

CHAPTER I

GENERAL INTRODUCTION

1.1 Introduction

The largest impact of petroleum activities on the environment resulting from some of the waste water or produced water discharged into the environment in higher concentrations than that found naturally. Gas emissions, liquid and semi-liquid and solid waste are the main categories in which wastes can fall. Some wastes have a considerable impact on the environment, while others have slight effect. Production of huge water in onshore and offshore oil and gas process has been recognized to be a major operational problem (Igunnu & Chen, 2012). It has been also recognized as a major risk of the environmental in area surrounding the field.

Applying an appropriate wastewater management plan leads to minimizing or eliminating the impact on the environment. Management and treatment of oilfield produced water to reuse for hydraulic fracturing to maintain reservoir pressure is main issue for this is study, and to displace oil to production wells then reduce the excessive of water production is a well-established mature operation. Moreover, the important factors that effect on hydraulic fracturing additives and causes scale and damage to the injection and production wells during such operations has been much studied.

Reusing produced water (wastewater) can reduce the demand for fresh water and change the waste into usable water resources. Appropriate treatment is a key factor to determine whether produced water recycling is economical or not, which will depend on the produced water quality and quantity. Water quality analysis is necessary to choose the “best” treatment processes for recycling. Since the chemical constituents of produced water, such as organic matter and Total Dissolved Solids (TDS) vary with different formations and geological locations, it is impossible to implement the same treatment design at different locations. Therefore, treatment technologies would need to be customized for each area according to the water quality and quantity (Arthur et al., 2011).

1.2 Problem Statement

Produced water in the Sudanese oil fields increased largely in the recent years as the oil production increased and the old fields matured. Approximately 1.5 million bbl /day of water are produced in central region fields. Due to the environmental impacts, standard procedures and analysis are required before water disposal or handling. Heglig Oilfield has excessive water production and the water cut was reached 95% with non-economical oil production. Although several studies were conducted in the field for treating the produced water, all the treated water was only for irrigation; recently, no method was presented for reusing the produced water in oil operations in the field, this work analyse and evaluate the treated water for re-using in water base fracturing fluids for maximum oil recovery.

1.3 Research Objectives

The main goal of this study is to evaluate the produced water after treatment for reusing in water injection process or in water base fracturing fluids; this includes the following:

1. To specify and analyse the produced water properties before and after field treatments and identify the required treatments
2. To remove all the contaminated materials in the produced water to match the international standards.
3. To evaluates the heavy metals and the total dissolved solid (TDS) in the produced water after the final treatment by Zeolite under different conditions of pH and concentration.
4. To study the effect of the different contaminated materials in the hydraulic fracturing fluids properties for two different fluids.

1.4 Scope of the Study

To achieve the goals of this study, the following several steps and procedures have been followed:

1. Samples of produced water were collected from Heglig oil field and analysed according to the American Public Health Association (APHA).

2. The analysis results were compared with (National Recommended water quality (EPA)) to identify the required treatments for the collected water.
3. Two different samples of Natural zeolite was collected from Wed kaolly (Elgedarf state) and was prepared.
4. The collected water was treated with different zeolite samples under different conditions of pH, metals concentration and zeolite concentration.
5. Two types of water base hydraulic fracturing fluids were prepared using different gelling agents.
6. The effect of metals and heavy metals in the rheological of the fracturing fluids was addressed under different pH, temperature, and shear rate.

1.5 Field Background

Heglig oil field is one of the largest fields of oil and gas deposits in the Sudan. It has been the site of conventional petroleum production for more than one decade (since 1999), but recently it has become producing water exceed the economic range. Figures (1.1), (1.2) and (1.3). Heglig Field is located in southeast and middle of Block 2B, Muglad Basin. Discovered by Chevron, Consist of 10 fields (Heglig main, Toma, El Bakh, El Full, Laloba, Kanga, Barki, Hamra, Simbir East, Rihan) a general structure which follow. Average distance between fields about 3 to 5 km. 8 layers are developed i.e. Aradeiba main, Aradeiba B, Aradeiba E, Aradeiba F, Bentiu-1, Bentiu-2 and Bentiu-3 and AbuGabra. First FDP carried out in 1998. Last FDP carried out in 2011. Field development started in June 1999 with development of 29 wells i.e. Heglig main (17), Toma (4), Barki(3) , Hamra(2), El Full (2) wells and El Bakh (1) well.

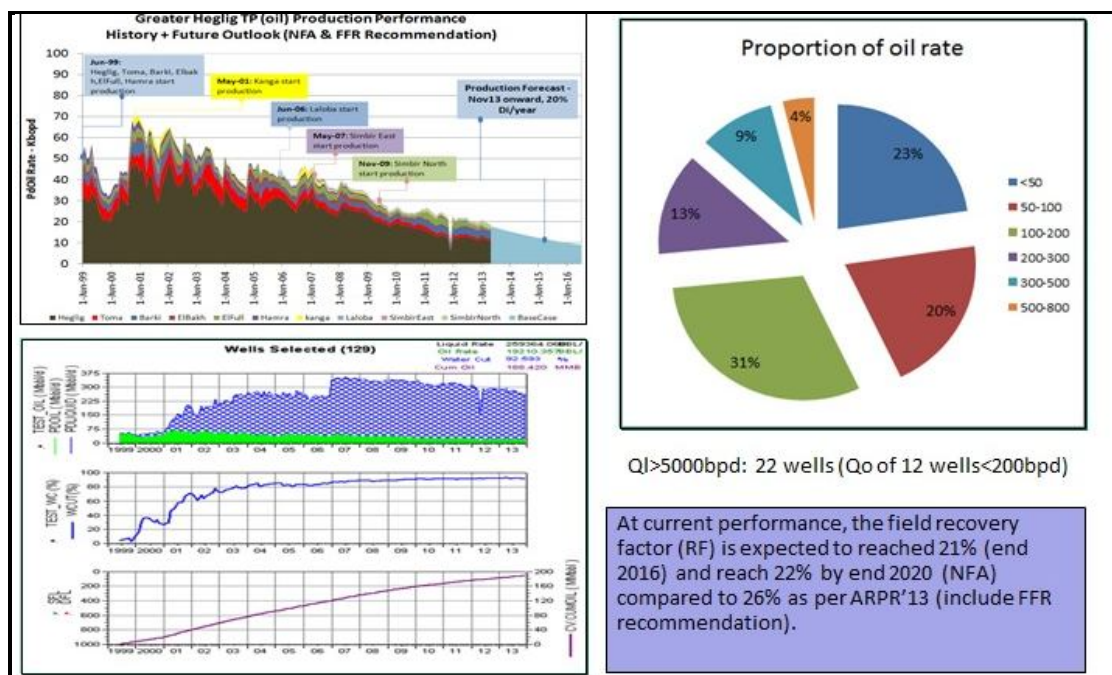


Plate 1.1 Heglig Field Background – Production Performance (Production Performance & Challenges GNPOC 2014)

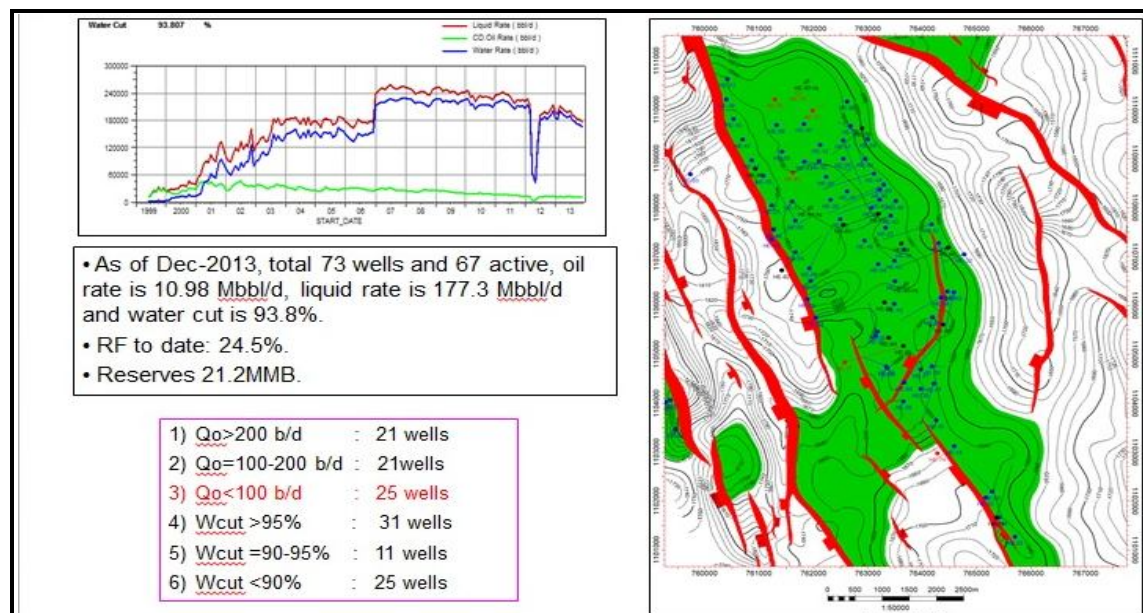


Plate 1.2 Heglig Main – Field Performance (Production Performance & Challenges GNPOC 2014).



Plate 1.3 Total of Water Production from 1999 Up To 2013 (Production Performance & Challenges GNPOC 2014)

1.6 Outline of the Thesis

The rest of this thesis is organized as follow: chapter 2 Theoretical back ground and literature review required to realization this thesis. The chapter encompasses two part of literature: part one management of produced water and part two produced water treatment and introduction of oilfield produced water, history of volumes of water production, composition of produced water, Problem cause by Produced water. Management issues encompasses: Injection for disposal, direct discharge, reused in oil and gas operations, Hydraulic Fracturing, Hydraulic Fracturing Fluids, Properties Of Fracturing Fluids, Types of hydraulic fracturing fluids, Additive Of Fracturing Fluids, Water for hydraulic fracturing, Produced water for hydraulic fracturing, Preparation of hydraulic fracturing fluids. Produced Water Treatment includes: Skim Tanks and Vessels, Separation Techniques Based on Filtration, Cyclonic Separation Methods, Precipitations (Precipitators), Membrane filtration technology, Thermal technologies, Gas flotation, Ion exchange technology, Treatments by zeolites (natural and synthetic zeolites), Water quality issues include (Ionic composition (Metals), Total dissolved solids (TDS), Total Suspended Solids, Oil and grease, Bacteria), as well as Formation damage during injection and fracturing processes. Chapter 3, Methodology, Materials includes three parts, part 1: general analysis of produced water and natural zeolite treatments, part 2: treatment processes by natural zeolites and part 3: possibility of usage produced water as base for fracturing fluids; Chapter 4, Results and Discussion, Finally chapter 5, conclusion and recommendation.