



# **INVESTIGATION OF THE POSSIBILITY OF CONVERTING SEAWATER TO DRINKING WATER IN HAMBANTOTA AREA BY REVERSE OSMOSIS**

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## Abstract

Hambantota is a district in the southern section of the dry zone, Sri Lanka. The population density 211 per square kilometer distributed variably depending mainly of availability of water and other facilities such as electricity and domestic requirements. 4.1 % of total population live in urban areas towns). People who live in suburbs are the most affected by the non-availability of safe water for drinking and other domestic purposes. Only 33.4% of households use piped born water and 55.3% use water from wells and 6.2% use water from tube wells. It has been reported that 60% of the ground water is bad quality and according to the World Watch Institute one third of the world population will face water shortages by the year 2020. This would create a situation where there will not be enough safe water for human survival. Therefore an attempt was made to convert ground water and seawater to drinking water.

In this research, a field study was conducted in Meegahajadura, 81°00' N and 6°21' E, a small village in Suriawewa Division from the north sector of the Hambantota District. Ten ground samples were taken from ten locations, from tube wells, which were 8 km radius from Meegahajadura junction. The water samples were chemically analyzed.

The chemical properties of the ground water samples tested varied drastically due to its association with the local variations of superficial mineral deposits, lake deposits, paddy alluvium which are of variable compositions and dry soil. The number of samples tested was not adequate enough to find a geological trend of hard rock pattern. None of the samples tested were up to the permissible limit of drinking water standards outlined by SLS 614. This and SLS 894 clearly indicates the necessity for ground water treatment prior to drinking,

A feasibility analysis was conducted as a qualitative and a quantitative analysis. The research shows it is feasible to desalinate ground water in the Hambantota district to



produce drinking water by RO. It is feasible to construct a brackish water RO plant of capacity 10m<sup>3</sup> per day to produce drinking water for Meegahajadura. The unit cost of producing drinking water by a seawater RO plant reduces to about US\$ 1 (Rs 100/=) per m<sup>3</sup> per day by year 2010. It is feasible to produce 40,000 m<sup>3</sup> per day by seawater RO plant to fulfill drinking and other domestic water requirements for the Hambantota district by the year 2021.

Owing to the complex nature of predicting the operating conditions of the RO permeate water, which varies greatly on feed water quality, operating pressure, temperature, a mathematical model was formulated. The purpose of this formulation is to predict the product water conditions of various feed water having varying values of TDS.

The model makes use of the Solution Diffusion Model and it employs feed water concentration of six solutes namely: Na<sup>+</sup>, Ca<sup>2+</sup>, Mg<sup>2+</sup>, Cl<sup>-</sup>, and K<sup>+</sup>, and as a whole it comprises of 99% of seawater. It was verified experimentally using diluted seawater to predict the product flow rate and TDS, total rejection of solutes, individual concentration of 6 Solutes in the product.

This formulated model was verified by running the 75000 GPD RO plant at the university by using diluted seawater as feed water making various concentrations of solutes. Plotting the experimental data and model on the same graph at constant RO pump pressure, it was calculated the error of fit of the experimental data to the model.

The experimental observations of the product flow rate and TDS, total rejection of solutes, individual concentrations of 6 solutes in the product, the % solute rejection of individual solutes and plant recovery fit the model to an accuracy of less than 16%.

# DECLARATION

I hereby declare that this submission is my own work and that, to the best of my knowledge and behalf, it contains no material previously published or written by another person no material which, to substantial extent, has been accepted for the award of any other degree or diploma of a university or other institute of higher learning, except where an acknowledgement is made in the text.



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## PREFACE

This is the thesis of the research project done for the fulfillment of Master of Science conducted by Department of Earth Resource Engineering at University of Moratuwa. The title of the project is Conversion of Seawater to Drinking Water in the Area by Reverse Osmosis. This research is based on the chemical analysis of ground water in the study area of meegahajadura in the Hambabtota district and the feasibility of introducing a Reverse Osmosis plant to desalinate brackish ground water and seawater.

Practical constraints are discussed for the implementation of RO plant and some recommendations are given for the improvement of the pilot RO plant used in the experiments and it is followed by the mathematical model to predict the operating variables of RO plant.

In chapters 1, 2, 3, 4 and 5 contain the introduction and the literature review on the area concerned, which convince the reader the necessity of the particular issue. Chapter 6 covers the study area, field visits and techniques used and its basics. Chapter 7 concerns with the observations of the experiments in graphical form and the discussion of the results obtained. In chapter 8, it is discussed the feasibility of implementing desalination of ground water and seawater with RO in Hambantota Area as a short and long term solution for the water problem against the other methods of desalination. Moreover, the predictions and limitations of the mathematical model are discussed and suggested the ways in which this model can be improved. Finally, chapter 9 gives the conclusions and recommendations of this research.

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