CHAPTER 5

CONCLUSION AND SUGGESTION

5.1 Conclusion

The ability of an engine oil viscosity modifier to provide the thickening performance in service is related to molecular size and molecular structure. Linear polymer used in this study with GPC polystyrene equivalent molecular weights of 180,000 was considered to be least stable to viscosity loss. Olefin copolymer sheared down more rapidly than other viscosity modifier types included in this study with a small change in viscosity loss after 30 cycles shear test. High molecular weight of 300,000 hydrogenated styrene isoprene star copolymer were shown to be extremely stable to number of shearing cycles about three times more than the ethylene propylene copolymer. Thus molecular weight gave an important effect to the shear behaviour. Increase in molecular weight also demonstrated that permanent viscosity loss became more pronounced.

Olefin copolymer can be destroyed more easily by permanently bond breaking. Star polymers sheared their arms gradually over a period of time beyond the standard 30 cycles shear test. Higher molecular weight and more branching isoprene styrene star polymer however demonstrated shearing behaviour similar to linear olefin copolymers with less shear stability. It is suggested that critical molecular weight also influences to the viscosity loss in Kurt Orbahn Injector shear test.

All viscosity modifier polymers included in this study were all passed the standard shear test according to JASO T 903 standard for four-stroke motorcycle application and also for other automotive applications of stay-in-grade performance. Therefore standard 30 cycles Kurt Orbahn Diesel injector rig test may not be suitable to distinguish or select the type of viscosity modifier. Modern lubricants have to perform in increasingly severe environments which are submitted to higher mechanically thermal, oxidative stresses for extended periods of time. Formulation for today then has to be formulated with good quality base oil, performance additive packages and viscosity modifier polymers. Many polymers types are already commercially available to produce multigrade oils but they provide different performance characteristics. Therefore, selecting type of viscosity modifier is also very important, to provide maximum performance with less effect from polymer properties.

Star type viscosity modifier polymers of this study showed the benefits in allowing for the use of heavier base stock. Star polymers were found to give better thickening efficiency and lower contribution to the low temperature test than olefin copolymer. This feature is useful in today's strict volatility requirements and to enhance the benefit of using multigrade oil.

5.2 Suggestion

Further analysis on effect of mechanical shear degradation on the viscosity modifier polymer can be studied more clearly by considering at molecular level of resulting viscosity modifier polymer using GPC technique. Changes or trend of polymer degradation for example changes of molecular weight and molecular weight distribution can be used to compare the

performance and polymer degradation mechanism of each type of viscosity modifier polymer after series of shearing cycles.

Four-stroke motorcycle lubricant is required only one oil to provide lubrication for all engine components including engine, transmission and gear. Therefore results based on shear stability bench test may not be adequate in viscosity modifier selection. Results of this mechanical shear test could be used to identify the relationship between bench test and the actual field trial shear behaviours.

Viscosity modifiers may also act differently in different type of base oils. Other four base oil groups classified by API including hydrocracked, catalytically dewaxed oil, wax hydroisomerization and synthetic polyalphaolefin or ester could be used to determine thickening and shear stability properties and interaction of viscosity modifier with base oil. These base oils differ from one another by the chemical nature and concentration of waxes. One viscosity modifier chemical type may be useful or give maximum benefit in one type of base oil but may not provide the same benefit to another type.