Wastewater recycling for industrial applications using membrane technology; case study, Bandar Abbas wastewater treatment

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Introduction

The volume of water consumption in 2000 was equal to 4430 km^3, while a significant increase in water demand equivalent to 5240 km^3 y until 2025 is predicted (1). Compared to this increase in water demand, the total volume of recycled water is relatively small; approximately 5% of the wastewater is collected and treated throughout the world (1). Municipal wastewater is increasingly recognized as a valuable source of water, nutrients, and energy. It is estimated that 380 km^3 of wastewater is produced worldwide annually, which is more than 5 times the annual volume of water from Niagara Falls. The large investment required to manage the human water cycle can be easily recovered by benefiting from the recycling of treated water (2). Water reclamation for industries is mostly done due to a lack of local water resources, either due to limited water resources or intense competition for energy supply. The ratio of industrial water to total water demand in developed and developing countries is 41%, and 3% respectively (3). Although industrial harvest tends to increase, it is estimated that $1.9\times10^9 m^3\ d^{-1}$ in 1995 will reach about $3.2\times10^9 m^3\ d^{-1}$ by 2025 (4-5). The regional difference in water reclamation shows that most of the projects, which are implemented in the industry, are concentrated in developed countries, where the amount of water consumption for industries is higher than in developing countries. In developing countries, there are a number of conditions that affect water reuse potential, including a lack of wastewater collection and inadequate treatment systems (5).
The purpose of compiling this article is to inform the world about the useful and effective results of recycling 100% of the wastewater of a city in Iran and turning it into industrial water to preserve the environment and achieve economic benefits.

Materials and methods

Bandar Abbas is a coastal city, where due to the high level of underground water, there is significant penetration of salty underground water into the sewage collection network. These conditions have caused disturbances in the wastewater treatment operation, and therefore the treated wastewater of Bandar Abbas city is not effective for the usual use of treated wastewater. For this reason, a mega project was planned, designed, and implemented to convert this poor-quality wastewater into valuable recycled water. This Megaproject is located in Bandar Abbas (BA); the south of Iran (fig.1), where a dense cluster of various industries such as oil and gas refineries, aluminum and steel production, and shipbuilding are located.

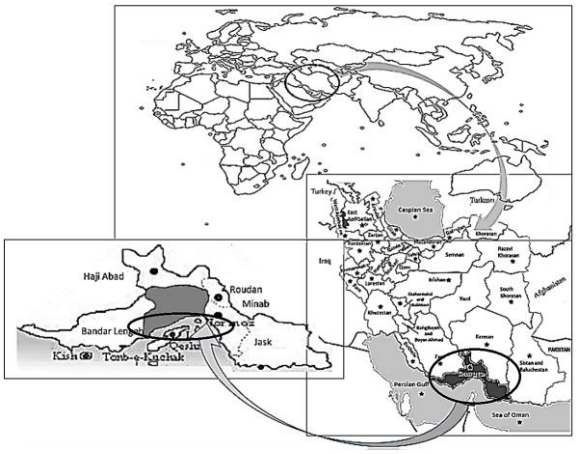

Figure 1. The location of the industrial water recycling project from the urban sewage in the south of Iran.

Construction of operation and process units based on a reverse osmosis desalination process, side structures and buildings, and electrical, mechanical, and precision equipment. During the implementation of this mega project, the facilities are being built as follows:

a) Reconstruction, development, and upgrading of the existing wastewater treatment plant in order to increase the capacity of the treatment plant from 64,000 to 100,000 m^3/d in Bandar Abbas city.

b) An 85,000 m^3/d capacity desalination plant with an (85% recovery) in BA city.

c) A 10,000 m^3 tank and a pumping station to store and transfer reclaimed water in BA city.

d) 22 km long reclaimed water transmission line with 900 mm diameter steel pipe.

e) 40,000 m^3 storage tank to store recycled water in the Persian Gulf Special Economic Zone.

f) 21 km long water distribution network to distribute reclaimed water in the industrial special zone of the Persian Gulf.

Results and concluding remarks

water reclamation opportunities should be identified and cost-effectiveness optimized with the participation of stakeholders through the development of synergies and the exploration of production opportunities. This project, which was accompanied by the participation of the industry sector and the Water and Wastewater Company of Hormozgan province, as well as the local authorities, was one of the important indicators that can show the role of inter-sectoral cooperation in the success of such projects. As the development of wastewater reclamation and reuse of wastewater can lead to many environmental and economic benefits, such as reducing water scarcity, reducing pollution emissions, improving soil quality, and saving production costs; therefore the project aimed to achieve the following goals; (a) Solving the environmental challenge of Bandar Abbas city, (B) Sanitizing the ecosystem of the shores of the Persian Gulf, and (C) Creating a single structure for 85,000 m^3/d sustainable water supply for industries in West BA. While the total cost of each cubic meter of purified water (of seawater origin) is about 1 to 1.1 USD, and transfer costs are also added to this cost, however, the total cost of one cubic meter of purified water is equal to 0.55 USD. This means that in some projects, in addition to environmental benefits and preserving water resources, rich economic benefits can also be achieved through the reuse of wastewater.

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