Technical and Economical Assessment Of Pretreatment Alternative Systems Associated with RO Desalination Plant

A thesis
Submitted to the Faculty of Engineering Ain Shams University for the Fulfillment Of the Requirement of M.SC. Degree in Civil Engineering

Prepared by

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STATEMENT

This dissertation is submitted to Ain Shams University, Faculty of Engineering for the degree of M.Sc. in Civil Engineering.

The work included in this thesis was carried out by the author in the department of Public Works, Faculty of Engineering, Ain Shams University, from September 2009 to June 2014.

No part of the thesis has been submitted for a degree or a qualification at any other University or Institution.

Date: ---- / ---- / 2014

Signature: ----------

Name: MAGGY FEKRY LABIB HENRY

DEDICATION

This work takes a period of my life
There are a number of people without whom this thesis might not have been written, to whom I wish to dedicate it

To my family

To whom suffered to educate, prepare me, helped me to build my capacities and to be as I am

TO MY FATHER

To whom continued to learn, grow and develop me and who has been a
Source of encouragement and inspiration to me throughout my life, to whom easy my life

TO MY MOTHER

I wish to dedicate it finally to whom supported me, and who was a great help for finishing this thesis as I wish and hope

TO MY SISTER

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ABSTRACT

Name: Maggy Fekry Labib Henry
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Specialty: Public Works, Sanitary& Enviromental Engineering

The present work technical, economic assessment, and comparison of viable alternative pretreatment systems, which may precede RO desalination is conducted with the objective to determine the most appropriate pre-treatment alternative. All alternatives are technically viable and produce adequate water quality for RO process.

The capital cost and the operation & maintenance cost (O&M Cost) of each component are determined and compared. The determination of the capital costs as well operation and maintenance costs are adapted from the models given by Qasim [49].The Comparative Life Cycle (CLC) costing method is adopted to compare the total cost for an infinite horizon considering differ life span of the components and an applicable interest rate. The cost of different plant capacities (1,000, 5,000, 10,000 and 50,000) m3/d have been also estimated and compared up to the year 2050 using the CLC method for various alternatives.

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Keywords: Pretreatment before RO Desalination Plant, Technical and Economical Assessment of Pretreatment Alternative, Reverse Osmosis Desalination Plant, Comparative Life Cycle) costing method

SUMMARY

Water is an integral part of live and has been always mankind's most precious resource. The total volume of water on Earth is about 1.4 billion km3, 2.5 % only of the total volume is fresh water and 97.5% is salt water. By 2025, 1.8 billion people will be living in countries or regions with absolute water scarcity, and two-thirds of the world's population could be living under water stressed conditions.A study by Trieb and Muller [18] pointed out that desalination may offer a solution to overcome water shortages in the MENA region [18&19].Reverse osmosis (RO) and Nano-filtration (NF) have long been utilized for desalination, softening and contaminants removal. Both technologies are manufactured, designed and built for "salt" and dissolved ion removal and not particulate matter. Therefore, proper pretreatment plays a critical role in the performance, life expectancy and the overall operating costs of these systems. Consistent high quality pre-treatment of the feed water is one of the most important prerequisites for long-term successful operation of seawater desalination plants.

In the present work technical, economic assessment, and comparison of viable alternative pretreatment systems, which may precede RO desalination is conducted with the objective to determine the most appropriate pre-treatment alternative. All alternatives are technically viable and produce adequate water quality for RO process.

Pretreatment alternatives included units to prevent the growth of bacteria; fouling caused by suspended solids; disinfection units to disperse calcium carbonate and sulfates precipitates in order to avoid scaling; and de-chlorination units to prevent the presence of residual free chlorine. Every alternative is composed of several components. The capital cost and the operation & maintenance cost (O&M Cost) of each component are determined and compared. The determination of the capital costs as well operation and maintenance costs are adapted from the models given by Qasim [49].The Comparative Life Cycle (CLC) costing method is adopted to compare the total cost for an infinite horizon considering differ life span of the components and an applicable interest rate. The cost of different plant capacities (1,000, 5,000, 10,000 and 50,000) m3/d have been also estimated and compared up to the year 2050 using the CLC method for various alternatives.

The study revealed that the total cost of membrane filtration techniques; namely: microfiltration, ultra-filtration, or Nano-filtrations generally more expensive than conventional media filtration. Moreover, the capital cost/m3 showed that on the long term nano-filtration is the most expensive solution, while microfiltration is the least cost option even compared to conventional media filtration alternative.

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