



***Preparation and Evaluation of Synthetics
Based Muds for Oil - Well Drilling Fluids***

**A Thesis Submitted for
Degree of Ph.D. in organic chemistry**

Presented by

Suzan El Desouky El Sayed Ibrahim

M.Sc., Chemistry, Al-Azher University, 2006

Department of Chemistry-Faculty of Science

Ain Shams University

Cairo, Egypt

2012



Preparation and Evaluation of Synthetics Based Muds for Oil - Well Drilling Fluids

A Thesis Submitted for

Degree of Ph.D. in Organic Chemistry

Presented by

Suzan El Desouky El Sayed Ibrahim

M.Sc., Chemistry, Al-Azher University, 2006

Supervised by

Prof. Dr. Elsayed Ahmed Soliman

Prof. of Organic Chemistry Faculty
of Science-Ain Shams University

Prof. Dr. Saad El-Din Desouky

Prof. of Petroleum Production-
Production Department Egyptian
Petroleum Research Institute(EPRI)

Prof. Dr. Amal Abdel Hafiz

Prof. of Organic Applied Chemistry-
Petrochemicals Department Egyptian
Petroleum Research Institute(EPRI)

Dr. Mona Mahmoud Dardir

Ass. Prof. of Organic Applied
Chemistry-Production Department
Egyptian Petroleum Research
Institute(EPRI)



Approval sheet

Title:

***Preparation and Evaluation of Synthetics
Based Muds for Oil - Well Drilling Fluids***

By

Suzan El Desouky El Sayed Ibrahim

M.Sc., Chemistry, Al-Azher University, 2006

This thesis has been approved by supervisors
committee.

Supervisors

Approved

- **Prof. Dr. Elsayed Ahmed Soliman**
- **Prof. Dr. Amal Abdel Hafiz**
- **Prof. Dr. Saad El-Din Desouky**
- **Dr. Mona Mahmoud Dardir**

Prof. Dr. Maged Shafik Antonious

**Head of Chemistry Department
Faculty of Science-Ain Shams University**



تحضير و تقييم طفلة الحفر ذات الأساس الزيتى المخلق لاستخدامها فى سوائل الآبار البترولية

الرسالة مقدمة من

سوزان الدسوقي السيد ابراهيم

(ماجستير العلوم فى الكيمياء - 2006)

كلية العلوم - جامعة الازهر

للحصول على

درجة دكتوراة الفلسفية فى العلوم (الكيمياء)

قسم الكيمياء - كلية العلوم - جامعة عين شمس

2012



تحضير و تقييم طفلة الحفر ذات الأساس الزيتي المخلق لاستخدامها في سوائل الآبار البترولية

الرسالة دكتوراه الفلسفية في الكيمياء العضوية

اسم الطالبة/ سوزان الدسوقي السيد ابراهيم

امضاء

• لجنة الاشراف

ا.د. السيد أحمد سليمان عبد العزيز

ا.د. أمل عبد الحفيظ محمد

ا.د. سعد الدين محمد دسوقي

د. منى محمود حسن دردير

رئيس قسم الكيمياء

أ.د. ماجد شفيق انطونيوس

قسم الكيمياء – كلية العلوم – جامعة عين شمس

2012



جامعة عين شمس
كلية العلوم
قسم الكيمياء

- ❖ اسم الطالبة / سوزان الدسوقي السيد ابراهيم
- ❖ اسم الدرجة العلمية الحالية : دكتوراه الفلسفية فى العلوم
- ❖ القسم التابعه له: الكيمياء
- ❖ الكلية : العلوم
- ❖ الجامعة: عين شمس
- ❖ سنة الحصول على الماجستير: 2006
- ❖ سنة التخرج: 1999 مايو
- ❖ التقدير العام: جيد جدا
- ❖ الوظيفة الحالية: باحث مساعد بمعهد بحوث البترول



جامعة عين شمس
كلية العلوم
قسم الكيمياء

الشكر

كل الشكر والتقدير للسادة الاساتذة المشرفين على الرسالة

ا.د. السيد أحمد سليمان عبد العزيز

أستاذ الكيمياء العضوية-قسم الكيمياء - كلية العلوم - جامعة عين شمس

ا.د. سعد الدين محمد دسوقي

أستاذ الهندسة البترولية - معهد بحوث البترول

ا.د. أمل عبد الحفيظ محمد (رحمة الله عليهما)

أستاذ الكيمياء العضوية التطبيقية-قسم البترولوكيماويات- معهد بحوث البترول

د. منى محمود حسن دردير

أستاذ المساعد الكيمياء العضوية التطبيقية - معهد بحوث البترول

على كل ما قدموه لى من نصح وتوجيه وما أفاضوه على من
علمهم الوفير شكر الله لهم.

وأخص بالشكر الجزيل الدكتور/ منى محمود حسن دردير على ما

قدمته لى من تعهد ورعاية شكر الله لما

كل الشكر والتقدير والعرفان بالجميل لوالدتهى وزوجى وبنتهى

وابنهى (حفظهم الله لى) واسرتهم على مساندهتم لى وتعاونهم .

A **CKNOWLEDGMENT**

First and all thanks for " **ALLAH**" for giving me the opportunity and the strength to accomplish this work.

I would like to deeply indebted to late Prof.Dr. Amal Abdel Hafiz, Professor of Organic Chemistry, petrochemicals Department, Egyptian Petroleum Research Institute(EPRI).

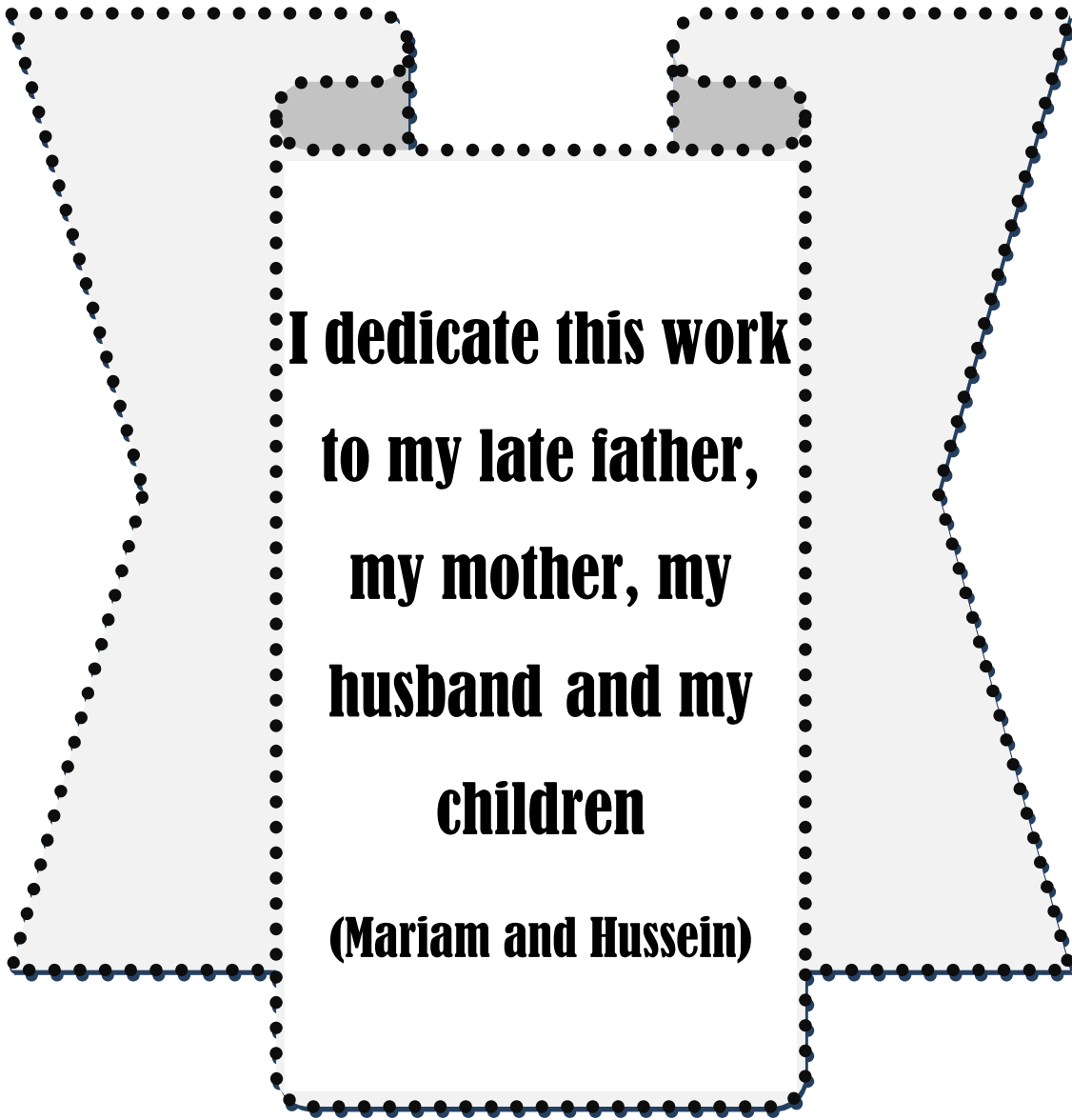
Also,I wish to express his great thanks and sincere appreciation to **Prof. Dr. Elsayed Ahmed Soliman** , Professor of organic Chemistry, Faculty of Science, Ain Shams University, for his valuable advises and continuous help during the research.

I would like to express my sincere gratitude and indebted to Dr. **Mona Mahmoud Dardier** Ass. Prof. of Organic Chemistry, Production Department, Egyptian Petroleum Research Institute, for suggesting the line of research and for her close and continuous supervision during all phases of this work and whose effort made her humble work a success.

Special thanks go to **Prof. Dr. Saad EL-Din Mohamed Desouky**, Production Department, Egyptian Petroleum Research Institute, for his kind helps, patiently, continuous advises and his time to read the manuscript.

Finally, all my thanks to all those who taught me and still do and all workers in Egyptian Petroleum Research Institute (EPRI).

Suzan El Desouky El Sayed Ibrahim



**I dedicate this work
to my late father,
my mother, my
husband and my
children**

(Mariam and Hussein)

AIM OF THE STUDY

Efficient drilling technology is essential to meet the needs of the oil industry. Both the challenges of new oil province especially in offshore waters, and the demands for efficient environmental protection have driven the development of new technology. Drilling mud is a key factor influencing drilling technology used in modern drilling operations. New oil industry developments involve directional and horizontal drilling as well as drilling in frontier area at greater and greater depth, such capabilities and conditions demon careful attention to the selection and engineering of efficient mud system.

Also, spent drilling fluids and drill cuttings are among the most significant waste strains from exploration and development activities in the oil and gas industry. They pose a serious and costly disposal problem for offshore operators who must barge spent mud and cutting to shore for land disposal if they do not meet the environmental protection agency discharge limitation or permit requirements due to disadvantage of both water-base mud and oil -base mud (traditional drilling mud).

The petroleum sector in Egypt import a large amount of chemicals annually for utilization as synthetic mud and additives for oil-well drilling fluids.

Our objective of this study is important. Due to the above mentioned reason, which have a biodegradable property prevent many from the environmental problems caused by the drilling fluids. In this thesis experimental work is conducted on the different prepared ester mud from stander and local materials, which might substitute the imported ester mud .The new prepared ester amides were evaluated as ester based synthetic mud for oil – well drilling fluids, according to API and OCMA specification, compared to the imported synthetic mud, to verify the advantages and disadvantages of the local mud.

SUMMARY

The drilling fluids or muds are generally used in drilling wells when drill by rotary method. The use of oil-based drilling fluids are usually more stable than water – base drilling fluids , more effective for lubricating drill bits and drill pipe , and are typically more stable than water – base drilling muds at the high temperatures especially when drilling deep wells . Because of these, and other advantages, oil-base drilling muds are directed used in many important well drilling operations.

The formulation of oil-based drilling fluid is manly from diesel and kerosene. Such petroleum – based oil are typically contain relatively large concentrations of aromatics and at least substantial concentrations of n-olefins, both of which may be harmful or toxic to animal and plant life . The drilling industry has developed several types of synthetic – based muds (SBMs) that combine the desirable operating qualities of oil-base muds with the lower toxicity and environmental impact qualities of water – based muds and also can improve drilling efficiency without polluting. The petroleum sector in Egypt imports large amount of chemicals annually for utilization as synthetic mud and additives for oil-well drilling fluids.

So the principle objective of the present study is to provide a new type of synthetic based mud drilling mud that combined the desirable operating qualities of oil based muds with the lower toxicity and environmental impacts qualities of water-based muds and also can improve drilling efficiency without pollution. Preparation is based on the following:

1. Amidation of Fatty Acids

Diethanolamine was refluxed with Hexanoic acid or Lauric acid respectively. The products were:

- i- N, N- diethanol hexanoamide (**A₁**)
- ii- N, N- diethanol lauricamide (**A₂**)

The products were investigated by elemental analysis and spectroscopic analysis (FT-IR).

2. Estrification of Fatty Amides

Both of the prepared fatty amide A₁ and A₂ were esterified with different concentration of oleic acid or linolenic acid to produce mono and di fatty ester amides. The new prepared ester amides were:

i- Mono-fatty ester amides

- N-ethanol N'-(ethyl oleate) hexanoamide (**H₁**)
- N-ethanol N'-(ethyl linoleate ester) hexanoamide (**H₃**)
- N-ethanol N'-(ethyl oleate) lauricamide (**L₁**)
- N-ethanol N'-(ethyl linoleate ester) lauricamide (**L₃**)

ii- Di - fatty ester amide

N,N-di (ethyl oleate) hexanoamide	(H ₂)
N,N-di (ethyl linoleate ester) hexanoamide	(H ₄)
N,N-di (ethyl oleate) lauricamide	(L ₂)
N,N-di (ethyl linoleate ester) lauricamide	(L ₄)

The structures of the new prepared fatty ester amides were elucidated by elemental analysis, spectroscopic analysis (FTIR), Gas chromatography/mass spectrophotometer and H¹NMR spectra.

3. Estrification of commercial Fatty Amide

The study include an esterification process of the commercial fatty amide N, N- diethanol cocoamide (A₃) with different concentration of oleic acid or commercial linolenic acid to produce mono and di commercial fatty ester amides. The new prepared commercial ester amides were:

iii- Commercial fatty ester amide

N-ethanol N'-(ethyl oleate)coco amide	(C ₁)
N,N-di (ethyl oleate) coco amide	(C ₂)
N-ethanol N'-(ethyl linoleate ester)coco amide	(C ₃)
N,N-di (ethyl linoleate ester) coco amide	(C ₄)

4. Biodegradability of Ester Amides

This study aimed to investigate the ability of some microbial strains to utilize different emulsion samples as sole source for carbon and energy. The mono and di-ester amides and control sample were tested to know the matter that has the ability of degradation

5. Evaluation of new prepared fatty ester amides and new commercial fatty ester amide assynthetic based drilling fluids (ester-based mud), all of them compared to the control mud sample, MR (imported ester mud).

These evaluation tests include the measurements of:

- a- Rheological properties of the mud Viscosity (Apparent viscosity, plastic viscosity and Yield point).
 - i- Effect of Temperature on the viscosity properties.
 - ii- Gel strength and thixotropy.
 - iii- Effect of temperature on Gel strength and thixotropy.

It was found that most of the new prepared ester based muds have high apparent, plastic viscosity and yield point than the using control mud sample, M_R (imported ester mud). The effect of temperature on the rheological of the mud formulation containing the prepared ester amides have good value compatible with the control mud sample, M_R (imported ester mud).