

Double Use Aviation Technologies--Extinguishing the Fire and Neutralization of Spills of Oil

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Abstract

The subject of the report is the double use of aviation technologies in the system of EMERCOM of Russia, both for fire extinguishing and neutralization of spills of oil. We mention the technical characteristics of the devices, providing a realization of double use aviation technologies. The main problem discussed is one of the trends of development of the above-mentioned technologies--using helicopters with tanks, placed on the external bracket.

1. Introduction

In this report we are raise the questions of using aviation technologies in the system of EMERCOM of Russia: 1) to extinguish the fire, 2) to neutralize spills of oil. We describe the technical features of the devices, providing a realization of double use technologies. We would like to draw special attention to one of the trends in development of aviation technologies--the use of helicopters with tanks on external bracket.

For the last few years in Russia and all over the world, aviation technologies have played a significant role in putting out landscape fires and fires in woods. These technologies have a number of advantages:

- water is delivered very quickly to the seat of fire;
- high effectiveness of "hydroimpact";
- no dependence upon the road system in the area;
- safety of all the participants and others.

Worldwide tendencies in the development of aviotechnologies aimed at liquidation of fires are based on two different trends, which are characterized in the first case by "total impact" and in the second one by "local impact."

The first one is connected with applying (using) planes, equipped with special tanks and the system of spraying water over the seats of fire. Russian airplanes AN-2P, AN-26P and hydroplane Be-12P have tanks with the capacity of 1,2,4 and 6 m³ respectively. For the last few years, aviation departments of the EMERCOM of Russia have used detachable aviation devices VAP-2 (Silver medal of 48-th World Exhibition of Innovation research and technology, Brussels, "Eurika-99") with a capacity of 40 m³, installed onboard IL-76MD aircraft.

The second trend of development of aviotechnologies for extinguishing fires involves using helicopters with tanks of different capacities on external brackets. In this case, the water enters the tank while the helicopter is hovering by means of immersion of the tank due to its own weight. This variant has the following advantages:

- Higher effectiveness of hydroimpact due to both its exactness and wide range of the specific expense of water ;
- Promptness of filling the tank with water (several seconds instead of two or more minutes);
- Increased safety of the flying fire-brigade while putting out the fire (It is not necessary to be in the air for a long time at the height of 50-80 meters);
- No dependence on land infrastructure for filling the water tanks.

In Russia, application of the second variant is much more effective due to the geography. There are a lot of open water reservoirs with the depth of 1-2 meters that can be used for filling water tanks. They can be found in practically any tract of forest.

The results of developing the second trend, researched while carrying out works for the EMERCOM of Russia, follow.

2. Historical Reference

The technology of putting out a fire by means of helicopters with water tanks on external brackets appeared at the beginning of the 1980s when a Canadian company, SEI Industries LTD, started using a tank named the "Bamby-Bucket" (BB). Today, these tanks are being used all over the world. Their capacity is from 0.3 to 10 tons of water. In comparison to the fire-bucket, the "BB" tank begins taking a very hard shape due to the system of hard and rope elements. A laced-up branch pipe closes the tank outlet. It fills with water due to lateral immersion of the tank. This can be achieved due to the load placed at the end of the shell and special chains. The process of filling up of the "BB" tank with water is similar to the one used with the fire-bucket, using its hard shape and lateral immersion.

However, use of "BB" tanks has a number of disadvantages. The main ones being:

- Longitudinal hardness of the "BB" tanks inhibits quick immersion, and even prevents immersion in certain wind conditions;
- Application of synthetic leather materials in "BB" tank construction makes the process of use and storing much more difficult. It also restricts use of the "BB" tanks at low temperatures;
- The hardness of the "BB" tank shell does not allow regulation of the tank's capacity.

3. New Devices

In Russia, mass production of a soft device for pouring water, the VSU-5 with the capacity from 3 to 5 tons, has begun. The VSU-5 has none of the disadvantages mentioned above. Besides, the VSU-5 is less than half the cost of the similar model BB HL-5000. Figure 1 shows the VSU-5 spraying water.

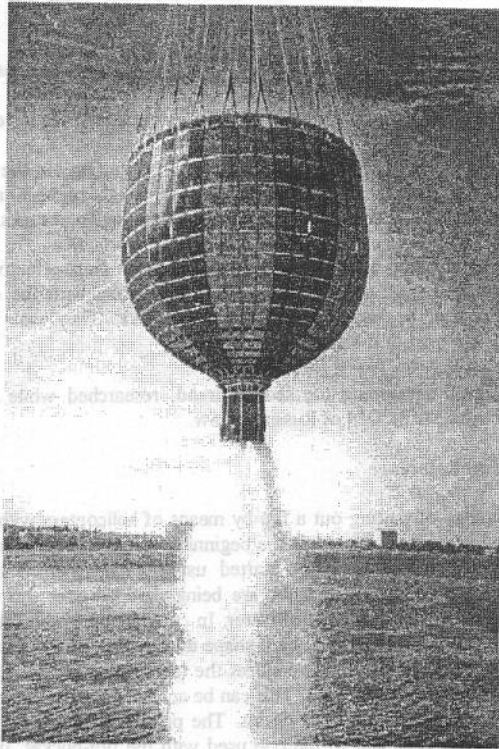


Figure 1 The VSU-5 spraying water.

The shell of the VSU-5 is soft and consists of two layers: The external layer consists of a kapron base with circular and radial tapes belts. The internal layer is made of rubberized kapron fabric to help germetization of the transported water.

In tests and actual use, the VSU-5 turned out to be very effective. For example, in August 1996, it was used during an oil fire in the Volgogradsky region. The helicopter used took water straight from the river not far from the seat of fire without landing. As a result, 480 tons of water were thrown down on the fire during the first day of work (120 x 4 tons).

The VSU-5 is much more advanced than the "BB" tank primarily due to the ability to quickly and effectively take in water. The pouring nozzle is opened automatically and allows the shell to fill during the immersion. The pouring nozzle is controlled from the helicopter's cabin. A special system was created to regulate capacity of the shell within 50%.

In 1997, EMERCOM of Russia ordered the VSU-15 with capacity of 15 tons for use with the MI-26T helicopter. The VSU-15, transported on the external bracket of the MI-26 helicopter, is can take water from open reservoirs with a depth of not less then 3 meters (lakes, rivers, seas). Other important factors are the hanging condition and forward motion.

The main technical characteristic features of VSU-15 are:

- | | |
|---------------------------------------|---------|
| - mass (dry) VSU-15, kg | - 255 |
| - max. diameter of the shell, m | - 3,1 |
| - height VSU, m | - 10 |
| - length of the external bracket, m | - 30-60 |
| - average consumption of water, l/sec | - 1000 |
| - time to fill with water, sec | - 25 |

The shape of the tank allows the taking of water safely, using the piloting technique of the MI-26 helicopter. It can also bring it to the seats of fire and pour it on the fire centers using as few people as possible.

The VSU-15 allows the capacity of the tank to be changed from 15 m³ to 10 m³ so that MI-26 helicopters with lower lifting capability can be used. Use of such devices shows that 1 ton of water sprayed over the fire zone for one second can extinguish a fire of middle intensity of size 5 by 100 meters.

During the last few years, EMERCOM of Russia has used the technologies mentioned above to extinguish fires in Krasnoyarsk, Khabarovsk, Krasnodar, Moscow, and Volgograd regions, and in Greece. They were also very effective in extinguishing burning oil products in the Volgograd region and Turkey.

4. Neutralization of Spills of Oil

In the EMERCOM of Russia, scientists are considering the possibility of using the described technical devices for the urgent neutralization of oil pollution on

the land and in the water. The idea is to bring special substances to the region of the oil pollution to prevent spreading on the oil. The importance of neutralizing oil pollution is emphasized by the fact that oil contributes 40% of all the pollution to the world oceans. Reagent solutions brought immediately to the pollution area remove oil from the water surface in different ways. Each of them has advantages and disadvantages. The best way of applying these combined methods is the following: first sorbents, then dispersants, and finally biological.

Sorbents absorb oil and oil products and form large agglomerates with the weight of several kilograms in water. These agglomerates stay on the water surface for several months and can be easily removed mechanically without leaving any trace. Dispersants are made for crushing oil film, transforming it into emulsion, and accelerating biochemical oil destruction.

The process of biological purification involves putting microorganisms into water reservoirs with oil. These microorganisms process the oil into ecologically harmless final products. The method is based both on the operation of inserted microorganisms and on stimulation of the existing microorganisms due to the extra food (such as mineral salt, carbohydrates, and other catalysts). The necessity of the application of bio-sorbents is also explained by the fact that hydrocarbons are dangerous to human health and the environment. They are easily dissolved in water and can neither be destroyed nor extracted in any traditional way. Bio-sorbents are therefore a final and compulsory stage of neutralizing oil spills.

Presently, work ordered by the EMERCOM of Russia is being carried out. It is aimed at the creation of helicopter-carried capability to neutralize oil pollution on water using the VSU-5. The VSU-5 is being equipped with an overhead spray, providing consumption of reagent solution at a rate of 50 liters per second. The overhead spray can also serve as a stand (base) of the shell for filling the tank on the land.

Figure 2 shows the overhead spray VSU-3N. 1 is foundation, 2 - soft shell, 3 - lateral overhead system, 4 - spraying elements, 5 - protective skirt, pnevmovalve. The inner shell of the VSU-3N is made of material that allows contacting solutions of aggressive reagents such as the type DN-75 dispersant.

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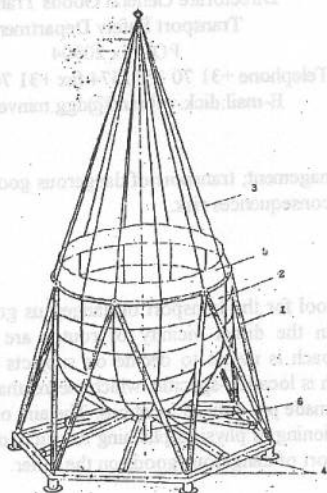


Figure 2. The overhead spray VSU-3N

The main technical characteristics of VSU-3N:

- mass, kg - 300
- max. inner volume, m³ - 3
- max. consumption of reagent, liters per second - 50
- length of overhead system, m - from 5 to 10
- working range of temperature, °C - from +5 to +40
- speed of transportation with reagent, km/h - 180

The process of employing the VSU-3N is as follows: First, the special reagent solution (sorbent, dispersant, or biopreparates) is poured from the tanker into the installed device, located on the land. Then, after filling, the overhead system is attached to the external bracket of the helicopter and transported to the center of damage of the oil spill. The operator of the helicopter controls the spraying of the reagent depending on the working conditions and the type of reagent.

It is also possible to use the above technology to combat insects, including locusts. For this use, the tank should be filled with the proper solution.