TANK FIRE PROTECTION: LESS IS MORE

An innovative foam technology by Swiss Fire Protection R&D can extinguish any combustible-liquid fire in a matter of minutes – regardless of the size of the tank

When it comes to defending property and lives against the perils of fire raging through combustible-liquid storage facilities, researchers at Swiss Fire Protection Research & Development (SFPRD) have reached an unusual conclusion: Less is more.

This may sound like a paradox; however we must understand that battling fires at oil refineries, chemical plants or other facilities is not a war of attrition. A show of force, no matter how massive, may not prevent millions of dollars in infrastructure from going up in smoke. Nor will it save the lives of people who get trapped, nor stop the disaster from polluting the air, soil and water.

Extinguishing a full-scale flammable-liquid blaze is perhaps the trickiest operation a firefighter will ever face – and the consequences of failure can be devastating, which has prompted SFPRD to develop a novel technology.

TODAY'S APPROACH: VALIANT EFFORTS, UNDESIRABLE RESULTS

The need for a new approach is palpable. Take the blaze that ravaged a fuel-oil tank at the Tankstore complex on Singapore's Pulau Busing Island in March. When firefighters on nearby Pulong Island spotted the flames, probably sparked by lightning, they instantly swung into action – even before the alarm could ring. Emergency services on the mainland were also mobilised in quick order.

Firefighters deployed two 'big guns' that can spray up to 23,000 liters of water a minute as well as firefighting foam. Yet they needed time to load the equipment onto a barge and ship it to the island. When they arrived, the temperatures of tanks adjacent to the fire had already risen to dangerous levels, meaning they might ignite at any moment. The priority was therefore to cool the hot tank walls with water to prevent the catastrophe from escalating.

Emergency workers doused the burning tank with foam, pressing on through radiant heat that left them dehydrated and exhausted. They extinguished the blaze in six hours through the combined efforts of 128 personnel and 31 emergency vehicles. Firefighters stayed on into the night to pump residual fuel out of the charred tank, which had a diameter of 36 meters and a capacity of 40,000 m^3.

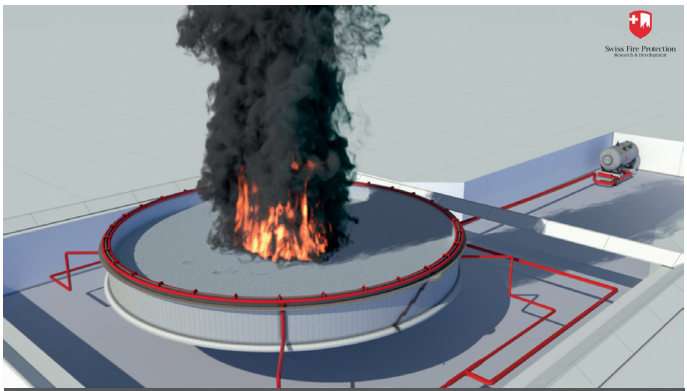
It required considerable effort to put out a blaze at a medium-sized tank. It might have been much worse: Today, the biggest tanks have diameters of 120 meters and a capacity of 200,000 m3. When fire strikes, it may last for days, devour several storage tanks, and cause numerous deaths.

And while the Singaporeans' actions were clearly heroic, some of their success was down to good fortune: Favourable winds, no mechanical malfunctions reported, problem-free passage over land and sea. Also, some of the firefighters had experience from battling a similar fire on a nearby island in 2016.

Emergency teams on Pulau Busing used the 'more is more' approach: More personnel, more equipment, more vehicles, more resources, more time, more damage, and more risk. This is how fire-fighters around the world confront combustible-liquid tank catastrophes – sadly, to little avail. In most cases, the best they can do is to keep the blaze 'under control', meaning they allow the flammable material to burn out while working to prevent the fire from spreading to other tanks.

Since 2000, more than 70 major combustible-liquid blazes have occurred at storage facilities around the world. Total financial damages

Full-surface fires are rare but they cause major trouble. The longer they burn, the more damage they inflict and there is also the risk that the blaze will escalate



The Pi Foam System starts extinguishment at the hardest spot: the tank wall. As soon as this is protected it then closes in on the fire like an iris

A successful extinguishment on the company's 25m diameter tank. The fire was smothered so quickly you can till see the billowing black smoke

from these disasters exceed $10 billion. What is worse, these incidents have killed 243 people and injured 1,669.

Associates at SFPRD have spent more than 10 years developing, testing and perfecting the Pressurised Instant Foam System, known as 'Pi Foam'.

The Pi Foam System could have subdued the flames Pulau Busing without massive mobilisation, without major to damage to the tank structure, and without requiring firefighters to risk their lives in the smoke and heat. And it would not have taken six hours: Pi Foam can extinguish any combustible-liquid tank fire, regardless of the tank's size, in less than 3.14 ( ) minutes.

'The original idea of the self-expanding foam came much earlier, but developing it into a system capable of extinguishing even the biggest tank fires took years,' says Istvan Szocs, inventor of the original system.

'There were many engineering obstacles to overcome. The hardest part was keeping it as simple as possible, as we considered that to be the key to cost-efficiency and reliability. As Antoine de Saint-Exupery said: 'Perfection is finally attained not when there is no longer anything to add but when there is no longer anything to take away'.'

PI FOAM APPROACH: HOW IT WORKS

The Pi Foam System is built around a centralised vessel that stores fire-fighting foam under high pressure. It is usually kept underground on the premises of the tank farm to ensure that it remains safe should a blaze break out.

The foam vessel is linked to each of the tanks through a network of pipes designed to withstand intense heat. These pipes connect to a set of special foam dispensers strategically mounted along the rims of the tanks.

When fire strikes, sensors send a signal that opens the vessel's valves, dispatching the foam to wherever it is needed, in seconds. The dispensers then unleash a wave of flame-quenching froth onto the burning liquid surface. Pi Foam can put out a fire on a small tank surface in half a minute and can extinguish a blaze at the biggest combustible-liquid storage tank in three minutes or less.

SFPRD's system is uniquely qualified to accomplish this feat because its components allow for a foam capacity that is scalable to any tank size. Traditional built-in extinguishment systems typically have a foam intensity of 4-8 liters per square meter per minute, which is hardly sufficient for extinguishing full-surface fires on tanks larger than 40 meters in diameter – but surely not before the tank is damaged.

The Pi Foam System's intensity can be up to 20 times greater; it can dispense as much foam in three minutes as traditional built-in systems can in an hour. It covers the burning liquid surface with a thicker foam blanket, smothering the fire before it gets a chance to consume much of the foam.

The three-minute limit is critical when it comes to battling storage tank blazes. Studies show that it takes only five minutes for a full-surface fire to raise the temperature of the tank walls to 500°C – the point at which the heat may inflict irreversible damage on steel structures. In such cases, the owner will need to either repair or demolish the tank. That means significant interruption in production, as well as losses in brand image or share capitalisation.

The risk of mechanical failure in the Pi Foam is negligible because it has very few moving parts, if any. It delivers foam strictly by means of pressurisation, so its scale is not limited by the capacity of pumps or foam mixers. It defeats any tank fire quickly and – most importantly – with no need for human intervention.

LOWER RISK AT LESSER COST

Tank farms are high-hazard areas. Unforeseen events such as lightning, valve leaks, human error and sabotage can occur at any time with ruinous consequences. In 2005, a hydrocarbon cloud caught fire and exploded at BP America's refinery in Texas City, Texas, touching off a blaze that killed 15 people and injured 180. The company incurred financial losses that ran into the billions of dollars, including $84.6 million in fines for safety violations.

Most tank farms currently rely on mobile systems for fire protection. This option is also the most expensive in the long term. Mobile units, as well as semi-stable systems, require firefighters to operate them, meaning emergency teams must be on duty 24 hours a day. This drives up operating expenses to ponderous levels.

Not only is mobile extinguishment costly, it cannot respond to a fire as quickly as a built-in system, no matter how speedy and prepared the fire-fighters may be. Once a fire strikes, emergency personnel need time for travel, preparation and setup before they can actually begin extinguishing. This gives the flames time to consume the combustible material, destroy the tank, spread to other areas, and escalate to unmanageable levels.

Traditional built-in systems, also known as stable systems, rely on sophisticated and sensitive machinery and incur high installation costs. Operators must conduct regular and sometimes costly maintenance to ensure that the mechanisms are in full working order.

The Pi Foam System costs less to install than traditional built-in systems and requires no maintenance beyond periodically checking its mechanical operability (pressure levels, valves, etc.) and testing the foam for proper consistency. Its annual operating expenses amount to a fraction of the corresponding costs for mobile units; the price of maintenance is also significantly less than for other built-in systems.

'The previous versions of the Pi Foam System have been used in around 25 facilities around the world, from power plants to strategic military kerosene reserves, pharmaceutical factories and of course tank storage farms,' explains Szocs.

'But the newest versions that we have developed in recent years are even more effective, both in terms of performance and cost.'

Every system comes with advantages and disadvantages, so it is incumbent upon any operator to examine the facility's precise attributes before deciding on something so crucial as a fire-protection arrangement.

FOR MORE INFORMATION

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