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QUALITATIVE COMPARISON OF THREE FOREST FIRE ENGINES USED IN HUNGARY

Abstract

In Hungary, a significant proportion of fires are outdoor fires, including forest and vegetation fires. Elimination of these is significantly different from firefighting in the built environment, the conditions preventing the intervention are mainly poor road conditions. This is where the limitations of medium- and heavy-weight fire trucks, which are often unable to approach the fire to the right extent, become apparent, necessitating a protracted pedestrian approach. In recent decades, several forest fire-specific vehicles have been regularized to solve these problems. These engines and their properties are examined in this article.

Keywords: qualitative, forest fire, fire engine, effectiveness

HÁROM MAGYARORSZÁGON ALKALMAZOTT ERDŐSZERES TŰZOLTÓ GÉPJÁRMŰ KVALITATÍV ÖSSZEHASONLÍTÁSA

Absztrakt

Magyarországon a tűzesetek jelentős hányada szabadtéri tűz, azon belül is erdő- és vegetációtűz. Ezek felszámolása jelentősen különbözik az épített környezetben végzett tűzoltástól, a beavatkozást akadályozó körülmények elsősorban a rossz útviszonyok. Itt mutatkozik meg a közepes, és nehéz tömegosztályú fecskendők korlátai, amelyek gyakran nem képesek a tüzet megfelelő mértékig megközelíteni, ezzel elhúzódó gyalogos megközelítés válik szükségessé. Az elmúlt évtizedekben több erdőtűz specifikus gépjármű került rendszeresítésre, amelyek ezeket a problémákat hivatottak megoldani. Ezeket a szereket, illetve tulajdonságaikat veszi vizsgálata alá a cikk.

Kulcsszavak: kvalitatív, erdőtűz, erdőtüzes tűzoltó gépjármű, hatékonyság,

1. FOREST FIRE ENGINES

On the tactics to be used by the alarmed fire brigade to eradicate a fire, 6/2016. Annex 1 of the NDGDM instruction, Fire fighting tactical regulations. The commander of the alerted forces shall determine the tasks to be performed on the basis of the content of this legislation and shall plan the steps for the implementation of the intervention [1]. The rules discuss the types of damages with different characteristics in twelve chapters, covering their specificities in each case. The chapter on Extinguishing Fires in Forest and Peatlands deals more closely with the topic of migration than the other chapters. It is, no coincidence that this also suggests that the approach to the damage site during the intervention is often difficult due to the terrain [2].

Fire engines systematized by the fire department are usually mixed-use vehicles that can be used on paved roads and in the field. Since the primary intervention units arrive at the scene of the accident with these fire engine, it is crucial that these agents are able to transport their crew as soon as possible and as close as possible. The early start of the intervention, the shortening of the duration of the free spread of fire, will largely determine the further course of the elimination of the damage [3].

The largest number of automotive fire engines in Hungary are the Mercedes Rosenbauer TLF4000, the Mercedes Rosenbauer Atego TLF4000 AT2, and the Rába R16 HEROES AQUADUX 4000 [4].

Picture 1 – Conventional firefighting with firehoses.

However, these fire trucks are more likely to be considered as universally usable vehicles, their off-road capability being primarily limited to relatively high quality dirt roads. Another disadvantage from this point of view is the high weight and the high altitude, in this context the high center of gravity. The length and long wheelbase of the vehicle are responsible for the large size of the turning circle [5].

Knowledge of these unfavorable characteristics for off-road use justified the definitions in the relevant part of the firefighting tactical regulations, which describes the difficulties of approaching damage and practically describes that roads leading to forest areas are in many cases impassable to fire trucks [2] [6].

Of course, this recognition is not new, there were several solutions to this logistical problem. In the midlle 2000s, several Professional Fire Departments acquired vehicles specifically designed to fighting against forest fires. Special forest fire trucks are designed for a purpose for which fire engines developed mostly for road use are of limited use. This is nothing more than the transport of water, equipment, and last but not least, intervening firefighters, preferably a squad by the fire (or as short a distance as possible) in a variety of difficult terrain conditions. It became the Mercedes Benz UNIMOG TLF 3000 CFS type specialized for forest fire.

Unimog U500 TLF 3000 CAFS

The U500 is a four-wheel-drive ladder chassis with three cabs and a 279-horsepower engine with good off-road capability.

The firefighting technical superstructure, designed and constructed by Rosenbauer, has a 2,700-litre water tank. There are also two foam tanks available for foam extinguishing, one 200 litres and one 100 litres. This allows the most suitable foaming agent to be selected for the desired inoculation mode.

Picture 2. Unimog U500 TLF3000 CAFS.

The vehicle is equipped on both sides with a 60-metre quick-acting NE-PI-RO nozzle. The vehicle is not equipped with a fire extinguisher or water cannon. The vehicle is also supplied with water by means of overpressure or suction. The vehicle has a hydraulic Rotzler AZ051 type winch with a load capacity of 5 tons and 50 metres of 12 mm diameter wire rope.

Despite its positive features, Unimog has only a limited ability to perform the expected tasks. The biggest shortcoming, in my opinion, is the small number of crew seats. In addition to the driver on duty, it can only transport two firefighters to the fire. In my opinion, a vehicle specializing in such tasks should definitely carry at least one squad. This would have been possible with the double cab version of the Unimog.

Its next problem was the high centre of gravity of the vehicle, which failed to forge an advantage over other fire trucks in this area, and even became much more tipper due to the long spring travel of the chassis. The agent, although made as a special forest agent in the traditional, somewhat conservative way, focuses primarily on “B” and “C” hoses for water inoculation. With these tools it is quite difficult to work and then a beam to install, especially in uneven, even mid-mountainous areas. In my opinion, with smaller diameter “D” hoses and nozzles, water quenching could be done much more efficiently. This is because the smaller cross-sectional radius is easier to control, easier to move forward with, or even retreat with. The capacity of 100-120 liters per minute of "D" nozzles is sufficient in most cases at lower fire intensities. Studies have also shown that small-diameter rays work more effectively in certain situations because of their usual “C” or fast acting nozzles, mostly because of their smaller mass. The use of “D” water rays would also be supported by water-saving use, which may be a priority in some areas [7]. High-pressure extinguishing systems already existed when the vehicle was put into operation, and their use could have been appropriate.

Overall, it is my opinion that the Mercedes Benz UNIMOG TLF 3000 CFS, although a versatile vehicle, has not been professionally fulfilled in its system. Despite its shortcomings, no further improvements were made in the decade following its introduction into the system, and the year 2020 brought a change when two newly developed vehicles were introduced into the system.

Table 1 - Comparison of Unimog properties. Created by the Author.

Adventage	**Disadvantage**
Great performance	It only carries 3 persons
Medium amount of water	High center of gravity
High ground clearance	High price
Big wheels	Poor off-road capability
High performance winch	Technically complicated
	Large size
	Heavy weight

Komondor S3

The S3 Komondor opens a new category in the history of Hungarian fire engines, with a replaceable body (forest fire or technical rescue container), a multi-purpose 3-axle, six-wheel drive vehicle with good off-road capabilities, originally developed for military purposes, but under further development. made it of interest to other members of the defense industry [8].

The vehicle is equipped with a ground fire extinguisher and two cab-operated water cannons. Inside, special equipment for extinguishing forest fires has been installed, and it is capable of transporting a total of 7,000 liters of water. The vehicle has a length of 8700 mm, a width of 2550 mm, a height of 3050 mm and a maximum permissible gross weight of 31 tonnes, which seems quite a lot on first hearing, even with six wheels it should have a considerable ground pressure. The system was introduced recently, the first experiences are yet to come, but we can say that it is a special vehicle, not only in its functions, but also in its dimensions, function and weight [8].

Picture 3. Komondor S3. Source: [8]

I think a remarkable feature of the vehicle is that the developer took great care to protect the drug and its occupants. In addition to the built-in emergency fire extinguisher, a so-called self-extinguishing equipment that can even be operated with firefighting foam. This provides great safety not only when working in a fire environment, but also to prevent the tire from overheating to an undesired extent when passing through a recently extinguished area [9] [10].

Two water cannons fixed to the front of the vehicle (i.e. even on the vehicle if equipped with a technical rescue container) can be operated remotely from the cab, independently of each other. The water cannons have a capacity of 1000 liters / minute and can be operated at a pressure of 10 bar. This is a significant amount of water, however, this performance can be supplied with water for just over 3 minutes, even with the vehicle's otherwise respectable 7000-liter extinguishing tank. Such intensive extinguishing is relatively rare. The literature I have studied suggests extinguishing with water primarily to control the lower intensity wings of the fire, and defining indirect tactics for extinguishing the fire front. This is because in the case of a crown burn, the intensity of the line of fire is so great that cooling the biomass is virtually impossible [11] [12]. The solution is to remove unburned biomass. Biomass can be removed mechanically or by igniting a counter-fire [13] [14] [15].

What can make this special vehicle even more difficult to intervene is is its large size and weight. The Komondor exceeds the Rába R16 fire truck in both length and width, only 300 mm behind it in terms of height, and its maximum permissible total weight is almost double [8]. I have already mentioned that the main obstacle to the use of the currently used fire engines is their large size and weight, these disadvantages are also present in this vehicle. And its weight will, in my opinion, further limit the transport routes that can be chosen. Due to the length of the vehicle and its three axles, its turning circle is presumably higher than that of universal fire trucks.

Table 2. Comparison of Komondor S3 properties. Created by the Auhros.

Adventage	**Disadventage**
Large amount of water delivered	Large size
Crew of 6 persons	Heavy weight
Ground extinguisher	High price
Self defense	High ground pressure
Water cannon	Great roundabout

Volkswagen Amarok

The Volkswagen Amarok forest fire fast responsible truck is an off-road vehicle with a maximum permissible gross vehicle weight of 3080 kg, on the platform of which a Rosenbauer UHPS SKID high-pressure extinguisher has been installed. This device meets the requirements of today in my opinion, its use requires less effort compared to traditional pre-assembled firehoses. It can carry 100 liters of water and 20 liters of foaming material, and is placed in metal crates on its platform in addition to the usual regularized hand tools, and there are also two chainsaws. A novelty for firefighters is the motorized back sprayer. The equipment mounted on it is difficult to access, it is not placed in compartments in the usual way, but in aluminum crates stacked on top of each other. If a device is in the inner lower crate, all crates must be unpacked to gain access. It is lengthy, physically heavy, and there is a risk of losing the locks that secure the boxes. Without them, the equipment cannot be fixed. Unfortunately, the number of people that can be transported here is less than a full squad, only four people. A vehicle-mounted winch also contributes to its usability.

Picture 3. Volkswagen Amarok.

It could be applied more widely if the equipment attached to its plateau could be removed even under camp conditions. In this case, it would also be suitable for transporting forces or

equipment, which can be a great help, for example, when ordering a retreat. This possibility should be borne in mind only because the Firefighting tactical regulations (already mentioned 6/2016) stipulates that attention must be paid, among other things, to the rapid departure of the endangered area and if the area to be protected, industrial or other facility, the primary intervention should be to secure the occupants [2]. In my view, this terms of reference may also apply to tourists stranded in the forest. For this purpose, a vehicle "stripped down" in this way would be suitable for transporting an additional six on the platform in addition to the four people transported in the cab, even with their equipment. I did not examine the occupational safety aspects of this procedure. (In addition, it could be used for a number of other tasks in addition to extinguishing forest fires, such as rescuing the wounded. For this task, fire departments often use forestry pick-ups, if available).

A situation similar to the one described could occur in the event of an unexpected change in meteorological conditions, for example in the case of the 2012 Bugacpuszta fire, some of the vehicles and forces used there had to be abruptly withdrawn to prevent material damage and personal injury [5]. In such cases, the proper flow of information between counterparts, management, and all intervening forces is key.

Amarok can even be used to perform messenger tasks if the EDR network coverage is inadequate or units that do not have the appropriate means of communication are involved in the intervention. Due to the small size, high performance and excellent off-road capability of the vehicle, it will surely be a useful vehicle for eliminating forest and vegetation fires.

However, I consider it a problem to consider the small amount of water delivered, the performance of the nozzle, which allows only 2.5 minutes of continuous operation. Practice shows that at a flame height of 1 meter, the spread of fire can be prevented by an area of 2 meters moistened with 0.5 liters of sprayed water per square meter. This means that 100 liters of extinguishing water allows you to extinguish only 100 meters of fire front in the mentioned case. This ratio increases almost exponentially with increasing flame height, so this amount of water is not suitable for extinguishing more intense fires [16] [17]. At the same time, it is a great tool for recooling frequent burnt logs and logs during post-processing, and could be used even more efficiently with a higher extinguishing water capacity. The extinguishing water tank

can be replaced by another fire truck or a hydrant. Cannot be filled from a pre-installed water tank.

The definition of an engine is a forest fire rapid responder, as such a special fire engine. In my opinion, a vehicle with similar properties could be really effective if the first respondents could arrive by the fire with it. This would be possible if this truck were capable of carrying 6 firefighters and had off-road capability similar to the Amarok.

Table 3 - Comparison of Amarok properties. Created by the Authors.

Adventage	**Disadventage**
UHP extinguisher	Only 4 firefighters deliver
Low price	Small amount of water
Simple technically	Equipment is difficult to access
Low weight	Water intake is only possible from a hydrant
Small size	
Good off-road capability	

2. SUMMARY

The developments of the year 2020 definitely mean an advance compared to the technology of the last decades, during which the forest fire fighting ability was mostly mean Unimogs and universal fire engines.

These, while not technically the past, did not tactically create a more advantageous position than in previous decades. Firefighting continued to be carried out by firefighters arriving in heavy, large vehicles with poor off-road capability. Conventional fire hoses are difficult to move around in the field and use a lot of water, so they are not economical.

The biggest problem remained the approach to the fire. If the fire is to be approached on foot, there is a lot of wasted time, and in addition, only a small amount of water can be transported by firefighters on their backs. This favours the spread of fire. Clearly, a vehicle is needed to transport the first respondents and the necessary water in the immediate vicinity of the fire.

Komondors carrying large amounts of water and Amaroks with lighter, better off-road capability offer new tactical possibilities. We don't have any practical experience yet, so I can only form an opinion about the vehicles based on my professional experience so far.

I consider the possibilities of using the Komondor fire truck to be limited due to its weight and size. In the Hungarian Great Plain region, which is most affected by large-scale forest fires, it may not suffer from its size, but the mass on the sandy soil will certainly cause many difficulties. Its primary task may be water transport, but from this point of view, I do not feel the technological progress compared to water transport so far. The role of high-performance water cannons in extinguishing forest fires is not significant. Its mass is unreasonably large, its armor causes this, this is not necessary during forest fires either. This unusual vehicle could certainly make better use of its special abilities in other roles [18] [19].

I see the limits of Amarok in the small amount of water transported and the number of firefighters that can be transported. Nonetheless, it will certainly be a useful tool that will be of great help to firefighters intervening in off-road terrain. Mobility, and usability on poor quality roads and difficult terrain creates new tactical possibilities. The free spread of fires can be shorter if these light pick-ups are used at the right time. This type of fire truck can easily reach

those parts of the area affected by the fire that were previously only accessible by foot. Here, it is able to intervene extremely effectively with its ultra-high-pressure system, and firefighters are able to put out fires in a short time with hand tools. This means a shorter fire front, less value for damage, shorter intervention time. Not surprisingly, this type of fire truck has become widespread during wildfire interventions in the United States.

The problem of wildfires would be solved by a vehicle that would be able to transport first responders by the fire and deliver larger amounts of extinguishing water.

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