

FOTE • REPORT

SAFETY ENGINEERING UPDATE

FOTE NOTES

At Russell Fote & Associates, our purpose is to provide our clients with the very best safety engineering and expert consulting services.

Since starting Russell Fote & Associates, Mr. Fote has given over **150 depositions** and has testified at over **25 trials**. He has been recognized as an expert in the state courts of: Illinois, Wisconsin, Iowa, Kentucky, Tennessee, Nebraska, Oklahoma, and West Virginia, plus U.S. District Courts in Atlanta, GA and Central Islip, NY.

We have two offices to serve you. Our Chicago office is located at 8770 W. Bryn Mawr Ave., Suite 1300, Chicago, IL 60631, which is about three miles east of O'Hare International Airport. Our other office is located in Wisconsin at 3635 Stonebrook Ct., Brookfield, WI 53005. You may reach us using the contact information listed at the bottom of this newsletter.

At Russell Fote & Associates, we continue to remain current on all safety engineering-related issues.

We invite you to visit our "home page" on the Internet. You may access our web site at: www.fote-engineering.com or E-mail information to our office at: rfote@wi.rr.com.

Propane Safety

Recent statistics from the National Fire Protection Association (NFPA) indicate an estimated 1,200 home fires are caused each year by propane ignition.

These 1,200 fires result in an estimated 34 deaths, 135 injuries and \$48 million in property damage each year.

NFPA further estimates that nearly 90 percent of propane fires involve some type of propane-fired equipment, with the most common types being gas grills, water heaters and stoves.

Propane, also named liquid petroleum or LP gas, is manufactured as a component during the crude oil refinery process.

Propane can be stored easily under pressure as a liquid, which facilitates the fuel's ease of transportation by rail car or truck through various distribution channels and ultimately to retail customers.

Large quantities of propane are sold annually to customers who have their 20-pound gas grill tanks filled at local retail outlets.

Propane is also delivered in bulk, for example, to large 500-gallon storage tanks installed in the yards of rural homes.

These customers usually use propane to fuel their furnaces, space heaters, water heaters, cooking appliances, and other equipment.

NFPA states the leading cause of these propane fires was a part failing or a leak. Therefore, propane leak detection is a top priority for reducing the number of fires caused by propane-fueled appliances and household heating equipment.

When a leak is discovered, the individual or individuals exposed need sufficient time to take corrective action to repair the leak, or at least escape the hazardous condition.

Propane is Odorized

When propane is manufactured from the petroleum refinery process, the final product contains no odor; an odorant is added as a primary safety precaution.

To comply with this safety requirement, NFPA developed a national voluntary consensus standard.

NFPA's Code 58 states propane shall be odorized and detectable by a distinctive odor at a concentration in air not greater than one-fifth the lower limit of flammability, which relates to approximately one-half percent propane in air.

Ethyl mercaptan is the odorant primarily used for propane. It has an extremely pungent odor and is similar to the smell of rotten eggs.

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NFPA recommends one pound of ethyl mercaptan per 10,000 gallons of liquid propane.

Detection of propane is a special problem because of its physical properties. Propane is much heavier than air, with a specific gravity of 1.5. Therefore, propane tends to seek low levels.

For example, a leak may occur in the control valve, burner or pilot mechanism of a water heater. These items tend to be near the floor.

A homeowner who uncovers a non-functioning water heater may not detect an odor when attempting to light the burner. If he or she bends to the floor with a lighted match, the propane gas may ignite, causing an explosion and/or fire and possible serious injury.

Rust, or more appropriately, iron oxide, reacts chemically with the ethyl mercaptan, thereby reducing and in some extreme circumstances, nearly eliminating ethyl mercaptan's odorant capabilities.

New tanks with non-coated inner surfaces, which are pressure tested with water and left to dry in air, are very susceptible to forming iron oxide on inner surfaces.

Iron oxide also forms on the inner surface of refilled, used tanks whose filling valves are left open, allowing air to enter the tanks.

The Human Response

Our olfactory system consists of odor receptors in the nose, which transmit nerve impulses to the olfactory bulbs inside the brain.

The olfactory system is sensitive to various odorants and is very inconsistent. Different individuals exhibit different sensitivities to the same odor.

Age is also a factor, causing reduced sensitivity to ethyl mercaptan. A past study was conducted using ethyl mercaptan to compare sensitivity in young adults under age of 25 to adults over age of 75. The older adults required 10 times the concentration of odorant in air to recognize the same odor level as the younger age group.

Another sensitivity factor is olfactory fatigue, which involves an individual's perceived intensity of an odor versus time.

The first defense for injury prevention for most propane-related fires or explosions is recognizing the seriousness of the leak.

When exposed to an odor for a few minutes, the olfactory system becomes fatigued to a point where the odor's magnitude appears to be only a fraction of its intensity at initial contact.

A general consensus by authorities on olfactory responses indicates odor-intensity drops by over 60 percent within two to four minutes of initial odor contact.

Also of concern is an individual's distraction by some activity not relating to the sense of smell. Studies in this area have focused on the brain's information processing related to odor detection.

Odors involve the brain's limbic system, the system that also triggers our emotions. That system may play an important part in distracting us from the physiological aspects of the sense of smell.

Odor Testing and Documentation

Since propane may be stored and transported in several different tanks before reaching the final customer's tank, it is extremely important each entity in the distribution chain conduct documented odorant testing.

NFPA's Code 58 requires odor testing when propane is delivered from the refinery to a bulk tank distribution facility.

Most industry experts recommend odor testing and the accompanying documentation be performed by the propane retailer when filling its tank trucks for delivery to customers.

This testing may be conducted by simple smell or using an instrument such as an odor meter.

Huitt vs. Southern California Gas Co.

The California Court of Appeals on October 7, 2010 reversed a lower court's verdict involving a natural gas explosion that seriously injured an experienced plumber, Mr. Michael Huitt and his helper, Mr. Matt Nino.

The trial court had awarded each plaintiff more than \$1 million in compensatory damages, plus a total \$5 million in punitive damages for the two men.

Although this case involves natural gas, safety-engineering principles concerning odor fade and warnings can easily be associated with most propane applications.

A plumbing contractor employed Mr. Hutt, an experienced plumber, and his assistant, Mr. Nino. On November 16, 2005, these men were sent to a local school's construction site to perform work.

(continued on next page)

Once there, their first job was to light a natural gas-fired water heater, which was located in a closet. Mr. Huitt turned on the gas valve, held down the red button and pushed the igniter to light the pilot, which did not light.

Since he had lit many water heaters in the past, he did not read the instructions posted on the water heater, nor did he read the instruction manual. Mr. Huitt turned off the gas valve to the water heater and opened another gas valve to purge air from the gas piping.

He testified that after several seconds, he closed this valve and reopened the gas valve to the water heater.

Since neither he nor Mr. Nino smelled any natural gas, he proceeded to again attempt to light the water heater. At this time an explosion occurred, which severely burned both men.

At trial, testimony was presented that in nature, natural gas is odorless and an odorant is added per Federal regulations to ensure it is readily detectable for safety purposes.

The explosion site was also a construction site, and the testimony provided did not discuss the extent of how much new gas piping was present.

The odorant commonly used in natural gas is a sulfur based compound, tert-butyl mercaptan (TBM). When TBM flows through new steel pipe that contains rust and metal oxides, a chemical reaction can take place to produce disulfides, thereby causing odor fade.

A mechanical engineer retained by the plaintiffs opined there was no

odorant in the natural gas because Mr. Huitt, an experienced plumber, would have smelled the odorant and therefore, would not have attempted to light the water heater.

Also, he opined Mr. Huitt was not at fault for his lack of reading the water heater's installation manual since he had worked with a similar water heater in the past. He was not installing it but just attempting to light the water heater.

However, it was shown during the trial that the water heater's installation manual included a warning regarding odor fade.

The appeals court recognized odor fade as being very hazardous and not common knowledge in the construction industry.

Also presented to the jury were several instruction manuals for other natural gas-fired appliances. Those manuals contained odor fade warnings.

Two other mechanical engineers who were experts for the defendant testified they performed calculations. They estimated the amount of time Mr. Huitt used to purge the gas piping was in the two minute range.

They evaluated the size of the closet, which contained the water heater, and the properties of natural gas. For natural gas to be ignitable, a mixture of about 5 to 15 percent of natural gas in air is required.

A defendant's employee, a measurement technician, testified during trial that on November 16, 2005,

sufficient odorant was present in the natural gas supplied to the school's construction site. The plaintiffs did not dispute his testimony.

The plaintiffs needed to present evidence to the jury that the defendant, Southern California Gas, should have issued a warning that could have been successfully received by them, thereby preventing the injuries.

Since odor fade occurs in new steel piping, any effective warning must be directed toward the construction industry, especially those involved with new construction, such as workers and customers.

Plaintiffs' failure to establish a causal connection between defendant's failure to warn and their injuries resulted in the appeals court reversing the judgment entered on the jury's verdict.

Further, it directed the trial court to enter judgment in favor of the defendant, Southern California Gas Co.

The appeals court recognized odor fade as being very hazardous and not common knowledge in the construction industry.

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Quote Box

"For every minute you are angry you lose sixty seconds of happiness."

.... Ralph Waldo Emerson

Propane Safety (continued from page three)

It encouraged the defendant and others in the industry to undertake efforts to educate those working in new construction about this hazard.

Summarizing

Our firm has been involved in several cases where the lack of sufficient odorant contributed to propane-fueled flash fires and resulting fatalities.

The first defense for injury prevention for most propane-related fires or explosions is recognizing the seriousness of the leak.

Preventative action can be initiated only through this immediate leak-recognition.

Ethyl mercaptan, the odorant used by the vast majority of propane suppliers, can fade due to reaction with the tank's iron oxide.

Also, ethyl mercaptan can cause the loss of one's odor sensitivity if exposed to it over a prolonged period of time or through psychological and emotional factors.

Odor fade is an on-going problem for the propane industry. The

industry has attempted to address these issues through documented testing.

However, with thousands of propane suppliers, poor work practices are not uncommon and result in safety loopholes and serious injuries. □



Russell Fote, P.E.,
C.S.P., C.F.E.I.
Expert Safety Engineer

For Expert Testimony, Talk to an Expert

Russell Fote & Associates has over 30 years of safety engineering experience. The firm's field of expertise includes: **fires, explosions, carbon monoxide, scalds, flammable liquids/gases, water heaters, appliances, furnaces, slips/falls and motor vehicle collisions.**

- Investigations & Reconstructions
- Hazard Analysis & Evaluations
- Depositions & Trial Testimony

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**For Expert Testimony,
Talk to an Expert**



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Propane Safety**

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