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5. BMT-nin İqlim Dəyişikliyi üzrə Çərçivə Konvensiyası (1992).
6. https://cop29.az/en/pages/green-energy-pledge-background-information
7. https://www.sciencedirect.com/science/article/pii/S2666202723002136
8. Kyoto Protokolu (1997).
9. Paris Sazişi (2015). 24

FEATURES OF DETERMINING THE SUFFICIENT NUMBER OF FORCES AND MEANS FOR EXTINGUISHING ALCOHOL-CONTAINING LIQUIDS, INCLUDING DURING ARMED AGGRESSION

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During the Russian military aggression against Ukraine, the enemy has carried out massive shelling both in combat zones and deep within the country's rear areas. To inflict fire damage, the enemy employs artillery systems, aviation assets, cruise and ballistic missiles, as well as unmanned aerial vehicles [1, 2]. As a result of these attacks, facilities – including those used for the storage of alcohol-containing liquids – suffer destruction, large-scale fires occur, and the affected areas become contaminated with explosive remnants of war, posing the threat of repeated strikes. Under these challenging conditions, emergency management authorities and fire-rescue units continue to respond to all fire incidents [1, 3]. Their operations are organized in accordance with regulatory requirements, with mandatory consideration of the specific situation at the scene and strict adherence to safety measures to protect firefighting personnel [1, 3].

Extinguishing ethanol fires can be carried out using low- or medium-expansion air-mechanical foam or by diluting the alcohol to concentrations at which self-sustained combustion ceases [4]. However, it is always necessary to assess the situation that may arise during fires at facilities handling alcohol-containing liquids [5]: as a result of an explosion of a vapor-air mixture inside a tank, its roof may partially or completely detach from the walls, and the fire may spread to adjacent tanks, other parts

of the alcohol storage building, and nearby facilities. The danger increases significantly if the integrity of the tank is compromised or destroyed, leading to the release of burning alcohol into and beyond the containment area; combustion of part or the entire surface of the alcohol; occurrence of jet (torch) burning of alcohol-containing liquid on the breathing valves, at the connection points of foam chambers and process equipment to the tank walls (roof), and at crack formation sites; the formation of "pockets" due to partial destruction of the stationary roof and deformation of the tank walls, which complicates fire extinguishing; the difficulty of supplying fire extinguishing agents to the tanks of closed-type alcohol storage facilities due to the short distance from the tank roof to the ceiling.

When using low- or medium-expansion air-mechanical foam produced from working solutions of “alcohol-resistant” foaming agents of special purpose, extinguishing can be carried out without prior dilution of the alcohol with water. If air-mechanical foam is produced from working solutions of general-purpose foaming agents (or special-purpose agents that do not contain specific additives), extinguishing can only be performed after preliminary dilution of the alcohol with water or with an aqueous solution of the foaming agent to a concentration not exceeding 30% by volume [4].

When extinguishing alcohol and alcohol-containing substances by the dilution method, the concentration is reduced to approximately 20% in the surface layer, corresponding to a flash point of about 40 °C. The amount of water or aqueous solution of the foaming agent required to dilute the alcohol-containing liquid in the tank to the specified concentration should be calculated using the following formula [4]:

$$V_{water} = \frac{\left(C_{inintial} - C_{target}\right)}{C_{target}} \cdot V_{inintial}, \quad (1)$$

where V_{water} – the volume of water or aqueous foaming agent solution, m^3;

$C_{initial}$ – the initial concentration of alcohol in the liquid stored in the tank, %;

C_{target} – the target alcohol concentration at which foam application is planned to begin, %;

$V_{initial}$ – the initial volume of the alcohol-containing liquid present in the tank, m^3.

Approximately, the volume of water (or working foaming agent solution) required for diluting the alcohol-containing liquid can be calculated using the following formula [4]:

$$V_{water} = k \cdot V_{inintial}, \quad (2)$$

where k –coefficient that depends on the initial alcohol concentration in the liquid (Table 1).

Low- or medium-expansion foam can be applied to the surface of a flammable liquid using either a "soft" or "hard" method [4]. The "soft" method involves delivering the foam onto the tank wall or an additional protective screen, deflector, or other structure, from which the foam gently flows onto the surface of the flammable liquid. The gentle flow slows foam breakdown and ensures maximum fire-extinguishing efficiency. The "hard" method consists of applying the foam directly onto the surface of the flammable liquid. In this case, the foam partially immerses in the liquid, which

is accompanied by its intensive destruction and a sharp decrease in its fire-extinguishing effectiveness [4].

Table 1. The value of the coefficient k depending on the initial alcohol concentration [4]

Alcohol concentration, %	96	90	85	80	75	70	65	60	55	50	45	40	35	30	25
k for dilution to 20 %	3.8	3.5	3.3	3.0	2.8	2.5	2.3	2.0	1.8	1.5	1.3	1.0	0.8	0.5	0.3
k for dilution to 30 %	2.2	2.0	1.8	1.7	1.5	1.3	1.2	1.0	0.8	0.7	0.5	0.3	0.2	0	0

The calculation of forces and means for extinguishing alcohol and alcohol-containing liquids is carried out according to the methodology for calculating forces and means for extinguishing fires of oil and petroleum products in tanks [4].

The application rate of foam solution for extinguishing fires of alcohol and alcohol-containing liquids in tanks, when using general-purpose and special-purpose foaming agents, is given in Table 2 [4].

Table 2. Application rate of foam solutions for extinguishing fires of alcohol and alcohol-containing liquids in tanks [4]

Application rate of general-purpose or special-purpose foam solutions, L/(m^2·s)	
In the case of extinguishing alcohol-containing liquids pre-diluted to 30% (by ethanol), using low- or medium-expansion foam	0.08
Application rate of alcohol-resistant foam solutions, L/(m^2·s)	
During the extinguishing of alcohol-containing liquids in tanks using low-expansion foam (regardless of the alcohol concentration in the liquid):	
In the case of applying foam using the “soft” method	0.12
In the case of applying foam using the “hard” method	0.20
During the extinguishing of alcohol-containing liquids in tanks using medium-expansion foam (regardless of the alcohol concentration in the liquid):	
When applying foam using the “soft” method	0.06
When applying foam using the “hard” method	0.10
In the case of extinguishing spills of alcohol-containing liquids, including spills in bunds and the inter-pile space beneath tanks, as well as fires on loading racks:	
When extinguishing with low-expansion foam	0.20
When extinguishing with medium-expansion foam	0.10
*Note: Despite the higher standard application rate of the foam solution, it is recommended to extinguish fires using low-expansion foam due to its superior insulating capability.	

When calculating the required foam concentrate reserve, the design foam application time is recommended to be chosen depending on the fire-fighting scenario. It may be as follows: for extinguishing fires of alcohol-containing liquids in tanks – 60 minutes; for extinguishing spills of alcohol-containing liquids in tank bunds and bonded storage areas – 30 minutes; for extinguishing spills of alcohol-containing liquids, including fires on loading racks – 10 minutes [4].

The minimum water application rate for cooling tanks should be adopted according to the baseline data for calculating forces and means for extinguishing fires of oil and petroleum products in tanks [4], depending on the type of operational task: for cooling a burning tank, water must be applied around the entire tank perimeter at a rate of 0.8 L/(m^2·s); for cooling a burning tank with simultaneous oil (or petroleum product) fire in the tank and bund – 1.2 L/(m^2·s); for cooling adjacent tanks, water should be applied along half of the tank perimeter – 0.3 L/(m^2·s); for creating a water curtain to protect breathing valves – 0.4 L/(m^2·s) [4].

During armed aggression, after the arrival of the fire and rescue unit at the site of an emergency, fire, or hazardous event, a person must be assigned to monitor the airspace for the threat of airborne attacks and to notify personnel of any danger [2, 3]. Those monitoring the airspace for potential airborne threats maintain communication with the operational coordination center [2, 3].

In general, it can be noted that determining a sufficient number of forces and means for extinguishing alcohol-containing liquids, especially in conditions of armed aggression, requires a comprehensive approach that takes into account the physicochemical properties of combustible substances, the nature and scale of the fire, the availability of water and foam extinguishing agents, as well as the ability to quickly maneuver units. In difficult combat conditions, the priority is to ensure the safety of personnel, effectively organize interaction between units, and rational use of resources, which together determine the success of fire extinguishing and minimizing the consequences of an emergency.

References

1. Okreme doruchennja DSNS № V-269. (2022). Pro organizaciju gasinnja pozhezh na skladah naftoproduktiv v umovah vedennja bojovyh dij. URL: https://if.dsns.gov.ua/upload/1/1/9/3/3/4/7/Vr00vOSx9wVORgnKSrdVAYnz6P9sLaTd1EVLmisK.pdf.
2. Dii' pidrozdiliv DSNS Ukrai'ny v umovah vojennogo stanu. Available at: https://dsns.gov.ua/upload/1/9/2/4/3/5/9/diyi-dsns-objednana-kniga-compressed.pdf.
3. Nakaz DSNS № 375. (2024). Pro osoblyvosti reaguvannja na nadzvychajni sytuacii' pid chas zbrojnoi' agresii'. URL: https://dsns.gov.ua/upload/2/0/8/0/8/1/6/rekom.pdf.
4. Kropyvnyc'kyj, V. S. (red.). (2016). Dovidnyk kerivnyka gasinnja pozhezhi. Kyi'v: TOV «Litera-Druk». 320 s.
5. Nakaz MVS Ukrai'ny № 340. (2018). Pro zatverdzhennja Statutu dij u nadzvychajnyh sytuacijah organiv upravlinnja ta pidrozdiliv Operatyvno-rjatuval'noi' sluzhby cyvil'nogo zahystu ta Statutu dij organiv upravlinnja ta pidrozdiliv Operatyvno-rjatuval'noi' sluzhby cyvil'nogo zahystu pid chas gasinnja pozhezh. URL: https://zakon.rada.gov.ua/laws/show/z0801-18#Text.

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