A1 JCAD itself,” McHugh explained. “The only thing we could do was develop materiel add-ons or software changes. The only thing the user has to do is remove the rain cap from the JCAD and insert the detector into a cradle.”

As a solution, scientists designed a separate

basis within a year. 📌



U.S. Army Research, Development and Engineering Command Chemical & Biological Center research chemist Bruce King, Ph.D., loads samples into the GCxGC HRTOF system.

# Researchers Combine Wearable Sensors, Advanced Mass Spectrometry to Gather Life-Saving Information

*By Ashley Mason*

Scientists at the U.S. Army Research, Development and Engineering Command Chemical & Biological (RDECOM C&B) Center are combining wearable chemical samplers and multi-dimensional chromatography to enhance Soldier protection by accurately identifying which and how much chemical warfare agent a Soldier has been exposed to.

As part of their jobs, Soldiers and first responders who perform sensitive site exploitations frequently enter areas containing unknown chemicals at varying toxic concentrations. The handheld detectors they use are susceptible to false alarms, may have a limit of detection higher than the amount present, and may not accurately identify the chemical class of compounds present.

If a Soldier is potentially exposed to a chemical warfare agent, even at sub-lethal amounts, it is a race against time to obtain samples and identify the agent, often in a background of dozens or even hundreds of other compounds. Sub-lethal amounts of agent could produce symptoms that can be misdiagnosed as common illnesses, so it is important to know what chemical warfare agents are involved in order to provide the correct

medical countermeasure. The RDECOM C&B Center's new method will improve accurate identification.

First, the wearable sampler clips on to a Soldier's uniform and collects information about various substances that the Soldier may have been exposed to during a mission.

"The sampler collects almost everything it encounters," said Bruce King, Ph.D., RDECOM C&B Center research chemist and project lead.

The samples collected will reflect the Soldier's day-to-day movements. The sampler is sensitive enough to collect the residue of soap the Soldier showered with, and analysis of the sample can reveal data such as whether the Soldier has recently fueled or operated gas- or diesel-powered equipment, and whether the Soldier has been exposed to any chemical warfare agents.

Then, RDECOM C&B Center researchers use the LECO Corporation Pegasus GCxGC-High Resolution Time of Flight (HRTOF) system to analyze the data gathered in the sampler and accurately identify the chemical warfare agents.

"In order for us to be able to separate and identify potentially thousands of compounds in a single sample, we utilize multidimensional gas chromatography coupled to a high resolution time-of-flight mass spectrometer. The system provides the separation and spectral resolution to pull characteristic peaks apart for differential analysis unavailable in field deployable systems. GCxGC-HRTOF has the ability to perform targeted analysis of threat list compounds and precursors with the confidence that a high resolution mass spectrometer provides, in addition to untargeted analysis that could identify a link between clandestine labs, which is unparalleled," said King.

The RDECOM C&B Center has already deployed several wearable samplers to Soldiers outside of the continental U.S., and researchers are working towards optimizing the samplers form factor. Additionally, RDECOM C&B Center researchers are using data collected from the deployed samplers to determine the most effective selection methods to analyze samples for early warning and attributions of waterborne chemical hazards. This research could lead to the ability to determine the source of chemical warfare agent release and identify global trends in the use of emerging threats. 🚩

# Working for the Warfighter

## Investing in Tomorrow's Military Leaders

By Maj. John Williams II



Major John Williams II, is the assistant product manager for science and technology portfolio integration at the RDECOM C&B Center. Williams previously served as an assistant product manager at the Program Executive Office for Simulation, Training and Instrumentation in Orlando, Florida. He graduated from the United States Military Academy at West Point with a degree in chemistry and life science.

Every summer, aspiring scientists and engineers participate in one of the U.S. Army Research, Development and Engineering Command Chemical & Biological (RDECOM C&B) Center many internship and outreach programs. Programs such as the Science and Engineer Apprenticeship Program and Minority Undergraduate Student Internship Program give students from high school through graduate school hands-on experience in their future career paths. While these programs provide an invaluable opportunity for prospective Science Technology Engineering and Mathematics (STEM) professionals, one of the RDECOM C&B Center's most impactful summer programs actually shapes future Army officers rather than future scientists and engineers.

In the AIAD program, the cadets shadow RDECOM C&B Center scientists to familiarize themselves with current projects and, in some cases, help with hands-on lab work. Though the program is short, it is impactful; few Army officers get a chance to interact directly with the Army science and technology community, especially so early in their careers.

The RDECOM C&B Center mentors connect the dots of how today's advanced research impacts tomorrow's battlefield. The AIAD cadets will use their experience as a frame of reference when describing Army science and technology to their colleagues, and in future decision-making as Army leaders.

**“ I am proud that the RDECOM C&B Center continues to make educating the next generation of Army leaders, scientists, and engineers a priority.”**

*Maj. John Williams II | Assistant product manager for science and technology portfolio integration at the RDECOM C&B Center*

The Academic Individual Advanced Development (AIAD) program is a two- to three-week program that gives cadets from the United States Military Academy at West Point and Reserve Officers' Training Corps programs a real-life look at how Army science and technology works. Unlike other summer students at the RDECOM C&B Center, the AIDA cadets will not apply to graduate school or pursue a STEM career after completing their undergraduate program. Instead most will become Army officers and spend the next four to five years leading Soldiers in one of the Army's 13 basic branches. This is a great opportunity for the RDECOM C&B Center to build the future leaders and commanders of the Army and shape how these future leaders think about Army science and technology. Thus, as host of the AIDA program, the RDECOM C&B Center has an important responsibility to help the cadets understand the role Army science and technology plays in contributing to Soldier lethality and survivability.

While many Army scientists and engineers do not wear the Army uniform, they serve every day in support of the Army. We need to ensure that AIAD participants leave the program with an appreciation of our support to the warfighter and feeling prepared to apply their knowledge to any Army leadership role.

I am proud that the RDECOM C&B Center continues to make educating the next generation of Army leaders, scientists, and engineers a priority. Investing in the development of a young leader is always a worthwhile endeavor. 🇺🇸



# Experiment Gives Soldiers an Opportunity to Work with Early Warning System

RDECOM C&B Center team brings tech to 2018 Maneuver Support Sustainment Protection Integration Experiment at Fort Leonard Wood

*By Jack Bunja*



The RDECOM C&B Center team places the Deep Purple unmanned aerial vehicle on top of a M1135 Nuclear, Biological, Chemical Reconnaissance Vehicle prior to the demonstration.

**N**

estled in the foothills of the Ozark Mountains, the 2018 Maneuver Support Sustainment Protection Integration Experiment (MSSPIX) at Fort Leonard Wood in Missouri tested new technology aimed at modernizing soldier protection.

Among the technologies being tested during the event was an autonomously cued aerial detection system developed by the U.S. Army Research, Development and Engineering Command Chemical & Biological (RDECOM C&B) Center. It includes the Deep Purple automated drone and the Array Configurable of Remote Network Sensors, or ACORNS, on-board chemical and biological detection system. The system is compatible with the Defense Threat Reduction Agency's (DTRA) Integrated Early Warning (IEW) system, and has been demonstrated as part of the IEW Advanced Technology Demonstration (ATD).

## How it works

The detection system uses a Light Detection and Ranging, or LIDAR, standoff detector to identify a plume of particles in the air that could be harmful to soldiers. This detection triggers the layered sensing system to autonomously launch the Deep Purple drone carrying the ACORNS detector. The drone flies to the plume, samples the air, and reports findings back to decision-makers in real-time.

"Our Deep Purple with the ACORNS can go out a distance and identify possible chemical, biological, and radiological threats, collect information at a distance, and keep Soldiers safely out of harm's way," said Mark Colgan, Unmanned Systems Team lead at the RDECOM C&B Center.

During test runs of the system, the team used a smoke machine to create a plume of smoke more than 300 yards away from the LIDAR detector. "We have been able to generate a smoke cloud, find the smoke cloud, and autonomously send a UAV into that cloud," said Fiona Narayanan, acting NBC Battlefield Integration Branch chief at the RDECOM C&B Center. "And then, not only send it into the

cloud to find where the highest concentration is, but continue to track that cloud. That piece is really nice because then you can determine where the entire contamination area is."

## In the hands of Soldiers

Beyond field experimentation with the detection system, the real value of the MSSPIX event is the ability to get emerging technology into the hands of Soldiers. During the exercise's first week, Soldiers from the 63rd Chemical Company, 2nd Chemical Battalion, 48th Chemical Brigade spent time with RDECOM C&B Center researchers training in operation of the system and returning feedback about how the system could be improved to provide the support they need in the field.

"We are really trying to fall in line with the Army's goal of more demonstrations, more prototypes, and getting input from the Soldiers sooner rather than later, so we can get a better product into materiel development," said Maj. John Williams II, assistant product manager for science and technology portfolio integration at the RDECOM C&B Center.

Initial feedback from the group of Soldiers working with the development team was positive.

"This is beneficial and it will save us a lot of time. It'll keep troops out of the hazard and in the CBRN world, that's kind of what we worry about," said Pfc.



Patrick Uhen, U.S. Army 63rd Chemical Company, 2nd Chemical Battalion, 48th Chemical Brigade. "It can be a lot faster and a lot more accurate and I can send it to places I might not be able to drive,"

The MSSPIX exercise concluded with a demonstration of the technology for a group of distinguished visitors from various Department of Defense organizations. The demonstration gave researchers an opportunity to showcase their work and explain to senior leaders how the technology aligns with current Army priorities.

RDECOM C&B Center's Engineering Director, Michael Abaie, attended the senior leader event to speak with Soldiers who worked with RDECOM C&B Center technology and to convey how important this program could be for the Army's strategic goals. "This is all about modernization," said Abaie. "It's about how we start achieving and overcoming and overmatching our near-peer competitors. Our ability to get new equipment, new technologies, and new capabilities to the warfighter as quickly as possible allows us to get over that hurdle."

### Next steps

The future of the RDECOM C&B Center autonomously cued aerial detection system depends on the evaluations of the benefits it provides to Soldiers, the improvements made during these evaluations, and, most importantly, having partnership agreements within the Department of Defense to move forward with the research and development.

"My hope after MSSPIX is that we get some solid transition agreements and that this equipment ends up being part of a program of record," said Williams. "Once we transition this technology, we want to keep developing the system so it can accurately fill any materiel gaps and other requirements the owners may have." 🚀



Major John Williams (left) prepares the team for the demonstration at MSSPIX.



Private First Class Patrick Uhen, U.S. Army 63rd Chemical Company, 2nd Chemical Battalion, 48th Chemical Brigade and RDECOM C&B Center engineer Mark Colgan examine the Deep Purple unmanned aerial vehicle prior to testing.





# RDECOM C&B Center Works Toward Bringing Safer Smoke to the Warfighter

Getting better training rounds into the hands of our warfighters in Europe

*By Brian Feeney, Ph.D.*

Pyrotechnics experts and production managers from across the Department of Defense came together at the U.S. Army Research, Development and Engineering Command Chemical & Biological (RDECOM C&B) Center to review the progress of a program to replace HC smoke with the less toxic HX smoke in 155mm M116A1 Smoke artillery projectiles currently used to create battlefield obscurity for training by U.S. Army forces in Europe.

The production management review (PMR) took place in the RDECOM C&B Center Berger Auditorium on April 25 and included a field demonstration at one of APG's test ranges.

Subject matter experts and managers from Program Executive Office Ammunition's Project Manager Combat Ammunition Systems (PMCAS), the U.S. Army Armament Research, Development and Engineering Center, Pine Bluff Arsenal, U.S. Marine Corps Systems Command, McAlester and Crane Army Ammunition Plants and the Bluegrass Army Depot took part in the event.

RDECOM C&B Center engineers and pyrotechnicians developed HX smoke to replace the legacy zinc-hexachloroethane based HC smoke used to create smoke screens on the battlefield. HC is an irritant and

potentially toxic to unmasked warfighters. It is also toxic to the environment as an aquatic pollutant. M116A1 projectiles with HC payload were last produced in the 1980s.

PMCAS' Conventional Ammunition Division stated at the PMR that the M116A1 with HX program is their top priority since there are limited numbers of original M116A1 training rounds remaining and white phosphorus cannot be used in Europe. "By July of this year, we plan to have HX canisters available for the production personnel at Pine Bluff Arsenal to place in artillery shells in order to prove the production concept," said Kevin Fritz, the chief



A demonstration shows the concealing power of a new, less toxic HX artillery smoke payload at a production review held at the RDECOM C&B Center April 25.

of the RDECOM C&B Center Obscuration & Nonlethal Engineering Branch. “The modified M116A1 projectiles will then be proven operationally during a live fire test.”

After the formal briefings on the preparations for production, the group traveled by bus to a test range on Aberdeen Proving Ground’s Gunpowder Peninsula and watched a static demonstration of the volume of smoke released by three canisters of HX simultaneously.

Four HX-filled smoke canisters are placed into each 155mm artillery shell along with a fuze and expulsion charge. Upon detonation of the expulsion charge, the smoke canisters are pushed out of the projectile and a cloud of smoke is generated from the canisters for a minimum of 70 seconds after they hit the ground. The smoke lingers in the atmosphere for several minutes after that. In both cost and performance HX is similar to the original HC smoke formulation.

However, mastering the production of these artillery rounds after a 30-year hiatus involves some relearning. “RDECOM C&B

**“By July of this year, we plan to have HX canisters available for the production personnel at Pine Bluff Arsenal to place in artillery shells in order to prove the production concept.”**

*Kevin Fritz | Obscuration & Nonlethal Engineering Branch chief at the RDECOM C&B Center*

Center engineers led by Nino Bonavito, chief of RDECOM C&B Center’s Pyrotechnics and Explosives Branch, are working side by side with Pine Bluff Arsenal production personnel to transfer this skill and work out the production issues,” said Fritz. This includes new techniques related to formulation mixing, canister pressing, reaming, and crimping operations.

The effort of transitioning from HC to HX smoke is well worth it, according to Fritz. “All of us who work in obscuration are proud to be a part of protecting the warfighter on the battlefield. We get feedback from the field describing how we helped save lives, and that is a very rewarding part of our mission.” ▲

# Meeting Paves Way for Additive Manufacturing Apprenticeships

Maryland commerce officials, RDECOM C&B Center leaders agree on need for workforce development

By Bradley Kroner

Collaborative efforts between the Maryland Department of Commerce and the U.S. Army Research, Development and Engineering Command Chemical & Biological (RDECOM C&B) Center could yield new apprenticeship and internship programs.

Two officials from the Department of Commerce toured the Center's Product Development Facility to learn more about additive manufacturing and how an expanded partnership could grow the industry and its workforce.

Using additive manufacturing since 1989, the RDECOM C&B Center is a pioneer in the field, using the process to create drones, sensors, and other tools for the warfighter. Since 2014, the Center has been a member of the Regional Additive Manufacturing Partnership of Maryland (RAMP MD), a public-private partnership consisting of industry leaders, educational institutions, nonprofits, and government agencies.

Through this partnership, the RDECOM C&B Center served as a model for private-sector companies looking to expand additive manufacturing efforts.

"Local industry is using the Army to get up to speed and make Maryland a leader in this industry," explained Mark Schlein, associate director for product development in the Center's Engineering Directorate. "Additive manufacturing has been around for quite some time, and now, it's starting to get into the hands of the masses. They're looking to see where this capability is going in the future."

Sharon Markley, director of education and innovation in the Commerce Department's Office of Strategic Industries and Entrepreneurship, said she hoped to explore the possibility of expanding apprenticeships and internships, perhaps through working with regional community colleges.

"It's incredibly striking that the capabilities here are available not just the military, but to businesses and students," Markley said.

Markley remarked that one employee found work at the Center after going to community

college to learn about computer-aided design. She said she hopes to create similar opportunities by working with the Center, RAMP MD, the Maryland Technology Council, and the Department of Labor, Licensing, and Regulation.

"The next steps are to connect with RAMP MD to talk about how they can serve as the organizing body on behalf of the Center to identify what types of apprenticeships and internships could be available," she said.

Because additive manufacturing is still a relatively new industry, the workforce is fairly small. By working with the Commerce

benefits for research and development through enhanced collaboration and cross-pollination with industry peers.

"By connecting with private-sector leaders, we can stay relevant and stay in touch with the people who are making breakthroughs, giving us early access to emerging technologies," Schlein said. "The further ahead we are in the field, the better we can achieve our mission and deliver new capabilities to warfighters."

Retired Brig. Gen. Dean Ertwine, the Commerce Department's assistant director for military and federal affairs, said he saw opportunities for the Center to help grow a burgeoning field by sharing knowledge with industry, especially with small businesses.

"It's fair to say that Aberdeen Proving Ground and the RDECOM C&B Center are on the forefront of additive manufacturing, and we're fortunate for the Center being involved with RAMP MD," he said. "With our awareness now of what's going on at the RDECOM C&B Center, we can tie that in with other manufacturing entities and enable more access, especially for small businesses that have a need for additive manufacturing but might not have the experience or the money."

Schlein told Ertwine and Markley that, through RAMP MD, businesses can pay the RDECOM C&B Center to make products or even to use the equipment directly.

Speaking about how additive manufacturing "enables capabilities that weren't there otherwise," Ertwine pointed out that one mask he saw had pieces that would be "nearly impossible" to create using conventional methods.

"But with additive, it's just a matter of scanning and programming to get an item you couldn't make otherwise," he said. "It's an irreplaceable capability that you just can't do any other way."



Dean Ertwine and Sharon Markley of Maryland's Commerce Department toured the ADM facility with Mark Schlein, RDECOM C&B Center's associate director of product development.

Department, Schlein hopes to grow an effective apprenticeship or internship program, which could in turn boost the Center's production.

"We have a seven acre site with a state-of-the-art lab, so we have a lot of capacity here to perform more product development for the warfighter," Schlein explained. "What we need is a larger workforce to accommodate a surge in production."

Additive manufacturing differs from conventional methods in that instead of manufacturing parts by subtracting from raw materials, this process builds up, essentially printing layers of materials – like plastics and metal powder – to form an object. Combined with computer-aided design, additive manufacturing enables rapid prototyping and reverse engineering to accelerate the design process.

Expanded partnerships could also yield



◀ LEFT: David Love, winner of the Modern-Day Technology Leaders award, mentoring children as part of ACM's national Kids & Chemistry program.



RIGHT: Michael Simini, Ph.D., (left) and Alena Calm ▶ were honored at the NMTC Visionary Awards for STEM Education and Technology & Innovation Advancement.

## In the Community

Three RDECOM C&B Center scientists received awards in February 2018 for their extensive commitment to encouraging the next generation of scientists and engineers in their local communities.

*By Meg Holahan*

RDECOM C&B Center employees consistently go above and beyond their day-to-day commitment to serve the needs of our warfighters and extend their service into their local communities, including three of our RDECOM C&B Center scientists who were recently recognized for their Science Technology Engineering and Mathematics (STEM) outreach activities.

David Love, a chemist and collective protection subject matter expert in the Physical Protection Engineering Branch, received the Black Engineer of the Year Awards' Modern-Day Technology Leaders award in recognition of his STEM mentorship

and outreach efforts. In addition to his active involvement with the American Chemical Society's (ACM) national Kids & Chemistry program, which provides hands-on STEM activities for children ages 9-12, Love mentors local Harford County students and mentored an electrical engineering student from Prairie View A&M University through Aberdeen Proving Ground's Thurgood Marshal Mentoring Program.

At the Northeastern Maryland Technology Council's (NMTC) Visionary Awards for STEM Education and Technology & Innovation Advancement, Alena Calm, a biologist in the BioTechnology Branch, was acknowledged

with the Innovator Award for her personal dedication to developing and implementing innovative programs designed to help build the future STEM-educated workforce. Her outreach efforts have touched students in both Harford and Cecil counties through science fairs, STEM Days and laboratory design assistance, and reached as far as afield as Virginia and Nevada where she traveled to teach students about immunoassays.

Michael Simini, Ph.D., a research biologist in the Molecular Toxicology Branch, was presented with NMTC's Mentor Award for going above and beyond by sharing his knowledge and experience to inspire local students' interest in STEM career fields. In addition to volunteering for more than 20 years as part of the ACM's Kids & Chemistry program, he also participates in the Engineering in Elementary program and is chair of the Chesapeake Chapter of Sigma Xi Scientific Research Honor Society, which provides annual recognition to an outstanding Junior STEM student from every high school in Harford County. ▲



## The U.S. Army Research, Development and Engineering Command Chemical & Biological Center Partners with Maryland Department of Commerce

The recently opened Maryland Defense Technology Commercialization Center, or DefTech, is an innovative workspace co-located with the Harford County Community and Economic Development offices in Havre de Grace. The Edgewood Chemical Biological Center (RDECOM C&B Center) is one of three Aberdeen Proving Ground based Department

of Defense laboratory partners in this federally-funded initiative.

DefTech is an integral part of regional efforts, also supported by the Cecil County government, to bridge the divide between the commercial marketplace and technology developed for military applications. It brings

County and State officials join Maj. Gen. Cedric T. Wins, Commanding General, U.S. Army Research, Development and Engineering Command, Maj. Gen. Randy S. Taylor, Commanding General, U.S. Army Communications-Electronic Command & Senior Commander, Aberdeen Proving Ground and Edgewood Chemical Biological Center Director, Eric Moore, Ph.D. to cut the ribbon on Maryland's Defense Technology Commercialization Center.

local entrepreneurs and companies together with RDECOM C&B Center scientists and engineers provides an opportunity to breathe new and different life into existing U.S. Army technologies. DefTech also brings attention to the possibilities for expanding commercial application of military research and technology efforts, according to Amanda Hess, RDECOM C&B Center Business Management and Integration (BMI) Division.

"Our hope is that the relationships we build with our DefTech partners will help transfer the Army's innovative defense technologies to commercial companies and facilitate Cecil and Harford County business growth," Hess said.

The Center hosts office hours at DefTech every Wednesday from 10 a.m. until 4 p.m. and appointments may be scheduled through the DefTech website at <https://deftechmd.net>. ▲

## Collaboration Corner

By Meg Holahan

### RDECOM C&B Center Director Joins Panel to Inform Potential Industry Partners

U.S. Army Research, Development and Engineering Command Chemical & Biological Center Director Eric Moore, Ph.D., took part in a science and technology panel April 17 alongside Ronald Hann, Ph.D., from the Defense Threat Reduction Agency (DTRA) and Col. Margery Hanfelt from the U.S. Army Medical Research Institute of Chemical Defense (MRICD).

The panel was part of Aberdeen Proving Ground's Discovery Week Advanced Planning Briefing to Industry, meant to inform industry partners about future business opportunities and provide insight on current challenges and priorities in areas including research and development; test and evaluation; and chemical and biological defense.

Moore described RDECOM C&B Center's role

as the technical research, development, and engineering arm of the Chemical Biological Defense Program and highlighted the value of the Center's strong partnerships with DTRA, the science and technology arm, and MRICD, the medical arm. What makes the Center unique, Moore said, is that "the RDECOM C&B Center's combination of scientists and engineers allows us to go from the bench to the battlefield" when developing solutions to address chemical and biological hazards.

His example scenario, which could require simultaneous response to biological and chemical threats or multi-chemical threats, such as the April 2018 attack in Douma, Syria that allegedly included both chlorine and a nerve agent, clearly illustrates the complexity of real-world warfighter challenges. Moore explained that today's evolving threat

environment requires the Center to remain agile and that industry partnerships are critical to the Center's continued successful innovation in promising research areas such as the use of metal-organic frameworks for unique decontamination applications.

To adequately address current and future threats, the RDECOM C&B Center is working to improve access to less traditional partners, including small businesses that explore cutting edge disciplines and technologies like synthetic biology, nanotechnology, and optogenetics. In doing so, Moore hopes that the RDECOM C&B Center can build and expand industry partnerships in an effort to break down and eliminate innovation stovepipes. ▲

# RDECOM C&B Center Division Earns Department of the Army Safety Award

## Chemical Biological Test Division awarded for new risk management approaches

By Bradley Kroner

A team at the U.S. Army Research, Development and Engineering Command Chemical & Biological (RDECOM C&B) Center has earned one of the Army's highest safety awards after establishing new approaches to strengthening laboratory safety practices.

The Chemical Biological Test Division of the RDECOM C&B Center Engineering Directorate earned the Director of Army Safety Risk Management Award, a prestigious award presented by Brig. Gen. David Francis, commanding general of the Combat Readiness Center and director of Army Safety.

Francis presented the award on Jan. 9 in front of 100 Aberdeen Proving Ground (APG) safety officials during a safety briefing at APG North.

"The work this team does is exponentially dangerous, and it is directly applicable to what we're going to face in the future," Francis said. "This team took the initiative and showed the leadership how to take their own time and find ways to make their work safer. Their work is commendable and will improve both safety and readiness in the future."

The safety rules were developed through a committee comprised of multiple division staff members, as opposed to being created and handed down from the safety office. With members from each of the division's three branches, the committee examined the directorate's 15 safety initiatives and sought to create more tangible, clearly defined rules for safety and surety.

"One way we could make these safety initiatives more meaningful is to start in the lab with the staff that are in the lab and look at safety at that level," said Matt Shue, chief of the Chemical Biological Test Division. "Our goal was to take a look at the safety initiatives and what they were intended to do. More than that, we wanted to take a look around the labs at our operations and find things that are specific examples of what we can improve - tangible changes."

One outcome is a "sterile cockpit" rule to combat complacency. Used by airplane flight crews during critical times in flight, the rule is aimed at focusing crew members on the task at hand, instead of non-essential duties or activities like idle chat. Through this culture change, readiness is improved.

"We can't ever lose sight of what we're doing, how we're doing it, and why we're doing it," Shue said. "This is serious business and we shouldn't be chit-chatting about what we did last weekend."

Other outcomes include changing the vessels for storing, transferring, and delivering chemical agent; preparing chemical agent fact sheets for awareness; and installing lockboxes with medical countermeasures.

"We installed individual storage boxes that are all uniquely keyed so that the operators can have their medical countermeasures all in the same spot," Shue explained.

Additionally, the division is holding more "deep dive" reviews of standard operating procedures

the CB Test Division is a prime example," wrote Andrew Cote, a certified safety professional in the RDECOM C&B Center office of safety and human capital, in the nomination. "The CB Test Division's efforts have strengthened their posture for working with the most toxic compounds known to mankind and have served as a stepping stone to strengthen its safety culture for the next generation."

The RDECOM C&B Center directors concurred with the nomination and presented the award. Subsequently, the team was nominated for Department of Army Safety Risk Management Award, a nomination that was endorsed by the RDECOM C&B Center Director Eric Moore, Ph.D.

"The CB Test Division's initiatives have improved their ability to safely work with the most toxic compounds known to mankind and have served as a stepping stone to strengthen its safety culture for the next generation," Moore wrote in an endorsement to Maj. Gen. Cedric Wins, commanding general of U.S. Army Research, Development and Engineering Command. "The CB Test Division won the RDECOM C&B Center Excellence in Safety Award and is greatly deserving of higher level awards such as this prestigious award."

Historically, the Director of Army Safety Risk Management Award is a difficult award to win. Multiple awards can be presented through the Army world to individuals or organizations that demonstrate outstanding performance in the field of Risk Management (RM). RM is defined as the Army's principal decision-making process used to identify and assess hazards, determine and control risks and ultimately, prevent both accidental and tactical losses.

The RDECOM C&B Center previously won the award in 2015 for successfully destroying 600 metric tons of Syria's declared chemical warfare material aboard the MV Cape Ray using the Field Deployable Hydrolysis System. Safety was a critical component of the mission, which was completed in just 42 days, without any reportable accidents or releases to the environment. 🏆



to strengthen knowledge and promote cross-training in different areas.

"We come together as a big group, and it's been pretty effective," Shue said, explaining that the reviews serve as "multifunctional meetings" providing a roadmap for improved safety and professional development. "Everybody has a voice in it from the operator level up."

Shue called the award "a team effort and a team award," and noted, "We just want to make sure everybody is as safe as possible."

For their efforts, the division was successfully nominated for the 6th annual RDECOM C&B Center Excellence in Safety Award.

"The RDECOM C&B Center has encouraged the workforce to come up with innovative solutions to ensure that safety is of paramount importance and the creation of the Safety Initiatives Team and the work they have done in

# Publications and Patents

Quarterly listing

This page contains a list of U.S. patents recently awarded to the RDECOM C&B Center and a list of peer-reviewed journal articles recently published on research conducted by RDECOM C&B Center scientists. Both lists span dates from January 1, 2018 through April 15, 2018.

## PUBLICATIONS

(RDECOM C&B Center authors in bold)

**Title:** Molecular Dynamics Study of Competing Hydrogen Bonding Interactions in Multicomponent Diffusion in Polyurethanes

**Author(s):** **Varady, MJ; Knox, CK; Cabalo, JB; Bringuier, SA; Pearl, TP; Lambeth, RH; Mantooth, BA**

**Source:** POLYMER **Volume:** 140 **Pages:** 140-149

**Published:** March 28, 2018

**Title:** Computational Modeling of the Structure and Properties of Zr(OH)(4)

**Author(s):** **Iordanov, IO; Berrnudez, VM; Knox, CK**

**Source:** JOURNAL OF PHYSICAL CHEMISTRY C **Volume:** 122

**Issue:** 10 **Pages:** 5385-5400

**Published:** March 15, 2018

**Title:** Metal-Organic Framework Modified Glass Substrate for Analysis of Highly Volatile Chemical Warfare Agents by Paper Spray Mass Spectrometry

**Author(s):** **Dhummakupt, ES; Carmany, DO; Mach, PM; Tovar, TM; Ploskonka, AM; Demond, PS; DeCoste, JB; Glaros, T**

**Source:** ACS APPLIED MATERIALS & INTERFACES **Volume:** 10

**Issue:** 9 **Pages:** 8359-8365

**Published:** March 7, 2018

**Title:** Local Structure of Zr(OH)(4) and the Effect of Calcination Temperature from X-ray Pair Distribution Function Analysis

**Author(s):** **King, G; Soliz, JR; Gordon, WO**

**Source:** INORGANIC CHEMISTRY **Volume:** 57 **Issue:** 5

**Pages:** 2797-2803

**Published:** March 5, 2018

**Title:** Evaluation of Commercial-off-the-Shelf Materials for the Preservation of Bacillus anthracis Vegetative Cells for Forensic Analysis

**Author(s):** **Angelini, DJ; Harris, JV; Burton, LL; Rastogi, PR; Smith, LS; Rastogi, VK**

**Source:** JOURNAL OF FORENSIC SCIENCES **Volume:** 63

**Issue:** 2 **Pages:** 412-419

**Published:** March 2018

**Title:** Selenium Toxicity to Survival and Reproduction of Collembola and Enchytraeids in a Sandy Loam Soil

**Author(s):** **Kuperman, RG; Checkai, RT; Simini, M; Phillips, CT; Higashi, RM; Fan, TW; Sappington, K**

**Source:** ENVIRONMENTAL TOXICOLOGY AND CHEMISTRY

**Volume:** 37 **Issue:** 3 **Pages:** 846-853

**Published:** March 2018

**Title:** MOFwich: Sandwiched Metal-Organic Framework-Containing Mixed Matrix Composites for Chemical Warfare Agent Removal

**Author(s):** **Peterson, GW; Lu, AX; Hall, MG; Browe, MA; Tovar, T; Epps, TH**

**Source:** ACS APPLIED MATERIALS & INTERFACES **Volume:** 10

**Issue:** 8 **Pages:** 6820-6824

**Published:** February 28, 2018

**Title:** Solvent-Assisted Desorption of 2,5-Lutidine from Polyurethane Films

**Author(s):** **Boyne, DA; Varady, MJ; Lambeth, RH; Eikenberg,**

**JH; Bringuier, SA; Pearl, TP; Mantooth, BA**

**Source:** JOURNAL OF PHYSICAL CHEMISTRY B **Volume:** 122

**Issue:** 7 **Pages:** 2155-2164

**Published:** February 22, 2018

**Title:** Proteomic Characterization of Dermal Interstitial Fluid Extracted Using a Novel Microneedle-Assisted Technique

**Author(s):** **Tran, BQ; Miller, PR; Taylor, RM; Boyd, G; Mach, PM; Rosenzweig, CN; Baca, JT; Polsky, R; Glaros, T**

**Source:** JOURNAL OF PROTEOME RESEARCH **Volume:** 17

**Issue:** 1 **Pages:** 479-485

**Published:** January 2018

**Title:** Sorption and Desorption Kinetics of Nitroglycerin and 2,4-Dinitrotoluene in Nitrocellulose and Implications for Residue-Bound Energetic Materials

**Author(s):** **Kuo, DTF; Simini, M; Allen, HE**

**Source:** WATER RESEARCH **Volume:** 128 **Pages:** 138-147

**Published:** January 1, 2018

**Title:** Resuspension of House Dust and Allergens During Walking and Vacuum Cleaning

**Author(s):** **Lewis, RD; Ong, KH; Emo, B; Kennedy, J; Kesavan, J; Elliot, M**

**Source:** JOURNAL OF OCCUPATIONAL AND ENVIRONMENTAL HYGIENE **Volume:** 15 **Issue:** 3 **Pages:** 235-245

**Published:** 2018

## PATENTS

**Layered or mixed sorbent bed protective filtration device**

Patent number 9,931,592

Issued April 3, 2018

**Device for detecting and decontaminating hazardous chemicals**

Patent number 9,925,520

Issued March 27, 2018

**Composition of magnetic materials for sensing and decontaminating toxic chemicals**

Patent number 9,925,519

Issued March 27, 2018

**Layered or mixed sorbent bed protective filtration device**

Patent number 9,908,076

Issued March 6, 2018

**Porous metal hydroxides for decontaminating toxic agents**

Patent number 9,907,988

Issued March 6, 2018

**Multi-functional media for the removal of basic and acidic gases and other toxic vapors**

Patent number 9,895,674

Issued February 20, 2018

**Removal of nitrogen dioxide from gas environments using metal-organic frameworks**

Patent number 9,868,107

Issued January 16, 2018



Soldiers using the proposed field deployable contamination method would be able neutralize a munition in the field without presenting a public health or environmental concern.

# Field Deployable Decontamination

Researchers develop methods to mitigate threats in the field

*By Bradley Kroner*

Researchers at the U.S. Army Research, Development and Engineering Command Chemical & Biological (RDECOM C&B) Center are developing field deployable decontamination methods for situations where a warfighter may encounter small stockpiles of chemical agent.

Small stockpiles pose a threat to warfighters and their mission, and the size of the stockpile can present a logistical challenge for decontamination. By drilling into agent shells and injecting a chemical, warfighters can start a chemical reaction that renders the agent unusable for military purposes.

"This aims to address a scenario in which an Army unit comes across a clandestine laboratory that produces chemical weapons or a small stockpile with bulk agent or munitions," said David McGarvey, Ph.D., the RDECOM C&B Center project lead. "This project will enhance their ability to mitigate the threat and potentially transport it."

Without a decontamination method, Soldiers

may face transporting the agent, which would be a significant logistical challenge and could disrupt their mission. Detonating the agent would present public health and environmental concerns. RDECOM C&B Center research, done in partnership with Dr. William Creasy of Leidos Corporation, as well as Dr. Mark Kinnan and other scientists from the U.S. Department of Energy, is nearing a solution.

"By drilling into the shell and adding a chemical to the chemical weapon, Soldiers can plug the shell and walk away knowing that it's no longer capable of being used for military purposes," McGarvey explained.

Funded by the Defense Threat Reduction Agency, the capability is estimated to be two to three years from deployment, McGarvey said. So far, the methods have proved effective on the laboratory scale.

It's too soon to say specifically what materials are being used, but the two primary decontamination methods are hydride reduction, which breaks chemical bonds

into starting materials, and nitride reactions, which have proven highly effective but are less understood.

"With the nitride, we know it works, and we're investigating the chemistry of how it works," McGarvey explained. "Part of our mission is understanding the details in order to optimize reaction conditions."

"We've shown it's effective in small quantities," McGarvey said. "We're scaling up this year to larger scale testing, eventually looking at reacting a liter at a time."

The methods are being tested against all the major classes of agent – mustard, G-series, and VX.

"We're also looking at two binary chemical weapon materials – QL, part of a binary VX weapon, and DF, part of a binary G-series agent used in sarin," McGarvey said. "We've seen a good level of capability against all three of those classes." ▲



A half century old and suspected to be significantly contaminated, the Amos A. Fries Research Laboratory, also known as the Super Toxic Lab, is first on the demolition list.

# Demolitions Begin with Amos A. Fries Research Laboratory

Fifty-year-old toxic lab under remediation, demolition

*By Bradley Kroner*

A decade-long initiative to remediate and demolish old buildings at the U.S. Army Research, Development and Engineering Command Chemical & Biological (RDECOM C&B) Center has begun with the remediation of the 50-year-old Amos A. Fries Research Laboratory, Building E3300. The E3300 clean-up effort is being conducted by the RDECOM C&B Center Chemical Biological Application and Risk Reduction (CBARR) business unit.

"This demolition puts us on the right path to addressing our responsibility to the legacy buildings and our mission at Edgewood," said Col. Robert Phillips, Aberdeen Proving Ground's garrison commander. "It's reassuring to know that the people doing this have a proven track record of responsible and safe remediation and demolition. With their level of experience, CBARR is the right team for the job."

The initiative, expected to cost \$507 million over 10 years and \$20 million in 2018, is aimed at eliminating unused and obsolete buildings and modernizing Aberdeen Proving Ground's infrastructure, a key priority for the Army. Most of the 63 buildings on the demolition list are over 50 years old and the majority are no longer used.

"The decision to move out of a building is driven by building condition and its ability to execute the mission," said Mark Schaller, RDECOM C&B Center's facilities lead. "The focus for the Garrison and the RDECOM C&B Center is to reduce the footprint of these older unoccupied buildings along the 'technology corridor' of Aberdeen Proving Ground's Edgewood Area and make room for future building construction within the main RDECOM C&B Center campus. The 'technology corridor' includes not only

RDECOM C&B Center buildings but also the U.S. Army Medical Research Institute of Chemical Defense and the Public Health Center laboratories."

The construction of the Amos A. Fries Research Laboratory began in 1963 and was completed in 1967. It remained in use until 2014, when it was taken out of service and the majority of its operations were shifted to Bldg. E3400. Now, the building is the first to begin the demolition process.

"The decision to start with this building was driven by risk and continuing sustainment cost," Schaller said, explaining that "due to the potential residual contamination in hoods, drains, and ductwork, the building has continued to run its toxic exhaust filter systems and required heating to protect utility systems

from freezing.”

Without running those systems, it’s possible that chemicals could be released from contaminated equipment. Before the building can be razed, it must undergo a remediation process to ensure that no contamination remains prior to the demolition.

The Amos A. Fries lab known as the Super Toxic Lab. Traditional chemical and biological surety material, experimental agents, toxins, heavy metals, organic and inorganic compounds, radioactive isotopes, and mixtures of these substances were handled in this lab.

“It’s an old building -- not that it’s unserviceable,

## “When we get this done, it becomes the model for 42 other demolitions”

Tom Rosso | CBARR business manager

but it takes a lot to keep running,” said Cheryl Kyle, a CBARR project manager for the effort. “Because of the wide and extensive use of toxic materials in the labs of E3300, there are a lot of eyes on this process. We have placed the highest priority on E3300 and want it to be the first one to come down.”

“The chemicals themselves are no longer inside the building -- they were removed with the building’s closure. Where the concern lies is with equipment and objects that may have been previously exposed and contaminated by the chemicals,” said Kyle.

The CBARR business unit specializes in conducting chemical and biological operations with an emphasis on safety and surety. “Our staff is extremely well trained in handling agent, decontaminating buildings, and operating filtration systems,” Kyle said. “We have performed this type of work in the past at Aberdeen Proving Ground’s Edgewood Area, on buildings such as the Pilot Plant (E5625) and several other legacy structures.”

For the next two years, CBARR will be remediating the interior of the building to ensure the removal of contaminated materials prior to its demolition in the third year.

“When we get this done, it becomes the model for 42 other demolitions,” said CBARR Business Manager Tom Rosso.

CBARR will first remove materials with a low probability of contamination such as benches and ceiling tiles, which most likely weren’t exposed to agent, and then move to the higher

probability items like fume hoods and drains, which CBARR suspects were exposed to agent. However, throughout the remediation process the building will remain under continuous filtration.

“Without removing these items, you run the risk of exposing demolition contractors to chemical and biological hazards inside the building,” Kyle explained. “Also, if not removed, those chemicals could be released into the air when the building comes down.”

Low probability items will be sent to a landfill with permits consistent with the Resource Conservation and Recovery Act. High probability items will be incinerated.

After the two-year remediation is completed, the U.S. Army Corps of Engineers will handle the razing of the building.

Concurrent with the demolition effort, the RDECOM C&B Center is planning for future infrastructure investments that include reuse of the E3300 and E3200 Block areas. 🏗️



Tom Rosso, CBARR’s business manager, leads a tour of the laboratory and explains CBARR’s remediation plan.



Much of the remediation efforts will focus on fumehoods like this, which were likely exposed to chemical agent.



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