

**SYNTHESIS AND EVALUATION  
OF SOME SURFACTANTS FROM  
PETROLEUM  
BI-PRODUCTS**

**A Thesis**

**Submitted in partial fulfillment of the requirements**

**For the degree of  
M.Sc.In Organic Chemistry**

**By**

**Mohammed Taha Mohammed Hassanein**

**B.Sc.Chemistry (2002)**

**Faculty of Science ,Benha University**

**Department of Chemistry**

**Faculty of Science**

**University of Benha**

**2009**

## **SUPERVISORS**

**Prof .Dr.Ali Abdel Maabod** .....

**Professor of Organic Chemistry-Faculty of Science –  
Benha University.**

**Dr .Ahmed El Sayed Salem** .....

**General Manager of Research center –Misr  
Petroleum Company.**

**Dr.Sahar Mazen** .....

**Manager of Analytical Research Department-  
Research center –Misr Petroleum Company.**

**Head of Chemistry department**

**Prof. Dr. S. G. Donia**

## { ACKNOWLEDGEMENT }

Thanks to my great god I hopefully succeeded to finish this work properly. I hereby aim to express my deep appreciation to Prof. Dr. Ali Abd Elmaabod, professor of organic chemistry and vice dean of faculty of science for postgraduate and research, Benha University for his great help, keen interest, kind supervision and powerful support throughout this work.

Thanks are due to Dr. Ahmed El Sayed Salem, Manager of Research center - Misr Petroleum Company, who suggested and supervised the work.

I would like to express my deep love and appreciation to

Dr. Sahar Mazen, analytical Research center - Misr Petroleum Company, for support, encouragement and kind supervision.

Many thanks and appreciation to technical staff of research center and chemical

research , misr petroleum company.special  
thanks are alsodue to :

Chemist.Esmat Zydan ,Manger of research  
and development of chemicals.

## **[ CONTENTS ]**

### **1. Summary**

### **2. Introduction**

#### **2.1 Classification of petroleum crude oils**

#### **2.2 Petroleum crude oils refining**

##### **2.2.1 Distillation**

##### **2.2.2 Thermal cracking**

##### **2.2.3 Coking**

##### **2.2.4 Fluid catalytic cracking**

##### **2.2.5 Catalytic reforming**

##### **2.2.6 Alkylation**

##### **2.2.7 Hydrofinishing**

## **2.3 Lubricating oils refining steps**

2.3.1 Solvent extraction

2.3.2 Dewaxing

2.3.3 Clay treatment

2.3.4 Acid treatment

## **2.4 Base oil categories**

2.4.1 Paraffinic oils produced

2.4.2 Naphthenic oils produced

2.4.3 Aromatic oils

## **2.5 Residues from lubricating oils refining**

2.5.1 Residues types

2.5.2 Residues available locally

## **2.6 Linear alkyl benzene L.A.B. synthesis**

2.6.1 By-products from L.A.B. synthesis

## **2.7 Upgrading of lubricating oils residues**

2.7.1 General upgrading techniques

2.7.1.1 Upgrading of aromatic extracts

2.7.1.2 Upgrading of L.A.B. by- products

## **2.8 Sulphonation as upgrading technique**

2.8.1 Sulphonation process

2.8.2 Electrophilic sulphonating agents

**2.8.3 Classification of synthetic surfactants**

2.8.3.1 Anionic surfactant

2.8.3.2 Cationic surfactant

2.8.3.3 Non-ionic surfactants

2.8.3.4 Amphoteric surfactants

## **2.9 Oil spill dispersant in sea water**

### **Aim of the work**

## **3. Experimental ( part I &II )**

### **I.3.1 Materials**

I.3.1.1 Samples

I.3.1.2 Separation of aromatic extracts

I.3.1.3 Sulphonating, capturing and neutralizing  
agents

### **I.3.2 Determination of physical properties of the tested samples**

I.3.2.1 Specific gravity

I.3.2.2 Colour

I.3.2.3 Refractive index

I.3.2.4 Distillation range

I.3.2.5 Sulphonatable content

I.3.2.6 Hydrogen sulphide and mercaptans

I.3.2.7 Water content

### **I.3.3 Chemical structure of the tested samples**

I.3.3.1 Gas chromatography and mass spectra

#### **I.3.4 Sulphonation process**

I.3.4.1 Analysis of obtained sulphonic acid

I.3.4.2 Neutralization and preparation of surfactants

I.3.4.3 Analysis of obtained surfactants

I.3.4.3.1 Alcohol soluble materials

I.3.4.3.2 pH value

I.3.4.3.3 Kinematic viscosity

I.3.4.3.4 Cloud point

I.3.4.3.5 Total active matter insoluble in alcohol

I.3.4.3.6 Evaluation of synthesised sulphonic acid

#### **I.3.5 Evaluation of the formulated surfactants**

I.3.5.1 Detergency power

I.3.5.2 Wetting power

I.3.5.3 Emulsification power

I.3.5.4 Foam volume

### **II.3. Evaluation of oil dispersant**

**II.3.1 Effectiveness test of oil dispersant.**

**II.3.2 Toxicity and biodegradability test of oil dispersant.**

II.3.2.A Natural phytoplankton population.

II.3.2.B Shrimp.

### **II.3.2.C Fishes.**

## **4. Results and Discussion ( part I & II )**

### **I.4.1 Separation of aromatic extracts**

### **I.4.2 Evaluation of the physical and chemical properties of the tested samples**

### **I.4.3 Chemical structures of the tested samples**

#### **I.4.3.1 Gas chromatography and mass spectra**

### **I.4.4 Sulphonation mechanisms**

### **I.4.5 Evaluation of sulphonation processes**

### **I.4.6 Evaluation of physical and chemical properties of synthesised suphonic acid**

### **I.4.7 Evaluation of physical and chemical properties of the formulated surfactants**

### **I.4.8 Evaluation of the formulated surfactants**

#### **I.4.8.1 Detergency power**

#### **I.4.8.2 Wetting power**

#### **I.4.8.3 Emulsification power**

#### **I.4.8.4 Foam volume**

## **II .1 Evaluation of effectiveness test of oil dispersant.**

## **II .2 Evaluation of toxicity and biodegradability test of oil dispersant.**



II .2 .A Natural phytoplankton population.

II .2. B Shrimp.

II. 2 .C Fishes.

**II .3 Evaluation of physical and chemical properties  
of the formulated surfactants**

**5. References**

**Arabic summary**