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Relationship Between Properties of Floating Systems and Flammable Liquids in the Stopping Their Burning Technology

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Abstract. The contributions balance of isolation and cooling effects relative to the liquids surface to slow down their evaporation and to achieve safe vapor concentrations is determined. The influence of liquids characteristic temperatures and their water solubility on this process is considered. It is proven that the long-term effect of such means is provided by systems based on closed-pore floating solid materials (for example, foam glass, FG). It is proposed to increase the FG low isolation and cooling capacity either by coating it with an inorganic gel or by wetting it with water. Smaller evaporation retardation coefficients by gel were obtained for liquids with the higher water solubility. A 5–6 times greater cooling capacity of the wet foam glass than dry foam glass was obtained for both polar and non-polar liquids. A smaller cooling effect is observed for liquids with a higher vaporization heat and is similar for both the use of the dry and wet foam glass. It was found that for low-boiling non-polar liquids, the evaporation slowing down is more effectively achieved by using isolation effects, and for high-boiling polar and non-polar liquids – by using cooling effects. It is proved that the fire extinguishing effect by applying the foam glass layer on the flammable liquid surface occurs in a similar way for liquids with close equivalent cluster lengths and not flash temperatures.

1 Introduction

Industry often needs to store liquids large quantities that are highly hazardous and may be toxic. Containers accidents with these liquids are often associated with their spillage and the formation of a dangerous vapor concentrations zone [1, 2]. The authors [3] used the effect of acoustic emission to investigate the acoustic radiation accompanying the burning of crude oil and petroleum products, and presented the results of experimental and computational studies. In the zone, which is limited by the lower explosive limit (LEL), the combustible air mixture ignition with an explosion is possible. In the zone, which is limited by the maximum permissible concentration in toxicity terms, the people poisoning is possible [4, 5]. A dangerous cloud spreads from the formation place in the wind direction for a certain distance according to the conditions in the environment [6, 7]. It is easier not to eliminate, but to prevent the such situations occurrence. Therefore, relevant enterprises should improve both technological safety measures and effective means of reducing or completely eliminating the gassing zone in an emergency situation [8, 9].

Often, the toxicity lower limit is much lower than the LEL, so it is more difficult to ensure it. But it is possible to reduce this zone size for the emergency works period and ensure that people do not come into contact with it. It has led to the appearance of such fire-extinguishing compositions as gel-forming systems with a foam glass carrier [10]. The ensuring fire safety requires the gassing zone complete elimination. That is, the reliable reduction ensuring problem or gassing zone foam glass fire-extinguishing layer height. But a greater correlation is provided by the cluster equivalent length indicator, which assumes the molecules part evaporation in the form of dimers or larger supramolecular formations. This effect increases, and the foam glass fire-extinguishing layer decreases, if shielding the liquid surface with foam glass makes it possible to significantly reduce its temperature relative to the boiling point.

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