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Investigation of Fire Extinguishing Properties of Multicomponent Systems with Combined Action Based on Wetted Lightweight Bulk Materials for Extinguishing Polar Flammable Liquids

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Abstract. To extinguish flammable polar liquids, it is proposed to use a multicomponent fire extinguishing system consisting of one or two layers of wetted lightweight bulk materials. It has been established that wetting bulk materials leads to a significant increase in the following components of fire extinguishing action: cooling, insulation, and dilution. In addition, the introduction of water into the fire extinguishing system leads to a decrease in the concentration of vapors of polar flammable liquids above the fire extinguishing layer of bulk materials due to their absorption by water. Crushed foam glass with a granule size of 10–15 mm was selected as a bulk material for the formation of the base layer of the fire extinguishing system. To improve the insulating properties of the base layer, it is proposed to apply swollen perlite with a granule size of 1.0–1.4 mm or swollen lamellar vermiculite with a scale size of 1×2.5 mm to its surface. Such sizes of perlite and vermiculite particles enable them to fill the cavities between the granules of the foam glass base layer, which leads to an increase in the insulating properties of the fire extinguishing system. The following were experimentally determined: bulk density, buoyancy in methanol, ethanol, propanol-2, and acetone, moisture retention of bulk materials, and the fraction of material that spilled through the foam glass layer. The fire extinguishing capacity of the proposed fire extinguishing systems based on bulk materials in the case of extinguishing polar flammable liquids was experimentally determined. The systems based on bulk materials have a combined fire extinguishing effect by the following mechanisms of combustion termination: cooling, insulation, and dilution. It is concluded that the advantages of the proposed system in comparison with existing fire extinguishing agents for polar flammable liquids are substantiated.

Introduction

The extinguishing of polar flammable liquids (PFLs) has peculiarities compared to the extinguishing of non-polar liquids. Conventional foaming agents (FAs) do not provide foam formation on the surface of the PFLs [1, 2]. For this purpose, it is necessary to use special purpose foaming agents. Such foams have less stability than conventional air-mechanical foams (AMF), and they collapse especially quickly under the influence of intense heat flows. Another disadvantage of these foams is the presence of environmentally hazardous substances in their composition [3–5].

To eliminate a number of disadvantages of foam fire extinguishing agents, it is proposed to use fire extinguishing systems based on granular foam glass (GFG) and gelators [6–9]. In addition to fire extinguishing properties, the gel layer provides high fire protection characteristics. Such systems are highly resistant to the burning of liquids. In addition, they have advantages over foam agents in terms of economic and environmental parameters. In such fire extinguishing agents, foam glass provides buoyancy to the entire system, and a gel layer is used to increase the insulating properties of the two-layer system. The disadvantages of this fire extinguishing agent are the need to use three separate supply devices. One of them must provide the supply of loose granular