EXPERIMENTAL STUDY OF ENHANCED OIL RECOVERY USING SILICA NANOPARTICLES AND GUM ARABIC ON MEDIUM CRUDE OIL AND CORES OF THE NIGER DELTA

BY

JOHN MAZI FELIX

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IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF MASTERS DEGREE IN PETROLEUM ENGINEERING

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SUPERVISOR: DR OYINKEPREYE D. ORODU

ACCEPTANCE

This is to attest that this dissertation is accepted in partial fulfillment of the requirement for the award of Masters of Engineering Degree in Petroleum Engineering in the Department of Petroleum Engineering, College of Engineering, Covenant University, Ota, Ogun State.

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Dean, School of Postgraduate Studies _____ Sign & Date

CERTIFICATION

I, JOHN MAZI FELIX hereby certified that this research work was carried out by me in the Department of Petroleum Engineering, Covenant University, Ota, Nigeria in partial fulfillment of the award of Master's degree in Engineering, Petroleum Engineering (Reservoir Engineering) and therein supervised by Dr. Oyinkepreye D. Orodu. Moreso, this thesis, "**EXPERIMENTAL STUDY OF ENHANCED OIL RECOVERY USING SILICA NANOPARTICLES AND GUM ARABIC ON MEDIUM CRUDE OIL AND CORES OF THE NIGER DELTA**" is certified as my true work.

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DEDICATION

This thesis is first and foremost dedicated to the Almighty God for His enablement and His grace towards the completion of this research work and finally to my beautiful wife, Mrs. Felix Ununotovo Joy as well as my two lovely children Prince David Chiagoziem Felix & Princess Deborah Chimamanda Felix.

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ABSTRACT

New methods of improving recoveries have been investigated since they provide lower risks, costs and proven as compared to exploring for new reserves. Most reservoirs around the world are declining into their final phase of production; new techniques are essential in maintaining production and improve hydrocarbon recoveries. Thermal enhanced oil recovery methods for heavy crude is faced with major issues such as high cost, heat energy loss to unwanted zone, low thermal conductivity of rock and corrosion to wells have placed a burden to find new cost effective, more desirable and less disadvantageous methods for improving oil recoveries in such reservoirs. Among these enhanced recovery techniques (EOR) are chemical injection, which has focus on improving the effectiveness of water floods. The aim of enhanced oil recovery (EOR) is to manipulate the fluid-fluid properties and fluid-rock properties between the injected fluid and the residual oil phase to improve recovery efficiency. Water enhanced with nanoparticles (nanofluid) has recently gained research interest for enhanced oil recovery because of the possible physical and chemical properties imparted by the nanoparticles (NP).

The only challenge in the use of this technique from studies are substantial adsorption to rock formation, log jamming and mechanical entrapment due agglomeration of nanoparticles. Therefore, reservoir evaluation process should be carried out before NPs are injected into the reservoir to ensure the feasibility and prospect of enhancing oil recovery.

In recent years, nanofluid (suspended nanoparticles in brine) has been launched as a cheap, efficient and environmentally friendly alternative to other chemicals. The purpose of this project was to investigate and improve oil recovery after water flooding by nanofliud flooding. Nanoparticle used was silica nanoparticles (SiO_2) suspended in deionized water at 0.05 wt%. Flooding experiments were conducted on four core samples. Nanofluid flooding was performed on three cores while polymer flooding was applied for the last core sample and the experiments were performed at ambient conditions. SEM analysis was conducted to observe the possibility of adsorption of the NP and polymer to the sand grains of the core samples.

The results from the core samples show an additional oil recovery of 4.29 %, 2.022 % and 1.86 % respectively from three cores at nano-flooding rate of 0.5 cc/min. Another core gave a recovery of 33 % during water flooding and 38.2 % during polymer flooding thus giving an incremental recovery of 5.2 %.

These results have validated the effectiveness of chemical flooding, especially nanoparticles to successfully recover crude oil from reservoirs after water flooding usefulness has declined.

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