SUMMARY OF THE WORK

PART - I

Synthesis, Chracterization and Viscosity Studies of Homo and Copolymer of Methyl methacrylate and Evaluation of their Pour Point Properties in Different Lubricating Oils (Base Stocks)

This Part is divided into three chapters, Chapter I, Chapter II and Chapter III

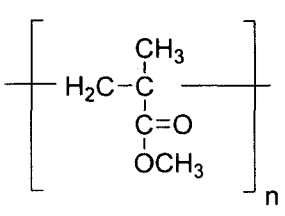
Chapter I A brief review of the present investigation

Chapter II This chapter is divided into two sections, Section A and Section B

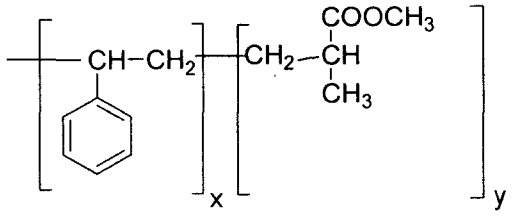
Section A comprises the Synthesis and Characterization of Homopolymer of Methyl methacrylate (MMA) and its Copolymers with Styrene and Evaluation of their Pour Point Depressant Properties in Lubricating (Lube) Oils.

Homopolymer of methyl methacrylate (MMA) and its copolymer using different compositions of styrene were synthesized and characterized. The viscosity measurements of the synthesized homopolymer as well as the copolymer in toluene solution at 313 K were performed. Different equations were used to calculate intrinsic viscosity, viscometric constant values and molecular weight of the synthesized polymers. The values of intrinsic viscosity and viscosity average molecular weight (M_v) obtained by the two methods (single point determination and graphical extrapolation) were compared in order to verify the validity of the single point determination for the polymers. Viscometric properties derived included the determination of specific viscosity (it determines the contribution of solute to the viscosity of the solution), the reduced viscosity (that provides the measurements of the polymer capacity of increasing the solution viscosity) and intrinsic viscosity. Structure of poly(Methyl methacrylate)

(structure I) and copolymer of Methyl methacrylate with styrene (structure II) is given below.



Structure I



Structure II

Section B comprises the Studies on the Viscometric Properties of MMA – Styrene Copolymers in Three Different Solvents in Comparison to the Respective Homopolymers.

Homopolymer of Methyl methacrylate (PMMA) and styrene (PS) and their copolymers were synthesized and characterized. The viscometric measurements of the synthesized homopolymers as well as the copolymers were performed in three different solvents. Different equations were used to calculate intrinsic viscosity and viscometric constant values of the synthesized polymers. The values of intrinsic viscosity and viscosity average molecular weight obtained by the two methods (single point determination and graphical extrapolation) were compared. Measurements of viscometric properties included the determination of specific viscosity (it determines the contribution of solute to the viscosity of the solution), the reduced viscosity (that provides the measurements of the polymer capacity of increasing the solution viscosity) and intrinsic viscosity.

Chapter III Consists of experimental and References

PART II

Studies on Synthesis, Characterization, Pour Point Depressant and Viscosity Index Improver Properties of Homo and Copolymer of Acrylates with Styrene

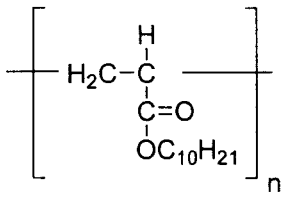
This Part is divided into three chapters, Chapter I, Chapter II and Chapter III

Chapter I A brief review of the present investigation

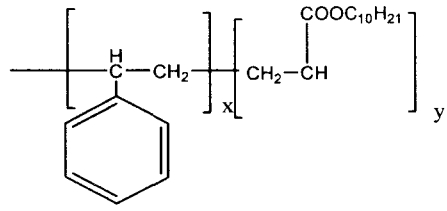
Chapter II This chapter is divided into three sections, Section A, Section B and Section C

Section A comprises the Synthesis of Poly(acrylates) and their Copolymer with Styrene and Evaluation of their Performance as Pour Point Depressant for Lubricating Oil

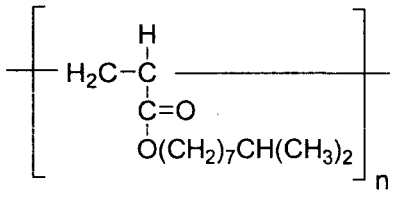
The potential for use of homopolymer of decyl acrylate, isodecyl acrylate, dodecyl acrylate and their copolymers with styrene as pour point depressant (PPD) additives in lubricating compositions has been investigated. The polymers (homo and copolymers) were prepared by free radical polymerization in toluene solvent, using benzoyl peroxide (BZP) as initiator and employing different levels of styrene (wt %) in the monomer mixture and were characterized employing TGA, FT-IR and FT-NMR techniques. Since the performance of such kind of additives in the field condition is very much dependent on the structure and morphology of the polymer dissolved in solvents, viscometric studies of the dilute solution of the polymers in toluene have also been employed. The resulting copolymers were evaluated for potential use as pour point depressant in lubricant compositions through ASTM method. The results indicated a good improvement in the performance of some of the experimental copolymers as compared to reference sample of poly(decylacrylate). Structure of poly(decyl acrylate) (Structure I), Copolymer of decyl acrylate with styrene (Structure II), poly(dodecyl acrylate) (Structure III), Copolymer of dodecyl acrylate with styrene (Structure IV) are given below-



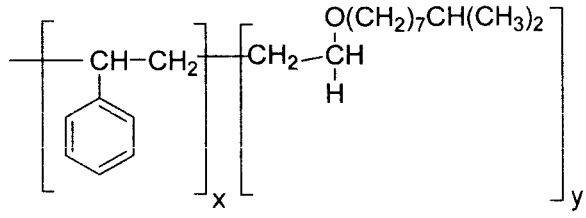
Structure I



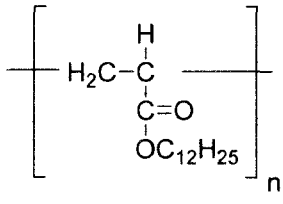
Structure II



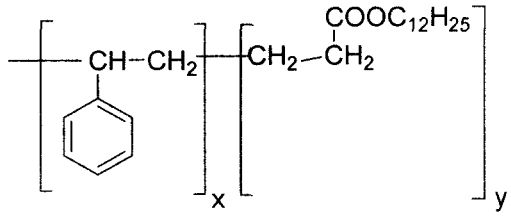
Structure III



Structure IV



Structure V



Structure VI

Section B comprises the Evaluation of Poly(acrylates) and their Copolymer as Viscosity Modifiers

Some long chain polyacrylate additives, such as poly(decyl acrylate), poly (dodecyl acrylate), poly(isodecyl acrylate) and their copolymers with styrene were synthesized and characterized. The enhancement of viscosity index (VI) of mineral base oils (lubricating oils) by the addition of prepared polymer as viscosity index improvers (VII) has been studied. Irrespective of the polymers (homo and copolymer) and nature of the base oils, VI values increases with the increase in additive concentration in the base oils studied.

VI values of the homopolymers indicated that better performance is obtained with the acrylate having greater chain length of the alcohols in the acrylate monomer. Again, branching in the carbon chain of the alcohol, detoriates the performance of the acrylate when used as a VI improver in the lube oil. Thus the chain length and its arrangements in the polymer of a viscosity modifier play a significant role when added in the lube oil to act as a VI improver.

Section C comprises the Comparison of Viscometric Parameters of the Homo and Copolymer of Poly(decyl acrylate) in Lubricating Oil

Viscometric measurements of the synthesized homopolymer as well as that of the copolymer were performed in the base oils at 40^0C. Different equations were used to calculate intrinsic viscosity and viscometric constant values and molecular weight of the synthesized polymers. The values of intrinsic viscosity and viscosity average molecular weight obtained by the two methods (single point determination and graphical extrapolation) were compared. Measurements of viscometric properties included the determination of specific viscosity (it determines the contribution of solute to the viscosity of the solution), the reduced viscosity (that provides the measurements of the polymer capacity of increasing the solution viscosity) and intrinsic viscosity.

Chapter III Consists of experimental and References

PART III

Synthesis Characterization and Viscosity Studies of Biodegradable Additives as a Potential Pour Point Depressant and Viscosity Modifier

Chapter I Short review on biodegradable lube oil additives

Chapter II

This chapter is divided into two - section A and section B

Section A comprises the comprises the Synthesis, Characterization, Viscosity Studies and Performance Evaluation of Polymer of Sunflower Oil and its Copolymers in Lubricating (Lube) Oil

Additives based on polymers of alkyl methacrylate used in lubricant composition improve the viscometric and rheological properties of the lubricant and provides fuel economy. They also looked upon to provide additional performance characteristics such as improved low temperature fluidity, disparsancy and thickening property. However, the recent demand for eco-friend technology guided us to incorporate the sunflower chemistry into the acrylate skeleton through the process of copolymerization in anticipation of getting an ideal blend of performance as well as eco -friend chemistry. The present investigation comprises the homo and copolymerization of sunflower oil with different mass fraction of methyl methcrylate (MMA), decyl acrylate (DA) and styrene, characterizations and their evaluations as a pour point depressant in base oils.

Section B comprises the Evaluation of Synthesized Biodegradable Polymers as Viscosity Modifier for Lube Oil

Polymer of sunflower oil, poly(methyl methacrylate), poly(decyl acrylate) and copolymer of sunflower oil with methyl methacrylate and also with decyl acrylate were synthesized and characterized. The enhancement of viscosity index (VI) of mineral base oils by the addition of prepared polymer as viscosity index improvers (VII) has been studied. VI of blended base oils made by the addition of these polymers is found to pass through maximum. It was observed that the occurrence of maximum depends on the mineral base oil used and the type and concentration of VI improvers.

Chapter III Consists of experimental and References