



Carbohydrates replace fluorine
as basis for new AFFF substitute

Sweet Smell of Success

Photos by Anton Riecher

Above and below at right, personnel conduct a live-fire demonstration of Solberg's RF3 during a foam workshop in Texas.

By ANTON RIECHER
IFW Editor

Fire fighting foams based on synthetic chemistry revolutionized industrial emergency response nearly half a century ago. However, ongoing environmental concerns worldwide are forcing fundamental changes in that chemistry.

The Solberg Company is positioning itself as a leader in that change with the introduction of its fluorine-free RE-HEALING fire fighting foam product line to the North American market.

“What we want to show you today is a product that doesn't have any of those issues,” said Dennis Kennedy, executive vice president of Amerex Corporation, Solberg's parent company.

He addressed a workshop conducted at the Beaumont Emergency Services Training complex in Beaumont, TX, that included live-fire demonstrations using full-scale industrial training props.

RE-HEALING foam concentrates are intended for use on Class B hydrocarbon and polar solvent fuel fires. Concentrates available include RF1 (one percent), RF3 (three percent), RF6 (six percent) and RF3x6 percent ATC formulations. The concentrates can be used to extinguish, prevent re-ignition and control the release of hazardous vapors.

Underwriters Laboratories listed, RE-HEALING recently completed its Factory Mutual testing. After a factory audit is completed, Solberg plans to announce the FM testing results for its foam and foam hardware in early 2014.

RE-HEALING concentrates are also European Committee for Standardization EN approved and hold International Civil Aviation





Live-fire demonstration using BEST's process unit prop.

Organization certification.

The name RE-HEALING refers to the results of burn back resistance tests that measure the foam's ability to maintain a stable blanket if the fuel beneath is exposed for any reason.

"This foam heals itself or flows back over much faster than any AFFF does," said Steve Hansen, Solberg's general manager.

The first demonstration, conducted by Alert Disaster Control, service partner to Solberg, was a fire in BEST's shoulder high 42-foot diameter storage tank training prop that was extinguished using a monitor nozzle with a self-educating non-air aspirating nozzle. Next, Alert simulated a spill fire in an industrial environment using foam eductors, hand lines and non-air aspirating nozzles to extinguish a 35-foot-square process unit "obstacle" prop.

The key issue for most foam utilizing synthetic chemistry is carbon chain lengths, Kennedy said. C₆ means the fluorosurfactant is six carbon molecules long or less. C₈ means that those surfactants are eight carbon molecules or longer.

"The C₈ and longer chemistry such as in the 3M product were great for fire fighting," Kennedy said. "It had great performance, burn back resistance and knockdown."

But effective in 2015, the US EPA Stewardship Program will require that all fire fighting foam sold in North America must be C₆ or less. Solberg completed the conversion of all its fluorinated foams to C₆ chemistry several years ago, while other foam companies continue to reformulate their fluorine based products to comply with the EPA's ever stricter standards, resulting in extended extinguishment time and diminished burn back resistance, Kennedy said.

Solberg opted to follow a different drummer.

"What we have is a product that is completely fluorine free – no C8, C6, fluorosurfactant or fluoropolymers," Kennedy said.

"It is synthetic foam that contains none of those regulated, targeted products."

Developed from complex carbohydrates, RE-HEALING foam creates a fluid and stable foam bubble structure.

"As a company, we didn't want to deal with future regulations that may affect the AFFF market," Kennedy said. "We wanted to move in a completely new direction and create something new."

With AFFF (Aqueous Film-Forming Foam), a film forms on the fuel surface that allows the bubble structure to spread and seal off the fuel vapors. However, RE-HEALING foam does not use any film forming agent.

"RE-HEALING foam consists of a variety of different bubble sizes," Kennedy said. "Think of the bubbles tumbling over each other, spreading across the fuel surface without relying on any kind of film or fluorine to accomplish that."

Hansen explained how RE-HEALING works by comparing it to protein foams, the predecessors to AFFF.

"How is it that you can put a meringue pie into an oven at 350 degrees Fahrenheit, leave it there for 15 to 20 minutes and have it come out not burned but a nice golden brown?" he said. "It has to do with heat reflection and absorption."

Protein foams rely on the same principal, Hansen said. When expanded, protein foam uses properties of heat reflection and absorption to maintain itself as it travels across the fuel surface.

Instead of proteins, RE-HEALING uses complex carbohydrates to do the same thing. Those carbohydrates are basically sugars, Hansen said.

"We use a combination of carbohydrates with a high molecular weight – polysaccharides – to give us the expansion and drainage time that allows this product to survive on hot surfaces," Hansen said.

The use of carbohydrates gives it a very high rate of heat absorption, Hansen said.

"When you do a test and the material hits the hot surface, it smells like you're going past the cotton candy at a carnival," he said. "As these carbohydrates caramelize it takes the heat out of the fire."

The foam is so effective at removing heat that in a preliminary test done using the BEST complex storage tank prop it was possible to touch the tank walls immediately after extinguishment without burning yourself, Hansen said.

RE-HEALING foam relates to AFFF foams in that it is applied at the same application rates, he said. And, like AFFF, RE-HEALING foam has a 20-year shelf life.

The fire protection business has a history of talking about "drop-in replacements," Kennedy said. Unlike the replacements for Halon, RE-HEALING truly is a drop-in replacement, he said.

"If you've got a foam system outfitted with AFFF you can literally drop in RF3," Kennedy said. "It's the same proportioning equipment, bladder tanks, sprinklers, everything."

The storage tank live-fire demonstration at BEST was conducted using standard, non-air aspirating, self-educating nozzles.

"What we use today is what you're going to use for this product," Hansen said.

Another important comparison to AFFF is competitive price,

he said. Also, Solberg's environmental warranty states that if another product with a better environmental profile comes on the market, Solberg will replace the foam it has sold with that product.

"We are going to make it as easy as we can for our customers to upgrade their AFFF to this product," Kennedy said.

Solberg maintains a 10-acre manufacturing and research facility in Green Bay, WI, which includes the largest non-government owned burn test laboratory in the country, Kennedy said. Part of the workshop was spent reviewing videos of UL 162 burn back resistance testing

Two inches of fuel is applied to a two-inch layer of water in a 50-square-foot burn pan. After a one-minute burn, a nozzle applies foam to the fuel surface until the fire is declared to be at least 90 percent under control.

After a five minute foam application, the nozzle is removed and the foam blanket is left undisturbed to determine how quickly it dries out. A torch is passed over the perimeter of the blanket to detect if vapor has broken through during the test.

"If we see that foam blanket ignite, the test is a failure," Kennedy said. No vapor is detected.

Next comes the burn back resistance test. A stove pipe is pressed down through the blanket. The foam inside the pipe is removed and the exposed fuel ignited. After one minute, the pipe is withdrawn to determine how far the fire will spread across the foam blanket within five minutes.

"Twenty percent of that pan can be re-involved and you would still have a successful test," Kennedy said.

With the pipe withdrawn, the blanket almost immediately closes over the exposed fuel, extinguishing the fire.

"We put the pipe right back in the same spot and repeated the burn-back test with the same results: self-extinguishment," Kennedy said

Kennedy said he has done the same test seven times in a row with the same results.

"I only have to do it once for a successful approvals test," he said.

RE-HEALING foam has been tested as effective on fuels as diverse as ethanol and methanol, allowing for different application rates, Kennedy said.

It offers some significant improvements over AFFF as well. Kennedy showed video of the burn back testing using AFFF manufactured by Solberg.

"When you pull the pipe you see what is referred to as a ghosting fire," he said. "The foam blanket ignites. That's acceptable. It isn't considered a problem by the testing agencies, especially with the changes related to C₆ chemistry."

As long as the fire does not continually burn in one spot on the foam blanket, the test is considered successful and is not counted as part of the 20 percent allowable area affected by burn back.

"We have never experienced a ghosting fire with RE-HEALING foam," Kennedy said.

Next is the issue of drain time, a measure of how quickly the water-foam solution drains out of the foam bubble. With AFFF, drain time is normally about two to three minutes. Alcohol resistant concentrates last as long as 12 to 13 minutes.

"The product demonstrated, the RF3, has a minimum drain time of 30 minutes up to 75 minutes," Kennedy said. "So when you start looking at the stability of the foam blanket, this should give you some indication."

Extinguishing times and foam expansion with RE-HEALING foam is in line with what would be expected from AFFF, Kennedy said. The extended drain time indicates RE-HEALING foam's resistance to vapor permeation.

Yet, the product presents no long-term environmental hazard.

"Our product biodegrades 100 percent," Kennedy said. "Other AFFF suppliers will tell you their product biodegrades to 95 percent within 28 days. That is true. What they don't talk about is the five percent that is going to be in the ground for centuries."

RE-HEALING's environmental credentials are so solid that RE-HEALING foam is eligible under the US EPA Supplemental Environmental Policy (SEP) for offsetting issued environmental fines, Kennedy said.

The storage tank training prop fire at BEST used 450 gallons of E3 low emission fuel. An RF3 foam solution was applied from one monitor stand using a 350 gpm self educting nozzle.

Michael Allcorn, managing director of Alert Disaster Control, said the application rate used for the demonstration was 0.24 percent, higher than the American Petroleum Institute recommended rate of 0.16 percent.

"We can argue back and forth about 0.16 against 0.24," Allcorn said. "Realistically, we all understand this fire fighting has evolved over the last 15 to 20 years, to a great extent due to the efforts of the Williams family and their technology. Understanding that, we now accept a standard application rate of .24 for these types of events."

The process unit prop was dealt with using two hand lines equipped with 95 gpm eduction systems.

"It's a drop-in application using the same equipment found on the plant site," Allcorn said. "There is nothing different in terms of how this foam can be produced through the equipment."

Singapore-based Alert, a global emergency response company, has been involved with RE-HEALING since its inception shortly after the demise of the 3M product lines in March 2000, Allcorn said.

"We commenced a four-year program looking for an alternative to what we had been accustomed to with the AFFFs," he said. "Our experience with the RE-HEALING product line goes back 14 years."

Before extending operations to the US about three years ago, Solberg had a long history in European foam manufacturing. In the 1960s, it manufactured 3M fire fighting foam for use in European markets, particularly the expanding offshore oil operations in the North Sea.

Solberg is also making inroads into the Asia-Pacific region, recently awarded a contract by Australia's New South Wales government for the supply of fire fighting foam.

"We've seen a number of product developments and changes that have taken us to where we are today," Allcorn said. "We have a product with a fire fighting performance that is equal to what we've had in the past while addressing the environmental issues that are catching up with us." 