



# INDUSTRIAL Fire World

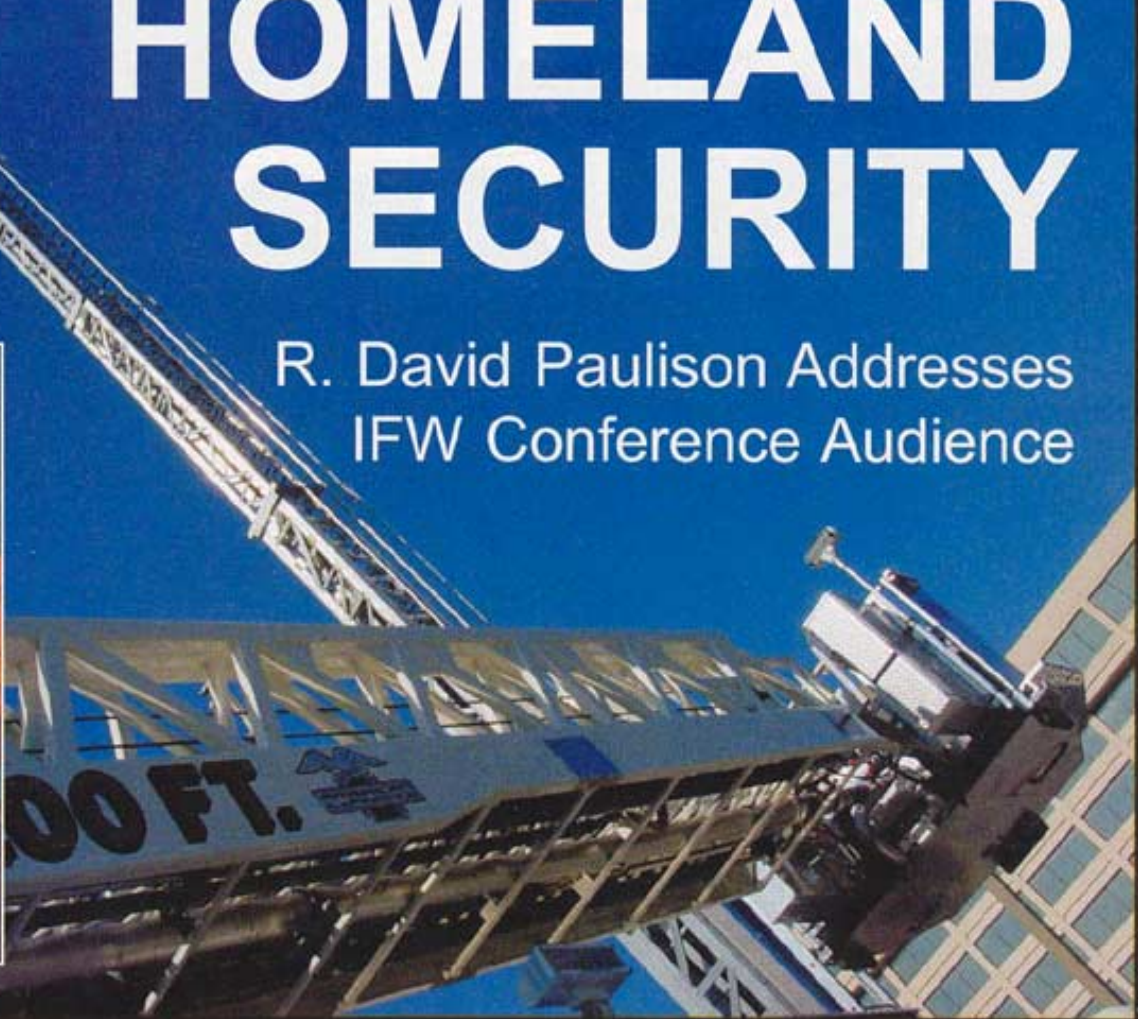
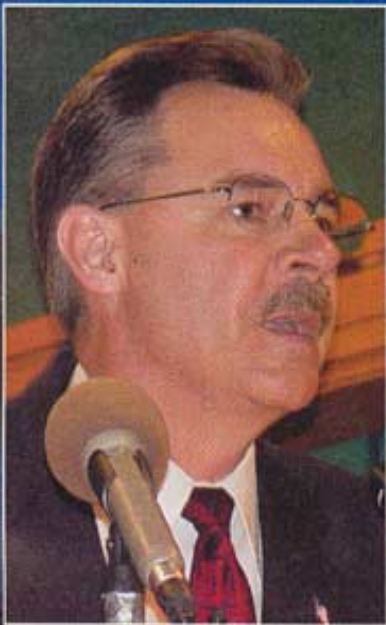
Volume 19 Number 3

May-June 2004

The Foremost Industrial Fire, Safety and Emergency Response Authority for Nineteen Years

## HOMELAND SECURITY

R. David Paulson Addresses  
IFW Conference Audience



INDUSTRIAL FIRE WORLD, P.O. Box 9161, College Station, TX 77842

Change Service Requested • Cover Price: \$6 • ISSN 0749-890X

PSRST STD  
U.S. POSTAGE  
PAID  
Pensacola, FL  
Permit NO. 67

New studies reveal that deluge systems installed on liquefied petroleum gas (LPG) tanks do not perform as well as they should in fires. Deluge water systems are designed to completely immerse a structure on fire with a steady stream of cooling water. To work properly, they must quickly flood the tank's outer shell and keep the entire surface wet until fire brigades can arrive to extinguish the flames. Any areas left dry during these precious few minutes will be susceptible to melting and rupture, as outside temperatures can climb to 2,000°F in just 5 minutes. According to numerous reports, deluge water systems tend to leave many tanks with dry spots, and in some cases they do not activate at all.

Unfortunately such findings are not limited to the industrial market: the National Fire Protection Association (NFPA) collected similar data in a 2001 study which found that sprinklers in office buildings fail to operate approximately 16 percent of the time.

This is disturbing news. LPG tanks typically contain liquefied propane, butane, or a combination of both. If a tank shell ruptures, the liquid will immediately vaporize into a cloud several hundred times the volume of the tank. This vapor cloud can self-ignite into what is called a BLEVE (boiling liquid expanding vapor explosion). Some of the world's worst refinery accidents started as small fires that eventually led to LPG tank shell rupture and BLEVE's. Mexico City's 1984 PEMEX disaster is perhaps the most infamous of these occurrences: 500 workers lost their lives and the entire terminal was destroyed in less than two hours as LPG tanks exploded one after the other in a catastrophic domino effect.

BLEVE's, widely considered to be the worst-case scenarios for oil refineries and petrochemical plants, must be avoided at all costs. It is for this reason that LPG tanks require more fire protection measures than any other steel structure. According to the American Petroleum Institute's (API's) published standards, "Fireproofing used in combination with water-application systems will provide fire protection until the water system is activated. It will also function as a temporary backup in case the water supply is interrupted or the water-application rate is inadequate." Exceptional and *reliable* fire protection systems must therefore be implemented and maintained on and near LPG tanks to safeguard surrounding equipment and worker's lives in the unfortunate event of fire or terrorist attack.

Passive fire protection, in the form of insulative coatings, can be applied directly to LPG tank shells. Where active systems may fail, passive

# Passive Fire Protection on LPG Storage Tanks

systems will reliably keep the tank shell cool in a fire for hours on end. George A. Patenaude, president of W.W. Patenaude Sons Inc., has been applying such fire protective coatings for over 40 years. Working as subcontractor to Jett Industries of Colliersville, NY, he fireproofed large propane tanks in Upstate New York with a unique cementitious fire protection product called Fendolite® M-II. Manufactured by Isolatek International in Stanhope, NJ, Fendolite M-II is both an insulative and energy absorbing material based on Portland cement and vermiculite. It is designed to adhere to steel even during rapid-rise fires, without decomposing, and to absorb heat energy via the release of steam. A cured thickness of 2-1/4" of Fendolite M-II can keep an LPG tank from reaching critical temperatures in a hydrocarbon fire scenario (a fire that reaches 2,000°F in the first 5 minutes) for up to 4 hours.

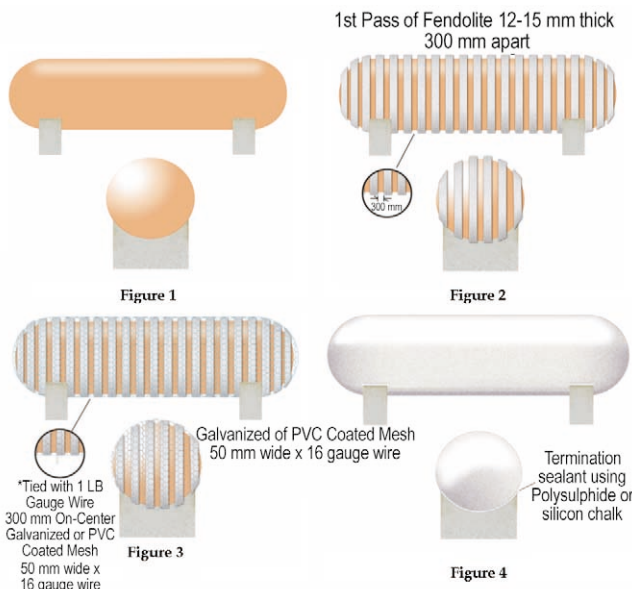
Once installed, a passive fire protection system will (hopefully) spend much or all of its life in an inert state. Ideally, it must not lose any of its potency. However, throughout this period it will inevitably undergo natural ageing, and have to endure various aspects of use and abuse. This concept, known as "Pre-Fire Durability", is especially important when coating LPG storage tanks, which can swell and shrink by as much as 5% upon filling and venting due to changing internal pressure. This constant volumetric change over time can wreak havoc on a tank's coating, so it presents a unique challenge to the fireproofing contractor.

Mechanical reinforcement, such as hexagonal mesh or diamond lath, is an integral part of the fire protection system in that it promotes pre-fire durability. It adds flexural resistance and improves adhesion of the fireproofing system.

However, LPG tanks present more of a challenge to the contractor than a typical piperack or vessel skirt. "You cannot weld or fasten reinforcing pins to the surface of an LPG tank," Patenaude warns. "And simply wrapping the tank with lath is not a good design. If the lath isn't embedded in the middle third of the fireproofing, flexural resistance cannot be achieved. It also leaves a void at the bottom of the tank where water is allowed to accumulate. This promotes rust."

Bijou Ganguly, director of Isolatek's Industrial Division, takes the argument one step further. "If installed improperly, the fireproofing system will not adhere to the tank. Past investigations have proven that adhesion failure occurs in areas where the metallic mesh touches the shell of the tank. To ensure pre-fire durability, any direct metal-to-metal contact within the product is strictly prohibited."

Faced with the dilemma of applying



## Why Active Systems Are Inadequate, and What You Can Do to Ensure Pre-Fire Durability of the Passive Fireproofing System

By DIEGO PENTA

reinforcement without attaching it to the steel, Patenaude consulted with Isolotek on how to solve the problem. They engineered a revolutionary method of application known as the “collar and band” method, which is illustrated in **Figures 1–4**.

The first coat of fireproofing is applied in a series of collars about two feet wide and spaced three feet apart. The mesh is then placed over the first coat and tied in place, effectively “floating” it off the surface of the tank. Because the mesh has such wide openings, the second coat of fireproofing can be sprayed directly through the mesh, filling in the three-foot wide gaps. A third coat is then applied to the tank to reach final thickness.

The end result is a uniform layer of fireproofing with mesh reinforcement suspended within the matrix. The mesh and the tank shell, although of dissimilar material, are never in contact with each other, preventing corrosion. The fireproofing system now has Pre-Fire Durability, fortifying the fireproofing system so it can withstand years of service.

The figures on page 12 detail Patenaude’s employment of the collar-and-band method in upstate New York. The orange coating shown in **Figure 1** is a primer coat specifically designed to prevent corrosion at the substrate by decreasing electric potential between the steel surface and the galvanized mesh. For this project, Patenaude chose a primer with excellent adhesion properties to the cement-based fireproofing.

Patenaude then applied the first coat of fireproofing in a series of collars enveloping the circumference of the horizontal tank, as detailed in **Figure 2**. Following established industry practice, he intentionally left this pass with a rough texture, as the first coat is not only responsible for holding the mesh completely off the surface of the tank, but it also must lend a good key for the second and third coats.

The mesh can then be applied after the first coat is allowed to set for 24 hours. To allow spray material through to the surface, the openings of the mesh must be at least 2” wide. Patenaude used 2” x 2” diamond mesh. The sheets of mesh were unrolled over the top of the tank and secured in place with stainless steel tie-wires at regular intervals along the perimeter of the tank (see **Figure 3**).

With the mesh taut across the surface of the first coat and held 1-1/4” off the surface of the tank shell, Patenaude continued spraying the remainder of fireproofing onto the tank. Conveyed directly through the 2” openings of the mesh, the fireproofing filled the open gaps between the bands, just up to the level of the mesh.

At 1-1/4” thick, the second coat was allowed to dry overnight before application of the third coat.

“The fireproofing material was very user-

friendly and easy to apply,” commended Patenaude.

The application took place in September of 2002. In Upstate New York, even autumn temperatures can sometimes go below freezing. As the fall wore on, Patenaude employed the use of insulating blankets to offset the colder night temperatures.

“If the temperature falls below freezing during application,” says Ganguly, “then the water in the fireproofing will expand as it freezes. Minor repairs might be required before proceeding with the rest of the application.”

“That’s typical when applying cementitious materials, whether you’re in plastering, construction, or fireproofing,” says Patenaude. “The trick is to keep the temperature above freezing, even during cold winter months.”

“We erected a complete heated enclosure for the third tank,” he says. “This proved to be a very efficient way to counter marginal weather and colder nights.”

A final inch of material above the mesh was applied to the tanks in the last coat, bringing the full thickness of fireproofing to two and a quarter inches. According to the GASAFE method of protecting LPG tanks, this thickness provides a 4-hour fire rating. To a firefighter, that four hours is critical. Without a fireproofing system in place, an LPG tank can suffer complete failure in less than 15 minutes.

With the fire protection barrier in place, there remained one final step. To fight water ingress from rainfall and corrosion from chemical attack (typical pH reading in an oil refinery falls in the 5.0–6.0 range), Patenaude sealed the fireproofing with a white top coat. Highly compatible with cement-based products, the top coat is used to provide enhanced weather protection for outdoor applications of cementitious fireproofing.

However, Patenaude did not apply the top coat until the following year. As a lasting testament to this method of applying cement-based fireproofing, even after the harsh winter of 2003, only minor repairs were required prior to the application

of the top coat.

“Because we were using a proper anti-corrosion primer, a final top coat, and because we successfully floated the mesh in the middle of the fireproofing, the tank is well protected from corrosion, water ingress, and volumetric change,” says Patenaude. “We took every step to ensure pre-fire durability of the entire system.”

The added safety and peace of mind provided by passive fireproofing systems are immeasurable. LPG storage tanks, if damaged by a localized fire that goes unchecked by an inactive deluge system, can do more damage to the installation than the actual fire itself should the tank shells reach critical failure. In a fire fueled by petroleum hydrocarbons, that failure can occur in as little as 15 minutes. If plant owners and engineers are more vigilant in specifying a combination of both passive and active measures, further tragedies on the scale of the Mexico PEMEX disaster can be avoided. □

*W.W. Patenaude Sons, Inc., founded in 1930, specializes in high performance coating installations for chemical, manufacturing, water treatment, and power generation industry. They have a 40-year history in fireproofing applications for industrial structures, tanks and equipment. They are a union contractor — all persons involved on this project were members of district council #9 brotherhood of painters and allied trades.*

# Fendolite® fireproofing

**Passive Fire Protection**  
for **petrochemical plants, oil refineries, and tunnels**

- Piperacks
- Sphere legs
- Vessel skirts
- LPG storage tanks
- Tank saddles and supports
- Concrete tunnel linings

**Jet-fire and blast resistant**  
**More independent fire tests than any other material in its class**  
**Certified to UL-1709, RWS, and BS476 Part 20 App. D for up to 4 hours**  
**Available in both Spray and Trowel grades**

For more information, contact Isolotek International at 1-800-631-9600  
fax 973-347-9170 / [www.cafco.com](http://www.cafco.com)

**ISOLATEK** INTERNATIONAL 41 Furnace Street  
Stanhope, NJ 07874

