English Summary

This thesis includes five chapters. The first of which is the introduction, chapter two includes the experimental details, while chapter three includes results and discussion, chapter four includes economical feasibility study and finally chapter five includes the references. The aim of the work in this thesis is establishing models of Alkyl Aryl Sulphonate which can be used as efficient surfactant which can be used as detergent dispersant additive for lubricating oils from local and available raw materials produced as by products from Egyptian petroleum refining labs.

Through this study LAB (Linear Alkyl Benzene) and HAB (Heavy Alkyl Benzene) were used as raw materials, which were analyzed using GC/MS. The experimental part includes synthesis some of these products as follow:

A) Sulphonation of LAB and HAB Using different sulphonating agents:

1) Sulphonation of HAB by using 98% H_2SO_4 at different conditions, temperature (45°-50° C, 50°-55° C, 55°-60° C and 60°-65° C), digestion time (two, three and four hours) and with different Acid/HAB ratios (1:1, 1.25:1, 1.5:1, 1.7:1, 1.8:1). It was found that the optimum sulphonation condition of HAB were (temperature 50°-55°C), digestion time (four hours) and (Acid /HAB ratio of 1.5:1).

The obtained optimum sulphonation conditions (temperature and digestion time) of HAB were applied on the sulphonation of LAB using different

Acid/LAB ratios (1:1, 1.25:1, 1.5:1, 1.7:1, 1.8:1). It was found that the optimum ratio (Acid /LAB ratio of 1.5:1).

2) Sulphonation of both HAB and LAB was also carried out by using dry SO_3 gas by using the optimum temperature and digestion time that obtained from sulphonation with 98% H_2SO4. The resultant sulphonic acids were analyzed international standard methods [Institute of Petroleum British (IP)], American Society for Testing and Materials (ASTM) and Shell Method Series (SMS).

B) The Synthesized Sulphonic acid of both HAB and LAB was neutralized using neutralizing agents Na_2CO3, in isopropyl alcohol. The final salts of (HAB) and (LAB) sulphonic acids were analyzed compared with commercial (SNS) [Sodium Naphtha Sulphonates] which is a major compound in manufacture of cutting oils.

The SLABS [Sodium (LAB) Sulphonic Acid] and SHABS [Sodium (HAB) Sulphonic Acid] were infeasible in manufacture of superbasic Detergent-Dispersant additive because their base numbers were relatively very small and these sodium salts have hydrophilic properties. The SLABS and SHABS can be used instead of SNS in manufacture of cutting oils.

C) This neutralization process has done on HAB, LAB sulphonic acids and DDP (Dodecyl phenol) using different trials.

The neutralization with CaO was complicated because it formed as very hard paste which was neither soluble in oil nor in water. So neutralization has done at different conditions of Temperature (55 $^{\circ}$ C, 70 $^{\circ}$ C, 90 $^{\circ}$ 100 $^{\circ}$ C and 140°-

160° C) and different Solvents (Benzene, Mixture of Toluene and Xylene) and using different Diluting Oils (Spindle Oil, metal process Oil, Transformer Oil and Gas Oil). The most suitable diluting oil was found to be Metal Process Oil. The neutralization was done in presence of methanol as promoter.

D) The best three products obtained from neutralization of HABS, LABS and Dodecyl phenol were analyzed. FTIR and other tests [Institute of Petroleum British (IP)], American Society for Testing and Materials (ASTM) and Shell Method Series (SMS) was applied to elucidate the proposed structure of presence of free hydroxylic group produced from half neutralization of Sulphonic acid [R.SO3CaOH] and Dodecyl Phenol [R.00a01^{-1}]. The FTIR spectra reveal broad bands at (3352-3401 cm^{-1}).

E) The best three products also undergo the next step "Carbonation Process" in order to produce Superbasic additives using CO2 gas. This process has done in the presence of methanol as promoter, Toluene as a solvent and the temperature (140°460° C). The ratio of CO2 gas was 0.9 mole to one mole calcium sulphonate or phenate used.

F) The final three additives produced was evaluated and compared with imported international additive by using FTIR and other standard international methods of analysis. From this evaluation we concluded that:

1- The additive produced from HAB has the same IR finger print as imported additives.

2- Additive produced from HAB has better detergency and dispersive power than that developed from LAB and DDP.

3- Additives produced from LAB and HAB have higher Total Base Number (TBN) than that produced from DDP.

4- Additive produced from LAB has higher oxidation stability than produced from HAB. This means shorter alkyl group sulphonate has better oxidation stability than longer one; this may be due to steric hinderance with longer alkyl group.

5- Additive produced from DDP has higher oxidation stability than producd from LAB. This means phenate has better oxidation stability than sulphonate.

The Economical feasibility study shows that the Detergent-Dispersant additive that imported to use as Lubricating oil additive can be produce locally through simple technique with lower price.

The production cost of additive locally is 61.3 less than the cost of imported one. The total cost to produce one ton of local additive is equal to 5278 L.E. including the prices of row materials production cost and administrative expenses. The price of imported additive is equal to 2200$, (13635 L.E.). Thus the production cost of additive locally is 61.3 % less than the cost of imported one.