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

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THIS THESIS WAS SUBMITTED TO THE DEPARTMENT OF EARTH RESOURCE ENGINEERING OF THE UNIVERSITY OF MORATUWA IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE (BY RESEARCH)

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Abstract

Habantota 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 .9ualitative and a quantitative analysis. The research shows it is feasible to desalinate ground water in the Hambantota district to

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produce drinking water by RO. It is feasible to construct a brackish water RO plant of capacity 10m3 per day to produce drinking water for Meegahajadura. The unit cost of producing drinking water by a seawater RO plant reduces to about US$ I (Rs 100/=) per m3 per day by year 20 l O. It is feasible to produce 40,000 m3 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 +, Ca2+, Mg2+, Cl, and K+, 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 o fthe 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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LIST OF CONTENTS

1. Introduction 1

1.1 Socio-economics and Availability of Water in Hambantota District..... 1

1.2 Water Distribution in Hambantota District..... 2

1.3 Problems Encountered by using Existing Resources..... 4

1.4 Desalination of Saline Water as an Option to Provide Good Quality Water..... 5

1.4.1 Overview..... 5

1.4.2 Desalination of Brackish/Saline water as an Option to Provide Good Quality Water in Hambantota..... 6

1.5 Study Objectives..... 7

1.6 Scope of the Study..... 7

2. Literature Survey: Physical features of Hambantota District Source of Ground Water Chemistry..... 9

2.1 Physical Features in Hambantota District..... 9

2.1.1 Morphology..... 9

2.1.2 Drainage..... 9

2.1.3 Climate..... 9

2.2 Geology, Weathering and Hydrology in Hambantota District..... 11

2.2.1 Geology-Crystalline Rocks..... 11

2.2.2 Geology-Superficial Deposits..... 11

2.2.3 Geology-Structure..... 11

2.2.4 Weathering..... 11

2.2.5 Hydrology..... 12

2.3 The Chemistry of ground water..... 14

University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
www.lib.mrt.ac.lk

2.4 The Effect of Geology & Climate on the Chemistry of Ground water..... 15

3. Literature Survey: Methods of Desalination..... 17

3.1 Thermal Processes..... 17
3.2 Membrane Methods..... 23
3.3 Comparison of methods of Desalination..... 24
3.4 Reverse Osmosis as the widely used Process of Desalination..... 25
3.5 Problems Encountered in operation of RO plants..... 25

4. Literature Survey: Reverse Osmosis Membranes Mathematical Models to describe..... 27

4.1 Irreversible Thermodynamic Models..... 27
4.2 Diffusion based models..... 28
4.3 Pore models..... 29
4.4 Charged Membrane Models..... 30
4.5 Introduction to Reverse Osmosis Process..... 30
4.6 Designing an RO System..... 31
4.7 Reverse Osmosis Membranes..... 35
4.8 Description of Operating Variables..... 37
4.9 Concentration Polarization..... 38

5. Literature Survey: Membrane Damage and Cleaning of Membrane..... 39

5.1 Trouble Causing Substances..... 39
5.2 Prediction of Fouling Potential..... 40
5.3 Physical –chemical Analysis of Feed Water..... 40
5.4 Pre-treatment Methods Against Membrane Fouling..... 41
5.5 Removal of Excess Chlorine..... 44

University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
www.lib.mrt.ac.lk

5.6 Cleaning of Contaminated Membranes..... 44

6. Literature Survey: Cost of Desalinated Water..... 46

6.1 Cost Comparison of Different Methods of Desalination..... 46
6.2 Factors contribute to RO become more attractive..... 47
6.3 Cost Components of RO..... 48
6.4 Components of Costs of Seawater RO..... 48
6.5 Components of Cost of Brackish water RO..... 49
6.6 Reasons for Cost Reduction of Desalination for Recent Years..... 49
6.7 Brackish Water Desalination Cost Comparison..... 52
6.8 Seawater Desalination Cost Comparison..... 52
6.9 Comparison of Cost Reduction in Time..... 53
6.10 An Example of Low Cost Seawater RO Facility..... 54

7. Material and Methods..... 55

University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
www.lib.mrt.ac.lk

7.1 Field Study..... 55
7.1.1 Selection of a Study Area to do a Case Study..... 55
7.1.2 Study Area..... 58
7.2 Ground Water Analysis..... 58
7.3 Operation of RO Plant..... 61
7.4 Formulation of Mathematical Model..... 63
7.4.1 Solution Diffusion Model with Concentration Polarization..... 65
7.4.2 Governing Equations..... 67
7.5 Finding Membrane Constant..... 69
7.5.1 Finding Solvent Permeability Constant..... 69
7.5.2 Finding Solute Permeability Constant..... 70
7.6 Verification of Model..... 72
7.7 Flow Chart of Model..... 72

8. Results and Discussion..... 73

8.1 Overview..... 73

8.2 Ground Water Analysis..... 73

8.2.1 TDS/ Conductivity/Chloride/Sodium..... 73

8.2.2 Sodium and Chloride..... 76

8.2.3 Iron and Manganese..... 77

8.2.4 Turbidity and Potassium..... 78

8.2.5 Analysis of Ca, Mg, and Total Hardness..... 79

8.2.6 Analysis of pH of Ground Water..... 80

8.2.7 Analysis of Fluoride..... 81

8.2.8 Analysis of Alkalinity..... 83

8.2.9 Analysis of Alkalinity and Total Hardness..... 84

8.2.10 Analysis of Copper, Sulphate, Chromium, Cadmium and Arsenic... 84

8.3 Economical Feasibility Analysis..... 85

8.3.1 Overview..... 85

8.3.2 Desalination with Reverse Osmosis, a Qualitative Analysis..... 85

8.3.2.1 Overview..... 85

8.3.2.2 Comparison of RO with other Desalination Technologies..... 85

8.3.3 Quantitative Analysis..... 88

8.3.3.1 Overview..... 88

8.3.3.2 Cost Calculation of Various Sources..... 88

8.3.3.2.1 Brackish Water Cost Calculation..... 88

8.3.3.2.2 Seawater Cost Calculation..... 89

8.3.3.2.3 Summary..... 90

8.3.4 A Cost Calculation Done for Operating and Maintenance Costs by Using Experimental Data..... 91

8.3.5 Recovery Calculation for Brackish Water Desalination By Experiment..... 92

University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
www.lib.mrt.ac.lk

8.3.6 Total Rejection Calculation for the Experiment..... 92
8.3.7 General Discussion of Feasibility Analysis..... 92
8.3.8 Limitations of Experiment..... 98
8.3.9 Recommendations for Improvements on the RO Plant used In the Experiment..... 99
8.4 Desalination Improvement..... 99
8.5 Adoptability of RO in Sri Lanka..... 100
8.6 Mathematical Model Verification..... 102
8.6.1 Overview..... 102
8.6.2 Prediction of Permeate Flow Rate..... 102
8.6.3 Prediction of Permeate TDS..... 104
8.6.4 Prediction of Total Solute Rejection..... 105
8.6.5 Prediction of Recovery..... 107
8.6.6 Prediction of Permeate Concentration of Ca..... 108
8.6.7 Prediction of Percentage Rejection of Ca..... 110
8.6.8 Prediction of Permeate Concentration of Mg..... 111
8.6.9 Prediction of Percentage Rejection of Mg..... 113
8.6.10 Prediction of Permeate Concentration of Na..... 114
8.6.11 Prediction of Percentage Rejection of Na..... 116
8.6.12 Prediction of Permeate Concentration of K..... 117
8.6.13 Prediction of Percentage Rejection of K..... 119
8.6.14 Prediction of Permeate Concentration of Cl..... 120
8.6.15 Prediction of Percentage Rejection of Cl..... 122
8.6.16 Prediction of Permeate Concentration of SO_4..... 123
8.6.17 Prediction of Percentage Rejection of SO4..... 125
8.7 Discussion of Predicting Operating Variables from Mathematical Model..... 126
8.7.1 Overview..... 126

University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
www.lib.mrt.ac.lk

8.7.2 Limitations of the Experiment..... 128
8.7.3 Recommendations for improvements on the RO Plant used In this Experiment..... 128
8.7.4 Further Improvement of Model..... 128

9. Conclusions..... 129

9.1 Ground Water Analysis..... 129
9.2 Economical Feasibility Analysis..... 129
9.3 Prediction of operating variables from mathematical model..... 130

References..... 131

Appendixes..... 136

University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
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LIST OF TABLES

Table 1.1 Global Desalination Capacity and the Related processes..... 6

Table 1.2 Installed Capacities of Desalination Plants in the World Categorized by Country 6

Table 3.1 Comparison of Energy Requirement of Different Desalination Technologies..... 24

Table 3.2 Comparison of Distillation & Reverse Osmosis Technologies..... 25

Table 5.1 Membrane Damaging Conditions..... 40

Table 5.2 Physical-chemical Parameters Required for Feed Water Analysis 41

Table 5.3 Some Cleaning Chemicals and Their Applications..... 45

Table 7.1 The Droughts in the Station 'Suriyawewa' 55

Table 7.2 Preservation Methods of Water Samples 58

Table 7.3 Water Analysis Techniques 59

Table 7.4 Composition of 1kg of Seawater 64

Table 7.5 Determination of Solvent Permeability Constant A..... 69

Table 7.6 Determination of Solute Permeability Constants Bi/Bj 70

Table 7.7 Calculation of Solute Permeability Constants 71

Table 7.8 Determination of Mass Transfer Coefficients 71

Table 7.9 Verification of the Model 72

Table 8.1 Potable Water Standards of Sri Lanka Standards Institution..... 74

Table 8.2 Comparison of RO with MSF 86

University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
www.lib.mrt.ac.lk

LIST OF FIGURES

Figure 2.1	Average Rainfall in Sri Lanka	10
Figure 2.2	Geological Classification of Ground Water in Sri Lank	14
Figure 3.1	Single Stage Flash Evaporation	18
Figure 3.2	Mechanical Vapour Compression (VC)	20
Figure 3.3	Four-effect Thermo Compression (VC)	21
Figure 3.4	Solar Distillation	21
Figure 3.6	Simple Reverse Osmosis Plant	23
Figure 3.7	Electro-dialysis Process	24
Figure 4.1	Reverse Osmosis Process	30
Figure 4.2	Seawater RO Typical Process Block Diagram	31
Figure 5.1	Trouble Causing Substances	39
Figure 6.1	Typical Concentration Ranges of Total Dissolve Solids (TDS) In the Feed Water for Distillation, RO, ED and EDR	46
Figure 6.2	Desalination Cost Ranges over Time	47
Figure 6.3	Cost Components of RO	48
Figure 6.4	Cost Components of Seawater RO	48
Figure 6.5	Cost Components of Brackish Water RO	49
Figure 6.6	Spiral – Wound Membrane Modules Cost Trends	50
Figure 6.7	RO Water Cost Vs Plant Capacity	51
Figure 6.8	BW Desalination Cost Comparison for 10 MGD	52
Figure 6.9	SW Desalination Cost Comparison for 10 MGD	52
Figure 6.10	Comparison of cost Reduction in Time	53
Figure 6.11	Cost Reduction Comparison	53
Figure 6.12	Tampa Bay Desalination Plant	54
Figure 7.1	Hierarchy of Water Requirement per Day	56
Figure 7.2	Map of Meegahajadura and Hambantota District	57
Figure 7.3	Parts of the RO Plant	60
Figure 7.4	Block Diagram of RO Plant Used in Experiment	59
Figure 7.5	Block Diagram of RO Plant	66
Figure 7.6	Concentration and Pressure Distribution in Solution- Diffusion Membrane	69

University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
www.lib.mrt.ac.lk

Figure 7.7 Calibration of RO Modules for A..... 70
Figure 7.8 Flow Chart of the Model..... 72
Figure 8.1 Analysis of Conductivity/TDS/Chloride/Sodium..... 75
Figure 8.2 Analysis of Sodium and Chloride..... 76
Figure 8.3 Analysis of Iron and Turbidity.....77
Figure 8.4 Analysis of Manganese and Potassium..... 78
Figure 8.5 Analysis of Ca, Mg and Total Hardness.....79
Figure 8.6 Analysis of pH of Ground water.....80
Figure 8.7 Analysis of Fluoride.....81
Figure 8.8 Analysis of Alkalinity..... 83
Figure 8.9 Analysis of Alkalinity and Total Hardness..... 83
Figure 8.10 Extrapolated graph of cost reduction intime..... 93
Figure 8.11 Permeate Flow Rate Vs Feed TDS for pressure 155 psi..... 102
Figure 8.12 Permeate Flow Rate Vs Feed TDS for pressure 150psi..... 102
Figure 8.13 ermeate Flow Rate Vs Feed TDS for pressure 145 psi..... 103
Figure 8.14 Permeate Flow Rate Vs Feed TDS for pressure 140 psi..... 103
Figure 8.15 Permeate Flow Rate Vs Feed TDS for Model at pressures
150 psi,155psi,145psi, and 140psi..... 103
Figure 8.16 Permeate TDS Vs Feed TDS for pressure 155 psi..... 104
Figure 8.17 Permeate TDS Vs Feed TDS for pressure 150 psi..... 104
Figure 8.18 Permeate TDS Vs Feed TDS for pressure 145 psi.....104
Figure 8.19 Permeate TDS Vs Feed TDS for pressure 140 psi..... 104
Figure 8.20 Permeate TDS Vs Feed TDS for Model at pressures
psi, 155psi, 145psi, and 14psi..... 105
Figure 8.21 Total Solute Rejection Vs Feed TDS for pressure 155psi..... 105
Figure 8.22 Total Solute Rejection Vs Feed TDS for pressure 150psi..... 105
Figure 8.23 Total Solute Rejection Vs Feed TDS for pressure 145psi..... 106
Figure 8.24 Total Solute Rejection Vs Feed TDS for pressure 140psi..... 106
Figure 8.25 Total Solute Rejection Vs Feed TDS for Model at 106
Figure 8.26 Recovery Vs Feed TDS for pressure 155psi..... 107
Figure 8.27 Recovery Vs Feed TDS for pressure 150psi..... 107
Figure 8.28 Recovery Vs Feed TDS for pressure 145psi..... 107
Figure 8.29 Recovery Vs Feed TDS for pressure 140psi..... 107
Figure 8.30 Recovery Vs Feed TDS for Model at pressures

University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
www.lib.mrt.ac.lk

150 psi,155psi,145psi, and 140 psi..... 108
Figure 8.31 Permeate Concentration of Ca Vs Feed Concentration of
Ca at pressure 155psi..... 108
Figure 8.32 Permeate Concentration of Ca Vs Feed Concentration of
Ca at pressure 150psi..... 108
Figure 8.33 Permeate Concentration of Ca Vs Feed Concentration of
Ca for pressure 145psi.....109
Figure 8.34 Permeate Concentration of Ca Vs Feed Concentration of
Ca for pressure 140psi.....109
Figure 8.25 Permeate Concentration of Ca Vs Feed Concentration of
Ca for Model at pressures 150 psi,155psi145psi, and 140psi ... 109
Figure 8.36 % Rejection of Ca Vs Feed Concentration of
Ca for pressure 155psi.....110
Figure 8.37 % Rejection of Ca Vs Feed Concentration of
Ca for pressure 150psi..... 110
Figure 8.38 % Rejection of Ca Vs Feed Concentration of
Ca for pressure 145psi..... 110
Figure 8.39 % Rejection of Ca Vs Feed Concentration of
Ca for pressure 140psi..... 110
Figure 8.40 % Rejection of Ca Vs Concentration of Ca for
At pressure 150psi, 155psi,145psi, and 140 psi for Model 114
Figure 8.41 Permeate Concentration of Mg Vs Feed Concentration
of Mg for pressure 155psi.....114
Figure 8.42 Permeate Concentration of Mg Vs Feed Concentration of
Mg for pressure 150psi.....114
Figure 8.43 Permeate Concentration of Mg Vs Feed Concentration of
Mg for pressure 145psi.....115
Figure 8.44 Permeate Concentration of Mg Vs Feed Concentration of
Mg for pressure 140psi.....115
Figure 8.45 Permeate Concentration of Mg Vs Feed Concentration of
Mg for Model at pressures 150 psi,155psi145psi, and 140psi ... 115
Figure 8.46 % Rejection of Mg Vs Feed Concentration of Mg for pressure
155psi..... 116
Figure 8.47 % Rejection of Mg Vs Feed Concentration of Mg for

University of Moratuwa, Sri Lanka.
Electronic Theses & Dissertations
www.lib.mrt.ac.lk

pressure 150psi.....116
Figure 8.48 % Rejection of Mg Vs Feed Concentration of Mg for pressure 145psi.....116
Figure 8.49 % Rejection of Mg Vs Feed Concentration of Mg for pressure 140psi.....116
Figure 8.50 % Rejection of Mg Vs Feed Concentration of Mg for Model at pressures 155psi, 150 psi, 145psi and 140 psi 117
Figure 8.51 Permeate Concentration of Na Vs Feed Concentration of Na for pressure 155psi.....117
Figure 8.52 Permeate Concentration of Na Vs Feed Concentration of Na for pressure 150psi.....117
Figure 8.53 Permeate Concentration of Na Vs Feed Concentration of Na for pressure 145psi..... 118
Figure 8.54 Permeate Concentration of Na Vs Feed Concentration of Na for pressure 140psi..... 118
Figure 8.55 Permeate Concentration of Na Vs Feed Concentration of Na for Model at pressures 150 psi,155psi145psi, and 140psi 118
Figure 8.56 % Rejection of Na Vs Feed Concentration of Na for pressure 155psi..... 119
Figure 8.57 % Rejection of Na Vs Feed Concentration of Na for pressure 150psi..... 119
Figure 8.58 % Rejection of Na Vs Feed Concentration of Na for pressure 145psi..... 119
Figure 8.59 % Rejection of Na Vs Feed Concentration of Na for pressure 140psi.....119
Figure 8.60 % Rejection of Na Vs Feed Concentration of Na for Model at pressures 155psi, 145psi and 140 psi 120
Figure 8.61 Permeate Concentration of K Vs Feed Concentration of K for pressure 155psi.....120
Figure 8.62 Permeate Concentration of K Vs Feed Concentration of K for pressure 150psi..... 120
Figure 8.63 Permeate Concentration of K Vs Feed Concentration of K for pressure 145psi..... 121

University of Moratuwa, Sri Lanka
Electronic Theses & Dissertations
www.lib.mrt.ac.lk

Figure 8.64 Permeate Concentration of K Vs Feed Concentration of K for pressure 140psi..... 121
Figure 8.65 Permeate Concentration of K Vs Feed Concentration of K for Model at pressures 150 psi,155psi145psi, and 140psi 121
Figure 8.66 % Rejection of K Vs Feed Concentration of K for pressure 155psi..... 122
Figure 8.67 % Rejection of K Vs Feed Concentration of K for pressure 150psi..... 122
Figure 8.68 % Rejection of K Vs Feed Concentration of K for pressure 145psi.....122
Figure 8.69 % Rejection of K Vs Feed Concentration of K for pressure 140psi..... 122
Figure 8.70 % Rejection of K Vs Feed Concentration of K for Model at pressures 155psi, 145psi and 140 psi 123
Figure 8.71 Permeate Concentration of Cl Vs Feed Concentration of Cl for pressure 155psi..... 123
Figure 8.72 Permeate Concentration of Cl Vs Feed Concentration of Cl for pressure 150psi..... 123
Figure 8.73 Permeate Concentration of Cl Vs Feed Concentration of Cl for pressure 145psi..... 124
Figure 8.74 Permeate Concentration of Cl Vs Feed Concentration of Cl, for pressure 140psi..... 124
Figure 8.75 Permeate Concentration of Cl Vs Feed Concentration of ClK for Model at pressures 150 psi,155psi145psi, and 140psi 124
Figure 8.76 % Rejection of Cl Vs Feed Concentration of Clfor pressure 155psi..... 125
Figure 8.77 % Rejection of Cl Vs Feed Concentration of Cl for pressure 150psi..... 125
Figure 8.78 % Rejection of Cl Vs Feed Concentration of Cl for pressure 145psi..... 125
Figure 8.79 % Rejection of Cl Vs Feed Concentration of Cl for pressure 140psi..... 125
Figure 8.80 % Rejection of Cl Vs Feed Concentration of Cl for Model at pressures 155psi, 145psi and 140 psi 126

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