CHEMICAL AND BIOLOGICAL DEFENSE PROGRAM
SBIR 06.1 Proposal Submission

General Information

In response to Congressional interest in the readiness and effectiveness of U.S. Nuclear, Biological and Chemical (NBC) warfare defenses, Title XVII of the National Defense Authorization Act for Fiscal Year 1994 (Public Law 103-160) required the Department of Defense (DoD) to consolidate management and oversight of the Chemical and Biological Defense (CBD) Program into a single office – the Deputy Assistant Secretary of Defense, Chemical and Biological Defense Programs, DATSD (CBD). The Joint Science and Technology Office for Chemical and Biological Defense (JSTO-CBD), Defense Threat Reduction Agency (DTRA) provides the management for the Science and Technology component of the Chemical and Biological Defense Program. Technologies developed under the SBIR program have the potential to transition to the Joint Program Executive Office for Chemical and Biological Defense (JPEO-CBD) if the appropriate level of technology maturity has been demonstrated. The JSTO-CBD Science & Technology programs and initiatives are improving defensive capabilities against Chemical and Biological Weapons. The executive agent for the Small Business Innovation Research (SBIR) portion of the CBD Program is the Army Research Office-Washington (ARO-W) (www.aro.army.mil/arowash/rt/).

The mission of the Chemical and Biological Defense Program is to ensure that the U.S. military has the capability to operate effectively and decisively in the face of biological or chemical warfare threats at home or abroad. Numerous rapidly-changing factors continually influence the program and its management, including planning for war-fighting support to asymmetrical threats, the evolving geopolitical environment, U.S. participation in the Chemical Weapons Convention, the threat of global proliferation of chemical and biological weapons, and DoD resources available. Improved defensive capabilities are essential in order to minimize the impact of such weapons. U.S. forces require aggressive, realistic training and the finest equipment available that allows them to avoid contamination, if possible, and to protect, decontaminate and sustain operations. Further information about the DoD CBD Program (and related programs) is available at the DoD Counter proliferation and Chemical Biological Defense Homepage at http://www.acq.osd.mil/cp.

The overall objective of the CBD SBIR Program is to improve the transition or transfer of innovative CBD technologies between DoD and the private sector for mutual benefit. The CBD SBIR Program targets those technology efforts that maximize a strong defensive posture in a biological or chemical environment using passive and active means as deterrents. These technologies include chemical and biological detection; individual and collective protection; decontamination; modeling & simulation; threat agent science; and medical pre-treatments, diagnostics, and therapeutics.

Submitting Your Phase I CBD SBIR Proposal

Your entire proposal (consisting of Proposal Cover Sheets, the full Technical Proposal, Cost Proposal, and Company Commercialization Report) must be submitted electronically through the DoD SBIR/STTR Proposal Submission system located at www.dodsbir.net/submission. A hardcopy is NOT required for CBD. Hand or electronic signature on the proposal is also NOT required.

You must prepare a Company Commercialization Report through the Submission site and it will be included with your electronic submission; however, it does not count against the proposal page limit. Update your commercialization information if you have not done so in the past year. Please note that improper handling of the Commercialization Report may result in the proposal being substantially delayed and that information provided may have a direct impact on the review of the proposal. Refer to section 3.5d at the program solicitation for detailed instructions on the Company Commercialization Report.

Be reminded that section 3.5.a of this solicitation states: “If your proposal is selected for award, the technical abstract and discussion of anticipated benefits will be publicly released on the Internet; therefore, do not

include proprietary or classified information in these sections". Note also that the DoD web site contains timely information on firm, award, and abstract data for all DoD SBIR Phase I and II awards archived for several years. This information can be viewed on the DoD SBIR/STTR website at http://www.acq.osd.mil/sadbu/sbir/.

The CBD Program has enhanced its Phase I-Phase II transition process by implementing the use of a Phase I Option that may be exercised to fund interim Phase II activities while a Phase II contract is being negotiated. The maximum dollar amount for a Phase I feasibility study is $70,000. The Phase I Option, which **must** be proposed as part of the Phase I proposal, covers activities over a period of up to three months and at a cost not to exceed $30,000. All proposed Phase I Options must be fully costed and should describe appropriate initial Phase II activities, which would lead, in the event of a Phase II award, to the successful demonstration of a product or technology. **The CBD program will not accept Phase I proposals which exceed $70,000 for the Phase I effort and $30,000 for the Phase I Option effort**. Only those Phase I efforts selected for Phase II awards through the CBD SBIR Program's competitive process will be eligible to exercise the Phase I Option. To maintain the total cost for SBIR Phase I and Phase II activities at a limit of $850,000, the total funding amount available for Phase II activities under a resulting Phase II contract will be $750,000.

Companies submitting a Phase I proposal under this Solicitation must complete the Cost Proposal using the on-line form within a total cost of $70,000 over a period of up to 6 months (plus up to $30,000 for the Phase I Option over a period of up to three (3) months). Phase I and Phase I Option costs must be shown separately.

Selection of Phase I proposals will be based upon scientific and technical merit, according to the evaluation procedures and criteria discussed in section 4.2. The CBD SBIR Program reserves the right to limit awards under any topic, and only those proposals of superior scientific and technical quality in the judgment of the evaluators will be funded.

Proposals not conforming to the terms of this solicitation, and unsolicited proposals, will not be considered. Awards are subject to the availability of funding and successful completion of contract negotiations.

CBD Program Phase II Proposal Guidelines

Phase II is the demonstration of the technology that was found feasible in Phase I. Only those Phase I awardees which achieved success in Phase I, as determined by the project technical monitor measuring the results achieved against the criteria contained in section 4.3, will be invited to submit a Phase II proposal. During or at the end of the Phase I effort, awardees will be invited to submit proposals for evaluation for a Phase II award. The invitation will be issued in writing by the organization responsible for the Phase I effort. Invited proposers are required to develop and submit a commercialization plan describing feasible approaches for marketing the developed technology. Fast Track participants may submit a proposal without being invited, but the application must be received not later than 120 days after the Phase I contract is signed or by the Phase II submission date indicated later, whichever date is earliest. The Fast Track technical proposal is due by the Phase II proposal submission date indicated later. Cost-sharing arrangements in support of Phase II projects and any future commercialization efforts are strongly encouraged, as are matching funds from independent third-party investors, per the SBIR Fast Track program (see section 4.5 at the front of this solicitation). The Fast Track application form must be completed electronically by firms through the DoD SBIR/STTR Submission Site (http://www.dodsbir.net/submission). Commercialization plans, cost-sharing provisions, and matching funds from investors will be considered in the evaluation and selection process and Fast Track proposals will be evaluated under the Fast Track standard discussed in section 4.3 at the front of this solicitation. Proposers are required to submit a budget for the entire 24 month Phase II period. During contract negotiation, the contracting officer may require a cost proposal for a base year and an option year, thus, proposers are advised to be mindful of this possibility. These costs must be submitted using the Cost Proposal format (accessible electronically on the DoD submission site), and may be presented side-by-side on a single Cost Proposal Sheet. The total proposed amount should be indicated on the Proposal Cover Sheet as the Proposed Cost. At the Contracting Officer's discretion, Phase II projects may be evaluated after the base year prior to extending funding for the option year.

The CBD Program is committed to minimizing the funding gap between Phase I and Phase II activities. All CBD Phase II proposals will receive expedited reviews and be eligible for interim funding (refer to top for

information on the Phase I Option). Accordingly, all Phase II proposals, including Fast Track submissions, will be evaluated within a single two-tiered evaluation process and schedule. Phase II proposals will thus typically be submitted within 5 months from the scheduled DoD Phase I award date (the scheduled DoD award date for Phase I, subject to the Congressional Budget process, is 4 months from close of the DoD Solicitation). The CBD Program typically funds a cost plus fixed fee Phase II award, but may award a firm fixed price contract at the discretion of the Contracting Officer.

Key Dates

06.1 Solicitation Open/Close	13 December 2005 – 13 January 2006
Phase I Evaluations	January - March 2006
Phase I Selections	March 2006
Phase I Awards	May 2006*
Phase II Invitations	September 2006
Phase II Proposals due	October 2006
Fast Track Applications due	September 2006
Fast Track Proposals due	October 2006

*Subject to the Congressional Budget process.

CBD SBIR PROPOSAL CHECKLIST

This is a Checklist of Requirements for your proposal. Please review the checklist carefully to ensure that your proposal meets the CBD SBIR requirements. **Failure to meet these requirements will result in your proposal not being evaluated or considered for award**.

_____ 1. The Proposal Cover Sheets along with the Technical Proposal, Cost Proposal and Company Commercialization Report were submitted via the Internet using the DoD's SBIR/STTR Proposal Submission website at http://www.dodsbir.net/submission.

_____ 2. The proposal cost adheres to the CBD Program criteria specified.

_____ 3. The proposal is limited to only **ONE** solicitation topic. All required documentation within the proposal references the same topic number.

_____ 4. The Project Abstract and other content provided on the Proposal Cover Sheet contains no proprietary or classified information and is limited to the space provided.

_____ 5. The Technical Content of the proposal, including the Option (if applicable), includes the items identified in Section 3.4 of the solicitation.

_____ 6. The technical proposal, Proposal Cover Sheets and Cost Proposal together is 25 pages or less in length. Pages in excess of this length will not be considered for review or award.

_____ 7. The Company Commercialization Report is submitted online in accordance with Section 3.5.d. This report is required even if the company has not received any SBIR funding. (This report does not count towards the 25-page limit).

_____ 8. The proposal contains no type smaller than 11-point font size (except as legend on reduced drawings, but not tables).

CBD SBIR 06.1 Topic Index

CBD06-101 TITLE: Low-Output, Rate-Adjustable Dry Powder Disseminator

TECHNOLOGY AREAS: Chemical/Bio Defense, Human Systems

OBJECTIVE: Design and build a contained (leak-proof), portable, low-output, rate-adjustable dry powder disseminator that does not generate charges on the powder particles during dissemination.

DESCRIPTION: Performance evaluation of biological aerosol detection/identification systems against biological warfare agent attacks in open field or test chamber testing requires a supply of dry biological aerosol particles made up of material at a density of about 1.2 gm/c.c. (actual density of matter without voids), with particle aerodynamic diameter in the 1 – 10 micron range. Currently available powder disseminators, while performing satisfactorily in open field testing, are unable to generate aerosols at low rates that are suitable for detection sensitivity tests of the detectors in chamber or ambient breeze tunnel testing. With the modification and fine-tuning of the existing technology, it is likely the requirement can be met. This topic solicits proposals to design and develop a portable, low-output dry powder disseminator that disperses 1-10 micron powder at variable rates from approximately 350 nanogram/minute to 1 mg/minute. Further, it is important that throughout the dissemination process, the dry powder particles remain neutral and do not carry positive or negative charges. Proposals should include a full description on the concept as how the lower limit of 350 ng/min can be achieved.

PHASE I: Develop an overall system design that can demonstrate the likelihood that this research and development approach can meet the requirements discussed in this topic. The design should allow the dissemination of powders in the 1–10 micron range. Biological simulants such as Bacillus subtilis var. niger spores, ovalbumin, and lyophilized preparation of Erwinia herbicola, a vegetative bacterium, and biological agents such as anthrax spores and lyophilized preparation of Yersinia pestis are candidates for dissemination development.

PHASE II: Develop and demonstrate a prototype system for the approach described, and conduct testing with simulants to demonstrate the feasibility for use in test chamber environment. Test chambers to be used in dissemination demonstration range from a one cubic meter Plexglasâ box to a 75-cubic meter glass and stainless steel walk-in type chamber. It is a requirement that the particulates do not cling to the walls of the chambers during the dissemination process.

PHASE III DUAL USE APPLICATIONS: This system has potential for use in environmental fields, e.g., it can be used to disseminate particles at controlled rate for air filter efficiency testing. It can also be used in medical field, e.g., powder inhalant dispenser.

REFERENCES:

Muhammad E. Fayed and Lambert Otten, Eds. Handbook of Powder Science & Technology, 2nd Edn., Chapman & Hall, New York, 1997.

Christopher S. Cox and Christopher M. Wathes, Eds. Bioaerosols Handbook, CRC press, 1995.

KEYWORDS: powder, disseminator, low-output, aerosol,

CBD06-102 TITLE: Realtime Detection And Identification Of Airborne Microorganisms Using Infrared Spectroscopy

TECHNOLOGY AREAS: Chemical/Bio Defense

ACQUISITION PROGRAM: JPBDS, JSAWM

OBJECTIVE: Develop the capability to concentrate airborne microorganisms and present the sample to an infrared spectrometer for detection and identification. Near real-time detection capabilities are required.

DESCRIPTION: Infrared spectroscopy has been used successfully to detect and classify microorganisms down to the genus and species level. Commercial applications utilizing this technology are beginning to appear. Techniques for extracting high quality infrared signatures from small quantities of material have also appeared. Current techniques such as lateral-flow-immunoassay and PCR technologies require microgram quantities of bacillus spore material for analysis. It is possible that infrared spectral analysis can be competitive with more traditional methods of biodetection if techniques for isolating microgram quantities of bacillus spores from environment and presenting the sample to the infrared spectrometer can be developed. The goal of this effort is to extract 0.1 microgram quantities of bacillus subtilis spores (approximately 10000 spores) from the environment and to detect and identify the organisms in real-time using infrared spectroscopy.

PHASE I: Techniques for concentrating aerosolized bacillus spores from the environment and presenting the collected to in infrared spectrometer will be developed. Techniques for filtration and electrostatic concentration will be examined. The system shall be able to detect and identify bacillus spores based on the infrared signature. Phase I is a feasibility study that may utilize a commercial IR spectrometer. The goal of the phase I effort is to develop a system that can concentrate and detect as few as 100000 bacillus subtilis spores (approximately 1.0 microgram of bacillus spores).

PHASE II: The system shall be integrated into a prototype system that includes both the collection/concentration system and the infrared spectrometer. An integrated concentration/detection system with reasonable concentration efficiencies shall be developed. The integrated system shall detect and identify as few as 10000 bacillus subtilis spores collected from the atmosphere (approximately 0.1 microgram of bacillus spores). This is approximately the number of spores that would reside in a monolayer of spores with an area of approximately 1 square millimeter.

PHASE III DUAL USE APPLICATIONS: If successful, this effort would yield a sensor capable of detecting airborne bacterial species without the use of perishable reagents. Rapid detection and identification of microorganisms have numerous applications in the medical and heath industries.

REFERENCES:

Classification and identification of bacteria by Fourier-transform infrared spectroscopy
D. Helm, Labischinski, G. Schallehn, and D. Naumann, .J. Gen Microbiol. 1991 Vol. 137, pp. 69-79.

Identification of medically relevant microorganisms by vibrational spectroscopy, K. Maquelin, C. Kirshner, L.P. Choo-Smith, N. van den Braak, H. Ph. Endtz, D. Naumann, and G.J. Puppels, J. Mircobiological Methods, 2002, Vol. 51, pp. 255-271.

Identification of coryneform bacteria and related taxa by Fourier-transform infrared (FT-IR) spectroscopy, H. Oberreuter, H. Seiler, and S. Scherer, International Journal of Systematic and Evolutionary Microbiology, Vol 52, pp.91-100.

The characterization of microorganisms by Fourier-transform infrared spectroscopy (FT-IR), D. Naumann, D. Helm, H. Labischinski, and P Giesbrecht, Mod. Tech. Rapid Microbiol. Anal., pp. 43-96. Edited by: Wilfred H. Nelson, VCH: New York, N. Y., 1991.

Microbiological characterizations by FT-IR spectroscopy., D. Naumann, D. Helm, and H. Labischinski,. Nature. 1991, Vol. 351, pp.81-2.

Biosensors for detection of pathogenic bacteria, D. Ivnitski, I. Abdel-Hamid, P. Atanasov, and E. Wilkins, Biosensors and Bioelectronics, 1999, vol. 14, no. 7, pp. 599-624.

Rapid detection and identification of bacterial strains by Fourier transform near-infrared spectroscopy., L.E. Rodriguez-Saona, F.M. Khambaty, F.S. Fry, and E.M. Calvey,
J Agric Food Chem. 2001, Vol 49, pp .574-9.

Discrimination of species in the genus Listeria by Fourier transform infrared spectroscopy, C. Holt, D. Hirst, A. Sutherland, F. MacDonald, Applied and Environmental Microbiology, 1995, Vol.61, No. 1, pp. 377–378.

Quantification of micro-organisms in binary mixed populations by Fourier transform infrared (FT-IR) spectroscopy, H. Oberreuter, F. Mertens, H. Seiler and S. Scherer
Letters in Applied Microbiology, 2000, Vol. 30, Issue 1, pp. 85.

Evaluation of infrared spectroscopy as a bacterial identification method.A.H. Lipkus, K.K. Chittur, S.J. Vesper, J.B. Robinson, and G.E. Pierce, J Ind Microbiol.,1990 Vol 6, No.1, pp.71-5.

KEYWORDS: Reagentless Biodetection, Infrared Spectroscopy, Electrostatic concentration, filtration.

CBD06-103 TITLE: High Sensitivity Receiver For Optimized Standoff Active Chem-Bio Sensor

TECHNOLOGY AREAS: Chemical/Bio Defense

ACQUISITION PROGRAM: PM Artemis

OBJECTIVE: We are seeking novel approaches to develop and demonstrate receiver sensor technology for detection of airborne toxic industrial chemical compounds, battlefield chemicals, and biological agents. The intent of the new receiver technology is to develop a robust sensor, with optimized sensitivity that can obtain spectral signatures of target chem-bio species using active standoff detection.

DESCRIPTION: Innovative and creative approaches to this research and development effort are requested to design and validate a high sensitivity receiver applicable to standoff detection of industrial and battlefield chemicals and biological agents from diverse platforms, including fixed site, vehicle, airborne, and man-portable types. Significant flexibility is allowed in formulating proposed approaches to meet the program goals. This effort directly supports both short-range and long-range goals for Contamination Avoidance, specifically in the Artemis, Joint Biological Standoff Detection System, Joint Surface Contamination Detector, Joint Service Wide Area Detector, and Joint Decon Visualization System programs.

It is well established that chemical and biological (bio) agents can be detected and discriminated with the use of lasers at ranges up to 10 – 20 km (chemical) and less than 5 km (bio) depending on concentrations and atmospheric conditions. Improving these parameters would be of immense value to the military, resulting in either or both decreased size/weight and cost.

Obviously, increasing the output power of the laser is not a desirable solution beyond a certain point. However, increasing the sensitivity of the detector would go a long way towards solving the problem.

In the past few years, experiments have shown that bio agents can be detected with fluorescence induced with ultraviolet (UV) laser radiation. More recently, other wavelengths within the 3 to 5 micrometer band (mid IR) are showing promise of even being a superior detection mechanism for bio detection. In addition, within the last two years, long infrared wavelengths (9 to 11 micrometers) accessible with the highly efficient CO2 laser, have shown the ability of detecting not only bio, but all common nerve and blister chemical agents, both in aerosol and vapor form. These exciting new developments could all benefit from increased detector sensitivity.

It is anticipated that the new research called for within this proposal would be focused more within the longer wavelength bands than within the shortest, UV band. The reason for this is that the current photomultiplier tube technology is close to its theoretical limits already and (perhaps even more importantly) atmospheric transmission within the ultraviolet is so limiting that great improvements are probably not reasonable to expect. The same limitations are not true with the mid and long IR bands. Because the long IR region is even more useful than the mid IR, a successful bidder must address at least this region.

As an example of the current state of the art, a laser radar (lidar) capable of meeting current chemical detection standoff requirements might have:
Energy per pulse = 100 to 200 mJoule
Pulse length = 100 nsec (one half the energy with the rest within 1 microsecond)
Repetition rate = 200 Hertz tunable from shot to shot within 64 lines of the CO2 laser spectrum including the 9P44 line.
Collection aperture = 14 inches
Field of view = 3 mrad

The detector is assumed to be mercury cadmium telluride (HgCdTe) with a nominal 1 mm square area, thus yielding a noise equivalent power (NEP) of approximately 3 nW at a bandwidth (BW) of 1 MHz. Manufacturers commonly specify this value in terms of the so-called Dstar = detector diam * (BW)1/2 * 1/NEP, which is normalized to detector area and bandwidth. Most detector Dstars are in the range of 1 to 4 x1010 cm-Hz1/2/watt and the magnitude of the detected signal to noise ratio depends directly on this quantity. This figure is limited by both the intrinsic detector/preamplifier noise, as well as the thermal noise fluctuations (so-called blackbody shot noise) of the 300K background. It is important to increase the effective Dstar by limiting the amount of blackbody radiation collected. This is currently done using a cooled aperture limiting the detector FOV. The performance can be improved by utilizing a cooled narrow band spectral filter, greatly improving the effective sensitivity of existing lidars. Factors of ten are not unreasonable although more precise calculations and measurements must be done. As noted, the preamplifier noise at some point may dominate the background limit. Thus cooling (It should be understood that “cooling” within this proposal denotes no lower than liquid nitrogen temperatures.) of this component may become important. Finally, it may be that using smaller detector elements can yield enough improvement in lower noise to justify smaller fields of view. It might even be that instead of using a single large element, one would be better off with an array of smaller, lower noise chips and then scan the same area that would have been interrogated with the larger spot. In summary, it is possible that very important increases in lidar performance can be obtained through any or all of these methods.

The results of this effort will be applied in the near-term to the Artemis acquisition program to enhance its CB detection capabilities on the multiple platforms for which it is being developed.

PHASE I: Phase I will be directed to analysis and design of an innovative, compact, rugged receiver incorporating technology or technologies that increase sensor sensitivity by a factor of 10X or more, compared to the current baseline, and can be adapted to cover most or all of the various wavelength bands for active chem-bio detection. The design must achieve rapid, sub-second detection of chem-bio aerosols and chemical vapors from standoff ranges. The key developmental components will be identified that would be essential to demonstration of the optimized receiver, and the expected performance of these components must be discussed with regard to sensitivity, spectral coverage, detection bandwidth (spectral and electronic), detection speed (tuning and readout), and noise (including impact of laser speckle).

PHASE II: All efforts are to be directed toward a laboratory demonstration of the key component(s) identified in Phase I, and a field demonstration of a breadboard level sensor to evaluate impact of range-dependent scattering, noise and return intensity dynamic range. The data base resulting from the component demonstrations will be used to develop a detailed conceptual design for a sensor. An outline will be provided of further work necessary to develop and demonstrate a fully integrated receiver and breadboard fieldable testbed sensor.

PHASE III DUAL-USE APPLICATIONS: Phase III military applications include optimized full-sized CB detectors for contamination avoidance and decontamination. In addition, dual-use intelligence and homeland defense applications could directly benefit from having a standoff chemical and biological detection device with optimized performance. Phase III commercial applications include spin-off detectors for standoff environmental pollution monitoring, civil defense, and for drug interdiction.

OPERATING AND SUPPORT (O&S) COST REDUCTION (OSCR): A single integrated sensor for detection of both chemical and biological agents will have greatly increased capability and reliability and faster response time compared to presently configured independent sensors. Increased capability will encourage deployment and acceptance of new and improved detection technology. Increased reliability will reduce the burden of O&S resources. Faster sensor response times associated with combined chemical and biological agent scanning will give

timely results, reducing O&S and manpower costs. Development of a single integrated sensor will reduce development, training, and depot maintenance costs compared to multiple sensors that can only perform a single task.

REFERENCES:
1. "Review of Active Chem-Bio Sensing", Cynthia Swim, Proc. SPIE 5416(2004)178.

KEYWORDS: chemical, biological, direct detection, LIDAR, standoff, coherent, heterodyne

CBD06-104 TITLE: Chemical Warfare Agent (CWA) Lightweight Field-Portable (Hand-Held) Medical Diagnostic Tool

TECHNOLOGY AREAS: Chemical/Bio Defense, Biomedical

OBJECTIVE: The development of a lightweight field-portable (i.e., hand-held) device that will detect/identify chemical warfare nerve agents (CWNAs) of operational concern and be used as a diagnostic tool by appropriate medical professionals in screening and treating individuals exposed to a CWA. The primary purpose of the device will be diagnostic testing of biomedical samples (e.g., urine) for the presence of nerve agent metabolites.

DESCRIPTION: Laboratory- based medical diagnostic systems have several limitations including relatively time and labor intensive sample preparation and analysis phases. Cholinesterase testing does not have the ability to identify the specific agent involved and can give misleading results if exposures involve pesticides. In addition, kits require consumable supplies and may present a logistical support burden. Therefore, the goal is to develop a lightweight hand-held field-portable medical diagnostic tool. This item will serve as a screening tool to identify those individuals exposed to a CWNA and determine those individuals who require treatment. The diagnostic tool will utilize an underlying detection technique based on high immunogenicity and high affinity antibodies against CWNAs. Such a detction technique has not been demonstrated for the detection of CWNAs.

The medical diagnostic tool should be capable of detection/identification of multiple CWNAs within the same class (e.g., sarin, soman, VX). The technology should have the potential to be modified and transitioned to detect vesicants. The detector must have a limit of sensitivity in the low ng/ml level (less than 10 ng/ml) for metabolites present in urine, a response time of less than 5 minutes and a specificity for nerve agents versus other compounds capable of suppressing cholinesterase which are not considered CWNAs. The item should be extremely compact (less than 4 cubic inches) and very lightweight (less than 0.25 pounds). The item should have a long shelf life (minimum two years, five years desirable). It should operate without an external power source and with minimal operator supervision. It should produce minimal or no hazardous by-products. The item must have low cost so it can be made available to the widest possible range of military forces and first responders. In addition, the item must be suitable for broad field operations and have minimal requirements for support, maintenance, logistics/supply and training.

PHASE I: Contractors will use their innovation and creativity to develop a detailed plan which articulates an effective strategy to formulate a diagnostic tool with the capability to detect/identify CWNAs. The plan must clearly describe how the device can detect/identify at least one CWNA within the nerve agent class. Sensitivity, reactivity, specificity, stability and cost are some of the key parameters that must be addressed in the detailed plan.

PHASE II: A proof-of-concept diagnostic tool will be developed that can demonstrate the capability to detect/identify multiple agents in the nerve agent class. An automatic reader and communications device will be demonstrated that detail the test results of the device. Evaluation of the device for sensitivity and specificity will be done by USAMRICD.

PHASE III: This technology has potential dual use applications and thus could be used in a broad range of military and civilian settings. For example, this device could greatly enhance the capability of civilian first responders to rapidly identify those individuals exposed to chemical agents and determine those individuals who require treatment.

REFERENCES:

Adams, T.K., Capacio, B.R., Smith, J.R., Whalley, C.E., Korte, W. D. The Application of the Fluoride Reactivation Process to the Detection of Sarin and Soman Nerve Agent Exposures in Biological Samples. Drug and Chem. Toxicol., 27(1), 77-91, (2004).

Technical Bulletin No. MED 296. Assay Techniques for Detection of Exposure to Sulfur Mustard, Cholinesterase Inhibitors, Sarin, Soman, GF, and Cyanide. Headquarters, Department of the Army, Washington, D.C. (1996).

Shih, M.L., McMonagle, J.D., Dolzine, T.W., Gresham, V.C. Metabolite pharmacokinetics of soman, sarin, and GF in rats and biological monitoring of exposure to toxic organophosphorus agents. J. Appl. Toxicol., 14, 95-9 (1994).

Shih, M.L., Smith, J.R. McMonagle, J.D. Dolzine, T.W., Gresham, V.C.Detection of Metabolites of Toxic Alkylmethylphosphonates in Biological Samples, Biol. Mass Spectrom., 20, 717-723 (1991).

KEYWORDS: Medical Diagnostic Tool, Chemical Warfare Nerve Agents (CWNAs), Vesicants, Detection/Identification of Multiple CWNAs, Field-Portable and Hand-Held Device, Low-Cost Item

CBD06-105 TITLE: Electro Osmotic Membrane Development for Chem-Bio Protection

TECHNOLOGY AREAS: Chemical/Bio Defense

OBJECTIVE: The development of a material which enables the active transfer of water through a membrane, while repelling chemical and biological agents.

DESCRIPTION: Waterproof membranes are a common building component. To harden a facility against chemical and biological attack, specialized membranes are required. The next generation of these membranes will have increased moisture transport while providing resistance to chemical and biological agents. Membranes that use an electronic gradient to produce an osmotic flow can provide that innovative solution. If a distributed electrode on each side of a membrane applies an electric field, this can be used to produce an osmotic driving force to move condensed liquids through the membrane. Potential distributed electrode material includes inherently conductive polymers (Catize, etc.) such as Heeger, MacDiarmid, Shirakawa , et al. have developed. The membranes developed in this SBIR could have a wide variety of military and industrial uses outside of the hardened military facilities applications.

PHASE I: A membrane surface which can actively transfer water vapor will be investigated. The system will incorporate the use of an electronic charge differential across the sides of the surface in addition to any other innovative modifications to the surface.

PHASE II: The membrane will be developed and demonstrated. Power requirements and vapor transport rate will be tested, as well as resistance to select chemical agent simulants.

PHASE III: The development of this film/surface will lead to advances both in civilian and military products. A fabric that can transfer water outside of the fabric has applications in tents, packaging materials, building membranes as well as next-generation of outdoor clothing.

REFERENCES:

1) "The Surface Eleftrochemistry of Inorganic Filtration Membranes," W.R. Bowen, D.T. Hughes, H.A.M. Sabuni. Engineering Materials Volume 61 & 62, pp.117-122 1991.

2) "Electrokinetic Phenomena in Fibrous Porous Media," Matthew W. Koziak, E. James Davis. Journal of Coloid and Interface Science, Vol 112, August 1996.

3) "Electro-osmosis and Polymer Depletion Layers Near Surface Conducting Particles are Detectable by Low Frequency Electrorotation," H. Baumler, B. Neu, S. Iovtchev, A. Budde, H. Kiesewetter, R. Latza, E. Donath. Journal of Colloids and Surfaces, A: Physiochemical and Engineering Aspects 149, (1999) 389-396.

4) "Electroosmosis of the Second Kind and Unrestricted Current Increase in the Mixed Monolayer of an Ion Exchanger," S. S. Dukhin, N. A. Mischuk, P. v. Takhistov, Kolloidnyi Zhurnal, Vol 51, No. 3., pp. 616-618 (1988).

5) "Theory of Electrokinetic Measurements in Sandwich Cells," Bruce D. Bowen. Journal of Colloid and Interface Science, Vol 98, No. 1. March 1994.

6) "Molecular Simulation of Membrane Based Separations of Ethanolic Electrolyte Solutions," H. Yan, S. Murad, E. Encisco. Journal of Fluid Phase Equilibria 183-184 (2001) pp. 279-287.

7) "Determination of Zeta Portential by Measuring Electroosmotic Flux in an Alternating Electric Field and its Applications in the Study of Membrane Fouling," Jin Wang, Zheng Liu, Jian Luo, Qinghua He, Fuxin Ding, Naiju Yuan. Journal of Separation Science and Technology, 35(8), pp. 1195-2000 (2000).

8) "Surface Electrochemical Properties of Mixed oxide Ceramic Mambranes: Zeta Potential and Surface Charge Density," M. Mullet, P. Fievet, J. C. Pagetti. Journal of Membrane Science 123, (1997) pp. 225-265.

KEYWORDS: waterproof membrane, electro osmosis, chemical defence, biological defence, active water control

CBD06-106 TITLE: Materials Research for the Development of Agent Standard Reference Materials and Analytical Test Apparatus

TECHNOLOGY AREAS: Chemical/Bio Defense, Materials/Processes

ACQUISITION PROGRAM: Joint Services Light Weight Integrated Suit Technology (JSLIST) Aquisition

OBJECTIVE: The objective is to develop semi-permeable membranes that are specific to chemical warfare agents (CWA), non-traditional agents (NTA), and toxic industrial chemicals and materials (TIC/TIMs). The membranes must be homogenous, reproducible, and of uniform thickness and quality to serve as a reference standard for Aerosol, Vapor and Liquid Assessment Group (AVLAG) protective garment testing and support the material protection testing for all material/suit acquisition programs in all services. Further, devise novel analytical test methodologies to measure performance of the material.

DESCRIPTION: Current materials available and in use as AVLAG material test standards do not meet the optimal standard reference material criteria. The ideal standard reference material must be proven to meet stringent quality control criteria, and must be without defects. As stated in the current Test Operating Procedure, "Permeation and Penetration Testing of Air Permeable, Semi Permeable, and Impermeable Materials with Chemical Agents or Simulants (Swatch Testing)" TOP 8-2-501, an ideal reference standard should be "homogeneous, reproducible, of uniform thickness, without defects". Further, a standard reference material should demonstrate limited ability to resist the permeation or penetration of chemical warfare agents so that testing can be performed rapidly.

TOP 8-2-501 states that "a standard reference test material would be of great value to evaluate new procedures or test fixtures and to compare the various test fixtures and procedures used in the past…". A material that satisfies the above criteria would fill a critical need in chemical agent permeability testing. With the expansion of new types of chemical and biological threats, and in response to the military's desire to create an overarching model that will improve material protection testing, a new standard reference material specific to these new threats, and in support of the overarching model, is imperative.

PHASE I: Develop and demonstrate efficacy of a prototype membrane standard reference material for chemical agent testing. Demonstration of the membrane's performance must follow procedures comparable to those outlined in TOP 8-2-501.

PHASE II: This phase consists of five parts: 1. Develop a plan and prototype for multiple production of the membranes. 2. Develop the appropriate quality control testing techniques to demonstrate that the membranes produced are homogeneous, reproducible, of equal thickness, and are without defects. 3. Develop various types of

membranes as needed to provide an optimal fit to the various classes of chemical, non-traditional, and biological agents and TIC/TIMs under test. 4. Develop a state-of-the-art analytical test system to test this membrane for reference material and barrier material capabilities. 5. Integrate the new methodologies and materials into the individual protection (IP) materials testing programs military-wide.

PHASE III DUAL USE APPLICATIONS: The technology developed in this research effort would have valuable potential for commercialization. These type of membranes, with chemical permeability selectivity, would be applicable to the DoD and the defense sector as a protective liner in the protective garment market. The technology would also provide the precise and consistent data that the overarching IP model will require and impact modeling capabilities throughout the military testing system. A selective, semi-permeable membrane of this type would also have private sector applications in the domestic preparedness market (i.e., hospitals, EMS). Further, there may be commercial applications for this type of semi-permeable membrane in industries such as food packaging.

REFERENCES: U.S. Army Test and Evaluation Command (TECOM), Aberdeen Proving Ground (APG), Maryland, Test Operations Procedure (TOP) 8-2-501, Aerosol, Vapor and Liquid Assessment Group (AVLAG), Permeation and Penetration Testing of Air-permeable, Semi-permeable, and Impermeable Materials with Chemical Agents or Simulants (Swatch Testing), 10 February 2004 (Draft).

KEYWORDS: Chemical/Biological defense, AVLAG, standard reference material, non-traditional agents, toxic industrial chemicals; overarching model

CBD06-107 TITLE: Computer-Assisted Strain Construction And Development Engineering (CASCADE)

TECHNOLOGY AREAS: Chemical/Bio Defense, Materials/Processes

OBJECTIVE: The objective of this SBIR is to develop and test in-silico based metabolic construction for assessing the potential for a biological system to produce specifically designed recombinant proteins. Existing genomic sequence data would be analyzed, compared, and integrated for predictive application and then tested in laboratory-scale production of a recombinant humanized antibody.

DESCRIPTION: The specificity, biodegradability, and non-toxicity of most proteins make them highly desirable for detection and inactivation of many noxious chemical and biological agents. Bioengineered proteins have been identified for numerous military-directed threats. Decontamination and neutralization with enzymes (acetylcholinesterases following nerve gas exposure); light-weight biodegradable engineered proteins with high tensile strength and impact absorption (recombinant silk proteins for personnel protective gear); specifically engineered humanized antibodies (for extremely specific biodetectors and for countermeasures against viruses, bacteria, and toxic proteins) etc. are some general examples. While the demand for specifically bioengineered recombinant proteins is great, the availability of high-capacity protein synthetic systems is extremely limited. In the selection of a production system the most general approach is to review the capabilities of the small pool of available bacterial, yeast, fungal, plant or animal cell systems. Each of the current systems suffer severe shortcomings, and an ideal producing organism is not available. The high diversity of metabolic capabilities in lessor developed organisms goes untapped for biotechnological applications. Although an enormous amount of genetic sequence information has been -and continues to be- generated for a broad variety of plants, animals, fungi and microorganisms, the interpretation of that information for specific biotechnological applications remains elusive. This SBIR seeks to support development of an in silico high-throughput metabolic reconstruction technology from the analysis of genomic sequence data. This would be integrated with known biochemistry, growth characteristics, and physiology of the organism. A model would be constructed of organismic functionality for strain selection and development for the production of high-value proteins. Finally, a proof-of concept would be developed in laboratory scale production of a selected recombinant humanized antibody. This would be selected with input from Army scientists.

The SBIR takes advantage of the extraordinary metabolic diversity in nature and selects the best organisms for producing the designer proteins, and would have broad military and civilian applications. As evidenced by the cited references, the development of metabolic reconstruction maps from genetic sequence data is relatively new. The process has been virtually unapproached for the selection and engineering of organisms for production

biotechnology. In addition to the applications identified above, other areas that could benefit from an authenticated high-throughput strain selection and development technology could include: chemical and biological threat identification and remediation; medical diagnostics; food and water contamination analyses; forensics; agriculture; medical monitoring; large scale production of engineered fibers; and many others.

PHASE I: Using the techniques of bioinformatics and rational design, the cooperation of microbiologists, molecular biologists, biochemists, and bioinformaticists would be used to select a system for comparative genetic analysis based on pattern recognition and known physiological and biochemical capabilities. A metabolic reconstruction map would be generated and authenticated with data and conditions from known strain production capabilities. The work would then proceed to the selection of an appropriate strain for laboratory-scale production of a humanized antibody that would be identified through input from Army scientists.

PHASE II: The selected strain would be engineered for production of the antibody. Further research would be conducted to develop, test, and thoroughly document the approach with the production of the humanized antibodies. Quantitative gene expression and protein synthesis would be determined. Alternative strain selection would be conducted for comparison to the in silico approach. It is anticipated that at the end of Phase II a research base will have been developed for application in technology for the detection, selection, and engineering of organisms for the production of high value, bioengineered proteins.

PHASE III DUAL USE APPLICATIONS: The technology would be modified and tested for a variety of military and civilian applications. The technology would be useful in research, production, and quality control for the biotechnology industry. The system takes advantage of a wide diversity of biosynthetic capabilities extant in the biological community.

REFERENCES:

Ahren DG, and Ouzounis CA. 2004. Robustness of metabolic map reconstruction. J Bioinform Comput Biol. 2(3): 589-93.

Becker SA, and Palsson BO. 2005. Genome-scale reconstruction of the metabolic network in Staphylococcus aureus N315: an initial draft to the two-dimensional annotation. BMC Microbiol. 5(1):8.

Borodina I, Krabben, P, and Nielsen, J. 2005. Genome-scale analysis of Streptomyces coelicolor A3(2) metabolism. Genome Res. 15(6):820-9.

Duarte NC, Herrgard MJ, and Palsson BO. 2004. Reconstruction and validation of Saccharomyces cerevisiae iND750, a fully compartmentalized genome-scale metabolic model. Genome Res. 14(7):1298-309.

Herrgard MJ, Covert MW, and Palsson BO. 2004. Reconstruction of microbial transcriptional regulatory networks. Curr Opin Biotechnol. 15(1):70-7.

Hoffman R, Krallinger M, Andres E, Tamames J, Blaschke C, and Valencia A. 2005. Text mining for metabolic pathways, signaling cascades, and protein networks. SciSTKE. 2005 (283):21.

Hsing M, Bellenson JL, Shankey C, and Cherkasov A. 2004. Modeling of cell signaling pathways in macrophages by semantic networks. BMC Bioinformatics 5(1):156.

Nikiforova VJ, Daub CO, Hesse H, Willmitzer L, and Hoefgen R. 2005. Integrative gene-metabolite network with implemented causality deciphers informational fluxes of sulphur stress response. J.Exp Bot. 56(417):1887-96.

Kell DB. 2004. Metabolomics and systems biology: making sense of the soup. Curr Opin Microbiol. 7(3):296-307.

Li A, and Chan C. 2004. Integrating gene expression and metabolic profiles. J. Biol Chem. 279(26):27124-37.

Patil KR, and Nielsen J. 2005. Uncovering transcriptional regulation of metabolism by using metabolic network topology. Proc Natl Acad Sci USA. 102(8):2685-9.

Pinney JW, Shirley MW, McConkey GA, and Westhead DR. 2005. metaSHARK: software for automated metabolic network prediction from DNA sequence and its application to the genomes of Plasmodium falciparum and Eimeria tenella. Nucleic Acids Res. 33(4):1399-409.

Sun J, and Zeng AP. 2004. IdentiCS-identification of coding sequence and in silico reconstruction of the metabolic network directly from unannotated low-coverage bacterial genome sequence. BMC Bioinformatics. 5(1):112.

Vo TD, Greenberg HJ, and Palsson BO. 2004. Reconstruction and functional characterization of the human mitochondrial metabolic network based on proteomic and biochemical data. J Biol Chem. 279(38):39532-40.

Villas-Boas SG, Moxley JF, Akesson M, Stephanopoulos G, and Nielsen J. 2005. High-throughput metabolic state analysis: the missing link in integrated functional genomics of yeasts. Biochem J. 388(2):669-77.

Yamanishi Y, Vert JP, and Kanehisa M. 2005. Supervised enzyme network inference from the integration of genomic data and chemical information. Bioinformatics. 21(1)468-77.

KEYWORDS: recombinant proteins, antibodies, metabolomics, in silico, bioengineering

CBD06-108 TITLE: Improved and Innovative Disposable Protective Garments

TECHNOLOGY AREAS: Chemical/Bio Defense, Human Systems

OBJECTIVE: To develop single use, disposable and robust garments that will actively protect personnel, equipment, and structures against contamination by chemical and/or biological (CB) agents, toxic industrial chemicals or materials (TICs, TIMs) during and after one or more attacks.

DESCRIPTION: There are many types of limited use or disposable protective garments and apparel designed to provide barrier properties, including surgical gowns and protective coveralls. Such protective garments are used in situations where isolation of a wearer from a particular environment is desirable, or it is desirable to inhibit or retard the passage of hazardous liquids and biological contaminates through the garment to the wearer. Chem-Bio protective suits are currently comprised of carbon-beads layered into textile materials. The Joint Service Lightweight Integrated Suit Technology (JLIST) is the standard chemical personal protection currently employed. The integrated carbon does perform its job of adsorbing chemical vapors as it was designed. Although extremely effective for adsorbing toxic vapors, activated carbon imparts only partial protection against chemical agents through physical entrapment within its pores without actual neutralization of the toxins. In addition, activated carbon has considerable problems with the preferential adsorption of water with subsequent release of already adsorbed toxins (off-gassing). Even though tests have shown that the contamination lodged in the textile materials and between the carbon beads or on the surface can be removed through standard laundry washing it would be much safer to have access to limited use or disposable protective garments that can self-detoxify. Development of reactive sorbents incorporated into protective garments that will decompose the toxins will enable disposal of such materials after intended use without any need for cleaning of contaminated clothing. This would tremendously reduce the logistical detail of replenishing chem-bio protective suits to the warfighter without compromising safety. Projections of rate of neutalization and efficiency of neutralization, cost to produce, simplicity to use and maintain, uniformity of strength and durability in use and storage are some aspects to be explored in the development of such a protective suit.

PHASE I: Develop and demonstrate the performance of reactive sorbents towards neutralization of select CWA simulants, TICs and TIMs. Include both liquid and vapor hazards in this selection. Incorporate promising sorbent materials into suitable textile swatches and measure select physical properties, and establish protective performance.

PHASE II: Perform scale-up studies including costs on the reactive sorbent preparation. Incorporate the reactive sorbents into a full-scale disposable protective garment. Develop production process for the manufacturing of the disposable protective garment. Measure all relevant physical properties. Conduct durability and storage stability studies. Test the prototype garment at an approved facility against actual chemical and biological agents.

PHASE III-COMMERCIAL APPLICATIONS: The proposed disposable protective garments will have commercial applications in a broad range of fields including medical care garments and products, mortuary and veterinary products, agricultural applications, petrochemical personnel, and personal care products. Examples of such products include, but are not limited to, medical and health care products such as surgical drapes, gowns, face masks, sterilization wrap materials and bandages, protective work wear garments such as coveralls and lab coats, and infant, child and adult personal care absorbent products such as diapers, training pants, swimwear, incontinence garments and pads, sanitary napkins, wipes and the like.

REFERENCES:
1. Layers of Protection, S. Clementi, D. Rowe, Military Medical Technology, Vol 8, Issue 6, 2004
2. Strategies to Protect the Health of Deployed U.S. Forces: Force Protection and Decontamination National Research Council, NATIONAL ACADEMY PRESS, 1999

KEYWORDS: protection, clothing, chemical protection, disposable, chemical warfare agents, biological warfare agents

CBD06-109 TITLE: Residue-Free Decontamination Wipes

TECHNOLOGY AREAS: Chemical/Bio Defense, Human Systems

OBJECTIVE: Develop a decontamination wipe that removes chemical warfare agents such as nerve agents and vesicants from equipment, without leaving any solid or liquid residues.

DESCRIPTION: Decontamination of equipment contaminated by chemical warfare agents is performed by means of solid sorbents, such as A200, a powder that is based on aluminum oxide found in the M100 Sorbent Decontamination Kit; or via XE-555, a powder based on an ion exchange resin formerly used in the M295 Decontamination kit. Decontamination utilizing these materials and systems under development leaves a powdered residue on the equipment, which can scratch sensitive optical equipment, damage intricate mechanical devices, and interfere with the effective and safe use of the equipment. Residues resulting directly from the use of existing decontaminants can also damage and degrade the performance of sensitive equipment to include field deployed chemical detection instrumentation. Additionally, a decontamination wipe that will remove chemical warfare agents from contaminated equipment without causing damage or leave any solid or liquid residue is required for interior decontamination. Compatibility with materials commonly used in military equipment is necessary. Wipes that permanently render the chemical warfare agent inert (e.g., detoxify) are preferred to those that merely adsorb agents without chemical destruction. To date, technical investigations have been ongoing to develop wipes using enzymes, nanoparticles, metal oxides, metal-catalysts, oxidation chemistry, and hydrolysis chemistry.

PHASE I: A novel prototype wipe and process for chemical decontamination of equipment will be developed. The proof-of-concept will be demonstrated to illustrate that surfaces contaminated with simulants representing chemical warfare agents can be effectively decontaminated while minimizing or eliminating any solid or liquid residues. Compatibility with various materials of construction will be determined.

PHASE II: Scale-up studies will be performed. Costs of production will be determined. Testing of the wipe with actual chemical warfare agents and other chemical compounds will be conducted at an approved facility.

PHASE III DUAL USE APPLICATIONS: The proposed decontamination wipe will have commercial applications in a broad range of fields where contamination of sensitive or fragile equipment may occur. Examples include, but are not limited to, electronics and optical measurement instrumentation.

REFERENCES:
1) http://www.edgewood.army.mil/ps/download/ECBC_m295.pdf
2) http://www.edgewood.army.mil/ps/download/ECBC_xm90decon.pdf
3) http://www.edgewood.army.mil/ps/download/ECBC_sds.pdf
4)ECBC: Experts in Equipment Decon Technology, J. Fuhr, Vol 7 Issue 3 Military Medical Technology, 2003
5) Decontaminationof Chemical Warfare Agents, Chem.Rev. 1992, 92, 1729-1743

KEYWORDS: chemical warfare agent, nerve agent, mustard, decontamination, residue, sorbent

CBD06-110 TITLE: Self-Contained Automated Vehicle Washing System with Water Recycling

TECHNOLOGY AREAS: Chemical/Bio Defense, Ground/Sea Vehicles

OBJECTIVE: To develop a process for the catalyzed oxidation of hydrocarbons in water contaminated by washing military vehicles in an automated wash system with operations situated near the front lines.

DESCRIPTION: Accumulated dirt on combat vehicles can become a major impediment to the performance of front line routine maintenance and minor repairs. This problem becomes a major logistical issue should there be a potential chemical attack since the toxic agents can be contained in the mud/dirt and can cover the surface of the vehicle. Personnel who must have access to the vehicle to perform such routine tasks as re-arming, refueling, minor maintenance, etc. can readily become secondary casualties. Unless these technicians can be assured the surfaces they are in contact with are not contaminated, the performance of these activities may present themselves as potential threats to their health and safety.

Currently there are no heavy duty, field deployable, self-contained washing systems which are capable of sustained operations when challenged with high solids content having potential to also be contaminated with chemical threat materials.

The most critical technology need addressed by this topic is the ability to recycle and decontaminate the wash water. The wash system should be capable of recycling the water while providing decontamination capabilities to sufficiently clean the water of solids regardless of the contaminant or the concentration of the contaminant (i.e. chemical agents, oils and other hydrocarbons, suspended and dissolved solids, etc.). Recycling the water reduces the infrastructure necessary to maintain a front-line washing system and the costs associated with the handling and disposal of the contaminated wash water in an environmentally compliant manner.

Supercritical Water Oxidation (SCWO) has long been discussed as a means to oxidize hydrocarbons in aqueous solutions. However, the high temperature and extreme pressure required to operate the process (1500 deg F and 3400 psig) create unacceptable corrosion conditions and solids precipitation problems that result in the SCWO units built with exotic alloys and requiring robust engineering designs characterized by high maintenance requirements/premature equipment failure. Corrosion and solids precipitation problems have prevented the extensive commercialization of the SCWO process.

Chemical catalysis in the petro-chemical industry has a successful track record of achieving chemical oxidation of hydrocarbons at far lower temperatures. Lowering the temperature required for the oxidation reaction to take place would reduce corrosion and the problems associated with precipitation of solids. Reducing the corrosive environment would equate into lower equipment acquisition costs, extended operating life, simpler designs, less operating power and improve the reliability of such recycling equipment.

The washing system MUST be capable of effectively washing combat vehicles which are extremely heavily soiled. The final envisioned washing unit should be unitized and portable while being simple to assemble and maintain in the field by unskilled workers. The washing system should also be automated to eliminate the need for personnel to be in the splash area surrounding the vehicle if it were contaminated with chemical agents. The wash pad should allow for inspection of the vehicle to insure proper washing prior to release from the pad and allow for minor manual cleaning in selected areas such as engine intakes, etc.

PHASE I: Screen available catalyst formulations used in oxidation reactions using typical wash streams such as those produced during the washing of combat vehicles. Conversion rate, life expectancy and poisoning potential would be collected on candidate catalysts. A prototype system would be proposed from the results of Phase I proof-of-concept. Identify a suitable heavy duty washing system to provide the basis for a hybrid and modified washing system capable of meeting the needs of the US Army in a combat environment including toxic agents.

PHASE II: Construct a prototype which meets the specifications and needs of the US Army for a portable, heavy duty vehicle washing system with water recycling capability. Evaluate the prototype under simulated combat conditions and provide a review of improvements for the commercialization of the design.

PHASE III DUAL-USE AND COMMERCIALIZATION: Heavy duty vehicles covered with high dirt loads are normally washed on large, dedicated heavy concrete wash areas which are not portable and represent major capital expense investments. Portable washing stations today consist mainly of simple floors over thin metal tanks with minimal capability to handle heavy vehicle loads and cannot effectively wash vehicles with high dirt loads. A new portable system capable of washing extremely dirty and heavy vehicles using recycled water would have extensive commercial applications. Primary industries such as road building, construction and emergency response operations, operating out of temporary locations, could benefit greatly from the availability of such a wash system. The environment would benefit by reducing the amount of dust, dirt and contamination carried on all construction and delivery vehicles.

The US Army would enhance its conventional operating capabilities to maintain and repair its equipment at or closer to the front lines as well as provide a capability to more effectively operate a force in the presence of chemical agents under combat conditions.

REFERENCES:
1) Yu-Chu Yang, James A. Baker, and J. Richard Ward "Decontamination of Chemical Warfare Agents, Chem. Rev., 1992, 92, 1729-1743.

2) Khaleel, A.; Lucas, E.; Pates, S.; Koper, O.; Klabunde, K.J.; "Nanocrystals as Absorbents for Chemical Agents and Air Pollutants," Proc. ERDEC Sci. Conf. Chem. Biol. Def. Res., 323-329 (1999).

3) Wagner, G.W.; Bartram, P.W.; Koper, O.; Klabunde, K.J.; "Reactions of VX, GD, and HD with Nanoscale MgO," J. Phys. Chem. B., 103, 3225-3228 (1999).

KEYWORDS: decontamination, chemical warfare agent, hydrocarbon, washing, vehicle maintenance