

# 3D-flexible intumescent fire protection mesh for building structures

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**Abstract.** The increased operational properties, main of which - ensuring fire resistance in the conditions of the hydrocarbon mode of the fire, resistance to low temperatures and lack of wet processes at installation are necessary for means of fire protection of structures of buildings and constructions of an oil and gas complex. The review of means of fire protection of new type - the constructive bent fire protection which advantage is the set of positive characteristics as constructive fire protection (a plate, a shell, etc. with dry process of installation), and coverings is submitted (plasters, epoxy structures, etc. with wet process of installation). Domestic experts (LTD Promizol, Moscow) developed the constructive bent fire protection for increase in building constructions of buildings and constructions of an oil and gas complex keeping operational properties in the conditions of the Arctic climate. Means of fire protection represents a grid with 3D - the reinforced structure. The closest analogy are products of the Hapufam GmbH and FLAMRO companies, but at the moment there are no data on a possibility of use in the conditions of the Arctic region for protection of bearing structures and cable systems.

## 1 Introduction

The increased operational properties, main of which - ensuring fire resistance in the conditions of the hydrocarbon mode of the fire, resistance to low temperatures and lack of wet processes at installation are necessary for means of fire protection of structures of buildings and constructions of an oil and gas complex.

The problem of ensuring fire resistance of building constructions at influence of the hydrocarbon mode of the fire with use of passive fire protection continues to remain relevant, and is in the centre of attention of many research and design organizations dealing with issues of fire resistance of building constructions including in aspect of calculation of fire risk [1, 2]. The leading positions in developments of means of fire protection continue to remain for experts of the USA, England, Germany, France which dealt with the matter from 70th years of the last century [3, 4]. Nevertheless, domestic manufacturers are also presented by a number of means of fire protection with qualitatively new indicators in the

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conditions of new requirements, as to fireproof coverings, and fireproof constructive materials [3 - 6].

It is necessary to stop on distinction of these means of fire protection which, at first sight, does not seem such obvious. Many experts were engaged in classification of means of fire protection [7 - 16]. Nevertheless, now there is no normative document on classification of means of fire protection, there is a number of the standards and sets of rules with incorrect terms and definitions sometimes contradicting each other. For example, in GOST 53295 Russian National Standard "Means of fire protection for steel structures. The method of determination of fireproof efficiency", the thin layer distending fireproof covering (fireproof paint) is defined as: "the way of fire protection of building constructions based on drawing on the warmed surface of a design of special paints or paint and varnish systems in accordance with GOST 28246 Russian National Standard, the building constructions intended for increase in a limit of fire resistance and having fireproof efficiency. The principle of effect of fireproof paint (a paint and varnish system) is based on the chemical reaction activated at impact of the fire as a result of which thickness of a fireproof covering repeatedly increases, forming the heat-insulation layer protecting a design from heating" (item 3.13) on the warmed design surface; constructive fire protection as: "the way of fire protection of building constructions based on creation on the warmed surface of a design of a heat-insulation layer of means of fire protection. Thick-layer structures for dusting, plasters, facing by slab by, sheet and other fireproof materials, including on a framework, with air layers and also a combination of these materials, including with the thin layer distending coverings treat constructive fire protection. The way of drawing (fastening) of fire protection has to correspond to the way described in the test report on fire resistance and in the project of fire protection" (item 3.6). Thus, constructive protection can include also thin layer coverings that in fact, cancels definition of constructive protection.

In the Set of rules 2.13130.2012 "Fire protection systems. Ensuring fire resistance of subjects to protection", definition of constructive fire protection is similar to GOST 53295 Russian National Standard, but the thin layer fireproof covering (the distending covering, paint) is defined also as "the way of fire protection of building constructions based on drawing on the warmed surface of a design of special paint and varnish structures with thickness of a dry layer which is not exceeding 3 mm increasing it repeatedly when heating" (item 3.3). In the same place, in item 3.6. definition of a fireproof plate as element of constructive fire protection, representing the hinged panel providing fireproof efficiency due to shielding of a design and also low heat conductivity of initial material of the plate is given.

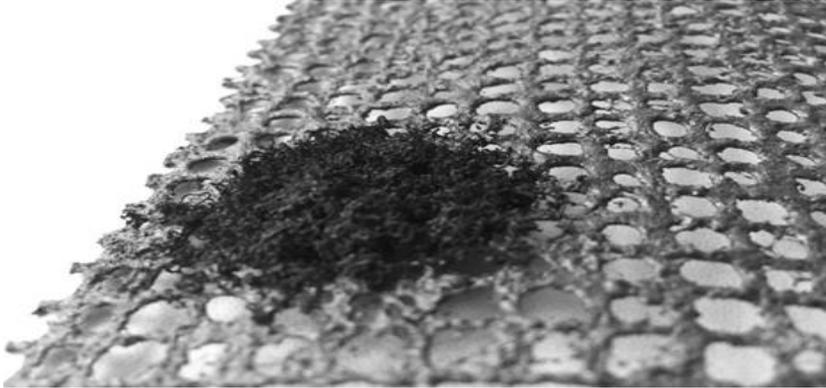
## 2 Research objective

Let us consider in more detail the roll means of fire protection, having at all similar technical and physical parameters, many advantages over other products in the field of fire protection, for example, the adoption of the form of construction (waste minimization), the speed of installation, installation at any time of the year and under different climatic conditions.

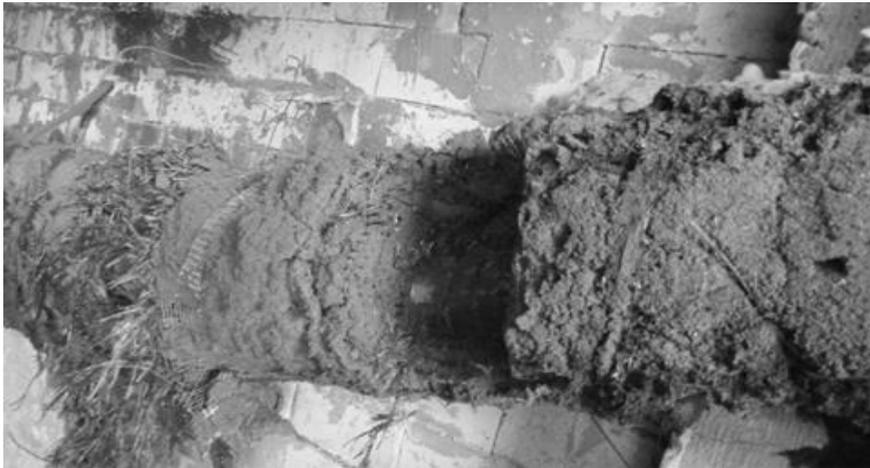
So, roll means of fire protection on the basis of mineral wool (with caching various materials) are widely presented by foreign and domestic developers. It should also be noted rarely used due to the high cost and technological features of the application of UV-curing materials, which take the form of construction during solidification. Promising are roll materials based on aerogel, production, which is also very expensive and in domestic practice is presented only in the laboratory.

Specialists of the LTD Promizol (Moscow) company developed new type of fire protection: the constructive bent rolled means of fire protection distending repeatedly at thermal influence that is uniting two types of fire protection - both constructive and distending (fig. 2, 3). The bent fire protection represents a grid with various normalized density on which the fire-protective distending structure is caused. Thus, any of above-mentioned definitions in GOST 53295 Russian National Standard and the joint venture 2.13330 is not suitable for this material.

The closest analogy of this means of fire protection are products of the HapuflamGmbH and FLAMRO companies, but at the moment there are no data on a possibility of use in the conditions of the Arctic region for protection of bearing structures and cable systems



**Fig. 1.** Formation of a thermal insulating foaming foam as a result of fire exposure at a temperature of 1000 ° C.



**Fig. 2.** The result of a fire test of a sample that lasted a 60-minute test in an oven at a temperature of 1000 ° C.

### 3 Materials and Methods

The grid, perhaps, to paint a number of pigments and give saturated colours. A layer of fire-retardant mesh with a density of 1.1 kg / m<sup>2</sup> with a thickness of about 1 mm on an I-beam with a reduced metal thickness of 3.4 mm shows a fire-retardant efficiency of at least 25 minutes. (Fig. 3, 4).



**Fig. 3.** Mesh 1,3 kg / m<sup>2</sup> before the test.



**Fig. 4.** Sample mesh after testing.

The studies continue with variations in various parameters, such as mesh density, cell sizes, number of grid layers, etc.

A feature of this bendable roll material-fire retardant mesh is:

- the material is quite technological (flexible and plastic) for installation up to-30S;
- possible installation and operation at 100% humidity;
- installation is carried out with the help of industrial stapler (stapler), bandage wire or special staples;
- not difficult installation on a product due to "sewing" of the General surface of protection (a monolith, a uniform surface), simple skills of cutting of a grid on an element before installation;
- does not require surface preparation, it is possible to mount the mesh in any condition of the surface of the protected element;

- high flame retardant efficiency due to the lack of adhesion-rigid mesh and protected surface. In real fire conditions during deformation of metal structures, the fire protection layer remains intact for a longer period of time;
- fire-retardant grid when swelling forms a thermal insulation coke around the grid, forming a reinforced material of increased mechanical strength, more resistant to external influences;
- the temperature of swelling 130-160C does not allow to warm up even metal structures with a small reduced thickness of the metal, it is possible to protect light structures.



**Fig. 5.** Protected by a roll mesh steel structures.

## 4 Results and discussion

Thus, the authors believe that at high rates of fire-retardant efficiency and durability of the performance characteristics of the roll of the bent fire protection, the adoption of the form of the building structure (Fig. 4), minimization of waste, speed and ease of installation, production of works at any time of the year and climatic conditions, such means of fire protection is effectively used for the purpose of increasing the limits of fire resistance of building structures of oil and gas facilities in the Arctic climate.

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