Gold Crew Benz-Out in Firefighting

June 12, 2018
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Introduction

In a study by Robert D. Daniels, et al., entitled Mortality and Cancer Incidence in a Pooled Cohort of US Firefighters from San Francisco, Chicago and Philadelphia (1950 to 2009) the health of 29,993 firefighters was followed for the period of 1950 to 2009. The conclusion of the study stated that the results confirmed a relationship between firefighting and cancer. The International Agency for Research on Cancer (IARC) has classified occupational exposure as a firefighter as possibly carcinogenic to humans and in an article written by Jamie Reno entitled Why cancer is the Number One Killer of Firefighters it stated that it is the toxins released by the fire and not the flames or smoke that are causing the high cancer rates among firefighters. In 2017 it was not heart or lung disease that was the number one killer. It was cancer. In still another article, Cancer: Ashville Firefighters Face Job Danger Even Deadlier than Fire by Karen Chavez, it is stated that "Cancer is now the leading cause of death among firefighters, according to the Firefighter Cancer Support Network and the International Association of Firefighters." In all of these studies and articles it was contamination of personal protection equipment that was a major factor in the exposure of the firefighter to the carcinogens released by a fire.

Two methods of decontamination are typically used, gross-decontamination and decon cleaning. Gross-decontamination is performed in the field and usually consists of some form of wash down with water. This method has two drawbacks. First, the contaminated water is disposed of into the storm drains and second, tightly embedded contaminates are still present. There is also the weather factor when gross-decontamination is performed in freezing temperatures.

Decon cleaning is typically performed at the fire house in a designated space ideally equipped with extractors, dryers and cleaning areas. The space should have an HVAC and exhaust system separate from the firehouse proper. In the cleaning areas the PPE can be allowed to out-gas safely. The main drawback of the decon cleaning is that it requires a dedicated and specially equipped space, which can be difficult to retrofit in a traditional firehouse.

Gross-decontamination of the firefighters and their equipment has become increasingly important as the number and concentration of toxic substances has continued to increase. It provides a method of immediate, but somewhat inadequate decontamination. Given that this method is not always as effective as it should be, new methods need to be evaluated and adopted. One of these methods is the use of Gold Crew Benz-Out to decontaminate turnout clothing and other personal protection equipment.

Benz-Out was originally developed to deal with the benzene, but has proved effective with other VOC, as shown when gasoline, which contains a number of VOC, is used as the test fluid. As stated in Systemic Exposure to PAHs and Benzene in Firefighters Suppressing Controlled Structure Fires by Kenneth W. Fent, et al., "In addition to PAHs (Polycyclic Aromatic Hydrocarbons), nearly all fires will produce other potentially carcinogenic aromatic hydrocarbons such as benzene". The National Cancer Institute has determined that Benzene exposure increases the risk of contracting leukemia and the Department of Health and Human Services (DHHS) has determined that benzene causes cancer in humans.

Scope

This paper will address the history, use, environmental impact and possible health concerns of Benz-Out as a method of vapor suppression and gross decontamination. It will endeavor to show that Benz-Out is safe to use by the firefighter and benign to the environment, presenting no significant health hazards or ecological degradation. Appendix A will contain the Safety Data Sheets for Benz-Out, Dawn Ultra Dishwashing Liquid and Dawn Ultra Plus Heavy Duty. The two Dawn products are defined by the US Consumer Product Safety Act as Consumer Products which, when used as intended (typical consumer duration and frequency), are exempt from the OSHA Hazard Communication Standard (29 CFR 1910.1200). This means that the Dawn products are so benign that regulation of the product is not necessary. A comparison of the data from the Safety Data Sheets will show a reasonable correlation with the data for Benz-Out.

History of Benz-Out

Gold Crew, the manufacturer of Benz-Out, uses the terms FX and Benz-Out interchangeably for its product. For the purposes of this paper the term Benz-Out will be used.

Benz-Out was initially used as a method for suppressing and encapsulating the volatile organic compounds (VOC) found at fire sites. In studies conducted by Jim Figueira, K9 accelerant detection dogs and photoionization detectors were used to confirm that the level of VOC could be significantly reduced by the use of Benz-Out and still be detected by the accelerant detection dogs.

Fire departments put a great deal of effort into their accelerant dogs. From initial selection of the animal to training it to recognize Volatile Organic Compounds, or VOCs, departments invest a significant amount of time, resources and dedication to bring a dog to service-ready status. Protecting that investment is paramount, not only for the department but also for the health and safety of the animal.

Throughout their career, accelerant dogs are constantly sniffing VOCs, be it for training, their annual certification or on-scene detection. Nearly all accelerant dog deaths can be attributed to cancer, which is linked to VOCs. This is where BenzOut can play a valuable role.

In a test of the product, the team took a microgram of gasoline and hid it in a training facility. The accelerant dog successfully located it. Using a PID meter, the sample measured 95 PPM within the first fifteen seconds of measurement.

The team then introduced BenzOut into the sample. Once again, the dog successfully located it. However, with BenzOut, the sample measured only 3 PPM and took nearly fifteen minutes to register on the PID meter.

It is logical to conclude that the 96.8% suppression of VOCs delivered by BenzOut will have a beneficial effect on the service life of the dog. BenzOut will make it possible to continue the animal's training, certification and field activities, but with much lower VOC exposure. Through BenzOut's neutralization of benzine offgassing, the animal's well-being is dramatically enhanced,

the department's investment is protected and a valued member of the firefighting team has a new level of protection and safety.

An additional study was performed where four drops of gasoline were deposited on absorbent pads and measurement made over the interval of one minute to establish a baseline. In this case the calibration was set for Isobutyl. Measurements were then taken using Benz-Out in concentrations of 2%, 4% 5% and full strength. In all cases a significant reduction in the VOC was seen. According to the United States Department of Labor the maximum time-weighted average (TWA) airborne exposure limit for benzene is 1 part per million for an 8-hour workday and the maximum short-term exposure limit (STEL) is 5 ppm for any 15-minute period. This low baseline shows the importance of reducing the levels of benzene and other VOC.

Table 1, Peak Readings using an Ultra RAE Photoionization Detector

VOC	Peak Reading
Gasoline #1 (4 drops)	190 ppm
2% Benz-Out	63 ppm
Gasoline #2 (4 drops)	218 ppm
4% Benz-Out	85 ppm
Gasoline #3 (4 drops)	215 ppm
5% Benz-Out	65 ppm
Gasoline #4 (4 drops)	224 ppm
Full Strength Benz-Out	78 ppm

Note: Peak readings are visually interpreted from the report graphs.

This use of Benz-Out for decontamination of personal protective equipment was developed jointly by the Washington State Fire Chiefs Association and EF Recovery.

In a study performed by Intertek for the NFPA, Investigation of Turnout Clothing Contamination and Validation of Cleaning Procedures – Phase 1, VOC were identified as contaminates on protective clothing supplied by the NFPA and collected from several departments. Another study performed by EIF Global in 2011 concluded that the retention time of ignitable liquids deposited on clothing could be as little as 10 minutes or as much as several days. A study by David A. Matthew, et al, entitled Firefighter Exposure to Contaminates and Residue Remaining on Personal Protective Equipment states in the summary that;

"We were able to confirm that the residue on our PPE from exposure to this smoke contains many of the heavier toxicants and carcinogens found in smoke and remains on our PPE for an extended period of time and likely through active decontamination procedures."

All these studies point to the importance of timely and effective decontamination of personal protection equipment. NFPA 1851 prohibits the scrubbing or use of high velocity spray for the decontamination of turnouts. Traditionally, rinsing with clean water or the use of a mild detergent has been used, but was not always effective and if not captured causes storm water problems. Benz-Out applied as a passive spray has proven to be an effective method of gross decontamination. Surfactants form spherical micelles which surround the hydrocarbon molecules forming micro emulsions. In effect, contaminates are broken down, rendered non-hazardous and rinsed away.

The typical application rate is between 1%, 3% or 6% depending on the type of suppression or decontamination required. Several tests conducted by Gold Crew saw detectable levels of benzene at 5 to 0.5 ppm before Benz-Out was applied. Afterwards the benzene reading was 0 ppm.

Environmental Impact

The Organization for Economic Co-operation and Development (OECD) has developed tests for confirming the biodegradability of chemical compounds. Per the Safety Data Sheet issued for Benz-Out all surfactant components and Benz-Out in general, were found to be readily biodegradable. In addition, aquatic toxicity is rated very low.

Table 2, Benz-Out Physical and Chemical Properties

Flash Point	None	Melting Point	32F
Specific Gravity	1.036 ±.01	Vapor Pressure mm/Hg	N/A
Pounds Per Gallon	8.64	Vapor Density Air 1	N/A
Solubility in Water	Complete	Reactivity with Water	No
Viscosity	15 Centipoise	Surface Tension 5%	29.1 Dyne/cm at 25ºC
Evaporation Rate	>1 as compared to Water	pH	9.5 ±.75
Appearance	Clear	Fire Extinguisher Media	N/A
Odor	None	Fire Fighting Procedures	N/A

Table 3, Benz-Out Stability and Reactivity

Stability	Stable	Incompatible Substances	None Known
Polymerization	No	Hazardous Decomposition Products	N/A

Disposal of Benz-Out is in an approved disposal area or in a manner that complies with all local, state, and federal regulations is straight forward and safe. If spills occur a small spill may be soaked up with absorbent material. A large spill should be contained with a dike and removed with a vacuum truck or pumped into a storage/salvage vessel. The residue can be removed with absorbent material. These minimal clean up requirements show the benign nature of Benz-Out.

The composition of Benz-Out is water and a proprietary blend of Ethoxylated Octylphenolic Surfactants.

Health Impact

The health hazards listed in Table 4, on page 5 of this document, show a side by side comparison of the hazards for Benz-Out, Dawn Ultra Dishwashing Liquid and Dawn Ultra Plus Heavy Duty. It is well to remember that the Dawn products are unregulated and considered to be non-hazardous. The comparison shows similar hazards for all three products.

Table 4, Health Hazards

Method of Exposure	Benz-Out	Dawn Ultra	Dawn Ultra Plus
Skin Contact	Prolonged or repeated exposure may cause skin irritation. A single prolonged skin exposure is not likely to result in the material being absorbed through skin in harmful amounts. The dermal LD50 has not been determined. Remove contaminated clothing. Wash exposed areas with soap and water. Wash clothing before reuse. Get attention if irritation develops.	Skin contact, rinse with plenty of water. Get medical attention if irritation develops and persists.	Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower. Get medical attention immediately if symptoms occur.
Eye Contact	Eye contact may cause irritation. Flush thoroughly with water for 15 minutes. Get medical attention.	Causes eye irritation. Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists get medical advice/attention.	Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Get medical attention immediately if irritation persists. Risk of serious damage to eyes.
Oral Ingestion	No hazards anticipated from swallowing small amounts incidental to normal handling operations. Large amounts may cause gastrointestinal irritation. Get medical attention.	If swallowed drink 1 or 2 glasses of water. Do not induce vomiting. Get medical attention immediately if symptoms occur.	Drink 1 or 2 glasses of water. Do not induce vomiting. Get medical attention immediately if symptoms occur.
Inhalation	Inhalation is not considered a method of exposure.	Move to fresh air. If symptoms persist, call a physician.	Move to fresh air. If symptoms persist, call a physician.
Chronic Exposure	No relevant information available for chronic exposure.	No information available for chronic exposure.	No information available for chronic exposure.
PPE	Personal protection consists of impervious gloves for solutions or where contact is repeated.	Use personal protective equipment. Do not get in eyes, on skin, or on clothing.	Use appropriate personal protective equipment.

Conclusion

Benz-Out has been shown to be a safe and effective method to address the problem of suppressing VOC at fire sites and for the gross decontamination of Firefighter personal protective equipment. Instead of just washing away contaminates, it encapsulates them and renders them harmless. It presents no environmental hazard and clean-up of spills requires only minimal effort. There are no major health hazards with Benz-Out, as shown by the comparison with the two forms of Dawn dishwashing liquid and is superior to soapy water. Benz-Out can be an effective tool in the effort to create a healthier work environment for the Firefighter.

Appendix A

This appendix contains the Safety Data Sheets for the following products.

Manufacturer	Product
Gold Crew	Benz-Out (aka FX)
Proctor and Gamble	Dawn Ultra Dishwashing Liquid
Proctor and Gamble	Dawn Ultra Plus Heavy Duty