Large-area decontamination is often left at home while other US CBRN elements are taken to the procurement ball. Pat Nelson asks whether decon is finally getting the recognition it deserves

The glass galoshes

In the world of airplatform decontamination, the whole does not equal the sum of its parts. The processes for decontaminating large items, including airplatforms, has been a particular and ongoing challenge for CBRN military leaders, as each area (or 'part')– both interior and exterior systems – presents a unique and very divergent set of materials and surface areas that drive highly specific decontamination requirements. Unsurprisingly, the US military's quest for a universal decontaminant to meet these very distinct and dissimilar needs has come up short. After years of investing R&D funding into military decon programmes that hold no hope of meeting all the tedious and often unrealistic decon requirements, the US is now taking a fresh approach and redefining what it considers to be a systems approach in their quest to find the "holy grail" of decontaminants.

Under the US CBRN doctrinal elements – Sense, Shape, Shield, and Sustain – decontamination, including airplatform decon, is categorised within the 'Sustain' element. This decon element is consistently treated as the Cinderella of the entire process. In terms of planning and funding, it is often addressed merely as an afterthought – one of those "nice-to-have" capabilities – and more often than not her stepsisters – Sense, Shape and Shield – receive the bulk of available funding. As CBRN defence monies pass through the other elements, the step-sisters receive the majority of defence CBRN funding, with detection technologies (Sense) taking the prime funding spot and the other two – communications (Shape) and collective protection (Shield) – coming in at second and third respectively. After these are dressed and ready for the ball, there is little remaining to adequately clothe decontamination's requirements. That said, due to recent events within the CBRN community, some promising decontamination technologies are beginning to magically emerge from the void – the step-child of CBRN is finally getting some of the recognition it deserves.

Recently, the Joint Program Executive Office for Chemical and Biological Defense (JPEO-CBD), under the direction of Major General Steve Reeves, assigned a new Program Manager (PM) Decon to sort out problems within existing programmes, to end those that were not producing promising technologies and to regroup the remaining programmes into a single Decon Family of Systems (DFoS). Only three programmes made the cut: Joint Service Transportable Decontamination System-Small Scale (JSTDS), Human Remains Decontamination System (HRDS), and the Joint Service Material Decontamination (JSMD) programme. These programmes are expected to work cohesively together with technologies that complement the others: the years of investing in the "one-decon-fits-all" approach has reached its long awaited conclusion. Yet the focus is still clearly on chemical and biological warfare agents, with radiological and nuclear decon still not even considered – clearly far too tough a nut to crack.

Within DFoS, aircraft interior decontamination has become part of the Joint Service Material Decontamination (JSMD) programme, which employs modified vaporous hydrogen peroxide (mVHP) – a dry, oxidative vapour phased technology – which not only penetrates and decontaminates the small structural crevices and joints of the interior, but is also suggested to be safe for the sensitive equipment contained within these spaces. The oxidative problems associated with

High pressure cleaning is not always the best policy for aircraft surfaces ©DoD mVHP on sensitive equipment have yet to be fully realised, however, as long-term monitoring shows that, despite initial testing reports, mVHP may have a slow oxidative degradation effect on the metals and circuit boards of the aircraft interior.

This vapour phased technology is intended to support decontamination activities both on the ground airplatforms and during flight for larger aircraft like the C-17 Globemaster III military transport aircraft – a challenge for the best of solutions attempting to pass the 'Safe-to-Fly' analysis. Add the weight of the bulk materials, highly concentrated hydrogen peroxide – which in itself is dangerous and highly oxidative – along with any necessary non-corrosion inhibitors and you are left with a very large chemical footprint and a potential logistical nightmare.

External airplatform decontamination has been just as problematic as interior decon. In addition to the structural crevices and joints, consideration must also be given to the much larger surface area and the vastly divergent materials used on the aircraft itself – some of which have highly absorbent qualities. Add to this mix the wild variation of environmental extremes in which these materials are exposed, and the numerous lubricants and petroleum-based fluids that make surface contact with the aircraft, and you have a major decon challenge.

Currently, biological and chemical decon processes for external airplatform decontamination employ different methods and technologies. The current technologies of choice include both mVHP for biological challenge agents and hot air chambers for chemical threats such as Sarin and Mustard. When an aircraft is suspected of being externally contaminated with a biological agent, the aircraft is placed inside an inflatable aircraft hanger where it is fumigated with mVHP. As the agent is destroyed, the modified hydrogen peroxide breaks down into the simple – and harmless – molecules of oxygen and water. The entire process takes approximately 48–72 hours. For chemical agent decontamination, a hot air chamber with hot air blowers is employed to burn off the agent. In this application, the aircraft is placed inside a hot air metal container, where it is heated and maintained at 165 to 185 degrees Fahrenheit for six to ten days. The hot air lyophilises and forces the agent off the platform surface. During this process, the air is monitored and sampled until chemical detection limits are below acceptable thresholds and the aircraft passes the Safe-to-Fly certification, whereupon it is returned to service.

Both of these decontamination technologies for external aircraft neutralisation have some rather weighty problems in their own right. There are still logistical questions around shipping, transporting and storing bulk, concentrated mVHP, which could prove to be extremely problematic during military engagements – especially ones performed in high-heat environs, due to the explosive nature of highly concentrated hydrogen peroxide. The hot air chamber method works quite well, albeit extremely slowly – keeping the aircraft out of service for up to a fortnight. You could also be hard pressed to find a hot air chamber at your disposal when needed. In the forward movement of battlefield scenarios, both methods fail to deliver what the warfighter needs to keep aircraft fully operational.

Seeking to overcome the battlefield challenge of airplatform decontamination, Nato established a biotechnology team of experts under the direction of the Hazard Management Subgroup within Joint Capability Group-CBRN. This team of experts, with participation from seven countries including the United States, United Kingdom, France, Czech Republic and Germany, are charged with employing the tools of biotechnology to create safer and less oxidative catalytic neutralisation methods for all battlefield and war fighter CB decontamination.

Catalytic technologies are rooted in biotechnological advances that lend several advantages over traditional chemical or physical decontamination methods, namely: they are highly efficient – a little bit goes a long way – and thus greatly reduce the chemical footprint and other logistical burdens of current methods; they are environmentally safe, in that they only react with the substrate for which they are intended; and they are non-oxidative or corrosive to aircraft surface materials.

This group, chaired by Dr. Joseph DeFrank, Senior Research Biologist for the US Army Edgewood Chemical and Biological Center (ECBC), has spent the last three and a half years collaborating with government, academic and industrial scientists to develop this multi-purpose catalytic decontaminate – beginning with use on specialised aircraft skin. Initial efficacy testing began in September 2008, with testing performed at various defence laboratories in the US and EU, including the French Centre d'etudes du Bouchet and the German Wehrwissenschaftliches Institut Fur Schutztechnologien. Boeing Integrated Defense Systems provided aluminium coupons painted with the military coating for the US Apache AH64D Attack Helicopter (Mil PRF 53039) to each laboratory, and the standard 10g/m^2 challenge was performed. In each instance, the catalytic solution showed no oxidative or corrosive damage to the plates while the neutralisation process came to completion.

Dr. DeFrank elaborated. "After many years of effort by researchers in academia, government and industry, catalytic-based systems are now available that can detoxify or destroy the majority of chemical (nerve agents and mustard) and biological (anthrax) warfare agents," he said. "The challenges still to be faced deal with the incorporation of these systems into decontaminants that are environmentally safe, as well as compatible with the materials they may come in contact with."

These catalytic technologies, while offering great logistical savings to the warfighter, do also have their limitation. Because they are biological in nature, extreme heat above 65 degrees Celsius can inactivate the solution; they also cannot be used in the presence of bleach, and their shelf life is currently limited to three years.

Airplatform decon, like all other decontamination activities, does not have a simple answer – there is no silver bullet where one solution does it all, nor is it likely there ever will be one. Where one technology excels, the others fall short and vice versa – it is a trade off. The new PM-Decon for the JPEO has made great strides in taking the first step with their innovative "Dial-A-Decon" approach, where they no longer try to force all decontamination activities into one neat little box. Several technologies are currently employed to decontaminate airplatform "parts" – both interior and external. This model will likely continue for some time, if not indefinitely. Novel technologies are under development – and some are commercially available – which can reduce the chemical footprint of current solutions – allowing the warfighter to slip on a safer and more logistically sound choice of decontaminants.