UNIVERSITI TEKNOLOGI MARA

DISSOLUTION OF BARIUM SULFATE SCALE USING ETHYLENEDIAMINETETRAACETIC ACID (EDTA)

IZZATI SYAHIRAH BINTI MOHD SALIKIN

B. Eng. (Hons) Oil & Gas

January 2019

ABSTRACT

Barium sulfate ($BaSO_4$) scale is one of the major problems that cause equipment breakdown consequently decline the oil recovery. In order to remove the scale, a chelating agent ethylenediaminetetraacetic Acid (EDTA) is used as a scale remover. The objective of this experiment is to identify the effect of temperature and concentration of EDTA to the dissolution of $BaSO_4$ scale. Different temperature and concentration of EDTA are varied to find the optimum effectiveness. Experiment was conducted at concentration of 0.5M, 0.05M, 0.01M, 0.005M, 0.001M and at temperature of 27 (room temperature), 40, 60 and 80 °C. Based on the results obtained from Inductively Coupled Plasma Mass Spectrometry (ICP-MS) 0.005M EDTA solution at 80°C is the most optimum condition as the solubility of barium sulfate was found to be 110.5 ppm. Further studies on infrared band changes, weight loss and surface structure of $BaSO_4$ scale was carried out at the most optimum condition as acquired. Fourier Transform Infrared Spectroscopy (FTIR), Electronic Balance and Geology Microscope were used to study those parameters. From FTIR analysis, some bands disappeared after the dissolution as vibrational mode of sulfate take placed. Weight loss experiment showed 1.4256 g of barium sulfate was dissolved in EDTA solution after dissolution process occurred and the solubility is calculated to be 88%. Observation of barium sulfate scale using Geology Microscope displays the changes in surface structure after placed in EDTA solution. Result obtained complement each other as barium sulfate scale before and after dissolution showed a difference in studied parameter. This study showed that EDTA at high concentration and low temperatures are not potent for $BaSO_4$ dissolution.

ACKNOWLEDGEMENT

First of all, I like to express my gratitude and merciful to Allah S.W.T for giving me a good health condition during the period to finish my research project. The opportunities for do this research have inspired and taught me lot of new things. I wish to express my sincere appreciation to my supervisor, Madam Effah binti Yahya, whose encourage, guidance, support and critics from initial to the final level to develop an understanding. Without her continued support and interest, this research report would not have been the same as presented here. I also would like to appreciate to all staffs and lecturers in Faculty Chemical Engineering, UiTM Shah Alam for extraordinary effort especially Madam Rohaida Zainordin and Mr. Mohd Nazmi Mukelas for the warm help during my experiment and for their cooperation and guidance in my experiments research.

This thesis also dedicated to my lovely mother, , my dear late father, Mohd Salikin B Abd Rahman, and my supportive brother Fahmi Aiman B Mohd Salikin with all their pray, love, care, patience and full support I have a courage to go through with all the obstacle to complete my thesis. I also would like to express my gratitude to all my friends that contributed their helps directly or indirectly by helping me finishing my thesis, thank you very much. Finally, I am incredibly thankful to the Faculty of Chemical Engineering for giving me this chance to do this wonderful and interesting project.

TABLE OF CONTENTS

CHAPTER ONE
INTRODUCTION

1.1 Research Background

Scales deposition that forms a sturdy layer on the inner surface of the pipelines, equipment and systems has long been a major and common problem in oil and gas industries. This issue might have effect on the optimum operating of equipment and normally cause breakdown. Sediment of scale on the tubes decreases the capability of boiler and heat exchanger to exchange heat. In desalinization, the scale not solely shortens the service lifetime of process equipment but will decreases amount and standard of produced water. In different operations, scale deposition blocks flow through the tubing string, and cause declination on the production of oil (Al-Hadhrami & Quddus, 2010).

According to (Kumar et al., 2018) these scales are due to the fluids incompatibility or changes of thermodynamics conditions which will lead to accumulation and precipitation that cause blockage to the pipelines and might decline the oil recovery. This leads to severe impact on oil field recovery and economic gains. The scale deposition within the oil field are sulfates such as barium sulfate (barite), strontium sulfate (celestite) and calcium sulfate (anhydrite, gypsum), calcium carbonates, iron, silica and variant insoluble sediments (Dickinson & Sanders, 2012; Senthilmurugan, Ghosh, & Sanker, 2011). Because of the extremely less solubility in water and insolubility in acids these scales are believed to be the most difficult scales to handle.

Scale deposition in petroleum production system such as injection well, production wells and production facilities must be removed as the scales induce a major delayed, significantly losses oil and gas production and decreased the well deliverability because it