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Types, Examples and Working Mechanism of Rheo-Improvers Lubricating Oil Additives

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Mini Review

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Abstract

Lube oil additives play an important role to facilitate our daily life. And the most important one is Rheo-Improve lubricating oil additive, because it is performance enhancing additive it consists of two type viscosity index improvers and pour point depressants. This mini review highlights of Rheo-Improvers importance. Viscosity modifier (preparation of some examples, general properties, working mechanism and factors that limit their action). Pour point depressants (examples, general properties, working mechanism).

Keywords: Rheo- improvers; Viscosity index improvers; Pour point depressant

Introduction

The major role in the science is how to make life so easy and eco-friendly. Lubrication is a feature of how to live an easy life. Lubrication in simply form is the use of material to improve one surfaces over another by using lubricant. Lube oil additives are chemical components or blend used at a specific treat rate, generally from 1 to 35 % of the oil volume, depending on the machine to provide one or more functions in the fluid. Some additives impart specific property to the base oil or suppress undesirable base oil properties and finally others enhance existing base oil properties. Lubricant is additive with oil mixed together to give very good efficiency and save the metal from friction and wear. There are many type of additives and today we will take about an important one (Rheo-improvers).

According to new classification of lubricating oil additives which depending on the working function the additives classify into 3 major category:

1. Rheo- improvers
2. Maintainers
3. Tribo-improvers

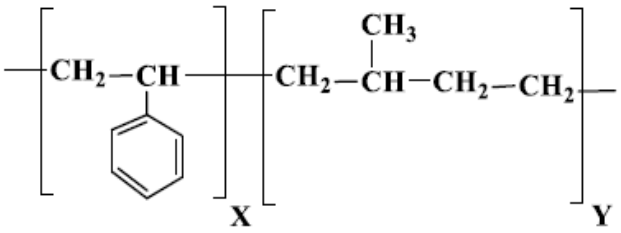
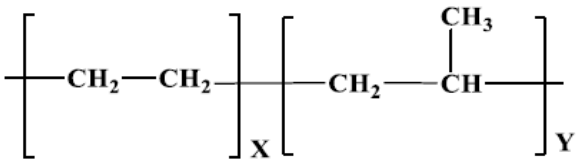
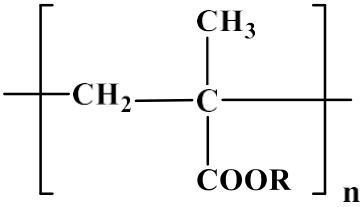
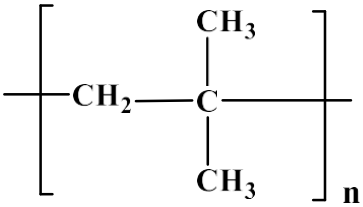
Rheo-Improvers (Rheological Properties Improvers)

Rheo-Improvers are responsible for fluidity of base oil. They contribute mainly under hydrodynamic conditions to the lubrication performance by changing or modifying the bulk properties of the liquid. They are lubricating performance additives. Rheological Properties Improvers could be categorized as tribo-improvers “indirect” between regimes of hydrodynamic and mixed lubrication [1].

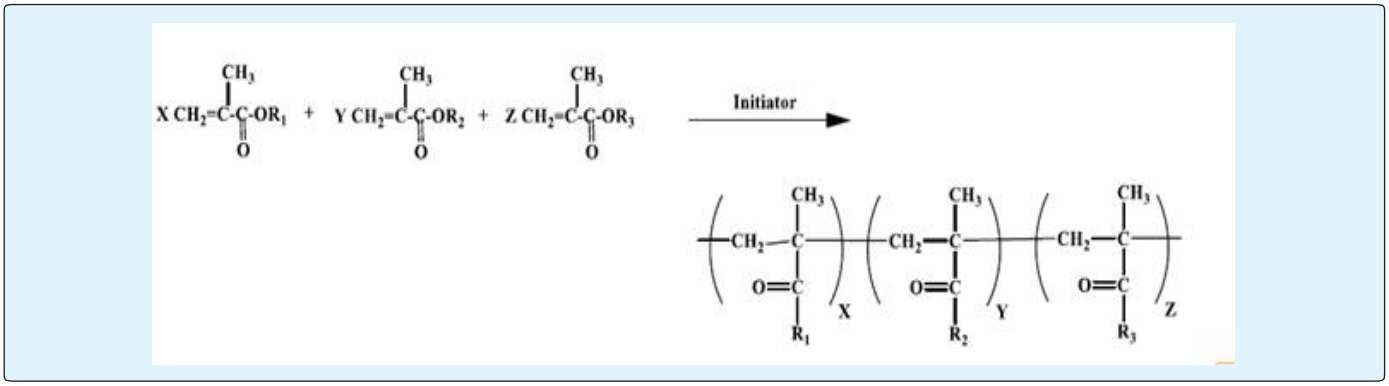
Viscosity Modifier

The most important property of the oil is viscosity. Formerly, viscosity modifier (VM) which can called also viscosity index improvers (VII) that reduce the rate of viscosity change with temperature. It is one of the performance additives engine lubricants. The bulk properties are dependent on the structure of the base fluids [1]. Structural features of VM are polymers and copolymers [2-9].

Examples [10]**:**

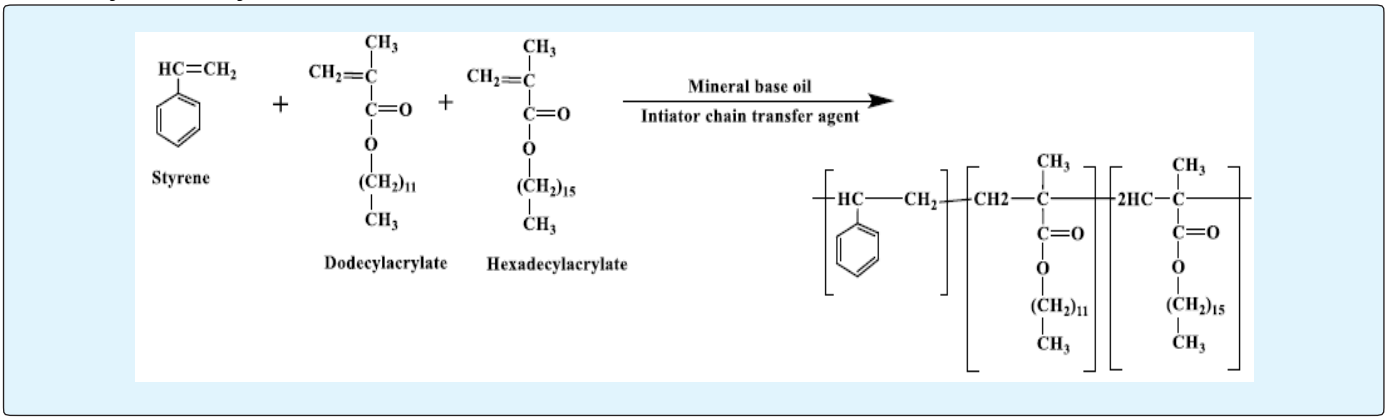
Some Examples of Viscosity Modifiers	Chemical Structure
SIP: styrene-co- isoprene	 SIP
OCP: olefin copolymers and the major classes are poly alkyl methacrylate and poly isobutylenes.	 OCP
	 Polyalkylmethacrylate
	 Poly Isobutylenes

PMA : polymethacrylates preparation



Preparation of Terpolymers as Viscosity Modifier

SPE: Styrene Poly Ester



This terpolymer in hexadecyl acrylate 70%, styrene 10% and dodecyl acrylate 20% give very good result as viscosity index improver 145 viscosity index [11].

Mechanism of Viscosity Index Improver: Polymers molecules expands as the temperature is raised, due to the increase in the solvation power, this increasing in size of the micelle counterbalance the reduction of the viscosity of the lube oil due to increasing temperature [12-14] , so VM decreases the changes of viscosity with temperature of the mixture [1] (Figure 1).

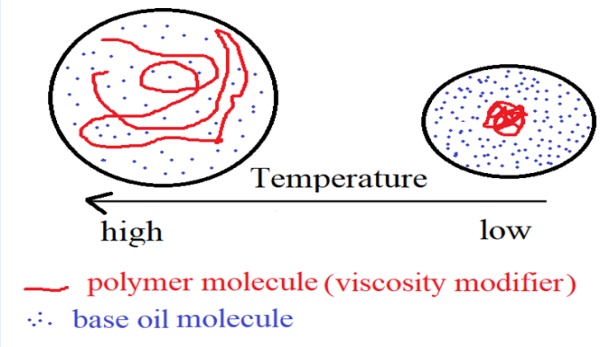


Figure 1: Working Mechanism of Viscosity Modifier.

General Properties of Viscosity Modifier: These additives are expected to satisfy the following general requirements:

1. Oxidation stability and absence of corrosive action;
2. Thermal stability (due to the viscosity modifiers are polymer so to make degradation need trace of peroxides catalyst not affect by temperature);
3. Compatibility with other additives present in the oil [10]

Factors that Limit the Action of Viscosity Modifiers

1. Nature of the base oil (chemical structure of base oil);
2. Concentration of the additive (an optimum concentration);

3. Molecular weight of the additive (increase the molecular weight increase the efficiency as viscosity modifier until limited weight);
4. Polymer composition (effect of the substituted radical, R);
5. Pressure (due to relationship between the pressure and temperature) [10, 2].

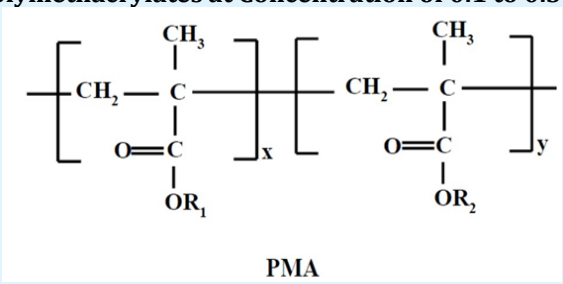
Pour Point Depressants

Pour point depressant is one of the performance additives engine lubricants [10]. The pour point is defined as enable lubricant to flow at low temperatures. The pour of an oil has been considered for a long time as the principal properties affecting the cold starting of an engine. At very low temperature the oil freeze (oil cannot pour or flow) that causes damage to the machine elements and although uses the pre-heating system but loose time and energy [1]. The reason of pour less is after refining and get lubricating oil there are fine wax crystals in the mineral oil which accumulate together under low temperature and make a lattice interlocking network which absorb the oil and prevent its pour or flow, so here appear the important of pour point depressant [15-24].

Structural features of pour point depressant (PPD) are polymers can be used to interfere with wax crystal growth and alter the formation of the interlocking network for examples:

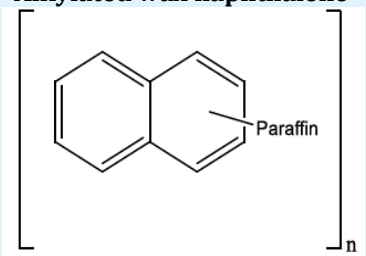
Examples

Polymethacrylates at Concentration of 0.1 to 0.5%

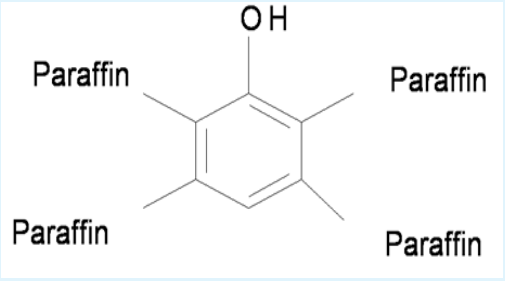


PMA

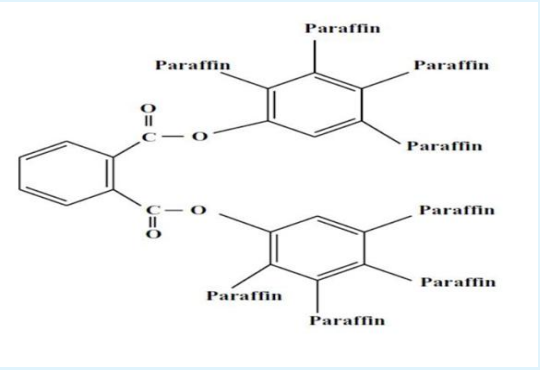
Alkylated wax naphthalene



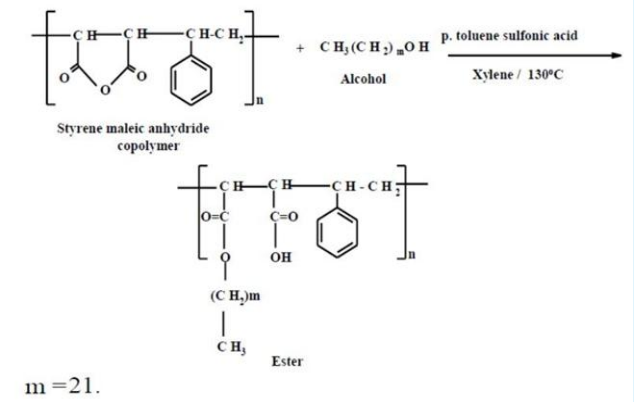
Long Chain Alkyl Phenols (Tetra Paraffin Phenol)[10]



Di (Tetra Paraffin Phenol) Phthalate



Esterification of Styrene-Maleic Anhydride Copolymer as Pour Point Depressant



This copolymer by using docosanol as an alcohol and in concentration 0.0625% give very good result as pour point depressant ≥ -24 [10,14].

Mechanism of Pour Point Depressant

When oil subjected to very low temperatures (freeze) may undergo changes in their physical properties:-

1. Solidification but without precipitation of a solid phase;
2. Solidification with precipitation of a solid phase [25-27]. This solid phasemay be according to size divided to

a) Macrocrystals of paraffins which cause total solidification of oil.
b) Microcrystals of wax which swell, forming a crystalline structure trapping a significant volume of oil [10, 14], so pour point depressant mechanism in simply way it means modify wax crystal formation to reduce interlocking at low temperatures and increase mobility of wax crystal around the flexible pour point depressants allowing the oil to continue to flow by adsorbed this type of additives on the wax crystals and inhibit the growth of a lattice interlocking network [1, 13, 15].

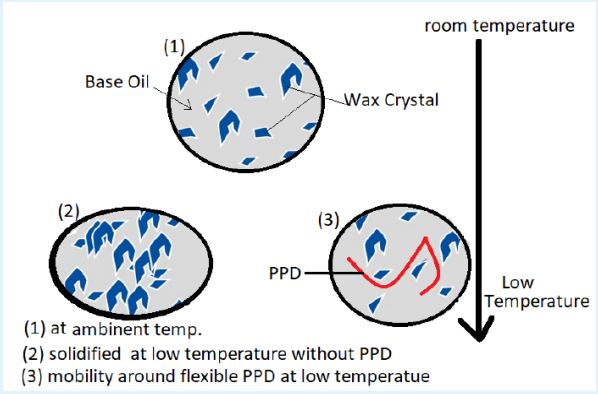


Figure 2: Working Mechanism of Pour Point Depressants.

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