The PPE detox

Decontex is a liquid CO2 decontamination concept for PPE that could significantly reduce firefighters' occupational exposure to cancer-causing chemicals. MD Tommy Verminck tells Ann-Marie Knegt why he believes the system could save thousands of lives.

Cancer is the leading cause of work-related deaths in Europe, and firefighters are particularly at risk. When tests revealed that PPE was partly responsible for firefighters' exposure to toxic chemicals, Tommy Verminck's career took an unexpected turn. The former head of the national procurement programme for all Belgian firefighting PPE is now heading up a new system of PPE decontamination using liquid CO2 that could be a game changer in terms of reducing a firefighter's risk of developing work-related cancer.

Decontex is already in use in 20 safety zones in the Benelux region and is gaining momentum elsewhere in Europe. Verminck is convinced of the system's benefits and importance. 'This will improve the protection of workers, provide employers with more legal protection, and save hundreds of thousands of lives over the next 15 years.'

It is a bold claim, but one that Verminck says is backed by science. Marianne Thyssen, the European Commissioner for Employment, Social Affairs, Skills, and Labour Mobility, issued a press notice in May 2016 about occupational disease. This stated that not only is cancer the number one cause of work-related deaths in Europe but that 53% of all work-related deaths are in reality cancer-related. Emergency responders make up a major part of occupational cancer diagnoses, and this is the target group of Decontex.

'Emergency responders, including firefighters, never really know what they are going to be exposed to, as opposed to people working in a factory with known risks,' says Verminck. 'Their only form of protection is their PPE.'

Firefighters are especially at risk. A biomonitoring trial of 100 firefighters in Antwerp in 2011 looked at levels of VOCs (volatile organic components) and PAKs (polycyclic aromatic hydrocarbons) by taking urine samples before and after an incident.

'Researchers noted the expected rise of VOC levels to 37% and the rise in PAKs to 85% after a fire. However, they also found an increase of 28% in VOCs and 68% in PAKs during RTCs and rescue scenarios where there was no fire,' explains Verminck.

These alarming results prompted researchers to look deeper, consulting leading professors at the Universities of Ghent, Antwerp, and Brussels, who came up with a concerning theory.

Toxic chemicals can enter the body in three ways: via the digestive system, via inhalation, and via the skin (percutaneous). At the time of the trials, the percutaneous route of toxin absorption was not well known, but the professors suspected that the raised levels of toxins revealed by the tests were caused by percutaneous absorption of particles contaminating firefighters' clothing.

This prompted the Brussels Fire Service to carry out further testing. Firefighters dressed in turn out gear sat in a room for four hours. They did not respond to any incidents. They were tested before and after the four-hour period, and the results showed a 48% rise in toxins in their urine. This confirmed the suspicion that contaminated PPE was part of the problem.

'These results caused quite an upset within the Belgian fire service and led to a much greater awareness of how to wear and maintain PPE properly,' says Verminck. 'The onus shifted to protecting the firefighter, and we developed a premium maintenance model.'

Boxes are supplied to Decontex clients in the fire service that are either carried on special decontamination units or on conventional fire trucks. After an incident, firefighters deposit the contaminated garments in the boxes – all garments are RFID-chipped by Decontex and linked to a management system. The box is scanned using a smartphone app and the nearest Decontex driver is dispatched to collect it, either directly from an incident or from the station.

'We have our own vans in Belgium, France and parts of The Netherlands,' says Verminck. 'We also have a contract with DPD, whose drivers will get a pop up on their in-cab screen when they are in the vicinity. The boxes are transported to one of our decontamination centres, where they are opened in a clean room and a specialist carries out triage.'

This triage involves a visual review of the state of the garments. 'Do they simply require decontamination or do they also need repairs? Based on this assessment, the garments are then sorted into bags for either visual contamination, damage, or non-standard contamination/hazardous materials. Then we put the garments through the decontamination process.'

The development of Decontex

Decontex NV as a company is the result of a project financed by the Flemish government, called Innovation and Business, involving detergent producer Christeyns, Electrolux, Procter & Gamble, the University of Ghent, and certification institute Centexbel. In total, more than €1 million (US$1.24 million) was invested to develop the decontamination process, which is based on NASA technology.

This technology was originally sold to three companies, including Electrolux, and other the partners became involved at a later stage. The result is the Deco2fire technology used by Decontex.

'The machine we have developed is relatively large,' explains Verminck. 'It weighs five tonnes and has a small drum with a 20kg capacity. This has space for around four fire suits and a couple of sets of gloves. The clothing is placed in the drum and is sucked into a vacuum. The drum is pressurised with CO2 gas, and because CO2 molecules are very small they can penetrate the fibres. As the machine increases the pressure, the CO2 liquefies and breaks the forces attaching the dirt and toxins to the garment.'

Then the drum begins to turn very slowly, at one revolution per minute, and the CO2 is filtered until all dirt and toxins are gone and the garment is completely decontaminated.

'What we have created is an ultimate level of decontamination for firefighting garments,' says Verminck. 'The EN 469 standard for firefighting PPE includes no information about how to decontaminate garments. NFPA1851 does, but we have based the system on the Reach regulations, which contain guidelines on Substances of Very High Concern. For textiles, these guidelines are defined in the Oeko-Tex standard.'

Oeko-Tex consists of four different classes: Class 1 textiles for babies and small children; Class 2 textiles, for example for use in underwear, that come into direct contact with skin; Class 3 for textiles that have no or minor direct skin contact, such as jackets; and Class 4 for furnishing materials.

Decontex is focused mainly on Class 3 clothing. A firefighting suit has multiple layers – an outer shell, a membrane, a thermal barrier, and a lining. If cleaned only with water, the garment will still contain high levels of contaminants. Tests on a two-year-old suit from Antwerp's fire department revealed a volume of toxins six times higher than permitted by the Oeko-Tex standard. The suit had been in several fires and cleaned using water. 'Water only really cleans the outer layer and doesn't do anything for the rest of the garment,' Verminck explains.

There are other unintentional benefits to CO2 cleaning, as it also eliminates microorganisms. 'Tests carried out in Dutch laboratory using our CO2 method showed that the PPE is cleaned to the standard required for use in operating theatres. Some might argue that you do not need that level of cleanliness for firefighting. However, I believe that it is a positive side effect that has the potential to avoid a whole host of other issues.'

Those other issues include C8 and C6 fluorocarbons, chemicals that are often used to coat the outer shell of firefighting PPE for water and chemical resistance. In a conventional PPE wash cycle at 85-90°C, these can enter the water system.

'These chemicals are bad for the environment and detrimental to human health and they also reduce the breathability of PPE. Therefore, we have created an impregnator called Imprecco. This substance can be diluted in liquid CO2 and only coats aramid fibres, not viscose or natural fibres. This means the suit is only coated on the outside. This has several advantages. The PPE maintains its breathability and there is no need to dry it.'

Garments that do not need to be dried last significantly longer, which is important because PPE is expensive. 'This method also has a much-reduced impact on the environment, because the contaminants are disposed of as hazardous waste and 98% of the CO2 is recycled.

Decontex also inspects garments for damage before they are returned, and has developed an automatic quality control system. This records data about each garment and informs fire services when PPE needs to be repaired or replaced.

At a time when concern is growing sharply about firefighters' exposure to toxic chemicals during the performance of their duties, as well as the dangers posed by PPE itself, Decontex offers a glimmer of hope. Contamination will remain an issue – there is no getting away from the realities of a firefighter's occupational exposure – but initiatives such as Decontex are for the first time offering fire services realistic and effective methods of mitigating those risks and putting the health and wellbeing of their firefighters first.

http://www.hemmingfire.com/news/fullstory.php/aid/3098