

Contents

English Summary	i
I Introduction	1
I.1 Crude Oil Classification.....	1
I.1.1 Paraffinic Crude Oil.....	1
I.1.2 Asphaltic Crude Oil.....	2
I.1.3 Mixed Crude Oil.....	2
I.2 Crude Oil Refining.....	3
I.3 Refining Steps of Crude Oil	5
I.4 Base Oil Categories.....	7
I.4.1 Paraffinic Oils Produced.....	7
I.4.2 Naphthenic Oils Produced.....	8
I.4.3 Aromatic Oils Produced.....	8
I.5 Lubricating Oils Classification.....	10
I.5.1 Automotive Lubricants.....	10
I.5.1.1 Engine Oils.....	10
I.5.1.1.1 Lubrication Requirements.....	12
I.5.1.1.2 Viscosity Classifications.....	13
I.5.1.2 Automatic Transmission Fluids.....	17
I.5.1.3 Automotive Gear Lubricants.....	17
I.5.2 Industrial Lubricants.....	17
I.5.2.1 General Aspects of Industrial Lubricants.....	17
I.5.2.2 Compressor Oils.....	18
I.5.2.3 Refrigerator Oils.....	18
I.5.2.4 Hydraulic Lubricants.....	19
I.5.2.5 Turbine Oils.....	19
I.5.2.6 Metal Working Oils.....	20
I.5.2.7 Process Oils.....	21
I.5.2.8 Textile Oils.....	21
I.5.2.9 Slide Way Oils.....	22
I.5.2.10 Transformer Oils.....	22
I.5.2.11 Other Related Lubricants.....	23
I.6 Lubricating Oils Additives.....	24

1.6.1	Antioxidants.....	26
1.6.2	Viscosity Index Improvers.....	28
1.6.3	Pour Point Depressants.....	30
1.6.4	Antiwear Additives.....	31
1.6.5	Rust Inhibitors.....	31
1.6.6	Antifoam Additives.....	31
1.6.7	Detergent-Dispersant Additives.....	32
1.6.7.1	Detergent Additives.....	33
1.6.7.1.1	Sulphonate Detergents.....	34
1.6.7.1.2	Phenate Detergents.....	40
1.6.7.1.3	Salicylate Detergent.....	42
1.6.7.1.4	Phosphonate Detergent.....	43
1.6.7.2	Dispersants.....	44
1.6.7.2.1	Succinimides.....	47
1.6.7.2.2	Succinates.....	48
1.6.7.2.3	Mannich Type.....	48
1.7	Aim Of The Work.....	50
II	Experimental.....	51
II.1	Materials.....	51
II.1.1	Raw Materials.....	51
II.1.2	Solvents.....	51
II.1.3	Catalysts.....	55
II.1.4	Sulphonating Agents.....	55
II.1.5	Neutralizing Agents.....	56
II.1.6	Base oil 100N.....	57
II.1.7	Diluting Oils.....	58
II.1.8	Carbonating Gas.....	58
II.2	Sulphonation Processes.....	59
II.2.1	Sulphonation of HAB by conc. H_2SO_4	59
II.2.2	Sulphonation of LAB by conc. H_2SO_4	61
II.2.3	Sulphonation using SO_3 gas.....	61
II.3	Neutralization of Synthized Sulphonic Acid.....	62
II.3.1	Neutralization using Na_2CO_3	62
II.3.1.1	Comparative evaluation of sodium light and heavy alkyl benzene sulphonate.....	63

II.3.2	Neutralization using CaO.....	63
II.3.3	Preparation of Detergent-Dispersant Additive.....	64
II.3.4	Preparation of Super Basic Detergent Additive.....	65
II.4	Standard methods.....	66
II.4.1	Neutralization Numbers by Potentiometric Titration....	66
II.4.2	Kinematic Viscosity of Transparent and Opaque Liquids.....	68
II.4.3	Calculating Viscosity Index from Kinematic Viscosity.....	69
II.4.4	Sulphated Ash for Lubricating Oil.....	70
II.4.5	ASTM color of Petroleum Products.....	71
II.4.6	Oxidation Stability by Rotating Bomb.....	72
II.4.7	Flash point by Pensky Marten apparatus.....	72
II.4.8	Determination of Metal Content via (ICP).....	73
II.4.9	Structure Group Analysis.....	74
II.4.10	Detergent – Dispersant Tests.....	75
III	Results and Discussion.....	77
III.1	Physical and chemical properties of Alkyl Benzene.....	77
III.2	Light Alkyl Benzene Molecular Structure.....	78
III.3	Heavy Alkyl Benzene Molecular Structure.....	82
III.4	Sulphonation of Alkyl Benzene.....	86
III.4.1	Sulphonation of HAB by 98% H ₂ SO ₄	86
III.4.2	Sulphonation of LAB by 98% H ₂ SO ₄	91
III.4.3	Sulphonation using SO ₃ gas.....	92
III.5	Neutralization of Sulphonic Acid.....	94
III.5.1	Neutralization using Na ₂ CO ₃	94
III.5.2	Neutralization using CaO.....	96
III.6	Evaluation of Super Basic Additive.....	105
IV	Economical Feasibility Study.....	116
V	References.....	118
	Arabic Summaryالملخص العربي	