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## **TRANSPORT OF DRINKING WATER IN CASE OF EMERGENCY SUPPLY OF INHABITANTS**

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**Abstract:** *This article focuses on planning and realizing of supply by drinking water in case of emergency supply of inhabitants. It also deals with some specific technical means which can be used for transport of drinking water as well as for supply inhabitants in specific conditions of emergency situation.*

**Key words:** *transport, emergency situation, emergency supply, drinking water, supply.*

### **INTRODUCTION**

There are only few substances on which life of majority living organisms is based on and it is water. Most people say that there is large amount of water on the Earth (71 % of Earth surface is created by salt water, which is in fact 97% of water existing on the Earth). The quantity of fresh water is very low, it is approximately 3% of total volume of water on the Earth (69% of fresh water is stored in glaciers, 30% is stored in underground and only 1% is the surface water and water stored in atmosphere).

Generally we can say that water is essential for human life. The water has several functions in our lives (biological, health protection, economical, cultural, social, political, martial and finally strategic).

It is very important to realize that water became strategic raw material in this century.

Different factors caused deficiency or waste of quality of water. The governmental administration is obligatory in case of emergency situation to provide emergency supply to inhabitants who suffer because of water shortage. The key factor in emergency supply is the transport of fresh water into stricken areas.

### **1. FACTORS RESPONSIBLE FOR DEFICIENCY IN AMOUNT AND QUALITY OF WATER**

Health and in fact the question of surviving is dependent on sufficient quantity of drinking water.

The fresh water with certain amount of minerals and vitamins is essential for non-problem functioning of human body. The water is responsible mainly for exchange of substances in body as well as for regulation of body temperature.

The basic requirement for use of water is its excellent hygienic conditions.

Water which is used for human consumption we can characterize as perfect fresh water in natural or modified state which can be used for drinking, cooking or different home purposes. The source of water and its transport should have no effect on quality or taste of water. Such water can be also used in food-processing industry in production, processing, conservation or in case of sale of products designed to human consumption.

The amount of water which is essential for human body is approximately 2,5 – 3,00 litres of water per day.

The thing is that approximately 1,2 billion people in the world do not have access to fresh, drinkable water and in addition to that approximately 3 millions of people die every year because of illnesses caused by contaminated water and lack of sanitation. Assuming the mentioned facts it is clearly visible that sufficient amount of fresh water is worldwide problem. The worldwide deficiency of fresh water is caused by many factors. The most important are:

- ◆ unequal distribution of fresh water sources;
- ◆ drought and desertification ( more than one quarter of Earth surface are extremely dry areas, and the area of deserts is enlarged by 100 000 km<sup>2</sup> every year);
- ◆ enlargement of polluted or contaminate water sources (increase of industry production, artificial fertilizers used in agriculture);
- ◆ wasteful usage of drinking water (using of drinking water instead of utility water);
- ◆ increase in world population (approximately 6,6 billions people live on the Earth);
- ◆ concentration of inhabitants in metropolitan areas (number of inhabitants in year 2005 are stated in Table n. 1);
- ◆ climatic changes (global warming).

Table n.1

Name of metropolitan area	Country	Approximate number of inhabitants
Tokio-Jokohama-Kawasaki-Čiba (Great Tokio)	Japan	36 510 000
Mexiko-Nezahualc6volt-Ecatepec-Naucalpan (Great Mexiko)	Mexico	22 790 000
New York-Newark-Paterson (Metropolitan area New York)	USA	22 310 000
Soul-Incheon-Bucheon-Govang-Seongnam-Suweon (Metropolitan area of capital city)	Korean Republic	21 740 000
Mumbai (Bombaj-Navi Mumbai-Kalvan-Thane-Ulhasnagar, Maharashtra (Brihanmumbai/Great Mumbai)	India	19 470 000

[Source: [http://sk.wikipedia.org/wiki/Najv%C3%A4%C4%8D%C5%A1ie\\_mesto](http://sk.wikipedia.org/wiki/Najv%C3%A4%C4%8D%C5%A1ie_mesto)]

The other factors which cause the decrease in amount of fresh water sources are different emergency situations caused by natural disasters or accidents (floods, earthquakes, tsunami, oil duct accidents, oil tanker accidents, etc.) For instance floods in Great Britain (July 2007) caused that approximately 350 000 inhabitants

had shortage of drinkable water. In fact there is also possibility of willful destroy of drinkable water sources by terrorists.

In case of drinkable water shortage it is needed to provide emergency supply of drinkable water to inhabitants.

## 2. TRANSPORT OF WATER IN CASE OF EMERGENCY SUPPLY TO INHABITANTS

In case when inhabitants have shortage of suitable drinking water because of emergency situation emergency water supply must be provided. Transport of drinking water should be provided by emergency supply and there are basically two ways:

- ◆ mass (supply of more than 50 inhabitants);
- ◆ individual (supply of less than 50 inhabitants).

As the emergency water supply it is meant to provide temporary minimal amount of water (5-15 litres per one person) to inhabitants located in stricken area. The emergency water supply can be characterized as the method of water supplying in case of crisis situation when existing supply system is completely or particularly functionless.

In case of emergency water supply the supply is provided:

- ◆ from public water-supply system (undamaged water-supply systems or their parts and their possible temporary connection);
- ◆ from unaffected wells;
- ◆ transport of drinking water using water tanker which is attached on lorry, water tanker trailer, container tanker extension;
- ◆ transport of packed drinking.

The realization of water transport demand high requirements on management of all related activities. In case of emergency transport it is important to consider following factors:

- ◆ regulations of water consumption (depend on individual situation);
- ◆ form of water supply and according to the form also to choose proper technical means as well as transport means
- ◆ regime of drinking water management;
- ◆ to inform inhabitants how is the drinking water distributed.

The management of water transport distribution (it does not matter which form of transport and distribution is chosen) to

inhabitants in stricken areas deals also with following aspects:

- ◆ where, to whom and when to distribute drinking water;
- ◆ the quantity of distributed water;
- ◆ who will provide water, or who will modify water to proper quality (agency, place of provision and modification);
- ◆ who provide water transport to given place;
- ◆ path of transport;
- ◆ given places of distribution and their possible alternatives;
- ◆ protection of distribution places (eventually transport vehicles) so that the quality of water will not change;
- ◆ sophisticated using of means for storage, transport and distribution of water.

Other factors which can influence the selection of the proper and optimal water supply form in case of emergency situation are following:

- ◆ type of emergency situation and its time duration;
- ◆ number of stricken inhabitants;
- ◆ weather conditions;
- ◆ hydrological conditions;
- ◆ scale of contamination of water sources;
- ◆ time of contamination of water sources;
- ◆ quantity and quality of means for provision, modification, transport and storage of water;
- ◆ state of transport infrastructure and its suitability for transport.

As the key element in process of emergency water supply we consider to be tanker trucks. It is transport mean most widely used in case of emergency situation. Some of the basic characteristics of tanker trucks are stated in table n.2. These trucks are designed for safe transport (partly also for storing) of drinking water into areas which were stricken by emergency situation (for example in case of floods in Great Britain in July 2007 more than 1000 distribution places were supplied thanks to the tanker vehicles). For effective usage of tanker vehicles we should consider following factors:

- ◆ to use the possible biggest volume of tanker vehicle so that transport will be effective;
- ◆ vehicle with good driving characteristics so that transport in difficult terrain is possible;
- ◆ to use only tanker vehicles which are designed for transport of drinking water (milk, beer etc.).

Table n. 2

Chosen technical data	Man NCS 7	CKV 7	CAV 11
Nominal volume (l)	5 800	7000	11000
Power of pump (l.min <sup>-1</sup> )	80	200	520/630
Total weight (kg)	11 990	21500	22400
Standby weight (kg)	5 990	13950	11460
Effective weight (kg)	6 000	7350	10940

Vehicle Man NCS 7 has laminated extension, which creates one-chamber tank for water. Filling of tank can be done from upper side of vehicle through the hood or by separate pump.

Vehicle CAV-11 is designed for drinking water transport especially in difficult terrain and on roads. Tanker extension is attached on carriage TATRA 815 - 2 P 13, which has complementary gear.

Tanker container CKV-7 has box construction with edge connection parameters ISO 1C which can be attached to vehicle TATRA T815. It is designed for transport, supply, storage, drawing and distribution of water in difficult terrain and extreme climatic conditions. It is typical by its excellent isothermal properties, which enables its proper function in extreme climatic conditions (temperature range from -40°C up to +50°C) Storage and excellent quality of water are guaranteed for 72 hours.

In case of using packing drinking water (in plastic bottles and containers with volume from 0,25 l up to 15 l) in case of emergency situation the amount of distributed water depends mainly on:

- ◆ volume of bottle or container;
- ◆ shape and dimensions of load surface;
- ◆ effective weight of lorry;
- ◆ driving characteristics of vehicle in difficult terrain.

Mentioned bottles should be loaded on suitable operating units, on wooden pallets EURO with dimensions 1200 x 800 mm (in 4 layers with height approximately 1,4 - 1,6 metres).

In case of using plastic bottles and containers for emergency water supply it is important to realize that manipulation with bottles with higher volume is more difficult, but bottles with lower volume are increasing total number of used packs.

As the best solution based on comparison of all packing types, amount of water stored and weight of palette are following manipulation units:

◆ 5 litres bottles (number of bottles 160, total volume 800 l of water and total weight of palette 843 kg)

◆ 2 litres bottles (number of bottles 384, total volume 768 l of water and total weight of palette 827 kg).

As the most suitable vehicle for transport of packing water, which is attached to palettes we consider vehicle T-815 because of its effective weight and excellent driving characteristics which enable transport of water also in difficult terrain. It is possible to load 13 palettes of 2 litres bottles with total volume of drinking water 9 984 litres or 14 palettes of 5 litres bottles with total volume of drinking water 11 200 l.

### 3. CONCLUSION

The transport of fresh water in case of emergency situation is very important task. The question of quantity and used transport mean lies on shoulders of governmental administration together with supplying company which usually distributes drinking water. The realization of water transport in case of emergency situation is complicated and the final solution depends on many factors. On the other hand we should not

forget that the supply of drinking water to stricken areas should be provided not only for inhabitants but also for people who take a part in rescuing teams.

### BIBLIOGRAPHY

[1] SEIDL, Miloslav: Logistická podpora riešenia krízových situácií. In: *Sborník z 8.konferencie s mezinárodní účastí „Externí poskytování logistických služeb“*. Pardubice: Institut Jana Pernera, o.p.s., 2007, s. 165-171, ISBN 80-86530-35-3

[2] TOMEK, Miroslav, SEIDL, Miloslav: Zásobovanie obyvateľstva pitnou vodou v krízových situáciách. In: *Zborník zo 6.vedeckej konferencie s medzinárodnou účasťou (2.časť) Riešenie krízových situácií v špecifickom prostredí*. Žilina: FŠI ŽU, 2001, s. 193-198, ISBN 80-88829-64-X

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### REVIEWER

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## ТРАНСПОРТ НА ПИТЕЙНА ВОДА ЗА СНАБДЯВАНЕ НА НАСЕЛЕНИЕТО В КРИТИЧНИ СИТУАЦИИ

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**РЕПУБЛИКА СЛОВАКИЯ**

**Резюме:** Тази статия насочва вниманието към планиране и осъществяване на доставката на питейна вода на за населението в критични ситуации. Разглеждат се също някои специфични технически средства, които могат да бъдат използвани за превозване на питейна вода, както и за снабдяване на населението при специфичните условия на критично ситуация.

**Ключови думи:** транспорт, критична ситуация, питейна вода, снабдяване.