INTRODUCTION OF A NOVEL HIGH END TECHNOLOGY FOR LARGE ATMOSPHERIC STORAGE TANK FIRES

FoamFatale™

TFEX Ltd.

FoamFatale™ technology makes it possible to make a huge step forward in protecting the environment against the damaging effects of storage tank fires

Abstract

The highest level of protecting the environment is provided by successful prevention.

The primary environmental effect is caused by the fire itself. In addition to the value of the material destroyed by the fire, the environment as such, our common treasure, also suffers. In the majority of cases the combustion products are highly damaging to our health. By burning fossil fuels the composition of the atmosphere changes, since carbon stored for millions of years in solid or liquid form is again released into the atmosphere in the form of carbon dioxide gas. And since uncontrolled fires always result in incomplete combustion all kind of by-products are also released into the atmosphere.

The secondary environmental effect is caused by the use of extinguishing materials.

The use of very large quantities of firewater can cause environmental damage when the, always, polluted water use cannot be properly collected afterwards and subsequently treated before it is released into the environment.

The use of artificial extinguishing materials always causes environmental pollution.

The level of pollution, i.e. the secondary environmental effect depends largely on the quality of the extinguishing material used and on the application technology, because these two factors define the quantity of the material necessary to extinguish a given fire.

And depending on the degree and speed of natural decomposition of the used extinguishing materials into harmless components the period the environment is under strain is determined.

We call a fire fighting technology "environmentally friendly" when it uses only natural extinguishing materials (water and gases, like nitrogen or argon, which are extracted from air).

We call a technology "environmentally aware" when it uses artificial (but not hazardous) materials for the extinguishment, but when compared to other technologies the application will result in:

- the shortest period of time between outbreak of the fire and extinguishment.
- highly efficient and effective use of extinguishing agent.

Setting up and managing proper fire protection facilities on hydrocarbon storage facilities operating under extreme conditions nearly always requires a non-traditional approach. The traditional method is not suitable when there are no firewater sources available. Examples are sites operating a substantial part of the year under very low ambient temperatures, but also storage sites in arid desert areas. Other examples are mobile military fuel storage facilities, which have no access to a high performance firewater network.

In some cases the owner has no choice but to opt for operating without any fire protection whatsoever.

In very low temperature situations it would be prohibitively expensive to build, maintain and operate firewater networks with heated reservoirs and pipelines. Such facilities are typically required when using the traditional fire protection methods as recommended by e.g. NFPA.

Completely new foam-making and foam application method was developed, which fully solves the firewater-related problems described above. This is the FoamFatale™ technology. The automatic and autonomous Self Expanding Foam system responds immediately after the ignition, and does not require any external supply of water or energy to operate.

It is considered to be representative of the Best Available Technology today. The fire surface is totally covered in maximum two minutes from the ignition, thus there is no time for the development of environmentally dangerous smoke or soot, and a major part of the stored material is also saved.

Contents

1. Conventional strategies, reason for low success rate.

The conventional strategies apply foam with mobile, semi-fixed and fixed equipment.

Foam proportioning

The foam concentrate has to be proportioned into the water. The operating range of the proportioning equipment is always limited. The range giving an acceptable deviation from the set point is even more limited. The response of the proportioner to quick flow variations is, generally speaking, not very good. Proportioning systems range from very simple and not very reliable systems to electronically controlled sophisticated and complicated, but therefore also vulnerable, devices.

Foam generation

To make expanded foam it is necessary to entrain air into the foam solution stream. Venturi-type aspirating devices are typically used for this purpose. Proper functioning of such a device is determined by the delicate balance between flow rate, upstream pressure and backpressure. Optimum performance can only be achieved in a rather narrow operating range. Blockage, or partial blockage, of the small-bore air inlet often occurs in fixed systems in locations where maintenance is not optimal. This results in malfunctioning.

Dependence on water

In conventional foam systems (including the CAFS too) the availability of firewater is essential. A number of steps are required to convert foam concentrate, water and air into expanded foam. The expanded foam can subsequently be applied onto the burning surface. In the majority of cases these activities take place close to the scene of the fire. Quite a team of trained manpower is required to set up these relatively complicated systems. In view of the stressful situation during any fire, mistakes are likely to be made resulting in mal-performance of the system.

Unmanned storage sites cannot count on turnout of sufficient fire-fighters within a reasonable period of time.

Over the past decades, the user had no choice but to accept these complicated and expensive systems. Sites that had no access to adequate water were left without protection. The owners/management, the Fire Administration and the Environment Protection Authorities had no choice but to accept the situation.

Conclusion

There are sites where:

- The implementation of conventional fire protection systems is facing serious technical problems.
- The cost to set up an installation complying with NFPA recommendations is too high.
- There is insufficient manpower available at short notice to operate a labour-intensive mobile or semi-fixed system.
- There is a need for an acceptable level of reliability.

2. Description of the new high performance fixed system

A method has been developed which eliminates the limitations of conventional systems.

The concept of this new system is that perfectly prepared foam is stored under pressure in a vessel. On release of the foam from the vessel, expanded foam is formed at the location where the expansion takes place.

The patented system is called "Self-Expanding Foam" system, abbreviated as **SEF®**.

Preparation of foam

- Self Expanding Foam is prepared well in advance under calm and controlled conditions. This eliminates the probability of an off-spec composition of the foam.
- The pre-mixed foam is stored in a pressure vessel until the moment of use.
- The foam remains homogenous for at least 10 years, as experience has shown.

Dimensions of SEF vessels

- Static **SEF®** vessels can be very large. The maximum quantity of stored foam is determined only by the mechanical manufacturing limitations.
- The maximum size of vessels on vehicles is determined by size and weight. The limiting factor is most probably the maximum allowable dimension of the vehicle as well as the maximum allowable axle load for the road system to be used.

Let's the foam expand

- On release of the **SEF®** the pressurized foam will expand. This in turn eliminates the need for aspirating devices.
- The release rate of the foam from the vessel is not bound by conventional limitations, like aspirating devices and such.
- The expansion ratio of the foam is independent from the flow rate; the pressure in the foam vessel is the only factor determining the expansion.

Operation of the system

- The operation of the whole system is extremely simple. All that is required is to open the isolation valve between the pressurised **SEF®** storage vessel and the foam application device.
- The simplicity eliminates the need for specialists to operate the system successfully.

Advantages of the SEF® system over a conventional system

- Requires no manpower resources to set up and operate at the scene of the fire.
- Is so simple that mistakes are unlikely.
- The foam is mixed under calm and controlled conditions, and is 100% consistent.
- Does not require any aspirating devices.
- Does have an unlimited flow range.
- Produces optimum quality foam at all flow rates.
- Has only a few critical elements requiring regular inspection.
- Requires considerably lower capital investment.
- Requires considerably lower maintenance effort and cost.

Applications where the SEF® concept can be used

- **Hydrocarbon storage tank fire fighting by superintensive foam flooding**
- **New concept airport crash tenders**
- **First intervention vehicles**
- **Skid mounted units**
- Fixed installations for restaurant cookers, fuel storage, underground fuel bunkers,
- Portable and wheeled fire extinguishers.
- **SEF®** tanks on vehicles, replacing or complementing conventional fire fighting vehicles.
- Foam supply on sites handling flammable liquids that have no firewater system.
- Foam supply for road car loading facilities handling flammable liquids.

Tank fire extinguishing by superintensive foam flooding

- **FoamFatal™** is a revolutionary new tank fire extinguishing technology, using a very high foam application rate. It is called Superintensive Foam Flooding (SFF).

- The extremely high foam flow rate is provided through the new foam application device, which accommodates the very large foam flow and prevents excessive velocities in the nozzle. It is called Continuous Linear Nozzle (CLN). The CLN provides an ideal curtain-like foam application pattern, thus providing substantial and continuous cooling of the tank wall.
- One of the advantages of the Self Expanding Foam concept is that it has no release rate limitations. By combining the **SEF®**method with the newly developed high capacity CLN, it is easy to achieve the application rates of 20-40 litres/minute/square meter.
- The result of this combination is an extremely high efficient system. Tests carried out on a 500 m^2 gasoline tank on fire repeatedly resulted in extinguishment in less than 40 seconds. The reliability of the system is very high; the valve is the only moving part in it.
- The **SEF®** storage vessel can be a stationary vessel located in the vicinity but at a safe distance from the hydrocarbon tank. An alternative option, requiring some intervention by manpower, can be a mobile **SEF®** storage vessel mounted on a truck.

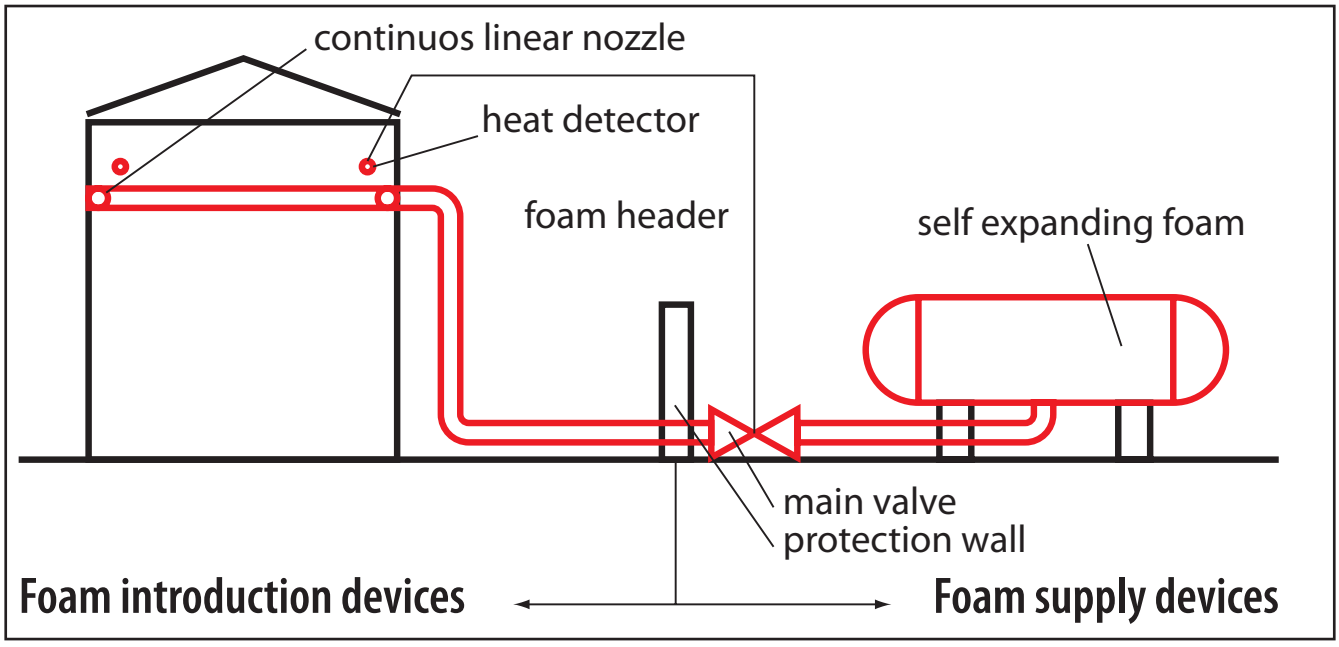

Figure 1. Principle of tank fire protection by SEF®

Advantages of the SEF® system over conventional systems

- Its **reliability level is very high:** the CLN can hardly be damaged by explosions or fire.
- It is **sabotage-proof,** the fire protection system of a tank farm built by our method has no common elements, like a fire water system, which when destroyed would cause the malfunction of fire protection systems using firewater.
- Requires considerably **lower capital investment.**
- Requires considerably **lower operating cost.**
- The system is **fully autonomous.**
- **Does not require firewater** at all.
- It **does not require external energy** sources, like fire truck or electric pump.
- It is so **simple** that mistakes under stressful fire conditions are unlikely.
- Automatic operation of the system further **reduces air pollution** caused by the fire.
- Its simplicity **eliminates the need for specialists** to operate and maintain the system.
- It uses **perfectly proportioned foam,** mixed under calm and controlled conditions.
- The foam is stored under pressure; **no pump** or other pressure-raising source is required.
- The pressure of the container determines the expansion; **no aspirating device** is required.
- Produces **optimum quality foam** at all flow rates.
- Its flow rate is virtually **unlimited;** pumps, proportioners, aspirating devices are not there.
- **Very high foam-producing rates** can be easily achieved at modest cost.
- Has **only a few key elements** requiring regular inspection.
- Is also suitable for the fire protection of rooms or large equipment and machinery.

Live fire test

A test tank was built by TFEX Engineering Co. Ltd. The tank was used for experiments with flow rates and types of nozzles ultimately resulting in the current mature system.

Live tests on this 500 m^2 gasoline fire repeatedly demonstrated that **after 40 seconds, the fire went out so abruptly as if it had been cut off.**

An automatic version of such a system will extinguish very large tank fires such as this within one to three minutes from the moment of ignition, without intervention from any person.

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