SUMMARY

This thesis includes four chapters:

1- Chapter 1, includes introduction and aim of work.

2- Chapter 2, includes materials and methods.

3- Chapter 3, includes results and discussion.

4- Chapter 4, includes the references.

Among the various polymeric additives employed to formulate modern engines and industrial lubricants, are the types which act as viscosity index improvers and pour point depressants.

This work is aimed at synthesing of some high homopolymers and copolymers which can be used to improve viscosity index and depress pour point for lubricants.

It can be a merit if these polymers acquired high shear stability under engines operation conditions.

Accordingly, the thesis is divided in the following parts:-

1. Introduction, which includes:
   - Properties of crude oils and their refining methods to produce lubricating base oils.
   - Classification of finished lubricating oils, either as engine or industrial lubricants.
   - Types of additives for lubricating oils, which in use to improve their properties or even enhance new properties.
   - Types, properties and effects of polymeric additives in use with different lubricants.
   - Polymerization techniques to synthesis different types of the polymeric additives.

2. Aim of the work is concentrated on synthesis of high polymers and copolymers, which can be used with base oils as viscosity index improvers and pour point depressants.

3. Experimental part, which includes the following:-
   - Methods to synthesis homopolymers and copolymers.
   - Properties of used materials and chemicals.
   - Specifications for used analytical and experimental instruments.
   - Measurements of properties for synthesized polymers which include the following:
     - Solubility in different base oils.
     - Molecular weight determination.
     - Structure characterizations via ^{1}H NMR and IR spectroscopy.
   - Measurements of performance properties for blends of synthesized polymers with neutral base oils, which include:
     - Measurements of viscosities at different temperatures.
     - Calculation of viscosity index for different blends.
   - Measurements of performance under different mechanical shear forces.
   - Measurements of pour point for different lubricant – polymeric blends at low temperatures.

4. Results and discussion, which includes:
   - Characterization properties for synthesized polymers.
   - Properties of synthesized polymers with neutral base oils.
   - Evaluations for polymers blends functions on properties of lubricant.

- Change in polymers chemical and their addition ratios are also considered.
- Relation between performance properties for synthesised polymers as additives with their monomers ratios, chain length of alkyl groups and final chemical compositions.

5. Summary

6. Sources and references for datas proposed techniques and evaluations methods, which are used allover the thesis.

In the experimental part the following reactions are carried out:-

a- Homopolymerization reactions to synthesis poly-alkylmethacrylates and polystyrenes.

b- Copolymerization reactions to synthesis styrene with the following monomers:

1- Octyl methacrylate (OCMA)
2- Dodecyl methacrylate (DDMA)
3- Octadecyl methacrylate (ODMA)

c- Quaternary copolymerization reactions between styrene and different monomers of alkylmethacrylates.

In all these reactions, dimethyl formamide (DMF) is used as a solvent, benzoyl peroxide is used as a free radical initiator.
Reaction temperature is 75 °C for a time of 4 - 7 hour.

Copolymers composition are evaluated and confirmed via ^{1}H NMR and IR spectroscopy.

To study rate of change in properties of polymer blends with base oils under different temperatures, copolymer of styrene-alkylmethacrylates is used at concentration 5% wt. Reaction temperature is withen the range from 30 to 90 °C.

Results are compared with homopolymers of polyalkyl methacrylates and polystyrenes under same conditions. whereas styrene-alkylmethacrylates copolymer viscosity values were intermediate among those of homopolymers, which improve the aim to prepare this copolymers.

Results are showed that styrene-alkylmethacrylate copolymers have viscosity values in between those of the other two homopolymers, such results support the thesis aim, i.e. to synthesis styrene-alkylmethacrylate copolymers with a good balance in their characteristics.

To detect the optimum percentage of monomers in the composition of copolymer which act as viscosity index improvers or pour point depressants, different ratios of styrene and alkylmethacrylate are used, from 0.1 mol to 0.9 mol styrene with vice verse 0.9 mol to 0.1 mol alkylmethacrylates. The best ratio is found at styrene 0.4 mol, with alkylmethacrylate 0.6 mol.

Molecular weight of synthesised copolymers are found within the range from 94509 to 385618, which is in accordance with what require to used as lubricant polymeric additives.

Influences of different parameters (chain length of different alkylmethacrylates and their incorporation ratios) on properties of synthesized copolymers are measured and discussed.

Viscosities and pour points for copolymers dissolved at different concentrations (0.5 – 2% wt) in a mixture of base oils (80% neutral base oil 260/290 and 18-19.5% bright stock oil) at temperatures 40 °C & 100 °C, are measured, then their viscosity indices are calculated. Obtained results are according to the following:

Synthesised copolymers and quaternary copolymers at conc. 2 wt. %	Change in			
	Viscosity, cSt		Viscosity index	Pour point
	at 40 °C	at 100 °C		
Blank lubricant mixture	69.7	6.8	92	-3
Sty-octyl methacrylate (I)	86.76	10.88	111	-18
Sty-dodecyl methacrylate (II)	100.23	12.59	120	-3
Sty-octadecyl methacrylate (III)	124.71	21.09	196	-15
Sty-OCMA-DDMA-ODMA (IV)	94.65	11.65	112	-6
Sty-OCMA-DDMA-ODMA (V)	105.55	13.09	120	-18
Sty-OCMA-DDMA-ODMA (VI)	93.89	11.48	110	-3

These results indicate that synthesised copolymers and quaternary copolymers can be used as viscosity index improvers and/or pour point depressants.

As these types of copolymers are not yet available commercially, therfore their performance efficiencies are comparatively evaluated with available commercial typed, e.g, styrene – isoprene copolymer and polyalkyl methacrylate.

Synthesised copolymers are found with performance properties better than commercial ones.

Shear stability index (SSI) is 16.9 @100 °C for synthesised copolymers found better in comparison to 25, for styrene-isoprene copolymer and 55 for polyalkylmethacrylates .

On the other hand, it has been found that synthesized [Sty-OCMA-DDMA-ODMA (V)] quaternary copolymer is the most efficient pour point depressant. It acquires more depression in pour point than polyalkylmethacrylate commercial additive, wheras it decrease from –3 °C to –18 °C at concentration of 0.5 % wt, while depression with the commercial additives is stopped at –12 °C

Achieved results can greatly help in synthesis of polymeric additives with high efficiency for multigrade motor oils over prolonged performance periods.