



Cairo University

RISK MANAGEMENT OF PRODUCED WATER FROM OIL WELLS

By

Omar Sherif Tawfik Mubarak

A Thesis Submitted to the
Faculty of Engineering at Cairo University
In Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE
In
Risk Engineering

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Title of Thesis:

Risk Management of Produced Water from Oil Wells

Key Words:

Risk; Management; Produced; Water; Oil,

Summary:

The present work investigates the best produced water management techniques to be used by oil and gas operators either minimization, re-using/recycling and disposal from technical and economical point of view and provides a scheme of work between the different techniques. A risk analysis study was carried to define and evaluate different risks that can lead to spillage and leakage of produced water to surrounding environment and personnel which are Management, technical and operation risks. This study also included risk assessment for produced water treatment plant effect on Air, land and water including consequences and suggested control actions.

Disclaimer

I hereby declare that this thesis is my own original work and that no part of it has been submitted for a degree qualification at any other university or institute.

I further declare that I have appropriately acknowledged all sources used and have cited them in the references section.

Name:

Date:

Signature:

Dedication

To all my family members, Mother, father, grandparents and brother for their support during preparing this study

Special Thanks to my Wife Menattallah Elserafy for her continuous support to me

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Table of Contents

DISCLAIMER.....	I
DEDICATION	II
ACKNOWLEDGMENTS.....	III
LIST OF TABLES.....	VII
LIST OF FIGURES.....	VIII
NOMENCLATURE	IX
ABSTRACT	IX
CHAPTER 1 : INTRODUCTION	1
1.1 OVERVIEW	1
1.2 PROBLEM STATEMENT	1
1.3 RESEARCH AIM:	1
1.4 RESEARCH METHODOLOGY	2
1.5 ORGANIZATION OF THE THESIS	2
CHAPTER 2 : LITERATURE REVIEW	3
2.1 INTRODUCTION	3
2.1.1 TYPES OF PRODUCED WATER	3
2.2 HISTORY OF PRODUCED WATER.....	4
2.3 PRODUCED WATER MANAGEMENT	6
2.4 PRODUCED WATER PRODUCTION.....	8
2.5 PRODUCED WATER CHARACTERISTICS.....	12
2.6 PRODUCED WATER TREATMENT:.....	15
2.7 MANAGEMENT TECHNIQUES.....	23
2.7.1 PRODUCED WATER MINIMIZATION TECHNIQUES	23
2.7.2 RECYCLE/ RE-USE TECHNIQUES	25
2.7.3 DISPOSAL/ DISCHARGE OF PW	26
2.8.THE COST OF PRODUCED WATER MANAGEMENT	27
2.9 PRODUCED WATER IMPACTS.....	36
2.10.SUMMARY.....	34
CHAPTER 3 : PRODUCED WATER ANALYSIS AND ASSESSMENT	35
3.1. METHODOLOGY AND RESULTS.....	28
3.2. RISK ANALYSIS STEPS	41
3.3. RISK ASSESSMENT:.....	42
CHAPTER 4: DISCUSSION AND CONCLUSION.....	64
4.1 DISCUSSION	68

4.2 RECOMMENDATIONS.....	71
4.3 CONCLUSIONS.....	73
REFERENCES.....	63
APPENDIX A: PRODUCED WATER MANAGEMENT COSTS.....	68
APPENDIX B: ANALYTICAL METHODS FOR PARAMETERS MEASURED.....	69

List of Tables

Table 2.1: PW Specifications from Oil and Gas Fields.....	11
Table 2.2: Produced Water Injection Percentage.....	14
Table 2.3: Typical Values of PW Characteristics from Oil Field.....	22
Table 2.4: The Most Common Heavy Metals of PW from Oil Field.....	23
Table 2.5: Oil and grease removal technologies based on size of removable particles.....	26
Table 2.6: Summary of produced water treatment techniques that achieve the objectives.....	27
Table 2.7. Disinfection PW Treatment Techniques	28
Table 2.8: Desalination Produced Water Treatment Techniques.....	29
Table 2.9: Miscellaneous Produced Water Treatment Techniques	29
Table 2.10: Technologies/Techniques for PW minimization.....	32
Table 2.11: Water Re-use and Recycle management options.....	33
Table 2.12: Produced Water Disposal Techniques.....	34
Table 2.13: Limits of Pollution in industrial Wastewater According to Egyptian laws.....	36
Table 2.14: Showing Environmental Effect of Components in PW Discharges.....	37
Table 2.15: Hazardous Chemical Effects on Health.....	39
Table 2.16: Limits of PW discharge.....	40
Table 3.1: First Sample Analysis Results.....	41
Table 3.2: Second Sample Analysis Results.....	44
Table 3.3: Third Sample Analysis Results.....	46
Table 3.4: Risk assessment Processes and Techniques.....	49
Table 3.5: Severity Risk Matrix.....	51
Table 3.6: Likelihood Risk Matrix.....	53
Table 3.7: Risk Matrix Indicators.....	54
Table 3.8: Management Risks.....	55
Table 3.9: Technical Risks.....	55
Table 3.10: Operational Risks.....	56
Table 3.11: Type of Risks.....	56
Table 3.12: Risk assessment of PW treatment plant 1.....	57
Table 3.13: Risk assessment of PW treatment plant 2.....	58
Table 3.14: Risk assessment of PW treatment plant 3.....	61
Table 4.1: Produced Water Volume Information.....	62
Table 4.2. Produced Water Management Information	63
Table 4.3: Treatment Techniques Recommended for Produced Water in Egypt.....	66
Table 4.4: Comparing Amount of PW Discharge To Sea With Amount of Reinjection.....	67

List of Figures

Figure 2.1: Typical Reservoir.....	12
Figure 2.2: World Produced Water Production.....	16
Figure 2.3: Yearly Discharge of Produced Water.....	16
Figure 2.4: Oil and Gas Generation.....	17
Figure 2.5: Breakdown of Produced Water Chemical Constituents.....	30
Figure 3.1: Sampling of Pw from Oil Field Site.....	43
Figure 3.2: Sampling of Pw from Oil Field Site.....	43
Figure 3.3: Pw Impact To Environment	50
Figure 3.4: Research Methodology	52
Figure 3.5: Management Risks Analysis.....	58
Figure 3.6: Management Risks Analysis 2.....	58
Figure 3.7: Technical Risks Analysis.....	59
Figure 3.8: Operational Risks Analysis 1.....	59
Figure 3.9: Operational Risks Analysis 2.....	60
Figure 4.1: Scheme Of Produced Water Management Techniques.....	65

Nomenclature

Abbreviation	Description
PW	Produced Water
PAHs	Polycyclic Aromatic Hydrocarbons
FW	Formation Water
BTEX	Benzene, Toluene, Ethylbenzene And Xylene
TDS	Total Dissolved Solids
Ca	Calcium
Mg	Magnesium
Co ₂	Carbon Dioxide
H ₂ s	Hydrogen Sulfide
NORM	Naturally Occurring Radioactive Materials
UV	Ultra Violet
ppm	Part Per Million
BOD	Biological Oxygen Demand
COD	Chemical Oxygen Demand
TSS	Total Suspended Solids
NH ₃	Ammonia
NO ₃	Nitrate
CN	Cyanide
Ba	Barium
Al	Aluminum
OSHA	Occupational Safety And Health Administration
EPA	Environmental Protection Agency
EEAA	Egyptian Environmental Affairs Agency
IGF	Induced Gas Flotation
DGF	Dissolved Gas Flotation

Abstract

Produced water is water produced alongside petroleum product, either from oil or gas fields. It can be found beneath underground formations. Oil and Gas production is either done onshore or offshore, and both result in different products and byproducts. PW is considered the major byproduct and derivative from the petroleum industry. According to its characteristics, PW can be either considered to have a worthwhile outcome or just considered a discarded product.

This thesis investigates the best and most feasible produced water management techniques as it is done through various practices and technologies with different approaches and ideas and it differs from field to field. These approaches can be summarized under three main general categories of management practices: 1) PW Disposal and Discharge 2) Minimization 3) Re-use/Recycle. A case study was carried on a selected oil field in western desert in Egypt by taking different samples of produced water from different points in the field and carrying out full analysis to determine physical and chemical constituents then providing appropriate management technique according the results of each sample. Produced water management techniques have advantages and disadvantages and differ from site to site. The thesis aims to define, summarize and analyze various PW management techniques employed all over the world and their possible applications in the Egyptian oil fields.

Risk assessments study for PW treatment facility impacts was carried in case of leakage and disposal and analysis of different actions that can lead to leakage and spillage either management, technical and operation risks. Also a full risk assessment of produced water treatment facility was conducted to study the possible effects on the surrounding environment (Land, air and water) and their consequences and action plans.

Chapter 1 : Introduction

1.1. Overview:

Despite the numerous sources and supplies of water, the poor management of water infrastructure, increase in human population, change of climate, and lack of economic and physical aids to protect the precious resources will result in a scarcity problem. The rarity of fresh water worldwide is also coupled with lack of accessibility to this water, which makes 1.2 billion people suffer from this problem[1]. To minimize the difficult problem, some methodologies should be implemented to fulfill the demand for safe water and develop a less polluted environment. Surface, ground, sea and rain water are all considered sources of water, which can be utilized in many different areas including domestic, agricultural, and industrial uses. PW is also another component considered one of the main waste streams produced in the oil and gas industries. The discharge of these wastes back to oceans and lakes without meeting the minimum treatment requirements will continue to increase water pollution and cause environmental problems [2]. Oil contamination can be hazardous to humankind and marine life as they are subjected to polluted water and soil[3]. Adverse effects have been reported on people's contamination with oil and organic compounds. It is therefore necessary to treat discharged streams from the oil and gas companies in order to protect the local environment as well as living creatures[4].

1.2. Problem Statement:

Oil and Gas operations are very complex and quite unique as they need specialized and experienced personnel and companies who should possess very high technological and technical capabilities. The personnel should also have the awareness, understanding and the ability to assess all kinds of risks, which they be faced during and after production. For example, PW can cause a lot of risks to the environment if not managed properly. In this thesis, The PW risks, their assessment and provide analysis are discussed for selected oil fields in Egypt.

1.3. Research Aim:

- Identify and analyze associated risks from PW leakage and spills from Oil and gas production in Egypt.
- Identify best PW treatment techniques
- Identify best PW minimization techniques
- Identify best PW re-using options
- Identify best PW disposal techniques
- Help oil and gas operators to decide upon the best and most feasible management technique for PW

1.4. Research Methodology

The study was conducted in the following sequence:

- A detailed literature review was carried out to cover the most important information about PW
- Data was collected from oil fields
- Complete analysis was performed for the collected samples
- Performing risk assessment for PW
- Proposing PW proper and feasible management techniques
- Concluding the findings and providing recommendations

1.5. Organization of the thesis

First Chapter includes an introduction about PW. Chapter 2 provides a summary about all PW management techniques with its advantages and disadvantages. Chapter 3 includes the analysis results of PW effluents from selected oil fields site and risk assessment. Chapter 4 includes the discussion and the conclusion.