

ARSENIC IN DRINKING WATER A REAL PROBLEM IN BEKES AND CSONGRAD COUNTIES

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Abstract

The choice of topic was motivated by the fact that in the Southern Great Plain (in Bekes and Csongrad counties) drinking water dealing tank vehicles appeared in several villages. We started to wonder whether the drinking water has become so bad or it is due to the EU regulations. Therefore, we started to study the subject more intensely. In Hungary the Drinking Water Program has been started which today has not been completed yet. The Resolution No. 3686 of the European Commission C (2012) allowed a further derogation until 25th December 2012. Since 26th December 2012 the acceptable limits have been: arsenic 10 µg/l, boron 1 mg/l, 1.5 mg fluoride/l. Hungary submitted a derogation request to the European Commission according to which the Drinking Water Program will be likely achieved by 2015. The media picked up on the phenomenon with a lot of emotion and sometimes exaggerated the real situation.

Key words: arsenic content, environment, healthy drinking water, water treatment, arsenic in media

INTRODUCTION

The problem is not a new one, since the unsanitary effect of arsenic in drinking water was recognized in the 1950s and until 1993 the World Health Organization (WHO) defined its limit value as 50 micrograms per litre. In Hungary the quality of water was assessed in 1981 when it turned out that more than 400 thousand people drink water with high level of arsenic. The first program to reduce this level started in 1983 with the result that by the end of the 1990s the concentration of arsenic got decreased less than 50 micrograms almost everywhere. In the Great Hungarian Plain the water of the artesian well contains more than 50 micrograms of arsenic per litre which has been well-known for several decades. The analysis of more than 5000 samples from water showed that in some places the drinking water has an unacceptable arsenic level. These two areas are a zone of 1270 km² between the rivers Duna and Tisza and also along the former Yugoslavian-Romanian border. (Erdelyi, 1991)

MATERIAL AND MEHODS

In Hungary there had been no intervention in case of companies of non public-utility, like institutional, firm or private waterworks and single water supply systems. It meant that it was necessary to complete a new countrywide survey of suitable sensitivity. The survey, which was accomplished in 1997-98 in the framework of the National Enviromental Health Action Program (NEKAP), later expanded in some points and supervised in 1999, involved all settlements of the country.

The purpose of the program was to protect human health by defining the requirements applied for drinking water. The Hungarian government knew even before joining the EU that the policy 98/83/EK of the European Council would have to be translated into the national regulations sooner or later. The first relating document is the governmental regulation 201/2001. (X.25) which included the quality requirements for drinking water and the order of control. The government appointed the end of 2009 as a final deadline by that time the arsenic concentration should have been reduced under the new limit value defined by the EU. The real problem is that –due to the increase of severity- today the WHO regards 10 micrograms of arsenic at most as acceptable and the EU joined to this value, too.

In the meantime, the government applied for derogation at the European Committee. The process was thought to get accelerated by the cohesive resources but it did not advance in the desired pace. It was in November 2011 the last time that the Hungarian government sent its new application for derogation to Brussels. However, the Committee prolonged the temporary exemption until 25th December, 2012, from this time on the regulations (1) have to be followed, otherwise Brussels would fine Hungary for 100.000 euros per day in the future. It succeeded only partly, the new deadline is the end of 2015.

The arsenic pollution involves the region of the Southern Plain in the most severe way, but it gives plenty to think about for the water suppliers in some other places of the country, too. As this pollution is of geological origin, the problem of this nature exists exclusively where the local waterworks work from the water basis of deep boring wells. In several places the present amount of arsenic is five times more than the limit value permitted by the EU. (2).

RESULTS AND DISCUSSION

The unsanitary effect of arsenic in drinking water and the relating individual and social damages

We are trying to find out what effect the arsenic in drinking water can have on the human organism and the environment. Surprisingly much information can be found about it.

First of all, what is the arsenic? The arsenic is a metalloid which belongs to the nitrogen-group (the 5th group of the periodic table) together with phosphorus, antimony and bismuth. The arsenic is a steel-grey, metallic of a light, crystalline, flavourless, inodorous and toxic substance which can be found mainly in the rocks of the earth's crust (0,1-20 mg/kg) and in the soil, prevailing in the deeper aquifers of the soil from which it gets into the drinking water. The arsenic of natural type can be found in Hungary (in the Carpathian-basin) in the world's third largest area, but the environment can be polluted with arsenic as a result of human activities (like mining; refuse dumps; melting of metals; carbon; oil; burning waste materials; pesticides with arsenic) (4).

It is severely poisonous in bigger doses that are why it is called the kings' poison or the king of poisons. Its organic compounds are relatively less toxic (though in different degrees), but its inorganic salts can be lethal even in a relatively small concentration (5). The arsenic is the history's best-known poison, even Napoleon is thought to die from it (6).

The arsenic can get into the human organism in three ways: from the air, and with the consumption of foods and drinking water. The arsenic concentration in the air is small, except for areas where the arsenic gets into the air space in higher concentration by an industrial activity and then breathing it in it can cause lung cancer. It can be taken into the organism by food consumption, depending on the eating habits, in a greater amount with foods of sea origin. Almost every food contains arsenic in smaller quantities. According to the EFSA database European consumers take inorganic arsenic with corn products, coffee, beer, rice and rice-based products, together with fish and vegetables. However, in Hungary the consumption of salt-water fish is low, according to the data of Országos Élelmezés és Táplálkozástudományi Intézet intake of arsenic is not more than 20 micrograms per person. It should be seriously considered that certain products of baby food contain more arsenic which is a potential source of danger in early babyhood.

Naturally, the arsenic is taken into our organism with the consumed food that is why it is so important to reduce the arsenic concentration of drinking water as much as possible.

The amount of arsenic which got into the organism with the drinking water can result in the acceptable level of 10 micrograms/l of arsenic concentration at most, assuming consumption of 2 litres of water per day. This value would not mean health risk in our country.

It is not enough if we drink cleaned water or mineral water instead of tap water with arsenic concentration over the limit value. It should not be used for cooking either because the arsenic concentration may increase while boiling the water (7).

The arsenic intoxication can appear as environmental damage, too. If the intoxication forms in a longer period of time, it is called chronic arsenism. In this case the complaints are milder. The first symptoms appear on the skin. First, lighter then darker plaques appear on the skin, mainly on the limbs. This syndrome is also called „black leg” disease because of the black ulcerous wounds formed on the legs. The lesion of the skin on the whole surface of the body is called „raindrop plaques”.

The symptoms of chronic arsenic intoxication can be seen in great number and forms in areas where the population is under the necessity of the consumption of drinking water with high arsenic level. Today, it can be experienced in Bangladesh, for example, where its concentration in the drinking water is very high.

In other areas where the arsenic concentration in the water is milder, the chronic arsenism causes long-term fatigability and weakness. Accumulating in the corneum, the arsenic causes skin dryness, increased pigmentation. Also, increased hair loss and typical stripes appear in the nails. That is why we should pay attention to this phenomenon in our country, too.

The arsenic intoxication often causes lack of appetite and alternation of diarrhoea and constipation.

The high arsenic concentration of the drinking water needs a special attention due to its future effects both on our environment and our health. The arsenic exposure experienced and suffered prevalingly in the earliest stage of life, in the embryonic phase can provoke stillbirth or premature birth. The breast-fed baby is protected from the arsenic intake, but later the baby food (especially the rice-based ones) is regarded as one of the possible sources of the arsenic intake. Also, in the childhood the food and water intake related to the body weight is higher than in the adulthood which increases the risk of arsenic exposure. In the growing constitution it is mainly the brain and nervous system which are sensitive to the arsenic the potential effects of which can be experienced much later, perhaps in the adulthood. Further on it degenerates the liver and the bones, weakens the immune system, and a certain nerve damage or paralysis can develop.

The risk, however, is relative. 30% of malignant tumours and cardiovascular diseases is caused by smoking. 51% of deceases is caused by

the cardiovascular diseases, while 22% by malignant tumours in Hungary which means that smoking is the main factor in the death of the fifth of the population. As compared to it, the problem with the arsenic seems to be insignificant. The solution and management of this problem will give enough to do for experts in water conservancy, so it can be experienced that their activity is very useful in this field (8).

It is also proved that these effects are intensified by malnutrition so the arsenic exposure in drinking water can be especially dangerous for families with bad social background.

All in all, we can state that today consumption of drinking water containing arsenic means a significant health issue for the population: illnesses, expenses of medical treatments and hospital treatment, reduction of income due to failing to go to work.

The impairment of the individual's health makes the damage in the society important, and as the rise of malignant tumours is significant, the authorities have to examine the quality of our drinking water, since the social security system spends huge sums of money on the treatment of the rising number of malignant tumours.

We think that the urgent call of the EU is not exaggerated at all because our country has been given days, years of grace in several times to reduce or put a stop to the arsenic level in drinking water.

Today the Government tries to solve this problem by using drinking water dealing tank vehicles or by distributing water in bags. The Ministry of Defence will soon treat the arsenic with a device for water purification developed by HM EI Zrt. and with mobile containers which replace the present situation. There are fairly different opinions about these solutions. Some say that they are very useful and timely, while others think them overhasty and wasteful.

The question is here: what technologies are known which are used to purify waters with arsenic. To find the final solution to the problem we studied the specialist literature. A lot of methods are known to purify the water from the arsenic. To choose the best technology it is essential to know the forms of arsenic that the water has, so firstly it is necessary to specify the physical and chemical forms of the arsenic found in the water to be purified.

It can be said in general that removal of the arsenate is a technologically acceptable solution. The primary reason for it is the molecule with arsenate-charge which can easily join to the surface of other particles while it is not typical for the neutral arsenite.

The present technologies to remove arsenic from water can be divided into three big groups:

- traditional technologies (coagulation, removal of ferro-manganese, emolition with lime)
- processes of sorption (activated aluminium-, and ferro(III)-oxide)
- membrane technologies (reversed osmosis which removes each component from the water, and nano-filtration, micro- or ultra filtration, though before them coagulation should be completed).

Removal of arsenic is with a traditional method (together with the removal of ferric and manganese). As the above the limit value arsenic level of the crude water from wells appears together with high level of ferric and manganese, removal of the pollutants can be accomplished with the traditional method, the removal of ferric and manganese. To remove flakes of arsenic content closed, under-pressured speed filters are applied.

The technological process of complex works to remove ferric-arsenic has the following typical steps: crude water with arsenic => pre-air insufflation => oxidation with chemicals => (coagulation with ferro-chloride) => speed filtration => water without arsenic content (9).

The typical efficiency to remove arsenic of these devices is 75-90% which can be increased even to 98% with an optimization process (10).

It is not necessarily justified to apply the latest top-technology (eg. the efficiency of the membrane technology, which is more expensive than the traditional method, can be ensured by the traditional, optimized process, too).

There are dozens of technologies to remove arsenic, however, the government intends to involve the national industry and experts, and also it desires to keep the financial profit of these investments in Hungary. To achieve these aims one of the military firms of the Ministry of Defence, the HM EI Zrt. started to realize a new technology to remove arsenic from water in 2008. The technology has been finished, and it is over the first pilot plant besides the official permission.

A sensational invention should be mentioned here which is connected to a Hungarian inventor, Laszlo Schremmer. He found out that a side-product of milling-industry, the chaff is suitable to filter the arsenic from the water, in addition to a number of other dissolved pollutants. He sold half of his idea to the HM EI Zrt in 2008, then in 2010 the other half of the patent rights of his invention. A serious business opportunity was seen in the device which can reach the same result in a much cheaper way than the other methods. The laboratory tests proved that the arsenic content of the water filtered through the suitably pre-treated chaff was reduced by 90% to the level of hardly 2 microgramme/litre, to the fifth of the limit values prescribed by the EU. What is more, it lessens the quantity of ferric, manganese and ammonia, which cause a lot of problems in several places,

in a similar proportion. The experimentally formed material of chaff-base for filtration was named ASR-10 (11).

However, the traditional technology is used even in the containers for water treatment (oxidation with chemicals, supply of ferro-chloride, adsorption of the oxidated, filtration, sludge treatment). Oxidation and adsorption of the arsenic is realized with the addition of chemicals, separation of flakes, precipitate with adsorbed arsenic is carried out in the filter. The filter is washed back between periods of filtration, the sludge with ferric and manganese of arsenic content is dewatered in the net-filter.



Figure 1 System of water treatment in a container

Source: http://www.innoteka.hu/cikk/konteneres_vizkezelo_rendszer_fejlesztese.588.html 2018.09.28.
(20)

It is advisable that the households themselves try to filter the tapwater with arsenic content used for cooking. However, it turned out from the survey executed in the framework of ArzenStop program that 86% of the inhabitants living in the settlements involved do not use any device for water purification. Almost one third of them think wrongly that removal of the arsenic content can be done with a very expensive device at home. Although, there is an arsenic-filtrating pitcher developed purposely for the removal of arsenic (12).

The invention of American researchers shows that it is possible to protect ourselves from the arsenic with a certain extent. For example: with the consumption of food supplements of folic acid or animal fats which helps our constitution to protect itself from the arsenic.

Opinions related to the arsenic

The arsenic became one of the top-topics picked up by the media then quickly it disappeared from the covers. The basis of the phenomenon was the reduction of the limit value regulated by the EU because of which much more settlements found themselves on the list of the endangered ones. Anyway, it is absolutely unimportant to apply for derogation from the point

of view that in Eperjes one of the wells gives water of 100 microgramme/litre while the other 150 microgramme/litre. The solution in case of Eperjes would be if its water networks were connected to the neighbouring Gadoros which is actually the end of the water networks of Oroshaza.” (16) However, it should not be forgotten that it is not a phenomenon which rises and then disappears quickly. The emotional overheat is not rare: in Bekes county two settlements – Oroshaza and Szarvas – are especially infamous for the high arsenic level in the drinking water. The water in Oroshaza tastes so bad that it is not fit to drink. I experienced it several times visiting my grandmother.” (14) „The acceptable arsenic level in drinking water has been reduced from 50 microgramme to 10 microgramme, so the Christmas Day was started with worries in lots of settlements.

The change involves primarily the regions of the Southern and Northern Plain but there are settlements scattered everywhere in the country where the water contains too much from this poisonous compound. There are some bigger cities in the list, too, like Bekescsaba, Gyula, Kecskemet, Oroshaza or Szeged, but the smaller settlements have to face with the biggest problem as a result of this modification.” (15) „Altogether 364 settlements, 1.362.445 inhabitants. In addition, in case of more 85 settlements, not listed in the „application for derogation” of September, there is an objection because of the arsenic level. That is how we get the extremely high number: 1.511.132.” (17)

The list of derogation includes 35 settlements in Bekes county (Medgyesegyhaza and Bankut are listed separately), altogether 107 421 persons are concerned, out of which all of the 35 are listed because of arsenic and 5 because of boron (Totkomlos, Kondoros, Bucsa, Kerteszsziget, Ecsegfalva). In case of fluoride there is no settlement involved in Bekes county. There is no settlement in Bekes county which are not concerned with arsenic (Elek).” (18)

The 1379/2012. (IX. 20.) Government decision on the measures is necessary for assuring the healthy drinking water. Acceleration of the Program to Improve Drinking Water is justified by both sides of petitioners and the authorities. The Ministry of Defence has been authorized to assure temporary water supply with its means in settlements where there is no other solution realized. The quality of drinking water has to be regularly completed and the inhabitants have to be informed about it.

CONCLUSIONS

It seems that the financial side causes the greatest problem here, too. Who has to pay the expenses? It has always been the state, the town councils task to supply the inhabitants with water, to build and improve the networks. In our region two waterworks: the Mako-Tersegi Víziközmű Kft-t

and the Alföldviz Zrt. are concerned the most. The organizations of the Government supervised the Program to Improve the Quality of Drinking Water in the Southern Plain (Del- Alföldi Ivovizminoseg Javito program), which was set up to comply with the serious drinking water parameters prescribed by the EU. The investment will be carried out by the union of the town councils in the small region, while the operation will be performed by the local waterworks.

However, we had no answer to the question of what degree of increase in water-rate the expenses of the water purification may generate in our settlement. Although, we have found some rough calculations in studies of other settlements according to which the water purification causes a significant increase in the water-rate.

The main problem is the expenses of investment which generate a dramatic increase in the water-rate. The Western technologies applied so far (there are a number of technical processes) are extremely expensive. In places where the program to improve the drinking water quality has been realized, the inhabitants could experience an increase of 120-150% in water-rate which resulted in their dissatisfaction (13). However, the development executed for the expected limit values has not only one-time investment expenses but the operational expenses will increase, too. It is especially true for the traditional technology. The amount of chemicals used to remove arsenic does not increase linearly with the reduction of the level of the expected concentration. At the end of the technology there is the arsenic side-product (eg. sludge with arsenic content) the expenses of storage and elimination of which are not negligible.

We can conclude that people should be more aware of their environment, they should not pollute the waters because the pollutants getting into our constitution can cause diseases or even epidemics. Purification of both temporary and final water is very expensive.

Thus, the problem is given, it has to be solved. It is very important that the local town councils have to execute the prescribed removal of arsenic. In our study we mentioned alternative technologies which can solve the present situation with different expenses. Otherwise, more settlements try to build a new well filtered in depth from which the arsenic level of the water is under the limit value.

Finally, we can underline that the drinking water with arsenic content will cause a significant health problem in Hungary, too, and the EU regulations emphasise the urgent solution thus helping the protection of our health.

It is not easy to find the answer to our question: Has the quality of our drinking water become so low or is the appearance of water dealing tank vehicles due to the EU regulations? It is a fact that as an effect of the recent

news a lot of people ask themselves whether they dare to drink or to give their family drink from the tap-water. Nevertheless, the Association of Hungarian Waterworks (Magyar Víziközmű Szövetség) says that „the quality of the water neither has become worse, nor will be worse”.

The toxic and damaging effect of the arsenic has been known for ages. With the improvement of professional and scientific knowledge related to the arsenic new evidences to prove its health damaging effect can be found that is why the level of acceptability (limit value) of the arsenic concentration in drinking water has been modified, the earlier limit value has been seriously reduced.

Our final conclusion is that the human health is the most important value so everybody – the town councils responsible for water supply, waterworks- has to join their forces so that the inhabitants can be provided with healthy drinking water under the limit value in the framework of the regional programs to improve water quality under the supervision of the Government institutions. It is essential to inform the inhabitants about it all correctly and regularly.

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