

Properties of Multi-Component Fire Extinguishing Systems Based on Light Bulk Materials

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Abstract. To extinguish flammable liquids, it is suggested to use a multi-component fire extinguishing system consisting of two layers. The first layer is designed to ensure the buoyancy of the fire extinguishing system. It is suggested to use crushed foam glass as the material of this layer. As the material of the upper layer, it is suggested to use light dispersed materials with increased thermal insulation properties. As such materials, the use of exfoliated perlite and vermiculite is justified. To increase the insulating and cooling properties of the fire extinguishing system, wetting of the upper layer with water is used. Bulk density, buoyancy in heptane and moisture retention of crushed foam glass, expanded perlite and vermiculite were experimentally determined. The insulating properties of binary layers of foam glass + perlite and foam glass + vermiculite were studied. The heights of the layers of dry and wet bulk materials necessary for extinguishing heptane were determined experimentally. A conclusion was made about the advantages of the proposed fire extinguishing system based on light bulk materials compared to the existing fire extinguishing means.

1 Introduction

The analysis of fire statistics allows us to conclude that currently fires involving flammable liquids are widespread and tend to further expand [1, 2]. Particular difficulties in extinguishing such fires are found when extinguishing flammable liquids [3, 4]. Many methods have been proposed for extinguishing such fires [5, 6]. When foams are used, either the foams themselves can pose a threat to the environment [7], or their decay products that act in mainly on the aquatic environment and soils [8, 9]. The analysis of the results of the work [10–12] allows to draw a conclusion about the prospects of using shock waves, high-speed pulse jets of liquid and pyrotechnic valves to increase the efficiency of extinguishing flammable liquids.

To date, foam fire extinguishing agents have been recognized as the most effective and universal means of extinguishing them [13, 14]. The most significant disadvantages of foams are their low stability and poor environmental parameters [15]. One of the significant disadvantages of foams is their low stability. Foams are destroyed under the action of intense heat from the flame of the burning liquid and from the contact of the foam with the surface of the liquid. In addition, foaming agents include environmentally hazardous components. Also, the use of foams for extinguishing flammable liquids leads to their contamination and the impossibility of further targeted use. This worsens the economic characteristics of foam fire extinguishing agents.

Thus, the issue of extinguishing flammable liquids currently does not have a comprehensive solution, which makes the development of fundamentally new fire extinguishing agents for these purposes urgent.

Analysis of recent research and publications.

To eliminate a number of shortcomings of foam fire extinguishing agents, it is proposed to use fire extinguishing systems based on granular foam glass and gel forming agents [16]. In addition to fire-extinguishing properties, the gel layer provides high fire-resistant characteristics [17]. An additional increase in fire-resistant properties can be provided by introducing into the fire-extinguishing system substances that swell under the influence of flame [18].