



IMPROVING EFFICIENT TECHNOLOGY FOR COLLECTING FLAMMABLE LIQUID SPILLS BEFORE THEY FIRE

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Abstract

The article presents the results of research on improving the technology of effective collection of flammable liquids spilled at industrial enterprises, oil depots and vehicles before they ignite. At the same time, existing methods are analyzed and their advantages and disadvantages are compared. The article proposes a new technological solution - an approach based on a mobile aspiration and filtration system, which not only improves safety, but also meets environmental requirements.

Keywords: flammable liquid, explosion, fire, module, structure, storage, spill, collection, technology, suction-filtration.

Introduction

Currently, flammable liquids (gasoline, diesel fuel, kerosene, etc.) are widely used in industry, energy and transport. However, their spills pose a serious fire and explosion hazard. Therefore, the development of fast, effective and environmentally safe collection technologies in such cases is one of the urgent issues. According to



statistics, thousands of fires occur worldwide every year as a result of spills of flammable liquids. This causes serious harm not only to human health, but also to the environment. Therefore, one of the urgent problems is to detect and improve the collection system for these liquids before they burn when they are spilled.

Research methodology

The analysis of the literature studied during the study shows that currently there are several effective methods for eliminating the consequences of situations associated with spills of flammable liquids. Among them, the following are widely used methods:

The use of absorbent materials - simple and fast, but ineffective in large quantities of liquid.

Manual collection (using a bucket, pump) - dependent on the human factor and with a high level of risk to life.

Automatic drainage systems - require permanent infrastructure.

According to the results of the study of the above methods, although all of them are useful for certain situations and conditions, they are found to be of low universality and high-speed collection efficiency. At the same time, the development of a Mobile Suction-Filtration Module for the effective elimination of emergency situations associated with emergency spills of flammable liquids was achieved. The main elements of this device are:

- portable suction pump;
- flammable liquid detection sensors (infrasound or optical);
- multi-stage filtration (to separate the liquid from the air);
- fire-resistant container.

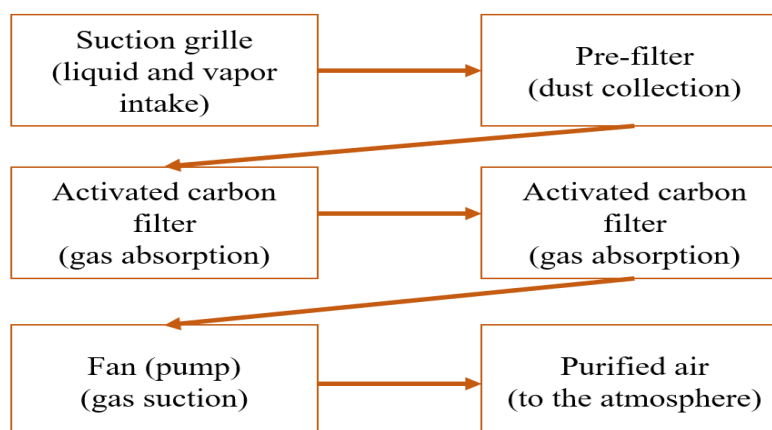


Figure 1. Operating diagram of a mobile suction-filtration module

The principle of operation of this device is that when sensors detect spilled liquid, the pump automatically starts, and the liquid is quickly drawn into a container, and the vapors released into the air are filtered from flammable liquid vapors (Figure 1).

The advantages of this module are characterized by the automation of the mobile device and its high ability to quickly collect flammable liquids, minimizing human participation in the process of collecting liquids, reducing the risk of explosion in production and industrial buildings, and being portable and adaptable to various locations.

Literature review

Modern scientific and practical sources play an important role in the development of technologies for the prevention and elimination of emergencies involving flammable liquids. A number of international and local scientific sources, standards, and legislative documents were studied within the framework of this study. In particular, the Law of the Republic of Uzbekistan No. URQ-1036 dated February 24, 2025 “On Ecological Expertise, Environmental Impact Assessment and Strategic Environmental Assessment”, Resolutions of the Cabinet of Ministers of the Republic of Uzbekistan No. 171 dated April 29, 2023 “On Measures for the Effective Organization of the Activities of the State System for the Prevention of Emergency



Situations and Action in Such Situations of the Republic of Uzbekistan”, No. 199 dated April 2, 2025 “On Approval of the Technical Regulation on the Safety of Lubricants, Technical Oils and Technical Fluids”, No. 121 dated March 7, 2024 “On Approval of the Regulation on the Procedure for Controlling Activities in the Field of Storage, Transportation, Use and Disposal of Chemical Substances (Products) with High Combustion and Explosion Hazards” and normative documents on emergency situations (VM resolutions, GOST, ISO) determine the legal basis for ensuring environmental safety, environmental protection and prevention of dangerous situations. In particular, the ISO 14001:2015 standard provides for reducing the negative impact on the environment through the implementation of an environmental management system at enterprises. These documents serve as a normative basis for the implementation of the proposed technological device - a mobile suction and filtration module.

Also, the work of Kh.Y. Karimov “Safety of Oil Products” (2021) focuses on safety measures when working with oil and oil products, describing the strengths and weaknesses of existing collection tools. This information served as the basis for a critical assessment of current methods in the study. The manual “Methods for Eliminating Oil and Oil Product Spills” by M.Kh. Kholboev shows the advantages and limitations of currently widely used absorbent materials, drainage systems, and manual collection techniques. These serve to substantiate the need for a new solution in the study. As a result of the study of international scientific sources and technical experiences, the work of M. Fingas “Oil Spill Science and Technology” provides a deep scientific analysis of oil spill detection, monitoring, and cleanup technologies. At the same time, the work “Oil Spill Environmental Forensics” by Zhendi Wang and Scott Stout describes methods for identifying the sources of spilled liquids and analyzing them based on differential approaches. These sources served as an important scientific and practical basis for developing the design of the device. The works “Fundamentals of Industrial Hygiene” by Barbara A. Plog and “Dust and Fume Control” by T. Allen reveal important aspects of industrial hazard protection, reduction of harmful impurities in the air, ventilation and filtration systems. These sources became one of the important literature in developing ways to reduce the release of flammable vapors into the air in a mobile filtration system.

Research results

During the conducted research, a prototype device of a mobile suction filtration module (Figure 2) was tested in laboratory conditions. According to the test results, 10 liters of gasoline were completely collected in 3.2 minutes. The spread of flammable liquid vapors into the environment was reduced by 80%. 92% of flammable liquid was effectively collected for reuse.

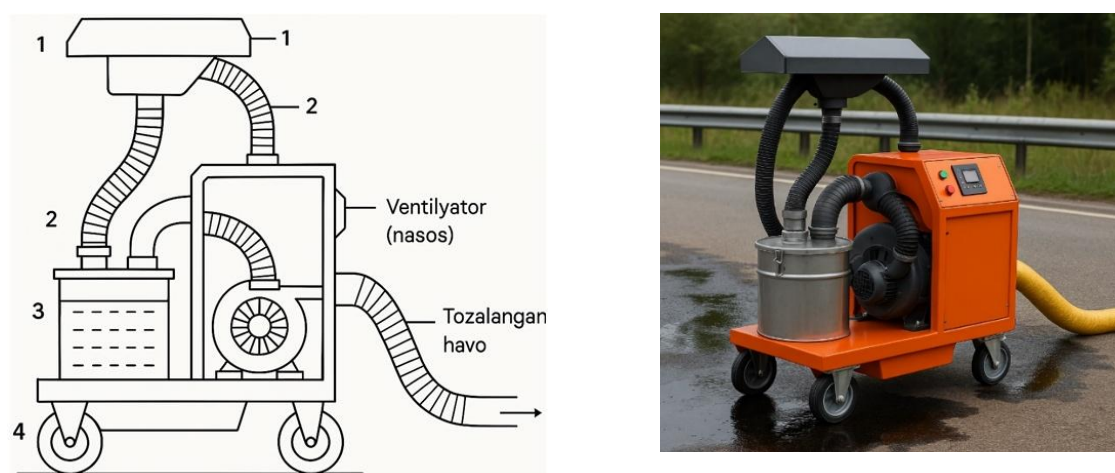


Figure 2. Appearance and drawing of the prototype of a mobile suction-filtration module

- 1) suction grille; 2) primary filter and gas absorption pipe; 3) mechanical dust filter and activated carbon filter for absorbing gases and vapors; 4) wheels

The proposed mobile suction-filtration technology can serve as an effective tool for industrial workers and emergency services. It can be further improved by introducing algorithms for detecting dangerous areas, adding autonomous energy sources, and developing models suitable for different types of liquids.

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