



Impulse Storm Powder Aerosols firefighting technology (ISAP) for transformer

Impulse Storm Powdered Aerosols technology (ISAP) has introduced into the fire protection market new concepts for total flooding fire extinguishment. Low efficiency and direct danger water fire extinguishing systems on electric objects has created a real need for an agent with total flood extinguishing capabilities that is also economic on a weight/volume basis and cost effective.

Such an application is the electric objects that are increasing in numbers, especially in crowded built areas where the land is expensive and limited.

Now electric objects presently protected by water deluge automatic systems, that include several dozens of cylinders, pumps and a lot of piping and nozzles combined with a fire detection system. The large cylinders under high pressure, big pump station, water reservoirs are located in a specific building adjoining the electric objects, thus occupying expensive land that otherwise can be profitable.

The most attractive fire suppression solution for such an application is the unique combined powdered aerosol system, that not requires pressurized cylinders, big piping, pumps and nozzles, and can be introduced into the electric objects without the need for the adjoining storage building. Such a system is described in the present paper, including the engineering considerations for fire detection and suppression within one combined unit, the aerosol discharge in situ, its flow pattern and filling capability, extinguishing and inertization evaluation as well as cost effectiveness.

ISAP technology is a new type of chemical extinguishing agent consisting of extremely small solid particles from 2 up to 50 microns mixes of two components:

1. Aerosol that are created in a chemical oxidation reduction reaction, and released in the aerosol form.
2. The special fire powder split on small particles by a high-temperature aerosol.

This highly efficient aerosol contains up to 40% solid particles and 60% gaseous molecules, has the flow characteristics of gas, and being lighter than air, is persistent and suspended in the air for long periods of time.

Because of the high volume expansion and small particle size the ISAP aerosol achieves superior extinguishing power, approximately 9 times that of Halon on a weight ratio.

ISAP acts on the fire in more than one way. It combines the heat absorption capability of dry powder extinguishing agents with the chemical interfering capability such as performed by Halon extinguishing agents.

ISAP composition creates active species, solid particles, that act either by heterogeneous chemical reactions on the particles surface or by homogeneous chemical reactions in the gaseous phase with the fire chain precursors (OH, H) preventing their recombination and thus stopping the combustion process.

The firefighting effect ISAP technology is summary effect of a fire aerosol, fire powder and neutral gas. Uniqueness of ISAP of an aerosol consists in unique effect of formation of an mix neutral gas\powder\aerosol in a cylinder. During formation disappear negative property of a standard aerosol - high temperature. The high temperature of an aerosol is absorbed special powder which at a absorb of heat loses negative property of powder - the big size of particles and is split on particles in several micron. As the result through a nozzle to the area of the fire leaves the cold aerosol improved several times fire powder and cold neutral gas. No other technology has these unique properties.

The ISAP aerosol composition can be delivered to a fire either directly, created in the combustion area itself or indirectly piped in from external generators.

Various modular systems have been designed according to the fire protection application.

The unique features of ISAP technology render it as a promising tool for existing traditional fire protection applications, as well as for novel approaches to fire protection.

The key characteristics that influence the design of application are:

- Similar to a gaseous agent, ISAP can flow around barriers and obstacles, behaving as a gas in its basic transport properties. It can be introduced into ductwork and be delivered to an area via forced convection.
- ISAP technology has excellent fire suppression characteristics, similar to dry chemicals, both of which are not less 12 times as effective on open air as CO₂ and up to 6 times as effective as any water mist system.

ISAP initiation is independent of oxygen supply and can therefore be effective under or within a liquid or at altitudes where oxygen concentrations are low.

Initiation of ISAP can be via electrical ignition or via hand push or self-ignition due to interaction with the fire.

ISAP does not require difficult piping, pressure cylinders, or valves. A device for containing the solid material is all that is normally required.

Pressure testing, weighting, pressure leak detection, rust visualization and other maintenance and testing of cylinder/pipes/nozzles/valves is not required.

ISAP for extinguishing transformers and other objects under electric voltage.

The above-described unique properties open the way for new technologies extinguishing transformers and other objects under electric voltage. Combined into one property aerosol and powder generate new properties for electrical facilities, which previously did not exist. For brevity, we show only two basic electrical properties of objects.

I

The new direction is the use of ISAP firefighting equipment for extinguishing different objects being under high voltage without cutting off the electricity on the object. The numerous tests conducted by our company jointly with scientific and research institutes of fire safety in Kiev, Ukraine, and Krasnoyarsk, Russia have shown perfect results. At present we have official documents stating that our ISAP technology are absolutely safe for extinguishing electric objects being under voltage of 35,000 volts.

As you can see below, our fire extinguishers and equipment show safety standards, which are over 40 times lower than the conventional standards safe for man. Moreover, during the use of our equipment there is absolutely no possibility for a short circuit on the object of extinguishing and the object itself cannot be damaged. We are not aware any other fire extinguishers and firefighting technologies with similar indices. According to the data available to us, the extinguishing of electric power stations by means of standard firefighting equipment is impossible without complete disconnection of electric power, which results in very big losses and human victims. With the ISAP equipment created by us it is possible to proceed to extinguishing immediately without awaiting the disconnection of electric power.

**The Ukrainian Scientific and Research Institute of Fire Safety
of the Ministry of Internal Affairs of Ukraine minutes
of tests on determining electric conduction of a firefighting substance jet
of an Impulse Storm fire extinguisher of special purpose**

Object of tests:

experimental samples of an impulse fire extinguisher of special purpose.

Aim of tests:

To determine electric conduction of a firefighting substance jet of an impulse fire extinguisher of special purpose.

Method of tests:

The determination of electric conduction of a firefighting substance jet is conducted by means of a special stand SVELS by measuring the active value of alternating current strength between the fire extinguisher and ground during its discharging on the metallic plate (target) having size of $(1000 \pm 25) \text{ И}$ $(1000 \pm 25) \text{ mm}$ being under voltage of $(35 \pm 3.5) \text{ kV}$ from a distance of 0.5 m (test 1-3) and 1.0 m (test 4-6).

The measured value must not exceed 500 mA (safety standard of Ukraine and Russia).

Tests results:

The results of determining electric conduction of a fire extinguishing substance jet of an impulse fire extinguisher of special purpose in the process of continuous ejection are quoted in the table.

The tests were conducted on a special proving ground under the temperature of 16° and relative air humidity 67%.

| No. of test | Distance from impulse fire extinguisher to target, m | Maximal value of alternating current strength between impulse fire extinguisher and ground I_{max}, mA | Compliance criterion $I_{max} < 500 \text{ mA}$ | Conclusion on correspondence to safety standards |
|-------------|--|---|---|--|
| 1 | 0.5 | 11 | $11 < 500$ | Corresponds |
| 2 | 0.5 | 12 | $12 < 500$ | Corresponds |
| 3 | 0.5 | 12 | $12 < 500$ | Corresponds |
| 4 | 1.0 | 8 | $8 < 500$ | Corresponds |
| 5 | 1.0 | 7 | $7 < 500$ | Corresponds |
| 6 | 1.0 | 8 | $8 < 500$ | Corresponds |

II

Particular important property of the Aerosol Storm technology is the powder's property to bind leaky transformer oil. In other words, besides extinguishing, the ISAP technology will be able to bind the spreading oil and shall not allow ingress of oil into the sewers and the neighboring transformers.

A brief description of the action stages is as follows:

The 1st stage.

The percussion action of the gas powder mixture. A powerful head of the gas and powder mixture physically knocks down the flame and quickly displaces from the burning zone the oxygen saturated air. Acts no longer than a second.

The 2nd stage.

The fire prevention powder physically covers the ignition centers, cools the burning surface, settles burning vapors and blocks oxygen access. Acts from the first second till complete fire liquidation.

The 3rd stage.

From the influence of the flame's temperature the fire preventive powder partially disintegrates extracting carbonic acid gas and inhibitors of burning, which in their turn create around the ignition center conditions incompatible with burning. Acts from the first second till complete fire liquidation.

The 4th stage.

The gas and aerosol mixture creates a three-dimensional cloud displacing oxygen, and the cloud saturated with the inhibiting aerosol promotes the extinguishing and prevents re-inflammation in the whole volume of the premises.

Acts from the first second till complete fire liquidation.

The 5th stage.

A fire prevention powder layer fully isolates the combustible surface from the ambient air and does not allow re-inflammation. The liquid stopped by the powder cannot spread. Acts unlimited time till complete fire liquidation and its consequences.

For the ISAP technology there is no problem of powder blocking. When there is no powder blocking, there is no problem of compulsory periodical examination of fire extinguishers and of their compulsory re-charging, the fire extinguisher's reliability and its effectiveness increase many times.

Very important that ISAP technology is not corrosive, not abrasive as any other firefighting powder.

ISAP chemical composition is protected with special hydrophobic additives to ensure full compatibility with most modern firefighting foams.