PRODUCTION OF THE SORPTION SHEET FROM COMPOSITE MATERIALS AS A LIQUIDATION AGENT FOR SPILL RESPONSE OF HAZARDOUS MATERIALS.

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INTRODUCTION

In the area of an accidental spill, there is often a conflict of interest between the desire to protect the environment and the necessity of the early recovery of freight traffic. Many factors directly affect the choice and implementation of appropriate technology in localization or liquidation. Under severe time constraints and many scenarios in the development of an accidental situation, it is not possible to solve this organizational task promptly. Moreover, the existing technologies and regulations for liquidation activities show their operational incapacity and delayed efficiency. Thus, in practice, localization and liquidation of accidental spills of dangerous freight is implemented partly or do not carry out at all. Summarizing the above we can come to the following conclusion: the traditional technologies of localization and liquidation for spills of dangerous freight on railway transport do not meet the current requirements necessary for operational and effective environmental protection. So, there is relevance in introducing new approaches, which, even under difficult conditions, will provide simplicity, universality, and efficiency in the organization of liquidation measures.

Today there are many ways for liquidation of accidental consequences when transporting dangerous freight, such as neutralization and others, but the most common technique is the use of sorption methods because they are characterized by highly efficient technological indicators – high degree of cleaning, low-cost price, simplicity to obtain them, and usability.

TOPICALITY. STATEMENT OF THE PROBLEM.

In general, it is planned to develop a unified sorbent as a universal way for localization and liquidation of the accident consequences while transporting liquid fractions of dangerous freight.

It should be noted that sorbents are used for liquidation of the accident consequences only when transporting liquid dangerous substances. So, the following classes of dangerous freight are singled out. Physicochemical-sorption methods for the localization and liquidation of accidental and technological spills can be applied, namely:

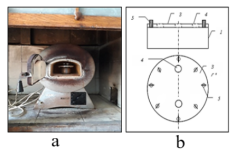
1) Class 3. Flammable liquids
2) Class 5.1. Oxidizing agents
3) Class 5.2. Organic Peroxides
4) Class 8. Corrosive substances

Table 1. An analysis of the practical application of sorption materials for different classes for dangerous freight.

Sorbents	Hazard class			
	3d class	5th class 5.1	5th class 5.2	8th class
Activated carbon	+	+	+	+
Sand	+			
Wool	+			
Wood chip	+			+
Dried cereal products	+			
Paper waste				+

METHODS AND MATERIALS

The process of waste carbonization was performed in the original carbonizer



a b

Figure 1. – Form for waste carbonization:
a) general view of a carbonizer,
b) principal diagram of the installation
1 – cylindrical form, 2 – space for waste disposal, carbonization zone, 3 – form lid, 4 – holes with reverse valves for removing carbonization products, 5 – fixing bolts of the form lid

Waste of coffe products

Wood shaving

As a raw material in the production of activated carbon [9], as an indicative example, the use of coffee grounds waste with a fraction from 0.1 mm up to 1 mm is proposed. From waste of wood chips or shavings, it is proposed to use a large or small chip or shaving of sizes from 5 mm up to 20 mm.

Carbonization was organized in a muffle furnace under coking conditions at a constant temperature from 100 ºC to 500 ºC with a temperature scale step of 50 ºC, the carbonization time of waste samples was 30 minutes. After receiving the sorbent we moved to the second part of the experiment, namely the definition of qualitative and quantitative indicators of the obtained sorption material.

RESULTS

No. Example	Weight of empty box(g)	Weight of a box with oil products(g)	Land weight (g)	Oil weight (mg)	Residual weight of petroleum products(g)	Sorptive capacity. (%)
Group No. 1						
1A	45.31	45.38	30.17	67.33	1900.00	82.00
2A	46.70	46.75	30.12	58.20	1600.00	85.00
3A	41.40	41.47	30.01	62.67	1755.00	83.50
standard	57.66	-	-	10	-	-
Group No. 2						
1B	45.31	45.36	30.03	47.53	1250.00	88.00
2B	46.69	46.73	30.06	38.56	950.00	91.00
3B	41.40	41.45	30.05	43.66	1120.00	89.50
standard	57.66	-	-	10	-	-
Group No. 3						
1C	45.31	45.35	30.01	38.66	955.00	91.00
2C	46.69	46.72	30.08	32.56	750.00	93.00
3C	41.40	41.44	30.05	35.54	850.00	92.00
standard	57.66	-	-	10	-	-

Table 2. Results of analyzing adsorption activity by the simulated solution of oil products.

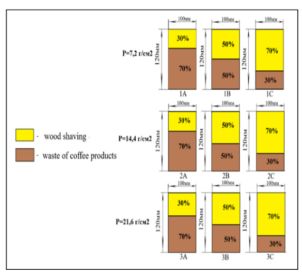


Fig. 2 Detailed mockups of sorption sheets with different parameters of components ratio.

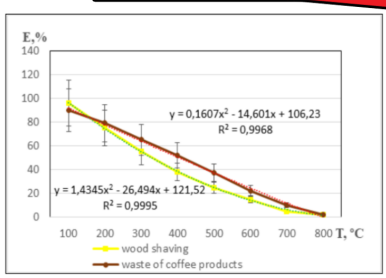


Figure 3. – Dependency graph for the product yield of carbonization from the temperature in the carbonization chamber

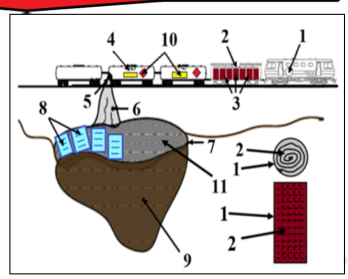


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Fig. 5A) Visualization of the procedure for liquidation the consequences of an accident while transporting dangerous freight (oil products).

1 – a locomotive; 2 – a car with the sorption sheet (8); 3 - containers with the sorption sheet (8); 4 – a tank with a liquid dangerous freight (10); 5 - a hole through which there is a spillage of dangerous freight (10); 6 - land drainage of liquid dangerous freight (10) according to the terrain relief; 7 – a zone of formation of spillage mirror (11); 8 – a sorption sheet; 9 – a zone of the damaged soil strata.

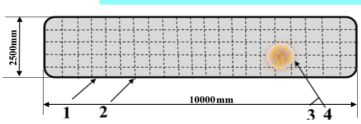

Fig.4a) The universal sorption sheet in stretched-out view.

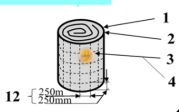

Fig 4b) The universal sorption sheet in folded – rolled form.

The proposed sorption sheet (8) contains a bag (1) from the filter cloth (2), coffee grounds (up to 70%) (3), wood shavings (up to 70%) (4) with a sorption cloth (8) 1200 g/m² and more. The sorption sheet (8) will additionally be backstitched. The cells (12) of the sorption sheet (8) are proposed to be made with a size of 250 mm × 250mm.

Contact of the sorption sheet (8) occurs first with a bag (1) from the filter cloth (2), and then with a mixture of carbonized coffee grounds (3) and wood shaving (4).

Fig. 5b) a container with the sorption sheet.

1 - a container for transportation of sorption sheets (8);
2 – the sorption sheet (8) in a folded form.

Thus, the use of the proposed universal sorption sheet (8) allows localizing and/or liquidating spills of liquid dangerous materials for 3d, 5th, 8th hazard classes at the level of adsorption activity greater than 90%.

CONCLUSIONS.

The authors recommend to use the developed universal sorption cloth for localization and liquidation of emergency consequences during transportation of dangerous goods.