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REVIEW OF UP-TO-DATE APPROACHES FOR EXTINGUISHING OIL AND PETROLEUM PRODUCTS

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Abstract

The paper provides a review of up-to-date approaches for extinguishing oil and petroleum products. The variability of extinguishing methods and fire extinguishing agents is noted. Fire extinguishing agents used in extinguishing petroleum products are considered in more detailed way, and their environmental characteristics are discussed. The ambiguity of using various foams for extinguishing the fire is shown. A new method for extinguishing oil and petroleum products, based on the acoustic effect, and the capabilities of acoustic fire extinguishers for preventing and eliminating the combustible hydrocarbon fires, and their identification are analyzed. The further development of known approaches and the simultaneous emergence of innovative methods for extinguishing oil and petroleum products are shown.

Keywords:
Oil;
Petroleum products;
Extinguishing agent;
Environmental characteristics;
Extinguishing foam;
Acoustic method.

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Introduction

The modern world is characterized by the widespread use of equipment and substances derived from natural hydrocarbons. Today, they are the initial raw material for further production in almost all spheres of human life from medicine to heavy industry. The exhaustion of these resources and the growing needs of human society require careful treatment of them, from the stages of their extraction and transportation to the stages of processing and production. This approach forces us to focus on each element associated with the waste of raw materials.

Emergencies associated with fires of petroleum products and oil should be noted as one of these elements [1]. Considering the high flammability of both natural hydrocarbons themselves and their processing products, in particular petroleum products, an important element of their rational handling is the prevention of their ignition or the rapid elimination of the fire.

At the same time, in recent decades, the environmental aspects of conducting various types of human activity have acquired a significant role. It should be noted that the extraction and processing of carbon-containing natural resources also make both a direct [2] and prolonged [3] negative contribution to environmental pollution. An additional polluting component is auxiliary reagents that can be used in the extraction of these minerals [4]. Emergencies at the facilities also have a negative impact [5]. At the same time, the fires of oil product are one of the most common types of emergency situations that have both a direct negative impact on humans and the environment, and an indirect impact by using the various extinguishing methods, technical elements and types of extinguishing compounds. Their incorrect use can aggravate the situation or have a significant additional negative effect on the components of natural and transformed ecosystems.

Having said that, an urgent issue is the search for effective and environmentally friendly methods and fire extinguishing agents used to extinguish fires of hydrocarbons, and, in particular, oil and petroleum products.

Review of up-to-date approaches for extinguishing oil and petroleum products using various substances

In modern conditions when the oil fires are extinguished, it is necessary to take into account all aspects of extinguishing the fire from fire extinguishing agents to specialized equipment [6].

The technical part takes into account the equipment, methods of supplying the extinguishing agent, or their combination. An important element

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is the protection technologies of the firefighters themselves [7], including automated individual devices [8]. Based on this, when the fires are extinguished in tanks for oil and petroleum products, the features of the tank itself [9], possible fire-resistant coatings of metal structures [10], methods of deploying fire departments [11] are taken into account.

In addition, an important issue is fire extinguishing agents used to extinguish fires of liquid hydrocarbons. The fires of oil and petroleum products are classified as fires of class B. To eliminate this type of fires, it is permissible to use water and various fire extinguishing agents [12]. In particular, being the most accessible and cheapest means, water, especially surface water, is also the most susceptible to pollution as a result of the use of petroleum products and fires associated with them, as well as anthropogenic activities in general [13]. It can be used to extinguish petroleum products in a sprayed [14] and finely sprayed form. In the latter case, the droplet size reaches 150 microns, but there are restrictions on the elimination of the area of ignition of petroleum products [15].

If we talk about more up-to-date approaches, then recently attention has been paid to the peculiarities of water supply during the fire [16]. It is proposed to use high-pressure installations for extinguishing the fires with water more efficiently. The specific features of the structure of water are discussed by the authors in the paper [17]. The use of hydrogels for extinguishing the fires is proposed. In paper [18] Khasanov discusses the effectiveness of screening sprayed water when petroleum products are extinguished. The use of nanomaterials dispersed with water for extinguishing liquid hydrocarbons was proposed [19]. The authors propose the use of aqueous suspensions containing functionalized and non-functionalized carbon nano-tubes. Hydrocarbon nanostructures in the composition of the hydrogel were proposed to be used as a highly effective agent for extinguishing the fires [20].

Thus, the methods of extinguishing oil and petroleum products by using water have limitations connected both with the need for a certain droplet size and with the level of its pollution.

However, today the most common method of extinguishing oil and petroleum products is the use of air-mechanical foams [21], including the layer-by-layer method [22]. The current gradation of these firefighting foams takes into account their protein or non-protein base and chemical composition. Various organic and inorganic additives are also introduced into the foaming agent, giving them certain characteristics (heat resistance, frequency ratio, etc.) [21]. Recently, biodegradability has become increasingly important for manufacturers and users of the firefighting foam.

Although the most effective in extinguishing oil and petroleum products are fluorinated film-forming foams of various compositions [23], their use in the most developed countries is either already prohibited or discouraged at various levels. The reason is the availability of the foamy organic pollutants (perfluoro organic compounds) in the decay products which are banned by Stockholm Convention on Persistent Organic Pollutants [24]. The use of foams based on surfactants that do not contain fluorine in the hydrocarbon chain is also controversial due to the need to use more of them with less efficiency in extinguishing the fires of class B [25].

The approaches considered in the papers by Gurbanova [26, 27] made it possible to assess the toxic effect on the environment of both inorganic components and organic components of foaming agents. At the same time, as an element of the integrated use of petroleum products, it should be noted the use of naphthenic acids as a component of a foaming agent [28] which surpasses fluorinated film-forming foams in terms of environmental characteristics.

The strengthening of environmental requirements for extinguishing agents stimulated the development of well-known and new directions in extinguishing oil and petroleum products. Thus, it is proposed to use so-called «fluorotelomers» with a carbon chain length of six carbons, in some cases the composition can range from 4 to 8 carbons. The compound contains fluorine atoms and claims to have less negative impact on the environment. It is difficult to clarify the composition of fluorotelomers, because manufacturers do not announce that, suggesting generic names. However, further studies have shown a lower efficiency of fluorotelomers in extinguishing the fires compared to classical fluorinated foams. At the same time, the question of their less impact on the environment remains open [29].

Powder compositions used in extinguishing the fires contain a non-combustible base, a water repellant, a depressant and activators, and are mainly inorganic in nature [12]. This allows the use of ecological approaches [30] for the rational choice of powder mixtures for extinguishing the fires, including class B.

Innovative areas include the use of gel-forming systems for extinguishing the oil fires. These systems, which consist of two separately and simultaneously supplied aqueous compositions, stored separately and consisting of mineral salts and silicon oxide, and are environmentally friendly. In particular, [31] the best environmental characteristics are declared for gel-forming systems based on magnesium chloride. Further developments in this direction have shown the promise to use granular foam glass both with the use of gel-forming systems and without them [32]. It has been noted that important characteristics are the size of the granules and the thickness of the foam glass layer on the surface of a combustible hydrocarbon, including the successive use of foam glass and a gel-forming system [33]. The environmental friendliness of foam glass as an inert material in this case is obvious.

The use of structured silica particles to obtain fast-

hardening foams was proposed by Abduragimov and co-authors as an environmentally friendly alternative to other foams for extinguishing the fire [34], although the authors recommend them to use, first of all, when solid combustible materials are extinguished. Another direction that increases the environmental friendliness of foams for extinguishing the fire is the use of natural compounds [25] or sea water [35] in their production.

Thus, a fundamental understanding of the chemical nature of the processes and phenomena, underlying certain approaches, used for extinguishing oil and petroleum products makes it possible to improve known methods and develop new ones.

Review of up-to-date approaches for extinguishing oil and petroleum products using acoustic effect

Among the latest developments aimed at combating fires of oil and petroleum products, a fundamentally new approach, considered by Levterov and co-authors, can be noted. It is based on the application of acoustic effects in the field of extinguishing. Thus, [36] with the fractal signal processing, it was proposed to use the acoustic method to extinguish various substances, including oil and petroleum products. Spectral signal processing in the acoustic method is considered in the work [37]. The proposed options allow both to detect fires [38, 39] and eliminate small fires [40]. Further development of the possibilities of using this acoustic method in extinguishing provides identification of substances in the zone of the fire [41].

Another application of the acoustic method is considered in the works of Wilk-Jakubowski. The author focused on the development of an acoustic extinguisher operating at a specific frequency of the acoustic wave [42]. The author suggests using the received equipment in various modifications for extinguishing the fires [43-46]. The same author also proposed a system that includes a deep neural network to detect fires and an acoustic extinguisher to extinguish them. It is proposed to use this system for early detection of fires, including tanks with flammable liquids [47].

The significant number of publications related to the use of acoustic effects for extinguishing says about the popularity of the proposed approach. In particular, in the works of a number of other researchers, it is proposed to apply the considered acoustic method, first of all, for the design of extinguishers. The authors are at various stages of development. Thus, the use of an acoustic extinguisher with a low-frequency sound wave for extinguishing was proposed in the work [48]. It is supposed to be equipped with a built-in sound alarm with a fire detection sensor. [49] The perspective of using the acoustic method and acoustic fire extinguishers are noted, but they emphasize the need for further research both in the frequency range and in specifying the technical characteristics of the device. In the work [50] the possibility of the influence of acoustic effects on a moving flame is researched, in particular, for extinguishing dripping of molten fuels. It is shown that the approach is effective at the initial stages, and with an increase in the dripping rate, the efficiency of extinguishing the flame by an acoustic wave decreases.

The perspective of the capabilities of acoustic extinguishers is considered in the work [51]. Traditional extinguishing agents like Nitrogen gas Carbon-dioxide gas (CO2) can be coupled with the sound waves to increase the efficiency of extinguishing.

Thus, in the works related to the acoustic method, the frequency ranges from 14 to 110 Hertz are considered, and the optimal distance to the object. The obvious environmental friendliness of the acoustic method, the safety of use and a positive economic effect, the possibility of its use to prevent fires of oil and petroleum products, both independently and in combination with other methods, to eliminate small fires are noted. The perspective of the direction also indicates the fact that acoustic waves, unlike conventional fire protection means do not leave pollution and do not emit gases harmful to human health. To identify the fire, the loudspeaker can automatically turn on when the flame is detected.

Conclusions

Thus, the work considers the existing approaches to extinguishing fires of oil and petroleum products, which include both the further development of old methods and the use of fundamentally new fire extinguishing agents and innovative methods, with an emphasis on their ecological nature.

The use of water in extinguishing the oil and petroleum products has limitations connected with both the need for a certain droplet size and the level of its pollution.

The fundamental understanding of the chemical nature of the processes and phenomena underlying certain approaches used in extinguishing oil and petroleum products makes it possible to improve known methods and develop new ones.

The acoustic effect, which is considered in the range from 14 to 110 Hertz, is characterized by environmental friendliness, safety and a positive economic component; the possibility of its use to prevent fires of oil and petroleum products, both independently and in combination with other methods, to eliminate small fire is noted.

References

1. Bakirov, I. K., Kaspranova, A. F. (2017). Consequences offiresand their impactonthe environment. *Problems of Gathering, Treatment and Transportation of oil and oil products,* 1, 186 - 195.

2. Safarov, A. Kh., Yagafarova, G. G., Akchurina, L.R., et al. (2020). Promising directions of soil reclamation contaminated with high-viscosity heavy oil. *SOCAR Proceedings,* 2,119 - 123.

3. Karabyn, V., Popovych, V., Shainoha, I., Lazaruk, Y. (2019). Long-term monitoring of oil contamination of profile-differentiated soils on the site of influence of oil-and-gas wells in the central part of the Boryslav-Pokuttya oil-and-gasbearing area. *Petroleum and Coal,* 61(1), 81 - 89.

4. Lazaruk, Y., Karabyn, V. (2020). Shale gas in Western Ukraine: Perspectives, resources, environmental and technogenic risk of production. *Petroleum and Coal,* 62(3), 836 - 844.

5. Gamiy, Y., Liashok, Y., Kostenko, V., et al. (2019). Applying european approach to predict coal self-heating in Ukrainian mines. *Mining of Mineral Deposits,* 13(1), 86 - 94.

6. Larin, O., Morozov, O., Nazarenko, S., et al. (2019). Determining mechanical properties of a pressure fire hose the type of «T». *Eastern-European Journal of Enterprise Technologies*, 6(7-102), 63 - 70

7. Budykina, T. A., Budykina, K. Yu. (2017). Advanced fire suppression technologies at fuel storage facilities. *RUDN Journal of Ecology and Life Safety*, 25 (1), 132 - 144.

8. Kostenko, V., Kostenko, T., Zemlianskiy, O., et al. (2017). Automatization of individual anti-thermal protection of rescuers in the initial period of fire suppression. *Eastern-European Journal of Enterprise Technologies*, 5(10–89), 4 - 11.

9. Abramov, Y., Basmanov, O., Salamov, J., et al. (2019). Developing a model of tank cooling by water jets from hydraulic monitors under conditions of fire. *Eastern-European Journal of Enterprise Technologies,* 1(10–97), 14 - 20.

10. Vasilchenko, A., Otrosh, Yu., Adamenko N., et al. (2018). Feature of fire resistance calculation of steel structures with intumescent coating. *MATEC Web of Conferences,* 230, 02036.

11. Bakirov, I. K., Arslanov, R. M., Konstantinov, E. V. (2016). Fire fighting service at enterprises of oil- gas branches of industry, extinguishment of tanks. *Petroleum Engineering,* 14(2), 199-203.

12. Sharovarnikov, A. F., Molchanov, V. P., Voevoda, S. S., Sharovarnikov, S. A. (2002). Extinguishing fires of oil and oil products. *Moscow: Kalan.*

13. Loboichenko, V., Leonova, N., Shevchenko, R., et al. (2021). Assessment of the impact of natural and anthropogenic factors on the state of water objects in urbanized and non-urbanized areas in Lozova district (Ukraine). *Ecological Engineering & Environmental Technology*, 22(2), 59 - 66.

14. Dadashov, I., Kireev, A., Zhernoklov, K. (2017). Ways to improve the environmental characteristics of extinguishing medium fore fire figting ofcombustible liquids. *Technogenic and Ecological Safety,* 1, 39-43.

15. Water mist fire extinguishing systems. Against fire. Safety encyclopedia. URL: https://protivpozhara.com/likvidacija-vozgoranija/modul/pozharotushenie-tonkoraspylyonnoj-vodoj.

16. Vasilevich, D. V., Lakhvich, V. V., Mikanovich, D. S. (2019). Promising means of fire extinguishing agents using high-pressure installations. *Journal of Civil Protection,* 3(3), 283-290.

17. Andryushkin, A. Yu., Afanasiev, E. O., Kadochnikova, E. N. (2020). Effectiveness of viscous hydrogel in extinguishing burning solid substances. *Fire and Explosion Safety,* 29(2), 53 - 62.

18. Khasanov, I. R., Orlov, O. I. (2019.) Efficiency of the screening capacity of sprayed water during a fire. *Tomsk State University Journal of Mathematics and Mechanics,* 60, 132-140.

19. Ivanov, A. V., Toropov, D. P., Medvedeva, L. V., Kalinina, E. S. (2019). Physical mechanism and method for fire liquid hydrocarbons by modified water suspensions of carbon nanostructures. *Fire and Explosion Safety,* 28(1), 22-34.

20. Koposov, A. S., Ivakhnyuk, G. K., Volodkov, I. V. (2017). The method to work out a highly effective extinguishing agent on the basis containing carbon nanostructures. *Scientific analytical journal «Saint-Petersburg University of State Fire Service of Emercom of Russia»*, 3, 48-53.

21. Sharovarnikov, A. F., Sharovarnikov, S. A. (2005.) Foaming concentrates and fire extinguishing foams. Structure, properties, application. *Moscow: Pozhnauka.*

22. Kokorin, V. V., Romanova, I. N., Khafizov, F. Sh. (2012). The problems of effective fire suppression of vertical steel storage tanks in the fuel layer. *Oil and Gas Business,* 3, 255 - 262.

23. Khil, E. I., Sharovarnikov, A. F., Bastrikov, D. L. (2015). Extinguishing the flames of burning oil and oil products by foam supplied under a layer and on its surface. *Technology of technosphere safety,* 6(64).

24. Loboichenko, V., Strelets, V, Gurbanova, M, et al. (2019). Review of the environmental characteristics of fire extinguishing substances of different composition used for fires extinguishing of various classes. *Journal of Engineering and Applied Sciences,* 14, 5925-5941.

25. Dadashov, I. F., Loboichenko, V. M., Strelets, V. M., et al. (2020). About the environmental characteristics of fire extinguishing substances used in extinguishing oil and petroleum products. *SOCAR Proceedings*, 1, 79-84.

26. Gurbanova, M., Loboichenko, V., Leonova, N., Strelets, V. (2020). Effect of inorganic components of fire foaming agents on the aquatic environment. *Journal of the Turkish Chemical Society, Section A: Chemistry*, 7(3), 833-844.

27. Gurbanova, M., Loboichenko, V., Leonova, N., et al. (2020). Comparative assessment of the ecological characteristics of auxiliary organic compounds in the composition of foaming agents used for fire fighting. *Bulletin of the Georgian National Academy of Sciences*, 14(4), 58-66.

28. Abbasov, V. M., Ismailov, T. A., Abdullaev, S. E. (2008). Improving the quality of the foaming agent obtained on the basis of amine complexes of petroleum acids. *Processes of Petrochemistry and Oil-Refining*, 3–4 (35-36), 203-207.

29. Kukharchyk, T. I. (2018). Fluorinated fire-figthing foams: manufacture, applications, ecological consequences. *Proceedings of the National Academy of Sciences of Belarus, Chemical Series*, 54(4), 487-504.

30. Loboichenko, V., Leonova, N., Strelets, V., et al. (2019). Comparative analysis of the influence of various dry powder fire extinguishing compositions on the aquatic environment. *Water and Energy International,* 62/RNI (7), 63-68.

31. Dadashov, I., Loboichenko, V., Kireev, A. (2018). Analysis of the ecological characteristics of environment friendly fire fighting chemicals used in extinguishing oil products. *Pollution Research*, 37(1), 63-77.

32. Tregubov D. G., Dadashov I. F., Kireev A. A. (2020). Extinguishing flammable liquids with fire extinguishing systems based on porous granular materials. *Proceedings of Azerbaijan State Marine Academy*, 1, 190-197.

33. Dadashov, I., Kirieiev., O., Trehubov D. (2018). Experimental research of burn rate and terms of extinguishing of standardized fire source of class B by consistent application of granular foam glass and gel-forming extinguishant. *Scientific bulletin: Civil Protection and Fire Safety*, 2(6), 70-78.

34. Abduragimov, I., Kuprin, G., Kuprin, D. (2016). Extinguishing effect mechanism of fast-hardening foams on the basis of structured silica particles. *Fires and emergencies,* 4, 50-56.

35. Taysumov, Kh. A. (2018). Containing thermal-resistant foam for prevention and fire extinguishing with the use of sea water of the Red Sea. *International Journal Of Applied And Fundamental Research,* 2, 49-52.

36. Levterov, A.A. (2019). Acoustic research method for burning flammable substances. *Acoustical Physics,* 65(4), 444-449.

37. Levterov, A. (2019). Acoustic engineering-technical method for preventing emergencies arising as a result of a fire inside a potentially hazardous object. *Problems of Fire Safety,* 46, 94-102.

38. Levterov, A. (2019). Identification of a technogenic emergency on the acoustic radiation of a hazard zone. *Municipal economy of cities,* 5(151),100-106.

39. Kalugin, V. D., Levterov, O. A., Tutiunik, V. V. (2018). The method of early detection of the source of ignition. *UA Patent* 127254.

40. Kalugin, V. D., Levterov, O. A., Tutiunik, V. V. (2019). Method of extinguishing a fire. UA Patent 137790.

41. Levterov, A. (2019). Identification model development of the burning substance in the zone of the burning seat. *Problems of Fire Safety*, 45, 92-97.

42. Stawczyk, P., Wilk-Jakubowski, J. (2021). Non-invasive attempts to extinguish flames with the use of high-power acoustic extinguisher. *Open Engineering,* 11(1), 349-355.

43. Wilk-Jakubowski, J. (2019) Device for flames suppression with acoustic waves. *Pl Patent* 234266.

44. Wilk-Jakubowski, J. (2018) Device for flames suppression with acoustic waves. *Pl Patent* 233025.

45. Wilk-Jakubowski, J. (2018) Device for flames suppression with acoustic waves. *Pl Patent* 233026.

46. Wilk-Jakubowski, J. (2018) System for suppressing flames by acoustic waves. *Pl Patent* 70441.

47. Ivanov, S., Stankov, S., Wilk-Jakubowski, J., Stawczyk, P. (2021). The using of deep neural networks and acoustic waves modulated by triangular waveform for extinguishing fires. *Smart Innovation, Systems and Technologies,* 216, 207-218.

48. Angeles, M. R., Rañada, J. V., Lopez, D. C., et al. (2020) Development of variable acoustic soundwave for fire prevention. In: *Alfred R., Lim Y., Haviluddin H., On C. (eds) Computational Science and Technology. Lecture Notes in Electrical Engineering, 603. Springer, Singapore.*

49. Philip, A. A., Shaji, A., Roy, E.S., et al. (2020). Fire extinguisher using acoustic waves. *International Journal of New Technology and Research*, 6(6), 17-22.

50. Xiong, C., Liu, Y., Xu, C., Huang, X. (2020) Extinguishing the dripping flame by acoustic wave. Fire Safety. *Journal – Special Issue of IAFSS International Symposium.*

51. Gore, S. R., Panchpor, J. U., Vaidya, S. M., Patkar, K. S. (2018). Study of acoustic waves for fire extinguishment: a review. *International Journal for Research in Engineering Application & Management (IJREAM), 04, Special Issue - AMET*-2018, 22-26.

Обзор современных подходов к тушению пожаров нефти и нефтепродуктов

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Реферат

В работе выполнен обзор современных подходов к пожаротушению нефти и нефтепродуктов. Отмечена вариативность способов пожаротушения и огнетушащих веществ. Более детально рассмотрены огнетушащие вещества, используемые при тушении нефтепродуктов, и обсуждены их экологические характеристики. Показана неоднозначность использования различных пен для пожаротушения. Проанализирован новый метод для тушения пожаров нефти и нефтепродуктов, основанный на акустическом эффекте, и возможности акустических огнетушителей для предупреждения и ликвидации пожаров горючих углеводородов и их идентификации. Показано дальнейшее развитие известных подходов и одновременное появление инновационных методов для тушения пожаров нефти и нефтепродуктов.

Ключевые слова: нефть; нефтепродукты; огнетушащее вещество; экологические характеристики; пена для пожаротушения; акустический метод.

Neft və neft məhsulları yanğınlarının söndürülməsinə müasir yanaşmaların icmalı

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Xülasə

Məqalədə neft və neft məhsulları yanğınlarının söndürülməsinə müasir yanaşmalar nəzərdən keçirilmişdir. Yanğınsöndürmə üsullarının və odsöndürən maddələrin variantlılığı qeyd olunmuşdur. Neft məhsullarının söndürülməsində istifadə olunan odsöndürən maddələr daha ətraflı nəzərdən keçirilmiş, onların ekoloji xarakteristikaları müzakirə olunmuşdur. Yanğınların söndürülməsi üçün müxtəlif köpüklərin istifadəsinin birmənalı olmaması göstərilmişdir. Neft və neft məhsullarının yanğınlarının söndürülməsi üçün akustik effektə əsaslanan yeni metod və alışqan karbohidrogen və onların identifikasiyalarının yanğınlarının qarşısının alınması və aradan qaldırılması üçün akustik odsöndürücülərin imkanları təhlil edilmişdir. Məlum yanaşmaların gələcək inkişafı və eyni zamanda neft və neft məhsullarının yanğınlarının söndürülməsi üçün innovasiya metodlarının meydana gələcəyi göstərilmişdir.

Açar sözlər: neft; neft məhsulları; odsöndürən maddə; ekoloji xarakteristikalar; yanğın söndürmə üçün köpük; akustik metod.