PART-2

BIODEGRADABLE MULTIFUNCTIONAL LUBE OIL ADDITIVES USING MODIFIED VEGETABLE OILS

PART-2/CHAPTER-1

BACKGROUND AND OBJECTIVE OF THE PRESENT INVESTIGATION

The automobile industry is flourishing day by day with the advent of new technologies and ever exploring ideas. Utilization of polymeric additives, their modification to obtain maximum effect with minimum dosage, or application of new potential lubricating additives has remained the key areas of research in this industry. But over the decade environmental issue has become the main concern which has pushed such industries towards a challenging area to adopt comparatively greener initiatives. Hence replacement or minimizing the application of traditional additives through the introduction of biodegradable ones has gained much pace during the years. To maintain the ecosystem, non–conventional sources of energy are getting huge attention, and hence the use of bio–lubricant is very attractive to reduce fossil fuel exploitation and increase its sustainability. A considerable no of research in the area of plant and animal-based oil is happening [1]. Vegetable oils and modified vegetable oils have become sustainable alternatives to petroleum-based materials for industrial applications due to their biodegradability, low toxicity, absence of volatile organic chemicals, easy availability, and relatively low price [2].

Vegetable oils are triglycerides consist of triglycerides (95–97%) and also mono- and diacylglycerides. Saturated fatty acid like tetradecanoic acid(14:0),palmitic acid(16:0),Stearic acid (18:0) and unsaturated fatty acid(MUFA or PUFA) like oleic acid & ricinoleic acid(18:1),linoleic acid(18:2),linoleic acid (18:3) forms tri-ester with glycerol in a varying ratio.

Vegetable oils have been used in various industrial products like wall finishes [3], paints [4], electrodeposition paints [5], water thinnable primers [6], and printing inks [7].

The viscosity Index of most vegetable oils is generally high compared to mineral oil. Another important property of vegetable oils is their high flash point. Most importantly, vegetable oils are renewable biodegradable, less toxic, and may reduce dependency on imported petroleum oils in the future, all of which account for a greener approach. But vegetable oils in their natural form suffer from insufficient oxidative stability due to a high percentage of unsaturation present in their backbone which implies that the untreated oil will get oxidized quite easily and becomes thick and polymerized to plastic-like consistency [8]. But this can be overcome by some modifications such as radical polymerization, epoxidation, transesterification, and selective hydrogenation [9-10].

Plant oil can be classified as edible or non-edible. The largest sources of vegetable oils are annual plants such as soybean, corn, linseed, cottonseed, or peanuts and some oil-bearing perennials such as the palm, olive, or coconut[11]. Among them, soybean oil has conquered one of the most prominent positions mainly because of its availability and composition for the production of biodegradable lubricant additives. Now linseed oil which is a colorless to yellowish oil obtained from the dried, ripened seeds of the flax plant (Linum usitatissimum), contains similar triglyceride as that of soybean oil but with a much larger amount of linolenic acid(18:2). Therefore, the level of unsaturation for the triglyceride in linseed oil is somewhat greater than that for soybean oil[12]. The production of linseed oil seeds in India is high enough to make it acceptable from an economic point of view. Most importantly linseed oil is prone to get polymerized by itself and hence can be used as

an impregnator either in natural form or blended with combinations of other oils, resins, or solvents, as a pigment binder in oil paints, as a plasticizer, and hardener in putty, in the manufacture of linoleum and wood finishing [13]. Some recent work on modification of vegetable oil as a potential lube oil additive are summarised below-

1. Cakmakli, B(2004) Investigated linseed oil and its peroxidation in air or oxygen flow at room temperature. The application of these Polymeric peroxides in swell management and tissue engineering was studied[1].
2. Becker, R, Knorr, A (1996) analyzed antioxidant efficiency of low erucic rapeseed oil as an oxidation inhibitor[8].
3. Ashraf, M, S, Ahmed (2007) investigated epoxy vegetable oil for blending with polymers of PMAA to improve physical and mechanical properties. Dehydrated epoxy castor oil was used in this case[13].
4. Ghosh, P, Karmakar, G,(2014) investigated biodegradable multifunctional lube oil additive based on sunflower oil in a solvent-free synthesis of polymers using thermal or MW irradiation using BZP and performance analysis as multifunctional lube additive[14].
5. Ghosh, P, Talukdar, S,(2020) investigated rice-bran oil homo and its copolymer with dodecyl acrylate and styrene as multifunctional additive[15].
6. Ghosh, P, Saha, D(2018) synthesized homo and copolymer of castor oil with alpha-pinene using AIBN as radical initiator and analyzed their additive performance[16].

Due to such versatile application of vegetable oil along with its fruitful properties such as ready to polymerize tendency, high unsaturation, easy availability, and some more, have provoked us to explore it towards the preparation of eco–friendly polymeric additives. Here we have prepared Castor oil and acrylate-based copolymers, Rapeseed oil styrene-based homo and copolymers, and rice-bran oil-based homo and copolymers with acrylate and alpha-pinene as potential lube oil additives followed by their characterization involving FT-IR, NMR, GPC, and their performance terms of VII, PPD, TGA, Biodegradability, antiwear property were monitored.

REFERENCES

References are given in BIBLIOGRAPHY under "**Chapter-1 of Part-2**".