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## Special technologies of rescue system in Russian Federation for forest fires

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Tekst jest udostępniony do wykorzystania w ramach dozwolonego użytku.

## SPECIAL TECHNOLOGIES OF RESCUE SYSTEM IN RUSSIAN FEDERATION FOR FOREST FIRES

*Roman Michalovič*

### ABSTRACT

Russian federation has a lot of special technologies for applications of extinguishing agents. Modern approaches include aerial firefighting technology, explosives, chemical agents inducing raining etc. Military industry continues to develop new resources, which are

later adjusted to rescue and emergency purposes. Forest fires are very often fought by specialized technologies including special terrain vehicles, aircrafts using water bags with fire retardants which are very effective in stopping the fire spread.

### KEYWORDS

Russia, rescue system, technology, fire fighting, retardants

### INTRODUCTION

The nature of the environment and the likelihood of particular types of incidents is decisive for civil and security policy of the state and hence the orientation and the use of available technology . While the the western world, including Australia are civil- security systems deal with many private institutions and companies, in the east it is a matter for government and companies work mostly on the order of government institutions while the private sector in this sector continues to grow. In the U.S. , Japan, EU, Australia, but also in Russia play an important role in the development of security technology universities and research institutes, institutes , accredited laboratories , simulation centers, etc. Owing to the results of applied research, the technology and equipment able to save lives even in the most desperate situations.

Technology development is the first, purpose of use, source of funding ie's requirements but especially capacity development centers ie technological research and development opportunities as well as professional staff erudition.

In technologically advanced countries, there are many state and private institutions, large and small companies dealing with security

technologies . While the commercially most interesting is their lengthy development and sales but training and staff training in working with them. Therefore, there is a number of small specialized companies, which have a very narrow focus to become a leader in the selected area . Security technologies used in emergencies in terms of duration of use can be divided into two main groups on preventive technologies and technologies of active deployment. . Another aspect is the technology division of their intended use:

- Fire
- Flood
- earthquake
- avalanche
- against storms ( tornadoes , hurricanes , typhoons , etc.).
- Against torrential waves
- Against Industrial Accidents
- against nuclear accidents
- Compared to road accidents , air, sea etc.

Active technology deployment can be divided into main groups. Primary automotive equipment, tools , personal protective equipment , etc. . Among secondary mainly include the search technology, communications technology , and other support resources.

## RUSSIAN RECENT SAFETY ISSUES

Every year there are hundreds and thousands for forest fires in Russia. In the summer of 2010, according to the Ministry for Emergency situations of Russia (EMERCOM) country had been suffering of 843 fires and 47 forest fires of peatlands at the same time. Smoke covered the entire European part of Russia. However, the activation of aviation technology was complicated due to smoke that reached up to 12 km height<sup>1</sup>. Water bombs were used within the fire fighting more likely.

Military-industrial complex of the Russian Federation as a secondary product develops efficient technologies for forest fires extinguishing, as well as seeking and rescuing people in large areas. Russia has lots of material and human resources to save lives and material values. This article touches on themes of technological application possibilities of flame retardants, as these are often applied across the board from the ground or from the air.

According to official information, the Ministry of the Russian Federation for civil defense, emergencies and elimination of consequences of natural disasters (abbreviated EMERCOM) State fire service has 220,000 firefighters, 13 600 buildings, 4,000 fire stations, 18,364 fire trucks, 49 fire motorboats. In addition, there are areas in Russia, general, trade unions and voluntary fire brigades with different levels of equipment . Total annual saving more than 90,000 lives and prevent damage of 120 billion. Rubles (2.8 billion. EUR)<sup>2</sup> . EMERCOM activities focus on fire prevention and fire active land and air protection, the search and rescue of lost persons in countryside, warning and evacuation of people from affected areas, rescue operations on rivers and water areas but also to rescue sailors from ships and submarines. EMERCOM operates in troubled areas where organized civil defense, finds and destroys

munitions and booby systems, which is active in anti-terrorist attacks<sup>3</sup>.

## FOREST FIRE

Forest fire is a fire that breaks out and spreads on forest and other forest land or breaks out on other land and spreads to forest and other forest land. The cause of forest fires may be a natural phenomenon (lightning), but the vast majority of these are human negligence . In this case, most of the discarded cigarette butt or disregard the prohibition of the establishment of forest fires and consequently insufficient to extinguish. The cause of the fire may become even tossed glass that sunny weather works like a magnifying glass. Firefighters are difficult to dispose Forest fires of because they usually occur in heavily accessible terrain where they cannot make full use of fire equipment and are very dangerous due to their potential to spread very fast. In addition, the behavior of fire in the wood is often unpredictable and fire can spread, for example, and under the earth, and it is very difficult to predict where resurface. Interventions on forest fires are therefore very time consuming and require a large amount profession of fire protection. Disposal of forest fires also requires a considerable amount of water, which should be often difficult to get a place of fire. The cost of disposal of forest fires are therefore very high.

## EMERGENCY TECHNOLOGIES

The technologies used for intervention in the affected areas must meet specific requirements with regard to the nature of the incident and an existing natural conditions. Within the country, there are differences in the number of particular types of intervention techniques used. Intervention techniques to use, what is the quickest to react to this incident and at the same time, the most effective intervention . For this reason, the intervention units available various types of cargo and passenger vehicles or helicopters or small motor-powered fast motorboats (rigid inflatable).

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<sup>1</sup> Cf. Emergency Technologies

<http://www.emergencytechnologies.com.au/vet.htm>

Moskva se chystá na čtyřicítky, požáry v Rusku zuří dál  
<http://www.ceskatelevize.cz/ct24/svet/97790-moskva-se-chysta-na-ctyricitky-pozary-v-rusku-zuri-dal/>

<sup>2</sup> Fire & Rescue NSW

<http://www.fire.nsw.gov.au/page.php?id=450>

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<sup>3</sup> EMERCOM of Russia

[http://en.mchs.ru/Forces\\_and\\_Facilities/Fire\\_Control\\_in\\_Russia](http://en.mchs.ru/Forces_and_Facilities/Fire_Control_in_Russia)

Hardware except fire gear (firefighting equipment, shovels, axes, saws) includes climbing equipment, communications equipment (transmitters respectively. Handsets with GPS, satellite phones), special protective clothing (fireproof overalls, chemical resistant overalls, respirators, oxygen cylinders). Interventions against the consequences of incidents are also often benefit from cooperation with the private sector, especially if the carriage of cargo or evacuation of persons or animals from the affected area. There are means of transport, especially buses, tractors, or other trucks. In addition techniques are also used draft animals, and the stubby often deployed rescue dogs.

When removing debris from caving is appropriate to use tracked vehicles, which is more maneuverable and threaten to puncture the wheels. Therefore, often used crawler dozers or modified military tanks. Wheel loaders and trucks are often no initial deployment of tracked vehicles can not be used.

Military equipment is used during flood, as it can get to people trapped on rooftops, in trees and under. They are used first, heavy trucks, motor boat , pontoon.

### GROUND EQUIPMENT

The most advanced Russian firefighting tanker truck ZIL AA13, 5/100-100/3 (Fig. 1) has a capacity of 13.5 tons extinguishing agent . As one of the few Russian vehicle has a fully automatic transmission, allowing a better focus on the ride and the interference.



Fig. 1 tanker truck ZIL AA13, 5/100-100/3

Fire-fighting interventions in difficult terrain, the chemical releases from industrial and military installations as well as forest fires or in remote areas with sparse infrastructure used successfully tracked vehicles such as the Ural (Fig. 2) with eight hoses able to penetrate deeply into fire



Fig.2 Russian carrier Ural fire

because self cooling or proven Russian rescue transporter Vityaz DT - 2P (Fig. 3) which resists extreme temperatures from - 40 to + 45°C. Because of its universal application and endurance is virtually irreplaceable<sup>4</sup>.



Fig. 3 Recovery transporter Vityaz equipped with a crane FASSI

Vityaz is a tracked vehicle with a joint connecting two parts of the vehicle (3) . The front part of the drive has a transport function and back . Type shown in Figure 10 is mounted with hydraulic arm crane FASSI, Italian production<sup>5</sup>.

<sup>4</sup> <http://ruslet.webnode.cz/technika/ruska-technika/letecka-technika/m-l-mil/mi-14pz/>

Cf. KRIŠŠÁK, P. - MÜLLEROVÁ, J.: *Úvod do termomechaniky*, Žilinská univerzita v Žiline 2006.

<sup>5</sup> <http://ruslet.webnode.cz/technika/ruska-technika/letecka-technika/g-m-berjev/be-200/>

## AIRCRAFTS

Aviation technology is primarily designed to fight forest fires, but can be used also in fires high-rise buildings . Ukrainian AN 32P (Figure 4) is primarily designed to fight forest fires . It has two independent tanks capable of once or twice deleted 8000 l of water, or two tanks with UV26 with agents that produce rain. This substance is either dry ice or silver iodide. These substances are found in containers under windows.



Fig.4 Antonov AN - 32P

Larger and more numerous fire represented a multi-purpose special Berjev Be- 200 (Fig. 5) has multiple uses in the rescue . It is primarily designed to fight forest fires with a carrying capacity of 13 000 liters of water is used for search and evacuation of people injured removal and transport of cargo This initially against submarine combat jet machine is capable of landing and take off from water surface and scoop water while in flight over open water with submerged rear fuselage . This has three special fire fighting water tank (those with four tanks, which are located under the floor of the cab cost, together take 12 000 kg of water), 50 rescuers with equipment, seated 64 wounded, 30 wounded lying on stretchers or the total weight of the load to 7500 kg or more<sup>6</sup>.



Fig.5 Current special Berjev Be- 200

## WATER BOMBS

Represent a very effective fire water bombs that have been developed in Russia . Effective water bombs were developed by a national development center Basalt. Water Bomb 2008 can extinguish the explosion 1000 m<sup>2</sup> water bombs as a modern fire extinguishing agent used in exceptional cases. . The pressure wave carries the microdrops of water that are dispersed over a long distance and efficient thanks to a pressure wave that attenuates fire and everything it stands etc. These bombs can be detonated in the air or on impact on the ground.

## FIRE RETARDANTS IN FOREST FIRES

The fire is defined as each burning which results in damage to property or the environment resulting in the death or injury of an individual or dead animals, fire retardant is also undesirable, in which endangered the life or health of individuals, animals, property or the environment<sup>7</sup>.

The course of fire is characterized by a number of chemical and physical phenomena are interrelated. Wildfire is the most drastic way to forest destruction. Has a huge impact on all the plants and animals living in the forest. Animals takes livelihoods and homes. Fires caused by humans by their negligence or disregard of risk in the use of fire. Another reason tend to extreme temperatures, together with direct exposure to the

<sup>6</sup> <http://ruslet.webnode.cz/technika/ruska-technika/letecka-technika/m-l-mil/mi-14pz/>

<sup>7</sup> Kriššák, P. - Müllerová, J.: *Úvod do termomechaniky*., Žilinská univerzita v Žiline 2006.

[8] Osvald, A. - Osvaldová, L. 2003. Retardácia horenia smrekového dreva. Vedecké štúdie. Zvolen: Technická univerzita Zvolen, 2003, 61 s., ISBN 80-228-1274-9.

sun is the initiator fires. He then usually supported by strong winds. It should be noted, however, that climatic conditions directly affects the person producing effluents, emissions. The current global warming will certainly not contribute to a reduction of the number of forest fires. It is a big issue also in Russia. Country is affected by large fires more and more often especially during the summer months.

These fires are even more dangerous is that often occur at locations not accessible to fire equipment, with insufficient respectively. Inappropriate source of water for extinguishing require enormous commitment of people, special fire fighting and sometimes aircraft. Direct damage associated with coverage of live trees, processed and unprocessed wood, gain or loss deterioration of wood raw material. Indirect damages arising entering other secondary pests, as well as increasing the cost of the consequences of fire . [9] Moreover, forest fires are a real threat to human life and cause ecological and economic harm to the adjacent settlements and urban areas. Just by the fire interfering with all the components of biota, is a return to the original state extremely difficult<sup>8</sup>.

Combustion in forest fires can be described as burning a whole set of organic material, which is composed of forest cover . When a fire breaks out in the woods, the plants treated with great ardor and occurs partial or even total necrosis of bark tissue, or even the entire tree. Living cells in phloem already begin to die at a temperature higher than 54°C and at a temperature of 80-150°C, the loss of all the water in the tissues as well as wood<sup>9</sup>. When applied to the flame with a temperature of 250°C, it takes longer time to start the wood gas leakages and the wood itself is ignited at a temperature of about 300°C. At a temperature above 450°C ignited gases escaping from the timber already in contact with the outside air and at a temperature above 600°C, the timber

itself becomes a source of combustion. Flame temperature of burning wood reaches 700 to 800°C. When burning crown conifer the temperatures arise around 1000°C with the flame height to 100 meters. When burning coniferous forest in the flame temperature reaches a value up to 1300°C<sup>10</sup>.

Retardants are special solutions applied preventively or during the fire at wood materials, thus avoiding their ignition. The principle of the protective effect lies that the process of combustion (or to temperatures above about 150°C) formed by its thermal decomposition on a surface of the material thick (up to several cm), a microporous non-combustible, heat-insulating foam layer, a relatively long time (up to 30 minutes) provides resistance to fire and radiant heat. Protection of wood materials from the devastating effects of fires has long been under discussion. There are numerous flame retardants slowing down the flame development. Preventive retardants are applied to floors, furniture design during production or when they are finalized<sup>11</sup>.

Another group of retardants is applied during the firefighting as an additive water substance. It is applied from the air by the aircrafts or helicopter to stop the flames.

There are various types of chemical retardants. They are in different substances. Typically like a dust or like a gel which is very effective in protection. Well known is FIRESORB®. It is a substance developed for fire fighting multiple uses. The way deliveries in liquid form, the composition can be applied directly in the fighting field using classic material means used to extinguish (portable shunt, tubing Bg, Cg, Dg, combined nozzle). The results of experiments have confirmed its high absorption ability, which makes it suitable not only for direct fire. Grip gel allows its application even on vertical

<sup>8</sup> Martinka, J. – Kačíková, D. - Hroncová, E. – LADOMERSKÝ, J.: *Experimental determination of the effect of temperature and oxygen concentration on the production of birch wood main fire emissions*. Journal of Thermal Analysis and Calorimetry 110:193–198 DOI 10.1007/s10973-012-2261-2. Springer. 2012.

<sup>9</sup> Müllerová J. - Mlíkulík M., Technology and safety of biomass combustion, Saarbrücken: LAP Lambert Academic Publishing, (2012).

<sup>10</sup> Zachar R M. - Skrovný R.: *Influence of heat on thermal degradation of spruce wood*, Acta Fac. Xylogiae, 49(1), 61-68 (2007).

<sup>11</sup> Müllerová J. *Fire Safety Properties of Heat Treated Wood*. Research Journal of Recent Sciences Vol. 2(12), 80-82, December (2013), UHROVÁ I. – eadem, Flame spread over biomass dust layer, Magdeb. brand Explosionsschutztag, Magdeburg (2013), Müllerová J. - MIKULÍK M., Environmental and health risks of solid fuel boilers' emissions, Košice: Multiprint, (2010)

surfaces. This property gel can be used for cooling of the surroundings but also creating firebreaks in preparation burning zone<sup>12</sup>.



Fig.6 Fire retardant applied from air

### CONCLUSION

In the development of rescue technologies Russia does not lag behind the West. In addition to standard high advanced aerospace technologies, durable and effective ground equipment developing new ways to effectively combat fires. The paper deals with the most effective examples of functional technologies as well as looking at the development of unconventional resources such as water bombs or application of substances that induce rain. These technologies are absolutely necessary for effective fire fighting in forest. The forest fires are very often in Russia, therefore many kind of specialized vehicles are used. Flame retardant or fire retardant are applied typically mixed with water to cover the wood before its temperature increases too much. Good retardant will resist 10 times longer than untreated wood. View of the Russian experience with the application of retardants and use technology to be very inspiring.

<sup>12</sup> Chromek I.– Benedik V. – Šmigura M. – Hlaváč P.: protection of wood based materials against fire by gels. ACTA FACULTATIS XYLOGIAE ZVOLEN, 52(2): 81–90, 2010.

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