REVERSE OSMOSIS AS A SOLUTION FOR WATER SHORTAGE IN IRAN

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ABSTRACT

Iran with a large area (1648000 sq. km) and high population (around 70 millions) suffers from lack of water resources especially in central and southern parts. Large increases in water demand with very little recharge have strained Iran's ground water resources resulting in serious decline in water level and quality. In southern provinces, drinking water with a TDS of 4000 to 5000 ppm is consumed. Even this low quality water is not available as much as the people need. In addition to drinking water, a high volume of water is used by other consumers including various industries.

The domestic and industrial wastewater may be used as resources for producing water. This is scientifically possible using appropriate technologies such as membrane processes. The produced water is a great resource for industrial and agricultural applications. This strategy minimizes the water crisis. A huge amount of water is saved for drinking.

Membrane desalination technologies including reverse osmosis have been used in Iran since1977 to provide water for domestic and industrial purposes. Applications include both brackish and sea water desalination with plant size ranging less than 100 m^3/day to 10000 m^3/day with total cumulative installed capacity exceeding 100 000 m^3/day.

In this paper some of the case studies indicating application of reverse osmosis for water reuse in Iran are explained. The objective of this paper is to summarize the experience gained form operating these plants over a long time.

Keywords: Reverse osmosis, Water shortage, Iran, Reuse

INTRODUCTION

The development of new-generation membranes that can tolerate wide pH ranges, higher temperatures, and harsh chemical environments with improved water flux and solute rejection has resulted in many applications for the reverse osmosis (RO) process. Some of the applications of reverse osmosis is seawater and brackish water

desalination processes, waste water treatment, production of ultra pure water, water softening etc.

Membrane processes have obtained considerable attention for the separation and concentration of inorganic and organics from various wastewaters. RO processes for wastewater treatment have been applied to the chemical, textile, petrochemical, electrochemical, pulp and paper, and food industries as well as for the treatment of municipal wastewater.

Water reuse is an important approach for finding new resources. This strategy focuses on wastewater treatment and water cycle. Membrane filtrations in general and reverse osmosis in particular are appropriate techniques for treatment of water and wastewater.

Iran suffers from lack of water for industrial and potable purposes. Water recycles and reuse is a source for producing water from waste water. Reverse osmosis may be considered as an appropriate technique for this purpose.

RO HISTORY IN IRAN

Reverse osmosis desalination has a relatively long history in Iran. The first RO plant in Iran was established in 1977 for make-up water of boilers in Sepahan industries group. The feed water was obtained from the nearby brackish wells with a capacity of 30 m^3/day. The hollow fibers Dupont membranes were used in the plant. Considering that the industrial application of RO has been started in 1967, indicates that Iran is one of the leading countries that employed membranes for industrial applications [1].

Nowadays many plants with much higher capacity has been designed and constructed in Iran. The main applications for these plants are production of industrial and drinking water from surface, well and seawater. More industrial water is produced compare to drinking water. A large RO desalination plant with a capacity of 24,000 m^3 per day is under construction. The total capacity of water production with membrane technology in Iran is around 100,000 m^3 per day [2].

CASE STUDIES

Treatment of Boiler's waste water in Behshahr Industrial Company

In Behshahr industrial plant, the consuming water contains total dissolved solids of 350 ppm and total hardness of 250 ppm. The waste water, mainly from boilers, contains 1500 ppm of total solids and the total hardness of 100 ppm. This waste water is one of the potential sources of water for the plant. The reuse of the waste water can be considered a benefit due to the environmental limitations.

Reverse osmosis is used for waste water treatment. The specification of the system is as follows. In the first stage 80 cubic meters per hour of waste water with the total solid of 1500 ppm is processed to produce 60 cubic meter per hour of polished water with the total solid of 350 ppm and 20 cubic meter per hour of concentrated water with the total solid of 4500 ppm. In the second stage the concentrated water (20 cubic meters per hour with the total solid of 4500 ppm) is treated to produce 15 cubic meters per hour of polished water with the total solid of 350 ppm and 5 cubic meters per hour of concentrated water with the total solid of 18760 ppm. This water is conducted to the evaporation unit. The dried solid of the concentrated water is discharged. This technique results in the production of 75 cubic meters per hour of treated water from 80 cubic meters per hour of waste water. The polished water is reused in the plant.

Treatment of discharged water from paint unit in Absal Company

For reuse of waste water in paint unit in Absal Company, the discharged water from paint unit is pretreated and processed with reverse osmosis. In this process around 5 cubic meters per hour of waste water with the total solid of 2620 ppm is treated. More than 80% of the water is recycled and reused in the plant.

The water that is processed by the reverse osmosis system has a low quality. It contains iron (0.2%), zinc (4.06%), manganese (0.5%) and nickel (0.35%). This results in high fouling tendency. To clean and regenerate the fouled membranes, more chemicals are needed. This means higher capital investment. The investment may be higher than the investment needs for processing surface water. However the shortage of water is the driving force for this investment.

COD removal from waste water in Bidestan Company

Bidestan is an alcohol manufacturing company which produces wastewater containing organic materials. The Chemical Oxygen Demand (COD) of the wastewater is high (around 40000 ppm). This wastewater is treated using biological techniques. However the quality of the treated wastewater (COD around 1000 ppm) is not good enough for discharge to environment.

In a research carried out by the authors, the reverse osmosis process was employed for polishing of the biologically treated wastewater. The COD of the wastewater was reduced to lower than 100 ppm. This water has a good quality to be used in the same plant.

CONCLUSIONS

Iran such as many other countries in Asia and Africa suffers from lack of water resources especially in central and southern parts. One of the main procedures for

overcoming this problem is reuse of the consumed water. This includes domestic and industrial waste water.

Membrane technologies in general and reverse osmosis in particular are among the leading techniques employed for this purpose. Reverse osmosis has been employed in Iran since 1977, shortly after the innovation of asymmetric membranes.

Many case studies indicate that the reverse osmosis process has the capability to carry out the waste water treatment for a long period without major limitations. In some cases the use of chemicals for membrane regeneration is high due to low quality of the feed water or process failure. However the demand for recycled water is the major driving force for investment in establishing new plants or continuation of running the old plants.

REFERENCES

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