Study of resource-saving viscosity modifiers of used oils

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Abstract. Experimental data were obtained for AA copolymers obtained as resource-saving thickeners using compensatory copolymerization of KS. The refractive index of the obtained heptilacrylate (HA) ether was determined on a digital refractometer DR301-95. The molar mass and density of the ether obtained and its solubility in solvents in ethanol, acetone, DMF and benzene were also determined. We also beat HA ether + styrene in a 1: 2, 1: 1, 2: 1 mole ratio.

1 Introduction

Large-scale measures are being taken in Uzbekistan to restore and purify used oils, improve their quality and develop high-quality technical oils. When using motor, transformer and industrial oils, they accumulate oxidation products, mechanical compounds, organic compounds and other contaminants, which drastically reduce the quality of the oils. Waste oils containing contaminants cannot meet demand and must be replaced with new oils. Waste oils used to store valuable oils are collected and recycled, which is extremely cost effective [1-4].

In used oil recovery, used oils can be purified based on the following physical-chemical, chemical and physical processes. The composition of used oils should not exceed 4% of water, emulsions, semi-liquid and liquid products. Such an assessment does not require complex technology for the recovery of used oils [5-8].

Currently, targeted research is being carried out around the world to improve resource-saving technologies and equipment for cleaning and regenerating used oils. In this regard, it is important to develop an improved design scheme for the waste oil purifier, to implement the process of cleaning oils from oxidation products on a resource-efficient basis. In this scientific work proposed by us, an improved schematic diagram of a laboratory device for cleaning oils used with polyacrylates has been developed. As a result of testing, the proposed copolymers were found to be extremely effective in used oil refining and recommended as resource-saving modifiers for used oil refining based on synthesized copolymers [9-12].

In this study, a new viscosity modifier (MV) for used waste oils is proposed as promising modifiers - good thickening ability, high resistance to destruction, significantly better quality compared to imported analogues.

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2 Methods

The development of practical aspects of the use of polymeric materials is closely related to the development of the synthesis of macromolecular compounds with new properties. Research on the production of new polymers is particularly promising in terms of saving resources and reducing the environmental burden on urban systems, including in the field of lubricants. Therefore, developments related to the participation of new monomeric compositions in polymerization changes are important, as well as the expansion of the range of composite homogeneous copolymers capable of performing the function of deformation-resistant viscosity modifiers (SVMs) by changing the synthesis conditions.

In initial studies, we formed a complex heptyl acrylate complex copolymer based on acrylic acid heptyl alcohol and obtained a composite copolymer from its monomers, then dissolved it in various DMF solvents, benzene, ethanol and acetone. Such thickeners extend the service life of lubricating oils and, accordingly, lead to savings in the consumption of starting oils and thickeners, which means they drastically reduce various mechanical and other waste oils [13-15].

To purify waste oils with polyacrylates, we used the new copolymers obtained by us by radical copolymerization of acrylic monomers with styrene at boiling and testing them as resource-saving MW (viscosity modifier) lubricating oils. In the experimental and research workshop, research work was carried out on the purification of used oils with polyacrylates.

3 Results and Discussion

Experimental data are obtained for AA copolymers obtained as resource-saving thickeners using compensatory copolymerization of KS. The refractive index of the obtained heptyl acrylate (HA) ether was determined on a DR301-95 digital refractometer (Fig.1,2). Also, the molar mass and density of the obtained ester and its solubility in solvents in ethanol, acetone, DMF, and benzene were also determined. We also beat the HA ether + Styrene in the ratio 1:2, 1:1, 2:1 mol.

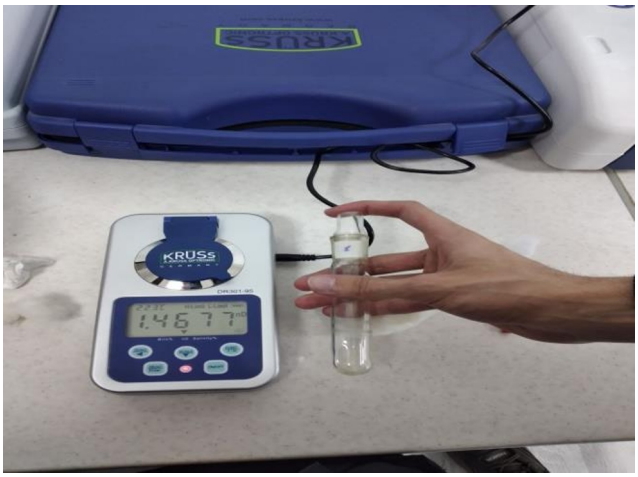

Fig. 1. Digital refractometer DR301-95

In this apparatus, the refractive index of heptyl acrylate ether (HA) was determined.

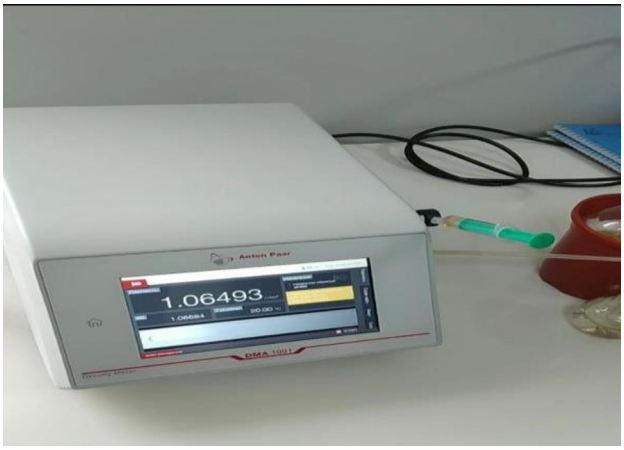

Fig. 2. Compact density meter DMA 501/ DMA 1001

In this apparatus, the density of heptyl acrylate ether (HA) was determined.

Synthesis of a number of copolymers based on AA+GS and St was carried out under comparable conditions. The new copolymers synthesized by us in the presence of various initiators and with a commensurate ratio of components using the compensation method have low MW values and a compositionally homogeneous structure. This suggested that they might have good thickening properties in mineral and synthetic oil bases. In this case, the homogeneity of their structure will manifest itself in resistance to destruction. To implement this assumption, the solubility of copolymers in petroleum and synthetic oil bases was first estimated. The solubility of the copolymers in oils was determined by studying the dissolution of copolymers at a concentration of 5 wt.% in a mineral oil base and a synthetic DOS base upon heating and stirring, followed by cooling to room temperature. In practical terms, we have obtained the heptyl acrylate HA ester. The synthesized samples of copolymers (AK-St, GA-St) are of interest as thickeners, because dissolve in DOS and used OM oils with the formation of stable solutions.

Description of the technological process and its scheme

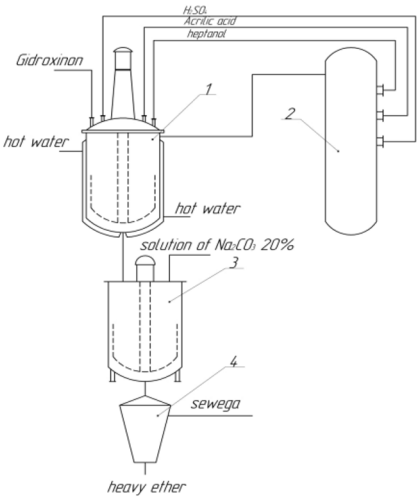

Fig. 3. Scheme of the laboratory installation for obtaining heptyl acrylate esher
1-reactor, 2-distillation column, 3-mixer, 4-separator

Acrylic acid, alcohol and sulfuric acid are added to the reactor (1) and heated to a pressure of 1 atm at 90° C. to form an ester, the reaction is controlled with hydroquinone. Reagents that have not reacted (2) are sent to the distillation column, regenerated and returned to the cycle. Upon completion of the reaction, the mass is sent to a shaker equipped with a stirrer (3) and neutralized with a 20% aqueous solution of soda ash (sodium carbonate).

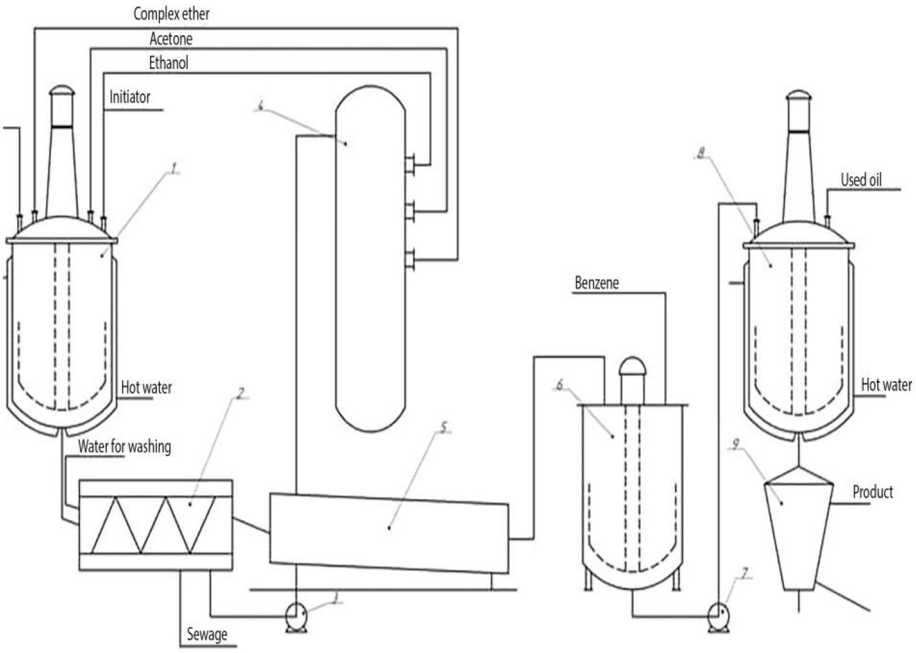

Fig. 4. Schematic diagram of waste oil treatment:
1.8 - reactor, 2 - drum filter, 3.7 - pumps, 4 - distillation column, 5 - drum dryer,
6 - mixer, 9 - separator.

In the reactor 1 we prepare the heptilacrylate (HA) ether copolymer and feed it to the drum filter 2, the copolymer does not react and is filtered from light volatile substances. The residue remaining on the filter is again washed in a small amount of filter drum equipment and sent back to the drum dryer for re-filtration and drying. After drying, the copolymer is sent to a mixing device 6. It is dissolved in benzene and reacted with a pump 7. In a reactor 8. The heated oil is subjected to a reaction at a pressure of 1 atm at a temperature of 70 ° C and the purified oil is separated from the residue using a separator 9.

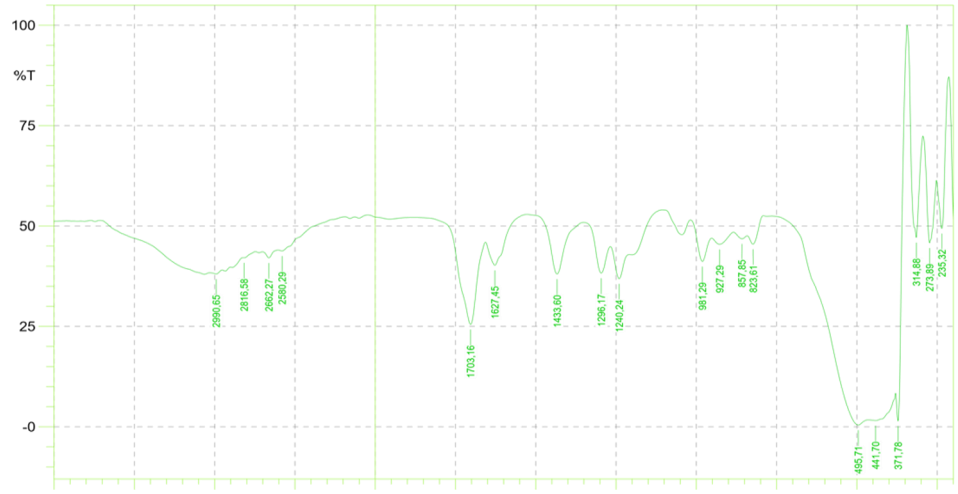

Fig. 5. Graph of variations in temperatures of the heated oil

Table 1. Correlation between Peak intensities of Base H and Base L

№	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	235.32	49.4	23.4	252.68	213.62	8.1	2.8
2	273.89	45.8	21.1	294.63	252.68	10.8	3.4
3	314.88	47.1	36.6	343.81	294.63	9.8	6.3
4	371.78	1.5	26.7	379.5	343.81	23.1	6.9
5	441.7	1.6	1.9	464.37	379.98	134.6	14.8
6	495.71	0.4	6.5	764.3	464.85	240.2	18.7
7	823.61	45.5	3.9	841.94	791.79	16	0.9
8	857.85	46.8	1.1	884.37	841.94	13.7	0.2
9	927.29	45.5	2.1	952.36	884.37	22.6	0.7
10	981.29	41.2	7.8	1018.42	952.36	22.5	2.2
11	1240.24	36.9	7.1	1267.72	1208.9	23	2
12	1296.17	38.3	8.6	1351.15	1267.72	29.3	2.5
13	1433.6	38.1	13.8	1527.15	1351.15	56.6	6.4
14	1627.45	40.2	7.3	1656.87	1527.15	42.6	2.8
15	1703.16	25.5	21.8	1872.9	1656.87	79.3	13.1
16	2580.29	43.8	0.7	2605.37	2187.78	130.5	-2.7
17	2662.27	42.1	1.7	2701.33	2605.37	35	0.6
18	2816.58	42.1	0.1	2823.81	2746.17	28.6	0
19	2990.65	38.1	0.6	3030.19	2952.56	32.3	0.3

In this case, an esterification reaction based on acrylic acid and heptyl alcohol occurs. In the esterification process, H_2SO_4 is used as a catalyst. The structure of the synthesized ether was studied by IR spectroscopy. The resulting GA-specific ester group appeared in 1296 regions.

In this study, a new viscosity modifier (MV) for used synthetic, semi-synthetic and mineral oils is proposed as promising modifiers - good thickening ability, high fracture resistance, significantly better quality compared to imported analogues.

4 Conclusions

1. In the process of boiling acrylic monomers with styrene by their radical copolymerization, a new copolymer was obtained and tested as a resource-saving MV (viscosity modifier) for used oils.

2. When studying the properties of radical copolymerization of acrylic monomers by a compensation approach under the conditions of solvent (monomer) boiling, copolymers were obtained.

3. We have obtained a heptyl acrylate ester modified with azoisomoic acid dinitrile (AAN), and received a patent certificate DGU No. 14025 issued by the Intellectual Property Agency under the Ministry of Justice of the Republic of Uzbekistan for the ester technology.

4. We managed to purify used synthetic, semi-synthetic and mineral oils used in various filters from local raw materials (polyester (TLFT-5 brand), Belting BF, CleanEl filter based on organic and inorganic fibers (Basalt + Cellulose + Macalatura).

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