

## Possible use of mobile water fog generators for decontamination tasks

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*Recently the number of engineering rescues within fire fighting actions has increased significantly. Fire fighters have to carry out more and more action in the presence of special, dangerous materials. In a lot of cases the operation is made using special protection equipment because of the toxicological effects of the materials on human health and the environment. As a final stage of the work, full personal and equipment decontamination is needed. There are a lot of fire fighters who ask: What kind of decontamination tools and materials are needed and how to carry out these tasks? The authors of this article are trying to answer the questions mentioned above.*

### Introduction

In the past after the rescue actions, the operational equipment was washed simply with water, (in case of “Trelleborg” protection suit the SCBA<sup>1</sup> with the mask were also washed) than as the best solution it was put into a polyethylene bag and sent to decontamination and checking center. Some of the problems were solved by the establishment of engineering rescue bases, but also new questions were emerged.

IPE<sup>2</sup>-s providing full body protection, special airproof, plastic salvage ware, (we can collect polluted IPE-s, tools after the action in them), emergency decon tents, pumps that are suitable to suck liquid dangerous materials, chem-proof hoses and many other special equipment have been taken into the so called “Chemical accident relief containers”.

An electric high-pressure washing apparatus has been packed to spray out liquid decontamination material. According to our opinion, this equipment is not the best for decontamination tasks in every case, because it has to be established within the polluted area because of its short work-hose. The other problem is the electric supply, because a generator or a lengthening cable is required which makes the task even more complicated.

<sup>1</sup> SCBA – Self Contained Breathing Apparatus, sometimes referred to as a Compressed Air Breathing Apparatus (CABA) or simply Breathing Apparatus (BA)

<sup>2</sup> IPE – Individual Protective Equipment

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As we all know, the decontamination task depends on:

- the type of the pollution material,
- the quantity of the pollution material,
- the concentration of the pollution material,
- the type of the decontamination agent and the medium,
- the available decontamination agents and equipment.

Taking all these parameters into consideration, we have found that a water fog apparatus with combustion engine is the best equipment for decontamination tasks in large scale. The most important demand is the adjustable pump pressure, because in some cases relatively low pressure is needed for the decontamination in comparison with the “normal fog generating” working mode. A special blast-pipe to release the decon solution and a hose to suck the liquid decontamination agent with an adjustable mixer are also necessary.

The official post of one of this article’s authors from the Fire Department of Győr has won as a prize in open competition a water fog generator with combustion engine type of IFEX UNIJET-FOG from the National Directorate General for Disaster Management which has been packed into a Mitsubishi Pajero L-200 vehicle. The equipment has been changed a lot so dispose over these abilities which are improved special application possibilities, so it is able to extinguish with water – and foam - fog and also drain and spray out decontamination solution.

The pump can be used between 10 and 210 bars. Its extinguishing lance with three watering nozzle is able to fit different decontamination tasks. Thanks to the different nozzles it can be formed to a lot of optical patterns. The water pump user chooses the form of the water bolt by turning the tappet on the handle to the right or left. There are possibilities to choose a circle form with 0°, a disc form with 25° or a special low pressure “CHEM” water bolt especially for decontamination. The extinguishing lance is connected to the pump by a high pressure hose, in this case of a 30 meters long, which can be additionally lengthened to fit actual needs.

In base position with low pressure the extinguishing lance gives a 2–3 meters “bound” optical pattern, in high pressure mode it gives 2–3 meters wide “spread” optical pattern, so decontamination solution can be spread out easily to polluted surfaces. The equipment can suck up the decontamination agent throw its pipe from an external source, than the amount for mixing with water from its water tank can be adjusted manually with a special mixing valve. It is also possible to operate it just from external sources. Two people are needed as a crew.

In the following part, we show some decontamination agents available on the market, which are useable in operations in the presence of dangerous materials. We

would like to highlight and suggest for use from them some decontamination microemulsion substances, as the most suitable solution to meet the requirements of the modern era and the environmental protection.

### Microemulsion for chemical decontamination

One of the best suitable decontamination material for modern requirements and needs is the TDE 202 produced by the Company of KÄRCHER, which is a two components agent forming from the liquid TDE 202LC and the powder TDE 202PC. This material produces its decontamination effect by mixing these two components.

The TDE 202PC is a solid state material, which contains the water soluble content active part (active chlorine), which is very effective against the dangerous materials. Further more it has got non-soluble solid particles (talc-powder), which has got a great role in the decontamination process by breaking-down the intoxicant drops on the surface, resulting surface increase and this way speeding up the reaction. Combining the TDE 202PC with the TDE 202LC makes a special form of emulsion the so called decontamination microemulsion. This emulsion is very useful for decontamination of various toxic chemicals and biological materials in wide temperature range.

By using the TDE 202 we can get a very effective decontamination emulsion well sticking on the surface. The emulsion is not freezing, doesn't run at down from the surface, so it is effective against different type of intoxicants diffused into porous surfaces (for example to decontaminate vertical walls). Using the components of this decontamination emulsion means a relatively low load for the environment. The emulsion using the TDE 202 mix design is stable at least for a 48 hours period, which is a definitive advantage during the application. Using of the prepared decontamination emulsion doesn't need difficult surface preparations; it can be carried up to the surface easily with different tools and ways. The prepared decontamination solution has a pH of 8.5.

#### *Chemical ingredients:*

Components of TDE 202PC: Sodium dichloro-isocyanuric acid,  $(C_3Cl_2N_3O_3)Na$ /  
Talc-powder  
Calcium chloride 2-hydrate/ $CaCl_2 \cdot 2H_2O$ /  
Sodium chloride/ $NaCl$ /

Components of TDE 202 LC: Xylene/ $C_6H_4(CH_3)_2$ /Marlowet (mavefor) emulsifier

#### *Summarizing advantages of microemulsions:*

- thermodynamically stable;
- forming spontaneously;
- surface-tension is small between the phases;

- using them in lot of cases we can substitute organic solvents for water tenside solution, which makes the process safer and probably cheaper;
- expand on oil and water surfaces also;
- dynamic system;
- they make materials soluble, that can originally soluble only in water or in oil.

Using microemulsions during the decontamination is giving a chance to accomplish the process even in wintertime, because the comparatively high concentration of the emulsifier causes definitive freezing point depression.

*Different decontamination mixture formulations:*

<p><b>Kärcher TDE202</b></p> <ul style="list-style-type: none"> <li>• 76.0% of water</li> <li>• 12.0% of TDE202LC (solution containing xylene and anionic tenzide)</li> <li>• 12.0% of TDE202PC (powder mixture containing talc-powder, Fichlor and sodium chloride)</li> </ul>	<p><b>CAD</b></p> <ul style="list-style-type: none"> <li>• 91.4% of water</li> <li>• 5.0% sodium dichloro-isocianuric acid (Fichlor)</li> <li>• 2.5% sodium hydroxide</li> <li>• 1.0% borax (disodium tetraborate)</li> <li>• 0.1% dodecylbenzene sodium sulfonate</li> </ul>
<p><b>Mikroemulsion (SDS5T)</b></p> <ul style="list-style-type: none"> <li>• 70.7% of water</li> <li>• 9.5% sodium dodecylsulfate (SDS)</li> <li>• 8.4% butanol</li> <li>• 4.4% toluene</li> <li>• 4.6% sodium dichloro-isocianuric acid (Fichlor)</li> <li>• 1.9% borax (disodium tetraborate)</li> <li>• 0.5% iodobenzoic-acid (IBA)</li> </ul>	<p><b>Cristanini BX24</b></p> <ul style="list-style-type: none"> <li>• 88.0% of water</li> <li>• 12.0% BX24 (powder mixture containing talc-powder and Fichlor)</li> </ul>

*Other agents, solutions suitable for decontamination:*

- Hot, water with detergent;
- Boric acid;
- Sodium hydrogen carbonate;
- Strong oxidizing agents (e.g. water solution of sodium hypochlorite or hydrogen peroxide);
- Organic solvents (alcohols, acetone, toluene, carbon tetrachloride, esters).

There are ready-for-use decontamination solutions available on the market, these are the followings:

- Alcoholic cold cleaners: to remove organic surface pollutions;
- “Bioversal”: to remove oil spots, biological pollutions;
- Ammonia solution: to decontaminate nerve agents, to neutralize acids;
- Sodium carbonate: to neutralize acids, usable in infuser equipment, additive in radiological decontamination;

- Calcium hypochlorite (water solution): useful decontaminant in wide range against inorganic and organic toxic compounds, even against nerve agents (pesticides).

It could be seen previously, that a wide range of possibilities and materials are existing to decontaminate almost everything on the accident site. However, sometimes it has to choose the agents, the equipment and the applications very carefully, because some dangerous materials can have fatal health effects to the human body in a very short period of time. So there are a few simple rules we should never break:

- If the danger is not known correctly, just expect the worst! So use full level IPEs with SCBAs and decontaminate everything carefully!
- If you do not have the required knowledge against the actual dangerous material, never improvise, but ask an expert!
- If personal protective gears had severely polluted with harmful materials that the full decontamination can not be solved on the scene, these tools have to be collected in a lockup vessel, than have to carry to a remote decontamination facility.

### Summary

In the past, it was the opportunity to carry out decontamination tasks with the units of the Hungarian Defense Forces and Civil Protection in many cases, respectively studying their decontamination and disinfection equipment. It has been established, that mainly the old tools are still in use (manual decontamination pumps, sprayers). It was no modern apparatuses similar to the mobile water fog generators suitable to accomplish special tasks.

It is appearing from the foregoing, that the type of UNIJET FOG apparatus excellently fits to tasks just mentioned, and what's more, the apparatus is able to give 2–3 meter wide floor, bound optical pattern thanks to the changeable pressure and the special extinguishing lance, so the decontamination and disinfection solutions can easily reach the polluted surfaces during the most various situations, areas. In most cases the carrier vehicle shouldn't go to the polluted area, thanks to the 100 meter long enlargeable hose, so the apparatus shouldn't be decontaminated, only the hose with the extinguishing lance. If the continuous supply with the decontamination material is solved, (which can supported also from external sources), apparatus could continuously work for hours, by this means the task could be accomplished in a very fast and effective way, not to mention the original fire extinguishing capabilities.

In some areas, where the risk of flooding is especially high, (Győr is also part of this category) after the flooding fire-fighters have been asked a lot of times to accomplish disinfection tasks. These tasks can be executed with this apparatus in a very effective way.

These cheap, easy-to-operate, mobile machineries would give an excellent device against other serious problems, such as the menace of bird flu, disinfection tasks in any areas of farming, bird beating and other large various terrains. In case of suddenly emerging infections, they can be easily settled as disinfection units at the borders or on temporarily established controlling points. Decontaminations of tires and chassis of a vehicle can be done within 2 minutes with these machineries. As our hope we were able to attract attention to the extraordinary advantages of these machineries, and sooner or later decision makers will vote for their testing or the establishing in large quantities.

### References

- GRÓSZ ZOLTÁN: *Az ABV védelem alapjai*, Zrínyi Egyetemi Kiadó Budapest, 2003. (Basics of CBRN defense.)
- KUTI RAJMUND: *A vízköddel oltás gyakorlati lehetőségeinek elemzése, különös tekintettel a mobil vízköddel oltó berendezésekre*, Dr Balogh Imre Emlékpályázat, BM OKF, 2005. (Analysis of practical possibilities of fire extinction using water fog with special emphasize on mobile water fog fire extinguishers.)
- ZÁKÁNY PÉTER: *A vegyimentesítés fejlődése a mentesítő anyagok és eszközök korszerűsödése tükrében a 60-as évektől napjainkig*, egyetemi szakdolgozat, ZMNE, 2005. (Evolution of NBC decontamination from the 60's till present time in the fame of the improvement of decontamination materials and equipment.)