

**THERMOPHILES BIOSURFACTANT PRODUCTION AND POTENTIAL
APPLICATION IN MICROBIAL ENHANCED OIL RECOVERY FOR HIGH-
TEMPERATURE RESERVOIRS**

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Matriculation Number: 18PCN01827

MAY, 2021

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TEMPERATURE RESERVOIRS**

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**A THESIS SUBMITTED TO THE SCHOOL OF POSTGRADUATE
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DEGREE OF MASTERS IN PETROLEUM ENGINEERING, COLLEGE OF
ENGINEERING, COVENANT UNIVERSITY, OTA.**

MAY, 2021

ACCEPTANCE

This is to attest that this thesis is accepted in partial fulfilment of the requirements for the award of the degree of Masters in the Department of Petroleum Engineering, College of Engineering, Covenant University, Ota, Nigeria.

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DECLARATION

I, **EFAJEMUE, AKPOVI EWAREZI (18PCN01827)** declare that this thesis titled “Thermophiles Biosurfactant Production and Potential Application in Microbial Enhanced Oil Recovery for High-Temperature Reservoirs” was carried out by me under the supervision of Dr. Emeka E. Okoro and the work presented in it are my own and has been generated by me as the result of my original research while in candidature for the degree of a Masters in Petroleum Engineering of Covenant University.

EFAJEMUE, AKPOVI EWAREZI

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Signature and Date

CERTIFICATION

We certify that the thesis titled “Thermophiles Biosurfactant Production and Potential Application in Microbial Enhanced Oil Recovery for High-Temperature Reservoirs” is a unique work carried out by **EFAJEMUE, AKPOVI EWAREZI (18PCN01827)** in the Department of Petroleum Engineering, College of Engineering, Covenant University, Ota, Ogun State, Nigeria under the supervision of Dr. Emeka E. Okoro. We have examined and found the work acceptable for the award of a degree of Masters in Petroleum Engineering.

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DEDICATION

This work is dedicated to God Almighty for his sufficient grace over me. I also dedicate my thesis to my family. A special feeling of gratitude to my amazing mother, Dr. (Mrs) O.O Efajemue whose prayers and words of encouragement pushed for tenacity ring in my ears. I dedicate this work to my beloved father who has been with the Almighty Father, Dr. Ovet Efajemue. May his wonderful soul continue to awaken to joyful activities.

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TABLE OF CONTENTS

CONTENT	PAGE
COVER PAGE	i
TITLE PAGE	ii
ACCEPTANCE	iii
DECLARATION	iv
CERTIFICATION	v
DEDICATION	vi
ACKNOWLEDGEMENTS	vii
TABLE OF CONTENTS	viii
LIST OF TABLES	xiii
LIST OF FIGURES	xiv
ABBREVIATIONS	xvi
ABSTRACT	xvii
CHAPTER ONE	1
1 INTRODUCTION	1
1.1 OVERVIEW	1
1.2 BACKGROUND OF STUDY	2
1.3 STATEMENT OF PROBLEM	4
1.4 AIM OF STUDY	4
1.5 OBJECTIVE OF STUDY	4
1.6 SCOPE OF STUDY	5
CHAPTER TWO	6
2 LITERATURE REVIEW	6
2.1 OVERVIEW OF CRUDE OIL RECOVERY	6
2.2 CRUDE OIL RECOVERY	6
2.2.1 PRIMARY RECOVERY	8
2.2.2 SECONDARY RECOVERY	8
2.2.3 TERTIARY RECOVERY	8
2.3 EOR APPLICATIONS	12

2.3.1	THERMAL PROCESS	12
2.3.2	CHEMICAL FLOODING	13
2.3.3	SOLVENT INJECTION	15
2.4	SURFACTANT FLOODING	15
2.4.1	SURFACTANT	17
2.4.2	CLASSIFICATION OF SURFACTANTS	19
2.4.3	BIOSURFACTANTS	23
2.4.4	PROPERTIES OF BIOSURFACTANTS	27
2.4.5	FACTORS AFFECTING BIOSURFACTANTS PRODUCTION	29
2.4.6	RECOVERY OF BIOSURFACTANTS	30
2.4.7	APPLICATIONS OF BIOSURFACTANTS	30
2.5	MICROBIAL ENHANCED OIL RECOVERY (MEOR)	31
2.5.1	EXOGENOUS APPROACH	32
2.5.2	INDIGENOUS APPROACH	33
2.6	EMPIRICAL REVIEW	34
	CHAPTER THREE	36
3	MATERIALS AND METHODS	36
3.1	MATERIALS	36
3.2	SAMPLE COLLECTION	36
3.3	ISOLATION OF THERMOPHILIC BACTERIA	36
3.3.1	ASEPTIC TECHNIQUES	36
3.3.2	MEDIA PREPARATION	37
3.3.3	ISOLATION OF MICROORGANISMS	37
3.3.4	THERMAL GROWTH OF THE MICROORGANISMS	38
3.3.5	GRAM STAINING	38
3.4	MOLECULAR DETECTION	40
3.4.1	BACTERIAL CULTIVATION AND DNA EXTRACTION	40
3.4.2	PRIMERS FOR PCR	41
3.4.3	DNA AMPLIFICATION THROUGH PCR	41
3.4.4	DNA PURITY AND QUANTIFICATION	41
3.4.5	GEL ELECTROPHORESIS OF PCR PRODUCTS	42
3.5	16S RRNA GENE SEQUENCING	42

3.5.1	PURIFICATION OF PCR AMPLICONS FOR SEQUENCING	42
3.5.2	<i>IN SILICO</i> ANALYSIS OF SEQUENCES	42
3.5.3	BLASTN	43
3.6	PRODUCTION OF BIOSURFACTANT	43
3.6.1	MEDIA FORMATION	43
3.6.2	EXTRACTION OF BIOSURFACTANT	44
3.7	EQUIPMENT FOR ENHANCED OIL RECOVERY	44
3.7.1	RESERVOIR PERMEABILITY TESTER (RPT)	44
3.7.2	THE SOXHLET EXTRACTOR	47
3.7.3	MANUAL SATURATOR	48
3.7.4	GLASS CAPILLARY VISCOMETER	49
3.7.5	DESICCATOR	50
3.8	EXPERIMENTAL PROCEDURE	50
3.8.1	CORE CLEANING PROCEDURE	50
3.8.2	POROSITY AND PERMEABILITY DETERMINATION	50
3.8.3	ESTABLISHMENT OF POROSITY AND PERMEABILITY OF CORE	51
3.8.4	BULK VOLUME MEASUREMENTS	51
3.9	CORE FLOOD SETUP	52
CHAPTER FOUR		54
4	RESULTS	54
4.1	ISOLATION OF MICROORGANISMS	54
4.2	THERMAL GROWTH OF THE MICROORGANISMS	54
4.3	MICROSCOPIC EXAMINATION OF THE BACTERIA ISOLATES	56
4.4	DNA PURITY AND QUANTITIFICATION	56
4.5	POLYMERASE CHAIN REACTION (PCR) OF 16S RRNA GENE IN BACTERIAL ISOLATES	58
4.6	BLASTN	58
4.7	PRODUCTION OF BIOSURFACTANT	59
4.8	ENHANCED OIL RECOVERY PROCESS	59
4.8.1	CORE FLOODING ANALYSIS	59
4.8.2	CORE PETRO PHYSICAL PROPERTIES	60
4.8.3	BIOSURFACTANT <i>BACILLUS NEALSONII</i> (BIOSURFACTANT B) AND <i>BACILLUS AMYLOLIQUEFACIENS</i> (BIOSURFACTANT A) FLOODING	61

	RESULT AND ANALYSIS ON CORE SAMPLE R1A, R1B, R2A, R2B AND R3A, R3B	
4.8.4	BIOSURFACTANT (B) FLOODING ANALYSIS ON CORE SAMPLE R1B.	63
4.8.5	EVALUATING THE COMPARISON IN RECOVERY FACTOR OF BIOSURFACTANT A AND B ON CORE SAMPLE R1A AND R1B.	65
4.8.6	BACILLUS AMYLOLIQUEFACIENS BIOSURFACTANT FLOODING ANALYSIS ON CORE SAMPLE R2A	66
4.8.7	BIOSURFACTANT (B) FLOODING ANALYSIS ON CORE SAMPLE R2B	69
4.8.8	EVALUATING THE COMPARISON IN RECOVERY FACTOR OF BIOSURFACTANT A AND B ON CORE SAMPLE R2A AND R2B	71
4.8.9	<i>BACILLUS AMYLOLIQUEFACIENS</i> BIOSURFACTANT FLOODING ANALYSIS ON CORE SAMPLE R3A	71
4.8.10	BIOSURFACTANT (B) FLOODING ANALYSIS ON CORE SAMPLE R3B	74
4.8.11	EVALUATING THE COMPARISON IN RECOVERY FACTOR OF BIOSURFACTANT A AND B ON CORE SAMPLE R3A AND R3B	77
4.9	TEMPERATURE EFFECT ON OIL MOBILITY	78
4.9.1	OIL RECOVERY PERFORMANCE OF BIOSURFACTANT A ON CORE R1A AT ELEVATED TEMPERATURE	78
4.9.2	OIL RECOVERY PERFORMANCE OF BIOSURFACTANT B ON CORE R1B AT ELEVATED TEMPERATURE	79
4.9.3	OIL RECOVERY PERFORMANCE OF BIOSURFACTANT A ON CORE R2A AT ELEVATED TEMPERATURE	82
4.9.4	OIL RECOVERY PERFORMANCE OF BIOSURFACTANT B ON CORE R2B AT ELEVATED TEMPERATURE	83
4.9.5	OIL RECOVERY PERFORMANCE OF BIOSURFACTANT A ON CORE R3A AT ELEVATED TEMPERATURE	85
4.9.6	OIL RECOVERY PERFORMANCE OF BIOSURFACTANT B ON CORE R3B AT ELEVATED TEMPERATURE	86
	CHAPTER FIVE	88
5	DISCUSSION	88
5.1	ISOLATION OF MICROORGANISMS	88
5.2	THERMAL GROWTH OF THE MICROORGANISMS	88
5.3	MICROSCOPIC EXAMINATION OF THE BACTERIA ISOLATES	89
5.4	DNA PURITY AND QUANTITIFICATION	89
5.5	POLYMERASE CHAIN REACTION (PCR) OF 16S RRNA GENE IN BACTERIAL ISOLATES	90

5.6	BLASTN	90
5.7	PRODUCTION OF BIOSURFACTANT	91
5.8	OIL RECOVERY POTENTIAL OF BIOSURFACTANT A AND B	91
5.8.1	BIOSURFACTANT FLOODING EXPERIMENTS	92
CHAPTER SIX		94
6	CONCLUSION AND RECOMMENDATIONS	94
6.1	SUMMARY	94
6.2	CONCLUSION	94
6.3	CONTRIBUTION TO KNOWLEDGE	95
6.4	RECOMMENDATIONS	95
	REFERENCES	96

LIST OF TABLES

TABLE	PAGE
2.1: Types of surfactant flooding.	17
2.2: List of common surfactant molecules with different types of charge: anionic, cationic.	19
2.3: Examples of the main classes of biosurfactants and their microbial origin.	25
3.1: The Mineral Salt Medium (MSM) and Concentration used for biosurfactant production.	43
3.2: Cleaning Solvent Properties.	50
4.1: Identification of Microbes Thermal Capacity using TBC.	55
4.2: DNA concentration and purity of isolates.	57
4.3: Core sample petrophysical properties.	60
4.4: Determination of porosity and permeability for all the core samples.	60
4.6: Simultaneous flooding process of water and <i>Bacillus amyloliquefaciens</i> biosurfactant.	61
4.7: Simultaneous flooding process of water, biosurfactant (B) on core sample R1b.	63
4.8: Simultaneous flooding process of water, <i>Bacillus Amyloliquefaciens</i> biosurfactant.	67
4.9: Simultaneous flooding process of water, biosurfactant (B) @ ambient temperature.	69
4.10: Simultaneous flooding process of water, <i>Bacillus amyloliquefaciens</i> Biosurfactant.	72
4.11: Simultaneous flooding process of water, biosurfactant (B) @ ambient temperature.	75
4.12: Performance of microbial surfactant A on core R1a at elevated temperatures	79
4.13: Performance of biosurfactant A on core R1a at elevated temperatures	80
4.14: Performance of microbial surfactant A on core R2a at elevated temperatures.	82
4.15: Performance of microbial surfactant B on core R2b at elevated temperatures.	83
4.16: Performance of biosurfactant A on core R3a at elevated temperatures.	85
4.17: Performance of biosurfactant B on core R3b at elevated temperatures.	86

LIST OF FIGURES

FIGURE	PAGE
2.1: Initial distribution of fluids in a reservoir.	6
2.2: Schematic of sweep efficiencies (Lyons and Plisga, 2015)	9
2.3: Capillary desaturation curve	11
2.4: (Left) Displacement of oil with unfavourable mobility ratio ($M > 1$), (right).	12
2.5: Thermal process control. Thermal energy is injected into the reservoir.	13
2.6: Chemical flooding, which is the injection of water and chemicals.	14
2.7: Principle of flooding, where residual oil is trapped in the reservoir.	16
2.8: Surfactant molecule and surfactant orientation in the water.	18
2.9: IFT versus salinity for two different alcohol propoxylate sulfate surfactant experiments.	20
2.10: Determination of Critical Micelle Concentration (CMC) for two surfactants investigated.	22
2.11: Illustration of regions in which micelle formation occurs.	24
2.12: Chemical structure of mono-rhamnolipid (A) and di-rhamnolipid (B).	26
2.13: Chemical structure of a C15 surfactin molecule (Liu et al., 2012).	27
2.14: Scheme of surface tension measurement by ring method.	28
2.16: Mechanism of enhanced oil recovery by bio-surfactants.	31
2.18: Various methods for implementing MEOR.	32
3.1: Isolated Microbes on Plates.	38
3.2: Reservoir permeability tester (Reservoir Permeability Tester Manual, 2015).	44
3.3: Core holder (a component of the reservoir permeability tester).	46
3.4: Core sample arrangement in the core holder.	46
3.5: Accumulators for core flooding process.	47
3.6: MANUAL SATURATOR.	49
3.7: CORE FLOOD SETUP.	53
4.1: Trinity Plates of Raise & Flat.	54
4.2 (a) and (b): Gram staining test results of the R and F isolates.	56
4.3: Graph of Nanodrop Spectrophotometer showing the purity and concentration of isolate R.	57
4.4: Graph of Nanodrop Spectrophotometer showing the purity and concentration of isolate F.	57
4.5: PCR amplification of the 16S rRNA gene of the two bacteria isolates.	58
4.6: Raw Sequence data of the two microorganisms.	59
4.7: The Biosurfactant produced by <i>Bacillus nealsonii</i> and <i>Bacillus amyloliquefaciens</i> .	59
4.8: Volume of oil recovered during water flooding on the core sample (R1a).	62
4.9: Volume of oil recovered during water flooding.	63
4.10: Volume of oil recovered during water flooding.	64
4.11: Volume of oil recovered during water flooding.	65
4.12: Comparison in Recovery Factor of Microbial Surfactant A and B.	66
4.13: Volume of oil recovered during water flooding against the time of injection.	68
4.14: Volume of oil recovered during water flooding and <i>Bacillus amyloliquefaciens</i> .	68
4.15: Volume of oil recovered during water flooding against the time of injection.	70
4.16: Volume of oil recovered during water flooding and <i>Bacillus Amyloliquefaciens</i> .	70
4.17: Comparison in Recovery Factor of Biosurfactant A and B.	71
4.18: Volume of oil recovered during water flooding against the time of injection.	73

4.19: Volume of oil recovered during water flooding and <i>Bacillus amyloliquefaciens</i> .	74
4.20: Volume of oil recovered during water flooding against the time of injection.	76
4.21: Volume of oil recovered during water flooding and biosurfactant (B).	77
4.22: Comparison in Recovery Factor of biosurfactant A and B on core sample.	78
4.23: Graphical representation showing temperature effect on two different biosurfactant.	81
4.24: Incremental recovery based on the performance of biosurfactant A and B.	82
4.25: A graphical representation of temperature effect comparison for biosurfactant A and B	84
4.26: Graphical representation of and incremental recoveries comparison for biosurfactant.	85
4.27: Graphical representation comparing the temperature effect on biosurfactant A and B.	87

ABBREVIATIONS

API	American Petroleum Institute
$(NH_4)_2SO_2$	Ammonium Sulfate
$CaCl_2 \cdot 2H_2O$	Calcium Chloride Dihydrate
ppm	Concentration
cc/min	cubic centimetre/minute
K_2HPO_4	Dipotassium Phosphate
EOR	Enhanced Oil Recovery
IFT	Interfacial Tension
mN/m	Interfacial Tension
$FeSO_4 \cdot 7H_2O$	Iron(II) Sulfate Heptahydrate
$MgSO_4 \cdot 7H_2O$	Magnesium Sulfate Heptahydrate
$MnSO_4 \cdot H_2O$	Manganese Sulfate Monohydrate
g	Mass
MEOR	Microbial Enhanced Oil Recovery
KH_2PO_4	Monopotassium Phosphate
OFITE	OFI Testing Equipment
OOIP	Original Oil in Place
ppm	parts per million
mD	Permeability
k	Permeability, mD
PV	Pore Volume
Psi	Pressure
PVT	Pressure, Volume and Temperature
RPT	Reservoir Permeability Tester
s	Seconds
$NaCl$	Sodium Chloride
oC (or oF)	Temperature
cP	Viscosity
ml	Volume

ABSTRACT

Microbial enhanced oil recovery (MEOR) among other enhanced oil recovery (EOR) innovation is an important alternative approach when primary and secondary methods are not productive. The responsible factor for MEOR procedure is the microbes and their by-products like biosurfactants, biopolymers and so on. This study is focused on the use of biosurfactant produced by identified microorganisms in produced-sand from hydrocarbon sandstone reservoir in ex-situ MEOR at reservoir temperature. From the isolation result, *Bacillus Nealsonii* and *Bacillus Amylolyquefaciens* were the identified petroleum thermotolerant microbes. These microbes were used for the production of biosurfactant, the broth was used as the nutrient source and kerosene as a carbon source. The produced biosurfactants from the two microbes were applied in the MEOR at temperature (27°C, 80°C, 90°C, 100°C and 110°C) using a reservoir permeability tester equipment. Then we compare the recovery process of Biosurfactant A and B on core sample R1a and R1b. We discover that Biosurfactant B performed better than A at temperature 27°C, 80°C, 90°C, 100°C and 110°C with recovery factor of 55.2% - 46.7% and 64.1% - 0% respectively. Biosurfactant B performed better than A at temperature 27°C, 80°C, 90°C, 100°C and 110°C on core sample R2a and R2b with percentage difference at (49.6% - 46.2%) and (63.8% - 0%) respectively. Biosurfactant B performed better than A at temperature 27°C, 80°C, 90°C, 100°C and 110°C on core sample R3a and R3b with percentage difference at (48.3% - 41.7%) and (54% - 0%) respectively. Biosurfactant B achieved more significant results than Biosurfactant A. Thus these hyperthermophiles biosurfactants are good agents for MEOR.