Review Articles

PROVIDING CLEAN AND SAFE WATER IN THE ARAL SEA REGION BY USING WATER PURIFICATION EQUIPMENT PRODUCED IN THE CZECH REPUBLIC: KARAKALPAKSTAN REPUBLIC, UZBEKISTAN

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Abstract

The main reason for the worsening environmental situation in the Aral Sea is the shortage of water resources and the worsening quality of the water in the rivers feeding it. This is due to agricultural irrigation and the run-off sewage and agricultural drainage waters. The Aral Sea, once the fourth largest lake in the world has shrunk by more than 75% since 1960, because of the irrational use of water resources during the Soviet period. The two rivers which feed the Aral Sea were diverted to agricultural projects after 1960s and the drying-out of the Aral Sea has resulted in the growing concentration of chemical pesticides and natural salts. These substances are then blown from the increasingly exposed lake and contribute to increase the desertification. Other problems have also appeared while the level of water in the Aral Sea has been decreasing: fish resources and the number of wild animals are being lost, soil degradation and water salinization has been increased and the local climate has changed – all the mentioned have influenced the increasing health problems in the Aral Sea region. Total dissolved salts in water (TDS) in the Aral Sea regions range from 0, 4 grams to 4–6 grams per liter (g/l), which is higher than the international standard for water mineral content for human consumption (1.5 g/l). The situation is dramatic in local hospitals and schools due to the poor water treatment technology even in the major cities of the region. The irregular use of soil and water resources has heavily affected the economy and ecology of the country. The actual problem is to provide clean water to the people in the regions in the Aral Sea area who now have highly polluted and salty water. The main aim of this work is to develop a small water treatment infrastructure and the improvement of the water management systems by providing a safe water supply in the regions with high water salinity in the Aral Sea area. In recent years various types of water treatment technologies have been conducting by different water treatment companies in order to find the best technology to use in this area. Water purification processes are also operated with chosen water purification technologies where the tap water does not meet the required standards at the Republic's children TB sanatorium in Nukus city, the capital of the Republic of Karakalpakstan, Uzbekistan. The water purification technologies can reduce the soluble substances in the water from 800–1400 mg/l to 400 mg/l which makes the water more potable for children in the sanatorium.

Key words: Aral Sea, purification of water, soil degradation, water cleaning treatment, water analyses

INTRODUCTION

The Aral Sea between Uzbekistan and Kazakhstan, to the east of the Caspian Sea, used to be the fourth largest lake in the world in 1960s. The Aral Sea area was about 68 000 sq. km in 1960 but had been reduced to 26 687 sq. km by 2003. The two rivers feeding it, the Amu Darya and Syr Darya were diverted to irrigate cotton crops in Central Asia during the Soviet period. Between 1962 and 1991 the level of the Aral Sea fell by 16 m. The mean water level was 53 m in 1960s. Just 40–45 years ago it was more than 400 km long and almost 325 km wide. The Sea has receded up to 120 km from its original shoreline, and has shrunk to 2/3 its original capacity. Land that used to be under water is now exposed to the air, and wind blows surface minerals for miles. The minerals in the water are more concentrated and the salt content (salinity) has increased from cca 1–2 g/l to cca 30–35 g/l, killing most fish and wildlife. For decades many countries have been affected by the desertification of the Aral Sea and the massive decline in the inflow to the Aral Sea which has created a myriad of social, economic, and environmental problems. The problems with fresh water and especially, drinking water are a major concern in the Aral Sea re-

gion, where desiccation of the Aral Sea has become an ecological catastrophe. The reduction of the quality of drinking water is not only due to the inaccessibility and poor quality of water from natural sources, but also due to the poor water treatment technologies in the majority of the towns in the Aral Region. For instance, the tap water in the Republic's Tuberculoses sanatorium in Nukus city which is used for drinking does not meet EU drinking water standards and most at risk in this situation are groups of weak people who have low immunity – especially children. The salt content of the tap water is about cca 800–1400 mg/l which is more than EU drinkable water standards (500 mg/l) and this reduces the effects of the treatment of child patients in the sanatorium. For this reason the sanatorium was chosen for carrying out the water purification processes. Advanced water purification technologies and implementing Czech know-how for water treatment process in the sanatorium helped to decrease the tap water salt content from 1400 mg/l to 400 mg/l and had a very positive effect on the young patients during the rehabilitation period.

MATERIALS AND METHODS

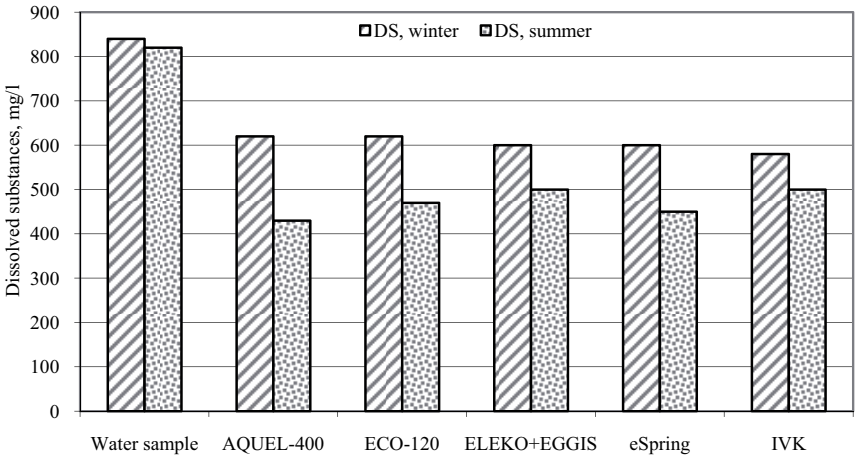
The Initial condition in the Children Anti-tuberculosis Sanatorium in the Nukus city, Karakalpakstan

The sanatorium is a tuberculosis treatment hospital and is inhabited by 250 to 300 children during the winter and summer periods respectively. The water taken for analyses from the city water taps had a high salt and other mineral content. The salt content in the tap water was cca 800–1400 mg/l which is worse than the required EU standards (EU standard is maximum 500 mg/l and minimum 400 mg/l for child patients during the rehabilitation period). For this reason the drinkable water has a high risk for children in the sanatorium who have low immunity during their rehabilitation period. The research is based on the experience of water purification in the Aral Sea area through the project results of "Improvement of the quality of drinking and irrigational water in the Aral Sea area by cleaning equipment and filters produced in the Czech Republic". As mentioned above, the water samples taken which are being used for drinking are unsafe and are harmful for the health of children in the sanatorium and the groundwater salinity was also higher then in other places in Karakalpakstan. The sanatorium focuses on the medical treatment of children who are suffering from tuberculosis and for this reason it was chosen for the project realization. During the water purification process in the sanatorium the quality of the water and the maintenance costs of the water treatments were taken into account at every stage.

Gathering samples and results

The water samples taken from the city supply water tap were tested in both the summer and winter periods using different types of water purification technologies. Using different types of water purification technologies provided the opportunity to find out the best equipment for the local conditions (Figure 1). The main water characteristics in the research were as follows: magnesium (Mg), calcium (Ca), chlorides, sulphates, dissolved substances, pH, temperature and conductivity. One of the most important characteristics for the water treatment

Figure 1: Water sample – Nukus, water test results of the Children anti-TB sanatorium



technologies is the content of soluble substances. On the basis of these results the most suitable water purification equipment: Reverse Osmosis AQUEL 400, ECO-120 and IVK (Uzbek product) was chosen for the further water purification processes in the sanatorium. These water purification technologies reduce soluble substances in the water from 850 mg/l to 400 mg/l by cleaning the microbes and other water damage, which made the water more potable for the local people and children in the sanatorium.

Water purification process in the sanatorium

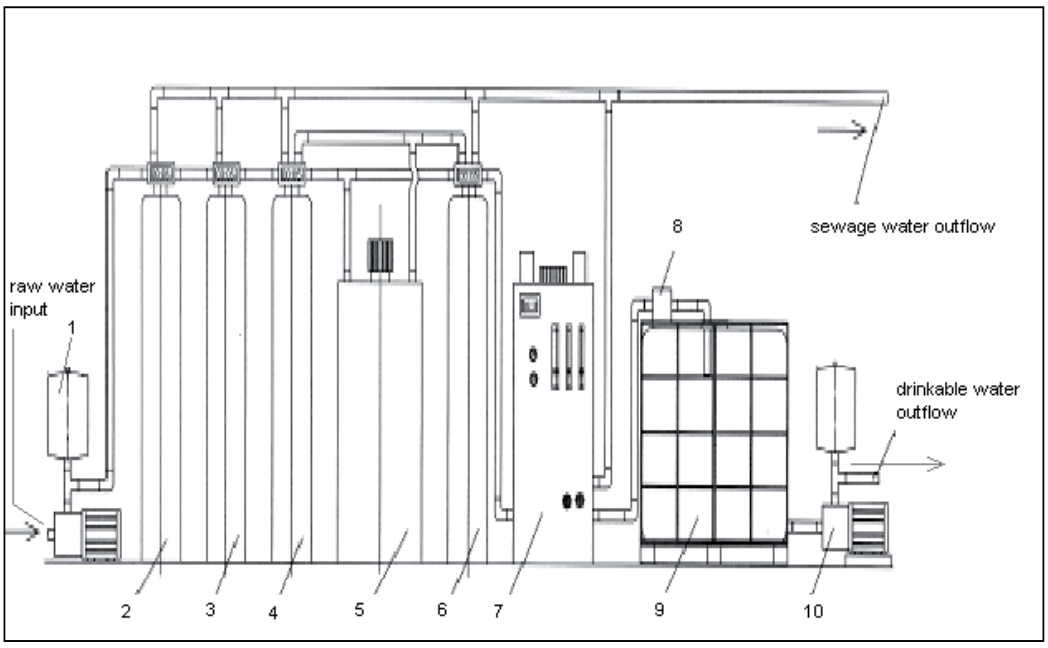
The observed results (Figure 1) show the different water purification technologies are used in the sanatorium. During the water purification process, in the first, the water was cleaned of sand and other damage with a carbon – sand filter then passed through the water softeners to the main purification equipment – Reverse Osmosis which was equipped with different water treatment regulators. These water treatment regulators were set to reduce the salt content of water to 400 mg/l. A salt content lower then 400 mg/l will not answer the required standards either. After all the operations the purified water will be gathered in to the water tank which has capacity of 2 m^3 and from there will be distributed by pumps to the water tap of the sanatorium (Figure 2).

RESULTS AND DISCUSSION

During the water testing and laboratory analyses the optimal water treatment method and equipment to use in the Aral Sea area was found. According to the local conditions the most effective Czech devices were implemented with Uzbek products: AQUEL 400, ECO-120 and IVK system (Uzbek product). These water treatments purify water in accordance with local conditions. The suspended solids were removed by different type of mechanical filters then the water was softened and disinfected with water treatments which made the water potable for children in the sanatorium. The water hardness was decreased with the Uzbek product (IVK filter) which makes the water softer then the other filters. The main water purification process (decreasing dissolved substances and salt) was carried out by a Reverse Osmosis system. In some conditions, when Reverse Osmosis decreased the content of useful minerals, re-mineralization of the purified water was undertaken before supplying it to the children in the sanatorium. As mentioned above,

Figure 2: The scheme of water purification in the Nukus TB sanatorium

1 = Pump with a pressure vessel for the supply of raw water; 2–3 = Carbon-sand filter body; 4 = Body of water softeners; 5 = Container for the preparation of regenerative saline solution for water softeners with stirrers; 6 = Water softener body; 7 = Reverse osmosis; 8 = Disinfector of water; 9 = Retention tank IBC – volume of 1000 L; 10 = Pump with a pressure vessel for the distribution of purified and treated water



the water purification treatments decrease the dissolved substances from 800–1400 mg/l to 400 mg/l and the IVK system controls softness and minerals in the purified water in the sanatorium. Czech water purification technologies and know-how are comparable with advanced countries and in some parameters (minimizing personnel requirements, Czech know-how and supply at a reasonable price) is ahead of its competitors.

CONCLUSION

Access to drinkable water significantly decreases the migration and poverty of people in the Aral Sea region. The Czech water Reverse Osmosis purification technologies (AQUEL 400), ECO-120 and the Uzbek product (IVK) fully meet the local water purification requirements and standards. As we know, water quality can not be defined by only one parameter. But, thanks to the advanced water purification technologies the water management systems, hygienic and sanitary knowledge of local people have improved in the Nukus sanatorium. Additionally, water purification technologies have had a very positive influence on the living conditions of the children.

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