Foaming with questions

That the use of foam continues to cause headaches for firefighters became obvious during the Fourth Firefighting Foam Conference that took place over the summer in the Reebok Stadium (UK). Here are some of the highlights of a most thought-provoking event.

Dr Korzeniowski said that replacing C8 with C6 may not be a direct "drop in" replacement, and that many foams on the market would have to be reformulated and then undergo re-certification to the relevant fire standard.

Life safety, property protection, product safety and environmental stewardship: Dr Stephen Korzeniowski, DuPont USA

Dr Stephen Korzeniowski of DuPont USA, on his fourth time at the Reebok conference, focused his presentation on life safety, property protection, product safety and environmental stewardship. He pointed out that the fact that finding chemicals in the environment does not necessarily mean they are harmful – but it does raise questions about their fate and overall risk. His first message was that AFFF foams do work and are the most effective agents today, "but the question today is are they still suitable for all Class B fires considering the potential environmental consequences.

"But you need the right agent for the right fire and some agents work better than others. All agents have consequences, and to our knowledge nothing works as well as fluoro-surfactants for foams fighting Class B fires." Industries are moving towards using less environmentally biopersistent molecules in their foam concentrate formulation, using molecules with six fluorinated carbon chains (C6) as opposed to potentially more biopersistent mixtures containing C8 and above fluorosurfactants. Many foams already use 99% C6 fluorosurfactants, but he said that replacing the C8 with C6 may not be a direct "drop in" replacement, meaning that many foams on the market would have to be reformulated and then undergo re-certification to the relevant fire standard. These compounds may take up to two or three years to requalify. Dr Korzeniowski presented some of the toxicology and environmental studies conducted on C6 fluorotelomers, and the results showed that they have low toxicity, and are not classified as bioaccumulative by published regulatory criteria. He emphasised that C6-based fluorotelomer agents in AFFF did not degrade to or behave like PFOS and that to believe otherwise was a misnomer. In addition, "PFOA is a potential impurity in the historical products but it is not added or used in manufacture." The industry is moving to six carbon chains or less, and the tendency of bioaccumulation and toxicity is to become more favourable the shorter the carbon chains. Dr Korzeniowski also addressed concerns that 6:2 FTS was the same as PFOS – it is not, he said, the structure and properties are not similar. "Recent studies with 6:2 FTS and related surfactants has shown that they have low acute and aquatic toxicity, and are significantly lower in potential biopersistence than PFOS." He outlined test results with rainbow trout and rats to show that 6:2 FTS was not bioaccumulative by regulatory standards. Dr Korzeniowski ended his presentation with an outline of the voluntary *2010/15 PFOA Stewardship Program: Guidance on Reporting Emissions and Product Content* pioneered in 2006 by the US Environment Protection Agency in partnership with industry, which contains two milestones. First is to reduce PFOA and related chemicals from facility emissions and in product content by 95%

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no later than year-end 2010, and to work toward eliminating PFOA from emissions and in product content no later than 2015. Initial biomonitoring studies seem to prove that the program is working very well. "The bottom line is that choosing the best foam is a combination of performance, reliability and life safety balanced with toxicology and environmental impact," concluded Dr Korzeniowski.

Fluorochemicals in the environment: Dr Annegret Biegel, German Federal Environment Agency

Dr Biegel-Engler began by highlighting that per- and polyfluorinated compounds (PFCs) are a group of approx. 850 different chemicals with the common property: they have one of the strongest chemical bonds in nature, which confers upon them high stability against heat, UV radiation and biological degradation. The properties of PFCs are unique: their water/dirt/grease repellency means they are found not only in foams but also in a number of consumer products such as frying pans, paper coatings and textile production.

"Because of their stability we have problems in the environment. We are measuring PFCs not only in water, air, soil and animals (eg polar bears and European fish) but also in human blood and breast milk. In all blood samples which have been studied, PFCs can be found in low concentrations. We are concerned about PFCs in humans, because the half-life of PFOS and PFOA in human blood is more than four years. Additionally, PFOS and PFOA are carcinogenic and toxic to reproduction. Some PFC are less toxic but we don't yet know what the chronic behaviour of these persistent

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Dr Sthamer-Hamburg has launched the alcohol-resistant and fluorine-free Moussol FF 3x6, which complies with EN 1658 and has just passed class B ICAO.

chemicals is – we won't know for another 20 years' time. And the one big problem is having a strategy to dispose of PFCs, because they can only be destroyed by burning at very high temperatures."

Dr Biegel-Engler showed data on how PFCs are transported through the air. The volatile PFCs can be degraded into the persistent PFCs like PFOA and PFOS which can now be found in the arctic and deep sea.

Dr Biegel-Engler showed a number of slides on the latest studies regarding water samples, including one study regarding the river Elbe, where a wide range of different PFCs have been detected. "We don't only have a problem with PFOS and PFOA, but with short chain molecules too." Those short chain PFCs are more and more used as an alternative to PFOS and PFOA.

The sources of PFCs in surface water are for example municipal waste water treatment plants, as consumers use lots of products containing PFCs. PFCs can`t be degraded in plants so the watersoluble PFCs get washed into rivers and oceans. PFCs that adsorb to organic matter accumulate in sewage sludge. By using PFC-contaminated sewage sludge as a fertiliser they can be taken up by plants which pass them on to humans. Additionally PFCs have been detected in groundwater, which is often a source for drinking water.

Dr Biegel-Engler emphasised that it had been mentioned that the longer a molecule's carbon chain the more bioaccumulative the molecule, suggesting that usage of shorter chain molecules in foam would be less harmful for the environment. "But the shorter chain compounds are more mobile in soil and better soluble in water. Moreover, they are still persistent. Even with shorter chains we have no idea of how to get rid of them or clean the water to rid it of the PFC compounds. The toxicity might be lower with shorter chains, but we have no idea yet what kind of effects we will measure in the environment in 20 years' time."

She concluded by advising people to use as little PFCs as possible, and not to use PFC foam for training. "And if you need to use foam be aware that you contaminate the environment for a

long time. If possible collect and treat contaminated water. And most importantly for us, be aware that the shorter fluorinated chain compounds are not an environmentally friendly alternative to PFOS and PFOA.

Achieving requirements for Civil Aviation organisations: Luc Jacobs, Solberg

Luc Jacobs of foam manufacturer Solberg presented on his experience of recent work by the International Civil Aviation Organisation (ICAO) to create a better performing foam for ARFF operations, class C. A number of manufacturers sent foam samples to be tested by ICAO's proposed new extinguishing requirements, and Solberg's was the only foam to pass. Jacobs

Injunction granted to Chemguard over UL Identifier

United States District Court Judge Reid O'Connor of the Northern District of Texas entered an Order this week (week commencing 28th September) in Case 3:09-cv-01155-O in favor of Plaintiff Chemguard granting Chemguard's request for an injunction with respect to US Foam Technologies' (USF or US Foam) use of Chemguard's UL identifier. The Court directed USF to "Identify and issue a general recall to all customers specifically identifying what product(s) may have been mislabeled as Chemguard product(s), directing them to avoid using mislabeled product, and to return that product to USF." Roger Bower, President of Chemguard, commented, "Chemguard is pleased that the Court has taken action with regard to US Foam's admitted misuse of Chemguard's UL identifier and looks forward to the correction of this problem with product on which firefighters across the country rely upon." Mr. Bower went on to state, "Chemguard's allegations regarding US Foam's misrepresentations concerning US Foam's 'First Strike A/B' and 'Military Spec Approved' products remain pending before the Court. Chemguard is confident that the Court will ultimately make the correct determination concerning these allegations and find it appropriate to remove them from the marketplace."

In issuing his ruling, Judge Connor noted: "Many consumers require [UL certification] as part of their bid specifications." Judge Connor noted that Chemguard learned on May 14, 2009, that US Foam was selling firefighting foam using Chemguard's UL identifier. He observed that: "Both Chemguard and USF agree this was improper." He also noted that Chemguard purchased UL and military specification foam from USF and "According to Chemguard, USF's military specification foam did not perform as required by military specifications. . . Other foam Chemguard purchased from USF revealed, according to Chemguard tests, that it did not perform according to UL or other relevant standards."

In issuing his ruling, Judge Connor stated: "USF admits it has falsely designated USF products with Chemguard's labels. After considering US Foam's arguments, the Court concluded: "The Court is persuaded that USF's use of Chemguard labels have either actually deceived and confused potential customers, and a presumption exists that it has done so. Therefore, Chemguard has established a likelihood of success on the merits of its substantive claim based on USF's false use of Chemguard's labels."

Mr. Bower further stated, "Chemguard is concerned with the safety of the public and the firefighters that protect them. Our company does not want to be associated in any way with product that does not perform in accordance with industry standards and which is relied upon by firefighters to protect the public from tanker, aircraft, and other serious fires. We felt a responsibility to bring our findings to the attention of the proper authorities to enable them to make an informed judgment of what action is appropriate to protect the public and to keep Chemguard's reputation from being potentially blemished by the wrongdoing of another company."

was naturally proud that this was the case, but his presentation concentrated on concerns regarding the proposed class C requirements. He outlined that the lab test for level C may not reflect the wide range of firefighting equipment used by different airports, such as aspirating nozzle, water sprays etc. He pointed out that while class C did not stipulate a particular type of steel for the test fire tray, heat output between mild and stainless steel could differ tenfold. "And these tests were conducted indoors, but we have experience of outdoor and indoor testing and there are big differences." He also expressed reservations about reducing the rate of application of foam and where would the line be drawn. If required rates were reduced to 1.2 litres of foam per minute, in theory one fire truck could replace two – or if there were two, an airports category could increase. "So you have the same amount of foam and double the size of plane, which is a bit scary." Jacobs warned against closely matching the critical application rate of a foam – below which it would not work and be consumed by the fire – with the requirements of a new standard. Safer would be to have a standard that says a foam should operate at six litres per minute, and have it still work to the standard at half that. Flexibility in application rates is needed. To achieve the pass to class C, Solberg tripled the level of fluorosurfactant used in its class B – more so than its military spec product. "If you go for such a product then you get excellent performance but you have to be able to collect and burn it, and that's the consideration."

It costs around one euro to incinerate a litre of foam water – at Buncefield around 20 million litres of foam water were used.

Ecoguard fluorine-free firefighting foam: Dr Thomas J Martin, Chemguard

Dr Martin, Chemguard, began by saying that although fluorosurfactants are essential for AFFF foams and are not going away any time soon, fluorine-free foam products have been around for a long time and there is a present and growing customer base requiring them. Ecoguard was developed as a synthetic fluorine-free foam in response to this market demand. "Its key ingredient allows it to spread quickly and to be burnback resistant." In addition, Ecoguard has low toxicity, being an optimized hydrocarbon surfactant blend, and is readily biodegradable. "Typical properties are that it has the appearance and effect of a low expansion foam, depending on the discharge device." Dr Martin presented the favorable results from aquatic toxicity and biodegradation testing for Ecoguard, adding that it had also been evaluated against AFFF for firefighting performance. "Ecoguard has about the same fast control and extinguishing time as an AFFF, but burnback is a slightly different story." Dr Martin was referring to the fact that, while AFFF foams form a film and spread across a fuel surface, Ecoguard does not. Instead, Ecoguard relies on a thick and extremely stable foam blanket for burnback resistance. "Ecoguard passes the UL test criteria for topside and sprinklers." To stress that Ecoguard is a viable alternative to AFFFs, Dr Martin further commented, "Fluorine-free

A mobile treatment unit for foam water runoff could be up and running two years from now.

foams are a maturing technology that has been developed for a growing market and are qualified for use in specific areas where they pass the test requirements. As with other foams, there are trade-offs," alluding to the fluorosurfactant C8+ to C6 transition. "Our job as suppliers is to provide options."

Moussol, fluorine-free foam: Jan Knappert, Dr Sthamer-Hamburg

Jan began by correcting a previous speaker and pointing out that Dr Sthamer-Hamburg first developed alcohol resistant fluorine-free foam in 1953 and that the company had been leading in this industry since then. "You've heard a presentation from Dr Annegret Biegel from the German Federal Environment Agency and in the UK we have an environment agency that gives firefighters and manufacturers a hard time to make sure foams don't harm the environment." Jan went on to outline some of the foam used by German firefighters (most of whom are supplied by Dr Sthamer) – multipurpose, high expansion foam, used effectively for vehicle fires. "But there is increasing use of biofuels and conventional foams will have problems with the alcohol content.

"AFFF is not as effective tackling fuels enhanced with alcohols, so firefighters will have to change to alcohol resistant foam. At the same time, there is pressure to minimise foam usage in training and in anger." If that wasn't enough, the environmental issue has resulted in many questions for manufacturers from the fire services.

The solution is a multipurpose foam that works as effectively as an AFFF and is also alcohol resistant. "We are still travelling this road, but in the meantime we have Moussol FF 3x6, which is alcohol resistant and fluorine free, self healing, and complying with EN 1658. Last week it passed class B ICAO and it is being used at Newquay Airport in the UK." Jan finished his presentation by warning against firefighters putting all their eggs in one

Firebuy's new foam framework – foaming with choice

In July, Firebuy, the national procurement body for the English Fire and Rescue Service, launched the new National Foam Framework at the 4th Firefighting Foam Conference at the Reebok Stadium, Bolton. At the event, Firebuy's Michelle Van Toop (pictured) introduced the new multi-supplier framework which is a radical departure from the previous OGC (Office of Government Commerce) contract and now features five suppliers and over 90 products at competitive prices. Firebuy's new Firefighting Foam Framework agreement is not just available to all UK Fire and Rescue Services, MOD and public sector organisations, but also the Civil Aviation Authority and members of the Airport Operators Association, UK Petroleum Industries Association and the Tank Storage Association. It offers a multi-supplier choice of:

- Fluorine free foam
- Protein foam
- Fluoroprotein foam
- Film forming fluoroprotein foam
- Alcohol resistant film-forming fluoroprotein foam
- Synthetic detergent foam
- Aqueous film-forming foam
- Alcohol resistant aqueous film-forming foam
- Training foam
- Wetting agents and other media

Full details of the framework agreements including specifications and prices for general contract and for the MOD are available via the members' area of the Firebuy website. To register or to get further information visit www.firebuy. gov.uk or contact Paul Allison on paul.allison@ firebuy.gov.uk.

Suppliers on the Framework Agreement are:

- Angloco Ltd, Angus Fire
- AUXQUIMIA SA
- Delta Fire
- Solberg Scandinavian UK Ltd.

The project to re-specify and re-tender the national foam requirement has taken over a year and Firebuy acknowledges the assistance of the CAA, MOD and the Chief Fire Officers Association, as well as the many F&R Authorities who lent significant resources.

"Firebuy's firefighting foam framework agreement now offers more choice of suppliers, a more diverse range of products and is available to a wider selection of risk owners – a huge advance on the previous OGC contract." said Michelle Van Toop.

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Fire Fighting Foams & Equipment

The foam of choice for hydrocarbon fires for Williams Fire & Hazard Control's Kelvin Hardingham is AFFF ATC, due to its stronger "survivability".

fluorine-free basket. If a big event happens a state-of-the-art premium quality AFFF is needed.

A mobile treatment unit for water used during firefighting operations: Dr Martial Pabon, DuPont

Dr Pabon's focus was on the treatment of foam water effluence collected from large incidents such as Buncefield. The goal, to extract the fluorosurfactant from the water, so that the concentrate part can be incinerated. The alternative is to incinerate millions of litres of contaminated water rather than several kilograms of surfactant. To put it in context, Dr Pabon estimated that at Buncefield around 20 million litres of foam water were used. It costs around one euro to incinerate a litre of water. Two years ago, at the previous Reebok conference, a filtration technique was discussed using activated carbon.

Today, Dr Pabon's research has moved to reverse osmosis, which has cost, performance and maintenance advantages over activated carbon. Pabon explained how the first stage of the process uses electrocoagulation to rid the water of fuel droplets and other impurities. The second process uses reverse osmosis via a membrane. The process was tested with actual fire water with a concentration of 150ppm of fluorosurfactant. Following treatment the fluorosurfactant levels were below those capable to be detected by the equipment used by Dr Pabon, and therefore well below those stipulated by water treatment regulators. In large scale production, it is envisaged that such a treatment plant could treat 4.5m^3 of water per hour, with costings around 0.5 dollars per m^3 – quite a difference from the one euro per litre of current incineration costs (1,000 times cheaper). "Of course the equipment has to be purchased and that's why I was talking of using a mobile unit. We want to absorb the fixed cost of the equipment and electrocoagulation at 100,000 dollars, and reverse osmosis at 150,000 dollars. This is for treatment of 10 million litres of water in three months. This cost is perfectly reasonable and competitive compared to incineration."

Following a question and answer session, it was established that the unit could be scaled up for water treatment to start two years from now. It was also suggested that big refineries could have such a plant on site which under resilience arrangements could be available within two hours.

We fight big fires! Kelvin Hardingham, Williams Fire and Hazard Control

Kelvin Hardingham of the 30-year-old, Texas-based company began his presentation by stating that he was not an environmentalist or scientist, but just a firefighter.

Williams Fire & Hazard Control company has put out over 170 large flammable fires, including an 82m diameter tank fire of blended gasoline in 2001. "I have always seen two very clear missions in my role as operational firefighter. First is to reduce the number of incidents related to the fire, and second to extinguish any fires quickly and safely. At the same time we use every effort to reduce fire damage to a minimum, which includes property and the environment. That has not changed in 45 years."

Hardingham expressed concern that considerations that used to be at the bottom of the list have gone to the top. "Last week an airport fire chief wanted to talk abut foam. I asked him what his criteria were, and he said ICAO A or B as the base line. Above the baseline the only issue was the environment. I asked about fire performance, he said no, it was the environmental impact. If I was landing on that airport that would concern me."

At another meeting a refinery chief was having to change all his foam stocks. "He said that he had no say in the changeover, and that the decision came from the environmental department of the corporate headquarters. They said the foam had to be EN standard, but the rest was about the environment. The chief was not happy about that."

There followed an impressive number of incidents that Williams Fire had been involved with, all with one common factor. AFFF ATC (alcohol type content) foam had been used in all the incidents as the preferred foam of use for Williams. "We test more foams than anybody else other than UL. We did 170 foam tests before coming up with a satisfactory one, and this year alone we've done 11 tests with different formulations. At the moment none have superseded the current foam we use."

Hardingham also listed as a factor of success the use of simple and reliable equipment, as well as a deep understanding of the hazard involved. "Foams used in systems are designed for property protection. Foam used by firefighters is a life safety issue. You want to make sure they go home to their families." He emphasised that many foams on the market had been designed purely to meet test criteria and pass standards.

Hardingham highlighted that an industrial firefighting team without full tank fire experience and with a mediocre foam concentrate would be in big trouble.

He concluded his presentation with the recent news in June involving 3M. The company was being sued by Washington County residents over claims that the company had allowed PFC chemicals to spill in their groundwater, and which had affected their properties' values.

In the court case – won by 3M – a study by the Minnesota Department of Health was mentioned which found no increases in cancer or other ailments in the affected area — despite years of exposure to PFCs in drinking water. "It was calculated that a Woodbury resident would have to drink 500,000 glasses of the water at once to get a PFC dose at the level believed to be harmful in mice."

In a question and answer session following the presentations, Hardingham was aksed why AFFF ATC was the choice of foam for hydrocarbon fires. He answered that in his experience AFFF ATC bubbles had a stronger thermal capability – which he termed "survivability" – which added an extra second or two. "It has a fast fire knockdown and it is our recommendation for all hydrocarbon fires."

All the foam conference presentations will be posted on the Industrial Fire Journal website. To receive an email alert when they are available, sign up for Fire e-news on www.hemmingfire.com.