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WATER SUPPLY OF THE HUNGARIAN DEFENCE FORCES, WITH A SPECIAL REGARD TO WATER PURIFICATION

Doctoral (PhD) Thesis

THESIS BOOKLET

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The water treatment company was established on the 1st of September, 2004 in Szentes, subordinated to the Ferenc Rákóczi II. Engineer Brigade No. 37 of the Hungarian Defence Forces (hereinafter referred to as: "HDF"), in order to fulfil an offer for the NATO (North Atlantic Treaty Organisation). As the commander of the company who founded the company, I had been the head of activities of the subunit until the summer of 2011, which has achieved full mobilizability under my control. The commissioning of new technical devices of the waterpurification company and the introduction of technologies necessary for their application took place in a period when almost all the other areas of HDF could be characterized by layoffs.

Water supply - and within this, water purification - covers a very wide area, the full examination of which I could not undertake due to its scale and complexity. Therefore during the preparation of my dissertation I observed the human water needs, such as the amount of the necessary drinking water and amount of water necessary for food preparation, healthcare, sanitation and washing activities. I paid a special attention to factors influencing the amount of potable water. From among the water purification devices, I only examined the technical tool of the waterpurification company and the high-performance camp water purification station - as the main subject of my work.

Hypotheses and formulation of the scientific problem

The drinking water supply rules, formulated in the 1960's have already become obsolete. As a result of climate change currently taking place, the weather of our country has become more extreme, resulting in an increasing effect of external factors on the tendencies of the necessary quantities of water. The determination of new standards necessitates a careful assessment of the interaction between external conditions and the water need of human body. Due to the large-scale increase of the population size and industrial production, a great majority of naturally occurring water sources is not suitable for human consumption without purification. The high-performance camp water purificationt station, systemized in 2004 into the asset base of HDF as a prototype, is able to produce drinking water by the purification of natural waters. The equipment representing the top of mobile water purification has arrived into an outdated regulatory environment, in which the main question was how it is able to exploit the maximum potential of this instrument under the existing conditions.

I started the research to solve the outlined problems by the below hypotheses:

- The water supply regulation of the HDF is obsolete and not compatible with the current

organizational and management structure; it is necessary to introduce new regulations.

- The observation of daily practice of water supply points out areas to be improved.
- The organisation of water supply tasks highlights areas to be re-regulated.
- The military regulations determining the amount of the necessary drinking water do not take into account the changed environment resulting from global warming.
- It is possible to determine new water quantity standards based on the careful examination of water needs necessary for the operation of the human body, furthermore, the external factors influencing them.
- The quality standards applied in the water supply of HDF do not take into account the features of operational application, thus in the current situation, soldiers either receive drinking water that is excellent from all aspects, or they do not receive anything.
- The capabilities of the organisation executing the monitoring of drinking water quality are limited only to the controlling of tools applied during peacetime.
- The comparison of the tool system necessary for the implementation of a well-organized operational water supply and the existing controlling capacity shows the capabilities of the current organisation.
- The possession of one of the latest mobile water purification equipments itself does not guarantee the production of drinking water in the required quality.
- By relying on the results of practical tests built on the daily training sessions of the water purification company, it is possible to determine conditions necessary for the optimal operation of the water purification equipment.

Research objectives

Based on my hypotheses, I set out the achievement of the below objectives for myself as a goal:

- to determine the water needs that can be associated with the functioning of the human body,
- to present the external factors that influence the water needs of the human body,
- to show the regulators valid in the water supply of HDF,
- to prepare an overview of water supply tasks and the possibilities of their grouping,

- to present the characteristics of the operational water supply,
- to assess the demand for tools in case of a well-organized water supply,
- to assess the type and size of the asset base available to the water supply of HDF,
- to determine the factors influencing the effectiveness of operation of the high-performance camp water purification station.

Research methods

It is possible to provide well-founded answers to the above questions exclusively based on a comprehensive research work that covers all details and handles the Hungarian Defence Forces as a single unit. For this purpose:

- I read and processed the standard literature on the topic;
- I read and processed the documents determining the water supply of HDF;
- I participated and obtained experience in domestic and international exercises (NATO exercises related to the NRF offers of the water treatment company);
- I collected updated information on the daily practice of HDF's water supply during personal discussions with the heads and battalion commanders of the Leading Bodies of HDF's Total Armed Forces Headquarters (hereinafter referred to as: HDF TAFH);
- I conducted experiments based on the training of the water treatment company;
- I carried out the analysis and synthesis of the acquired data set.

Brief description of the tests performed

In the *first chapter* I performed an analysis of the place and role of water purification and water supply in the execution of military operations, through historical examples. I found that the careful organisation and implementation of water supply - particularly in case of water-poor areas with a hot climate - may be of key importance from the aspect of an effective operation.

In the *second chapter*, based on the studying of the available documentation I introduced the physiological role of water in the human body. As the starting point of water supply, I determined the two basic functions of water fulfilled in the human body: the metabolic and heat regulation role. Thereafter, I presented the factors influencing drinking water needs, the air temperature, the radiated heat, the humidity, the air mobility, the physical activity and their

effects. I compared the most frequently applied methods for determining the environmental heat loads, then I made a proposal for the utilization of the calculated value of the apparent temperature for the planning of water supply of HDF. For the evaluation of the found apparent temperature values I determined the categories of environmental heat stress.

In the *third chapter* I prepared an overview of water supply tasks from soldier level to military department level, by grouping these tasks also according to the different operational levels. In the task system determined by me it is a novelty that I have introduced the task of further management of the purchased water, furthermore, I took into account the task of individual storage, too.

In order to illustrate the water quantities necessary in water supply and the number of applied technical tools, I prepared a large-scale calculation of drinking water needs of a military department, and the device and time requirement of water supply. Although the presented tool system is only a result of a theoretical draft, I took the currently applied quantitative standards as the basis for its determination, thus it is able to properly illustrate the size of asset base necessary for an adequate water supply. It is instructive to compare the amount of assets deemed necessary by me for a military department, with the amount currently available for the whole HDF.

In the *fourth chapter* I examined the water supply of HDF. I introduced the quantitative and qualitative standards regulating water supply, the technical devices applied in water supply, the Public health- epidemiological service exercising the monitoring of water supply within the HDF by official power and the daily practice characterizing the water supply of HDF. I found that the regulation system of water supply of HDF is obsolete, and Government Decree No. 201/2001 - determining quality standards on a national level - does not take into account the features of operational application of HDF. The systemized technical devices - with the exception of personal equipment - comply with the requirements imposed on them. I found serious deficiencies in the legal basis of the operation of the Public health-epidemiological service of HDF, still, the Service is able to fulfil the monitoring of peacetime water supply of HDF effectively, at a good level; however, it is not able to fulfil the increased needs occurring during the operational application concerning HDF as a whole. In daily practice, the available water transport equipment is used for the drinking water supply of soldiers in boot camps only very rarely, and instead of this, they are provided with bottled mineral water as “protective drink”. As the individual flask is practically useless, the soldiers try to resolve the storage of drinking water received for personal consumption, by non

systemized means, the flasks and drink backpacks of armies of other nations. Based on the result of my tests, I formulated the need for the preparation of a new water supply instruction, in which - in contrast with the practice applied so far - I propose to regulate not only the water quantities necessary for the implementation of the various tasks, but also the water quantities to be consumed, in a way that in my view the direct commander (at squadron commander level) should be made responsible for the water consumption. Based on the environmental heat load I determined the water supply categories to be applied, the rules applicable to stock formation and the position responsible for the determination of the specifically applicable category. I made a proposal for the amendment of Government Decree No. 201/2001 in connection with the operational application of the HDF. I pointed out that from the costs spent to the standard on the protective drinks - which are, in my view, mostly unnecessary - it would be possible to purchase individual water storage equipment necessary for the soldiers. Finally I made a proposal for the establishment of an operational laboratory supporting the direct hygienic control of water supply, and the related two-tier control system (operational laboratory - background laboratory).

In the *fifth chapter*, as the main chapter of my thesis I described in detail the operation of the high-performance camp water treatment station, together with the technical and technological experience of the past period. Based on my experience gained from the application of equipment and installations and operations implemented for testing purposes, I continuously pointed out areas that require development or transformation, then I determined critical points occurring during the operation of the water treatment equipment, the risks occurring at these points and the regulations necessary for their elimination. I developed the most optimal application method of the operator staff, which enables the continuous operation of the water purification equipment under the relevant regulations. I introduced a differentiated system of requirements dependent on the fulfilled position, in order to train the staff of sections in a more efficient way, and to make it possible to plan the training, I created a training program necessary for the specialized training of the water purification company. In order to achieve an efficient application of water treatment sections, I determined the application costs of water purification equipment per section.

Summary of conclusions

Water is our second most important lifeblood after the air. It has a determining role in the functioning of the human body. It ensures that the metabolic processes can take place, furthermore, by its thermoregulatory role it keeps body temperature at a nearly constant level.

The interaction of environmental heat load and physical activity has the greatest impact on water needs. Therefore, in order to be able to determine the exact water quantities necessary in water supply we have to know the extent of external factors having an impact on the body, for the determination of which I find the determination of the apparent temperature as the most effective one. Based on the determined apparent heat, it is sufficient to set three heat load categories to adapt to environmental conditions.

The currently valid water quantity standards practically do not take into consideration the changes in external conditions, the environmental heat load or the physical stress. By contrast, in the future we have to achieve that **soldiers drink potable water consciously, independently of the occurrence of thirst, proportionate to loss of water but in a quantity exceeding it.**

Water supply is a task based on the coordinated cooperation of multiple disciplines, the successful implementation of which is not possible without an appropriate written regulatory environment. Despite this, the water supply of HDF is regulated by an instruction that dates back to 1964. Similar is the case also with the regulation of operator training related to water treatment devices applied in water supply; however, the backlog here does not exceed a decade.

Based on the above, it is an inevitable task to prepare a new water supply instruction in which, besides the areas of responsibility related to the partial tasks of water supply, detailed prescriptions should be included on the required drinking water soldiers **SHOULD BRING** with themselves to the different training tasks and military operations, and from this the **QUANTITY** of water they should consume - depending on the environmental conditions - and the **FREQUENCY OF CONSUMPTION**. Section leaders should be made responsible for ensuring that the subordinated soldiers really consume the determined water quantities. In contrast with the current practice - where the heat alerts are ordered centrally, too - the power to determine a water supply category adapted to environmental circumstances, would be at the best place at the commanders of healthcare centres, as it would ensure the best the fulfilment of real needs of soldiers.

With respect to quality standards the situation is reassuring, as Government Decree No. 201/2001 does not contain any relief for the HDF. It is also the only drawback of the current regulation, as this way it is not possible to adapt to the unique circumstances of the operational application.

The characteristics of the operational water supply originate on one hand from the diverse circumstances occurring during the implementation and being quite adverse from the aspect of water supply, and, on the other hand, from the goal to be achieved. While in peacetime - besides the supply of soldiers - the main goal is to exclude adverse effects on health, the operational water supply - in a given case - has only to ensure short-term survival. In this situation the healthcare professionals performing the hygienic control of water supply have a determining role. The monitoring of the system should be carried out more frequently compared to peacetime; however, concerning the expected quality, it should be allowed to bring decisions exclusively after a careful consideration of opportunities, as in case of a lack of water, soldiers try to resolve their own water supply by their own, even by the utilization of uncontrolled water.

The requirements for drinking water quality to be applied at the Hungarian Defence Forces are determined by Government Decree No. 201/2001. (X.25.) on the quality standards and monitoring of drinking waters. Accordingly, the same rules apply to soldiers as to civilians. Therefore all prescriptions of the Regulation shall be met even under the current operational conditions. This means that if just one parameter of the controlled water, even to the slightest extent, exceeds the prescribed limit value, the use of the concerned water must be terminated. Obviously, it is not possible to resolve it under operational circumstances in every case, therefore by the amendment of Government Decree No. 201/2001 it is necessary to establish the possibility of determining the water quality standards to be met during the operational application of HDF by the head of the official body appointed for the fulfilment of public health-epidemiological tasks of HDF.

In the future an asset base larger than the current one will be necessary for the water supply of HDF during wartime, as during the development of the new water supply instruction the NATO standards and the effects of global warming shall be taken into account, as well. This necessitates quantitative norms bigger than the current ones and stocks counted for longer periods of time. The larger asset base requires a change in the control system, as well. The monitoring capacity of the Water Hygiene Laboratory of the Official Laboratory Department of the HDF does not allow the implementation of verification of this greater technical asset base. Therefore, in order to continuously ensure surveillance that is able to adapt flexibly to the operational conditions, there is a need to create an operational laboratory.

Since 2004 we have witnessed the development of a new professional culture. The waterpurification company has prepared for the professional and reliable fulfilment of its

tasks originating from its basic purpose. Thanks to the technology taken over from wastewater treatment, the high-performance camp water purification station, introduced into the system in 2004 is the water purification equipment that can be applied in the most versatile ways. In order to fully exploit its potential we have to precisely know the critical areas of the technological process, the occurring risk factors and the activities necessary for their elimination, as well. It is possible to execute the training of water purification soldiers in the most efficient way based on the differentiated system of requirements based on these knowledge and their role fulfilled in the water purification process. The current promotion system does not support the training of staff necessary for the implementation of tasks requiring special skills, this is why there is no time to apply another approach.

The fact that the update of policies and instructions does not keep up with the systemization of new technical devices, has adverse effects on the operation of the water purification station. What's more, a part of the measures adopted does not take into account the diversity and unique needs of the applied technical devices and procedures, instead it grossly simplifies.

For the cost-effective application of the waterpurification company we have to be aware of the real extent of costs related to the implementation of the various tasks, as it is possible to decide, whether the set goal is proportionate to the volume of resources necessary for its achievement, only based on this.

New scientific results

During my work it has become proven that my initial hypotheses were correct, and I was able to achieve my formulated research objectives. In doing so, I have achieved the below new scientific results:

1) I determined environmental heat load categories, based on which - compared to the climate-based differentiation that has been available so far only occasionally - it becomes possible to determine the water consumption standards much more precisely, by taking into account the existing external conditions, by which we can increase the safety of soldiers, too.
2) Based on the analysis of existing capabilities and needs, I made a proposal for the establishment of an operational laboratory, a new organisational element supporting the control of operational water supply of HDF, by which the security of operational water supply could be significantly increased.

3) Through a detailed analysis of water supply tasks I found that by the amendment of Government Decree No. 201/2001, the determination of temporary water quality standards to be met during the operational application of HDF should be transferred into the power of the head of the official body appointed for the fulfilment of public health-epidemiological tasks of HDF.
4) I presented the critical points occurring during the operation of the high-performance camp water purification station, I determined threats occurring in them and task necessary for their elimination, by taking account of which it is possible to ensure the expected quality of the produced drinking water.
5) I formulated a differentiated set of requirements in order to be able to make the training of the water treatment staff as efficient as possible.
6) I prepared a detailed analysis of costs related to the application of a water treatment section, by which I created the basis for a cost-efficient planning for the utilization of the water treatment company for civic purposes.

Practical use of research results

According to my selected topic, I examined the issues of potable water supply and the application of latest means of water purification. Thus the results achieved by me can be utilized primarily in connection with the modernisation of HDF's water supply and the application of the high-performance camp water purification station:

- during the revision of Water supply instructions of HDF;
- during the planning of purchasing of water supply devices of HDF;
- in the training of officers and non-commissioned officers of HDF;
- during the application of the high-performance camp water purification station and
- during the modernisation of the valid training program.

Areas requiring further research

In order to modernize water supply, a key task is to create a new water supply instruction. For this, however, there are two areas that require further research.

The careful determination of water volumes necessary for the various tasks and utilization purposes is of particular importance, as the too narrowly set norms may adversely effect the

operational capabilities of the HDF, whilst the unnecessarily generous standards cause significant extra financial load on the military budget.

A thorough examination is needed to determine the minimum water quality limit values to be met under operational circumstances, too; as a result of which it is advisable to determine prescriptions valid for the various operational situations depending on the consumption time.

List of publications of the author

[1] PADÁNYI JÓZSEF – KÁLLAI ERNŐ, *Új víztisztító berendezés a Magyar Honvédségben*, Haditechnika 2005. 2. március-április (50 %).

[2] PADÁNYI JÓZSEF – KÁLLAI ERNŐ, *A vízellátás új technikai berendezése*, Katonai Logisztika 2005. 2. sz. (50 %).

[3] KÁLLAI ERNŐ, *Az új rendszerű víztisztító eszközök és alegységek alkalmazásának lehetőségei és korlátai a Magyar Honvédségben*, Study for The Land Force Command, 2005, Central library of NKE, KV 532,

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[6] KÁLLAI ERNŐ*, Szemelvények a vízellátás történetéből*, Hadtudományi szemle, Online publication of ZMNE Kossuth Lajos Hadtudományi Kar tudományos, 2008. 1. sz.

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[12] KÁLLAI ERNŐ*, A Magyar Honvédség műveleti vízellátása egészségügyi ellenőrzésének aktuális kérdései,* Sereg szemle, Scientific periodical of MH ÖHP, 2010. 3. sz.

[13] KÁLLAI ERNŐ, *Utasítás a nagyteljesítményű tábori víztisztító állomás üzemeltetéséhez*, az MH ÖHP kiadványa, Székesfehérvár 2010.

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Curriculum Vitae of the author

Studies

High-school:	1983–1987, 601. sz. József Attila Ipari szakmunkásképző Intézet és Szakközépiskola, Agricultural mechanik.
College:	1996–1999, Gödöllői Agrártudományi Egyetem, Gazdaság és Társadalomtudományi Kar, TanárképzőIntézet, Engineer instructor.
Univervsity:	2005–2007 Zrínyi Miklós Nemzetvédelmi Egyetem, Bólyai János Katonai Műszaki Kar, Védelmi igazgatási szak, katasztrófavédelmi szakirány, Licensed defence administration manager.
Doctoral-school:	2007–2013, Zrínyi Miklós Nemzetvédelmi Egyetem (from 2011 Nemzeti Közszolgálati Egyetem, Hadtudományi és Honvédtisztképző Kar), Hadtudományi Doktori Iskola. Mine topic is Water supply of Hungarian Defence Forces with a special regard to water purification.

Military career

1993–1996	technical section leader as sergeant
1996–1997	earthmover platoon leader as staff sergeant
1997–2000	bridge builder platoon leader as master sergeant
2000–2001	earthmover platoon leader as second lieutenant
2001–2004	engineer technical company commander as lieutenant
2004–2011	waterpurification company commander as captain

2011–2013 deputy commander of garrison support command as major

2013– S7 chef

Foreign language

English, NATO STANAG 6001 3.3.3.3, 2006 ZMNE

German, C elementary, 2013 ORIGO

Computer knowledge

7 modul ECDL license, 2006

Other studies

Multinational forces orientation course (M5-42-A-04). NATO school Oberammergau, 2004

LOGREP user course, Strasbourg, 2006

Staff Officer's Military Terminology Course (ACT. 223.18), Budapest, 2010

Foreign experiences

EX Heroic engineer2004, Germany, 101 NLD engineer battalion, staff, liaison officer

EX Iron Sword 2005, Norway, 101 NLD engineer battalion, staff, liaison and staff officer

EX Noble Light II 2007, Germany, NRF HQ G-engineer staff, staff officer

EX Stedfast Jaw 2007, Germany, NRF HQ G-engineer staff, staff officer

HDF NSE Afghanistan 5, Afganisztán Mazar-e Sharif, Operational section, deputy chef

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