

*Vasil YEMIALYANAU (Senior scientific associate)
Syargei MALASHANKA (Senior engineer)
Volha CHARNEVICH, PhD (Academic secretary)
Research Institute of Fire Safety and Emergencies
of the Ministry for Emergency Situations of the Republic of Belarus*

FIRE FIGHTING IN TANKS WITH THE USE OF OPERATIONAL INSET SYSTEM

Key words: technology of subsurface fire extinguishing, vertical steel tank, fluorine-containing film-forming foam concentrate, integrated equipment for operational inset, storage of compressed air, high-pressure foam generator

Most fires on the territory of storage objects and oil processing and petroleum products happen in ground vertical steel tanks (VST). The tactics of fighting such fires requires submitting of medium ratio air-mechanical foam on the surface of the burning oil product by means of foam generators installed in the upper zone of tank or fed by special vehicles. However, the heat produced during combustion of petroleum products leads to the rapid destruction of the foam, and, consequently, to low efficiency of the foam attack.

Analysis of the situation by the fire fighting in VST with the regular means and ways shows the need of the new fire suppression systems, which have high fire extinguishing efficiency and less risk for personnel involved in firefighting.

One of the most effective and safest ways to extinguish oil and petroleum fires in tanks is a subsurface method, in which the foam of low ratio, obtained from the fluorine-containing film-forming foam (FFF), is fed through a pipeline to the bottom of the tank directly into the fuel layer [1].

The main advantage of subsurface fire technology is to prevent the re-ignition of a film coated fuel and to secure the personnel. Less foam is required for extinguishing, so that all foam enters in the fire zone.

However, VST equipment with a stationary subsurface fire extinguishing system and with the foam inlets (dry pipe sprinkler system) can only be carried out during overhaul, due to the high financial costs, which significantly limits the pace of subsurface fire extinguishing method.

According to the study [2] supply of low ratio foam in the layer of combustible liquids is possible not only through foam inlets pipes of fire extinguishing system, but also through the process communication (oil products pipelines, sea-floor sediments wash out pipes) situated at the bottom of the tank.

Research Institute of Fire Safety and Emergencies of the Ministry for Emergency Situations of the Republic of Belarus in the assignment of the State Scientific and Technical Program "Development and introduction of modern techniques, tools and technologies for the state system of prevention and liquidation of emergency situations and civil defense" has developed a set of equipment for operational inset in technological communications of tanks (equipment complex).

The complex consists of the integrated operational inset device (IOID), of the compressed air storing module (CASM) and high-pressure foam generator (HPFG).

IOID is designed to carry out the holes in the technological communications VST with oil and petroleum products and for the subsequent supply of fire extinguishing air-mechanical foam of low ratio in the fuel layer. They are allowed to be used for works not related with fire suppression (for example, an operative repair of pipelines).

To prevent sparking, the inner bandage cavity is filled with lubricating cooling liquid (LCL).

As a source of compressed air for pneumatic equipment by the performing of the operational inset is used CASM providing performance of compressed air of at least 1 m³/min by the pressure of 0.6–0.8 MPa during the whole operation of performance.

To obtain air-mechanical foam is HPFG used [3].

Ability of HPFG connection to the technological communication VST is determined by conditions of linear velocity limiting of foam supply to the tank and the length of technological communication.

Diagram of the equipment complex connection to the tank technological communication is shown in Figure 1.

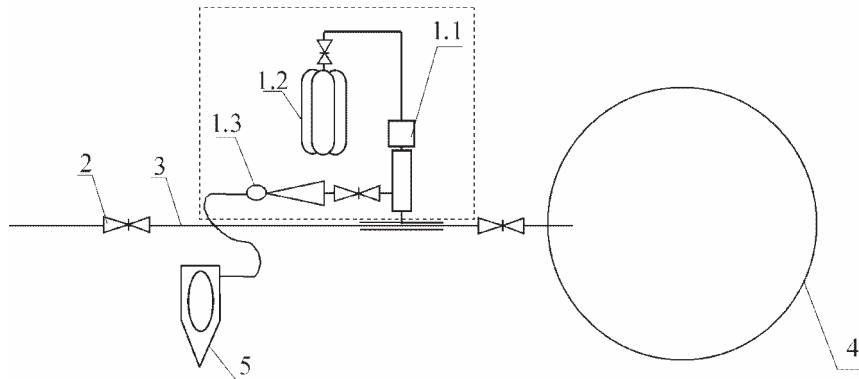


Fig. 1. Diagram of the equipment complex connection to the tank technological communication

1 – equipment complex of operational inset:

- 1.1 – integrated operational inset device (IOID); 1.2 – compressed air storing module (CASM); 1.3 – high-pressure foam generator (HPFG); 2 – valve;
3 – tank technological communication; 4 – tank; 5 – fire and rescue vehicle*

The order of equipment actions by the operational inset in the technological communication VST for subsurface fire extinguishing:

- After the arrived to the fireplace the fire and rescue personnel in coordination with the administration of the object determines IOID on the area of technological pipelines located behind the fire dike. If necessary, fire and rescue personnel blocks valves on this pipeline, paving the hose line from the fire and rescue vehicle (FRV) to the place of the inset, at the IOID inlet elbow is set HPFG. To prevent sparking, the inner IOID cavity is filled with lubricating coolant. The duration of these operations does not exceed 20 minutes.

To the operational inset device compressed air from CASM is supplied. Duration of the inset performance continues about 2–3 minutes depending on the thickness of the pipe wall. At the end of the inset performance rescue personnel under water fire-hose barrels protection opens valves on the way from HPFG to the tank and then from FRV through the HPFG is supplied air-mechanical foam to VST.

So, this developed equipment complex allows to submit air-mechanical foam in a layer of combustible fluids in not equipped with fixed foam inputs and fire extinguishing subsurface automatic systems VST.

The proposed fire extinguishing method allows to reduce risk for life and health of personnel, as well as increases the effectiveness of firefighting.

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SUMMARY

Vasil YEMIALYANAU
Syargei MALASHANKA
Volha CHARNEVICH, PhD

FIRE FIGHTING IN TANKS WITH THE USE OF OPERATIONAL INSET SYSTEM

Description of equipment set for operational inset, which is used to supply air-mechanical fire extinguishing foam in vertical steel tanks through the process of technological communication.

The proposed equipment set is a promising way of petroleum and petroleum products extinguishing in vertical steel tanks, which are not equipped with stationary fire extinguishing systems of subsurface fire extinguishing.