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USE OF MODERN EQUIPMENT FOR EXTINGUISHING ELECTRIC VEHICLES

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The fourth scientific and technological revolution, which began in the mid-20th century, has led to the rapid development of information and telecommunication systems, artificial intelligence, informatization of society and many other aspects of human development. The development of modern technologies provides great benefits to mankind, even if we consider a small time period of 10-20 years, which usually make our world better and more perfect. However, quite often, the introduction of new technological innovations fails, especially at the initial stages of operation, which can lead to a number of problems and the threat of emergencies.

Recently, humanity has begun to think about alternative energy sources that can replace hydrocarbon fuels. An undeniable leap in recent years has been made in the automotive industry. One of the most striking examples is the rapid growth and development of vehicles powered by alternative energy sources, among which vehicles running exclusively on electricity attract special attention. In the near future, such vehicles should completely replace traditional ones powered by internal combustion engines. Along with the introduction of new technologies, the number of threats and hazards to human life and health is also growing, and fire and rescue units must respond to them.

Due to the increasing use of electric vehicles, there is a problem with the procedure and general methodology for extinguishing lithium-ion batteries, which pose a major fire hazard.

The aim of the study is to analyze the world experience, technical means and approaches to extinguishing LIEBs (rechargeable batteries) in order to develop recommendations for the personnel of fire and rescue units on actions to be taken when extinguishing such fires.

One of them is the latest Rosenbauer BEST fire extinguishing system. Rosenbauer's high-voltage electric vehicle battery fire extinguishing system is a system for safe, efficient and rapid extinguishing of batteries based on lithium-ion technology. It enables direct cooling of battery modules or cells within modules and thus quickly stops the spread of thermal radiation from the cells.

The system consists of two main components - an extinguishing unit and a control unit (total weight of about 65 kilograms), which are connected by hose lines (Fig. 1).

Figure 1. Exterior of the Rosenbauer BEST fire extinguishing system and an example of its use

The fire extinguishing unit is placed on the battery and, if necessary, fixed with a jack on the car body or other points. It is best to place it on the underside of the vehicle. The control panel triggers the penetration of the needle-like tool into the battery case from a safe distance (up to 8 meters), while water is dispersed into the battery through the perforated nozzle.

Thanks to the piercing element's "shot" speed (8 milliseconds), it can quickly pierce all currently known battery cases. The water then fills the entire battery case (25-50 liters/min), providing fast and efficient cooling, thereby stopping the combustion itself and preventing re-ignition.

Table 1. Technical data of the Rosenbauer BEST extinguishing system

Water flow	32 l/min at 7 bar. (8 gal/min at 100 psi). Flow range from 25 l/min at 4 bar (6,6 gal at 60 psi) up to 50 l/min at 15 bar (13 gal at 215 psi)
Length hose	8 m as standard (315 in)
Air supply	2x 1l / 300 bar (0,26 gal / 4350 psi)
Weight ext. unit	Approx. 21 kg (46,3 lb)
Weight control unit	Approx. 22 kg (48,5 lb
Weight hose package	Approx. 24 kg (52,9 lb)

Once the battery cells have cooled down to a safe temperature range, the extinguishing agent can remain in the battery during transportation and at the place of possible quarantine. This means that water can be pumped into the battery at any time. The effectiveness of this fire extinguishing system is further proven by the reduced amount of water required compared to an alternative method of drowning the vehicle, which showed that 20 to 30 tons of water were required to achieve an equivalent result. With Rosenbauer BEST, the effective use of water to extinguish a vehicle's battery is approximately 2 tons of water, which ensures the use of only one fire and rescue vehicle tank.

Having disclosed the peculiarities of using this fire extinguishing agent for the purpose of eliminating the ignition of electric vehicles, it is promising and effective for use by fire and rescue personnel in eliminating such dangerous events. It is expedient to further consider the effectiveness of the use of refractory tackle, punch barrels and container-type export modules for the elimination of emergencies with the ignition of electric vehicle electrical systems.

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