

## Evaluation of Industrial Water Demand in Bahrain

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The Kingdom of Bahrain is located in an extreme arid zone, has limited nonrenewable groundwater sources, supplemented by desalinated and the reuse of treated wastewater sources that are being used to meet the total water requirements. During the last four decades, increased socio-economic development has contributed to the widening of the gap between available supplies and demands, resulting in the depletion and quality deterioration of groundwater and increased investments in desalination and wastewater treatment facilities. The country population has increased from 0.62 million in 1998 to 1.1 million in 2008, an average growth rate of 2.9%. The total water demands have increased from 65.2 Mcm in 1952 to 335 Mcm in 2007, with an allocation of 44.2% to the municipal (148.1 Mcm), 47.7 % to the agricultural (160 Mcm) and 8.1% to the industrial sectors (27.1 Mcm). The municipal water supply system partially provides water to the industrial sector. Industrial and commercial consumption from the desalinated municipal water supply was estimated at 7.4%.

In general, there are limited information on the actual industrial water consumption according to the type of industries and their operational and productive scheme, which presents a challenge to decision makers to formulate effective water management strategy. Even though industrial water demand is relatively small and ranges between 5-7% of the total water consumption in the GCC countries, water conservation can increase water use efficiency as well as reduce industrial pollution. Demand management measures for industries that depend on domestic supply can help reduce investment in water supply system and contribute to more water availability for the domestic consumption. Thus, the objective of this research is oriented towards evaluating the past, current and future trends of industrial water consumption, and suggest demand management measures that can enhance water use efficiency in this sector. These objectives were achieved through the evaluation of different data sources to delineate the trends according to the existing water sources and the type of management measures being implemented with focus on the water tariff.

The analysis indicated that industrial water demand increased from 12.1 Mcm in 1952 with water mainly available from groundwater source and increased to 27.1 Mcm in 2007 mainly from the municipal water supply system. The number of factories increased from 19 in 1953 to 193 in 2007. By extrapolation, the demand is estimated to reach 39 Mcm in 2025. The existing industries consisted of aluminum, food, beverage, pharmaceuticals, clothing, petrochemicals, constructions and small industries with some of them having their own water supply facilities. The analysis indicated that the industrial sector has increased its reliance on municipal water supply as the consumption increased from 0.043 Mcm in 1997 to 1.44 Mcm in 2000, to 1.61 Mcm in 2008, even though the number of factories has decreased from 254 in 1997 to 193 in 2008. Water conservation measures in the industrial sector in Bahrain consists only of the introduction of industrial water tariff in 1985 for water taken from municipal water supply system; however the tariff was reduced in 1985 to encourage industrial activities. The existing two tier tariff was not effective in reducing

consumption in comparison to the actual production and operation and maintenance costs. The study indicates the introduction 1985 tariff showed an increase in the water demand.

The research revealed that there is a lack of information on the water consumption by different industries as well as absence of conservation efforts to enhance water use efficiency in the industrial sector. It is recommended to establish a data base, the implementation of financial and technical incentives for implementing demand management measures focusing on the introduction of effective water tariff, recycling of grey water, water saving technology and awareness program for those involved in the operation and management of factories.