ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 8, Issue 12 , December 2021

Complex Processing of Used Engine Oils

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ABSTRACT: The article presents an overview of modern trends in the utilization of used motor oils in Uzbekistan. A scheme of complex processing of used motor oils is proposed, which allows obtaining valuable raw materials for the production of motor and transmission oils, greases, petroleum and coal coke, road and construction bitumen.

KEYWORDS: Recycling used engine oil, mechanical impurities, regeneration recycling, vacuum distillation.

I. INTRODUCTION

Millions of tons of used motor oils are produced annually in Uzbekistan, which undoubtedly poses a significant threat to the environment. Meanwhile, by developing recycling processes, in particular the processing of used motor oils, instead of accumulating waste, it is possible to obtain promising energy resources, the rational use of which will reduce the cost of production of the petrochemical and coke chemical industries of our country.
Possible directions for the disposal of used motor oils in our country can be presented in the form of a diagram shown in Fig. 1.

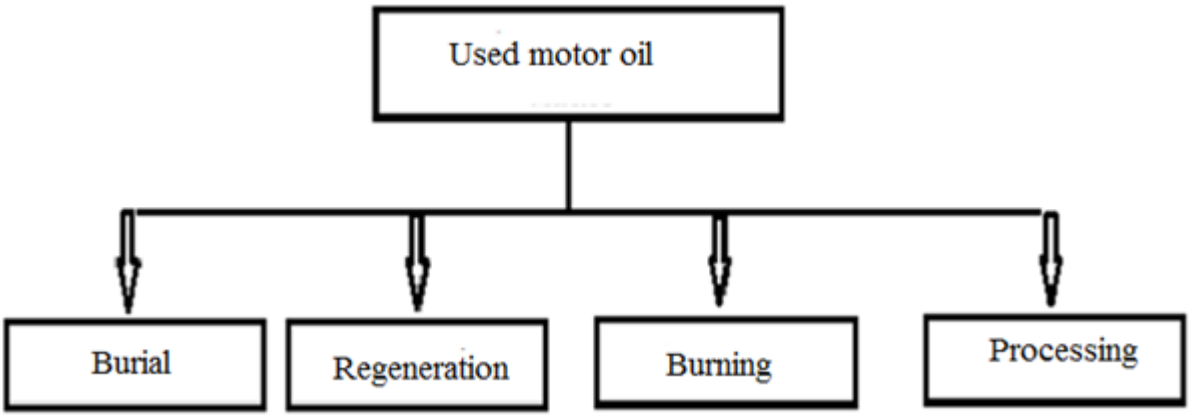

Fig.1.Directions of utilization of used motor oils in Uzbekistan

One of the earliest and economically impractical directions is the disposal of waste oils by draining them into the soil or reservoirs, which also poses a danger to the environment and leads to disruption of natural ecosystems.

The regeneration of used oils is a trend that began more than 40 years ago and is still developing rapidly. At most waste oil regeneration plants, mechanical impurities and water are simply removed from them [1], which cannot always restore the original properties of the oil. Therefore, deeper regeneration of oils occurs using vacuum, which, in turn, leads to an increase in the cost of regenerated oil.

It should be noted that solutions are also offered for the use of used motor oils with or without partial regeneration in a variety of technological processes. For example, work [2] shows the possibility of using waste oils as a complex collecting reagent for coal sludge flotation. The concept of using composite compositions for temporary protection of agricultural machinery from corrosion using used motor oils as a solvent base and a multifunctional additive has been developed [3]. On the basis of used motor oils, the author of the work [4] obtained soap (hydrated calcium and lithium) and hydrocarbon lubricants.

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The combination of factors such as high regeneration costs, environmental pollution from this process and, most importantly, stricter requirements for the quality of commercial oils has led to the development of technologies related to the use of motor oils as boiler and furnace fuel or its component.

II. MATERIALS AND METHODS

Meanwhile, methods of processing waste oils that allow to obtain a greater economic effect than from their combustion in heating systems have also begun to develop rapidly: joint processing in a mixture with oil at oil refineries and targeted processing by thermal cracking.

The existing mini-installation "Potram-Diesel", the action of which is based on the processes of thermal cracking and distillation, allows you to get from used engine oil: associated gas (3-4%), gasoline (4-5%), diesel fuel (80-85%), as well as semi-coke (3-5%) [5].

Despite such a variety of areas of use of used motor oils, in our opinion, it is more economically feasible to develop and implement schemes for the processing of used motor oils, allowing to obtain basic components for the production of motor and transmission oils, greases, on the import of which the economy of Uzbekistan depends.

Taking into account all the above, in this paper we will propose a scheme for the complex processing of used motor oils, the main directions of which are shown in Fig. 2

Considering the scheme, we note that the waste oil entering the processing is subjected to preliminary preparation: settling at a temperature of 60-65 ° C or centrifugation. At the same time, mechanical impurities and water are removed from it, which can accumulate in the oil during the operation of equipment, storage and transportation. In some cases, before settling or centrifugation, in order to wash out the remaining additives and, as a result, reduce the ash content of finished products, the oils may be pre-washed with water.

The prepared oil is subjected to vacuum distillation, where two streams I and II are obtained from it. Stream I is a fraction that boils at temperatures up to 400 ° C, which in its composition contains both fuel that enters the oil during the operation of equipment, and light fractions formed during vacuum distillation as a result of the decomposition of hydrocarbon raw materials.

Stream II is a fraction boiling at a temperature of more than 400 ° C, which in its composition contains resinous-asphaltene substances formed during the oxidation of oil hydrocarbons during the operation of machinery.

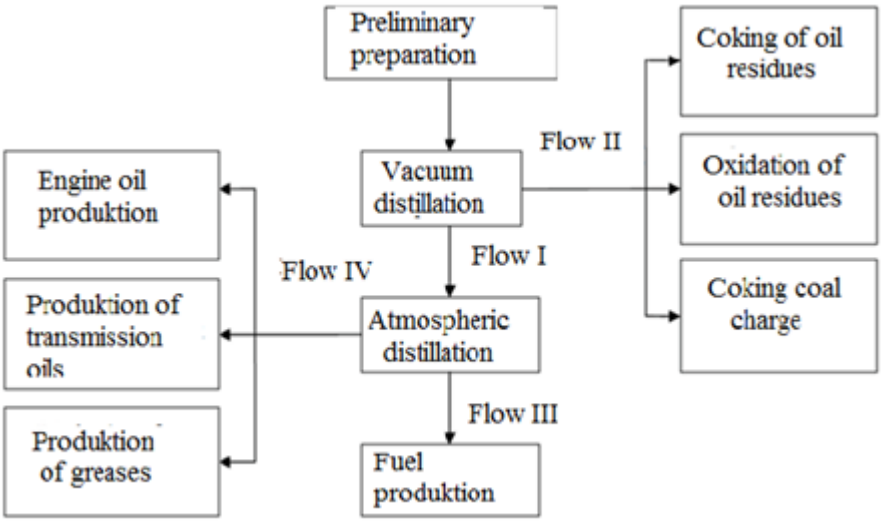

Fig:2. Scheme of complex processing of used motor oils.

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
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In the future, this fraction is a valuable raw material for the processes of producing petroleum coke, oxidation of oil residues to produce road and construction bitumen, as well as for coking coal charge. Moreover, in the process of obtaining coke from a coal mine, this fraction serves as a binding additive that allows increasing the percentage of cheaper, low-burning coals in the charge while maintaining the specified properties of coke.

Stream I is directed to atmospheric distillation, where it is divided into two streams: stream III - the fraction boiling off to a temperature of 360 ° C; stream IV - the fraction boiling off at temperatures of 360-400 ° C. In the future, stream III can be used in the production (compounding) of various types of fuel.

Stream IV is the basic component to which various groups of additives are added in the production of motor and transmission oils. Also, this stream can be a component to which lithium, calcium or sodium soaps are added in the production of greases.

According to the results of the conducted studies, it can be seen (Table 1) that stream II is suitable for the production of petroleum coke according to all verified indicators [6]. Bitumen obtained from such raw materials will have a number of positive properties: it will have low values of penetration, plasticity interval and sufficiently high values of extensibility, brittleness temperature and cohesion [7]. As a sintering additive in the charge for coking, this flow will also cause a lower ash content and a mass fraction of sulfur of the finished coke. Stream III is a by-product and may well be used as a component of motor and furnace fuel.

Table 1
Laboratory results

Name of indicators	Stream II	Stream III	Stream IV
Potential output,% (об)	37,50	6,20	54,30
Ash content, % (масс)	1,0	-	-
Mass fraction of sulfur, % (масс)	1,47	-	-
Coking ability, % (масс)	10	-	-
Fractional composition,% (об)			
- benzine fraction	-	2,49	-
- kerosene fraction	-	1,22	-
- diesel fraction	-	2,49	-
Kinematic viscosity at 100 ^{0}C, mm^2/s			
Viscosity index, units.	-	-	4,5
Flash point, ^{0}C	-	-	90
	-	-	219

Flow IV according to the above quality indicators, especially the viscosity index, mixed with a residual component with higher viscosity and flash point values, may well act as a base oil in the production of engine and transmission oils. This stream is also suitable as a base for thickening with various metal soaps in the production of greases [8].

If it is necessary to obtain more high-boiling products by fractional composition, then the flow I can be selected not up to 400 ° C, but, say, up to a temperature of 450 °C or 470°C. Losses during the implementation of the proposed scheme for the processing of used motor oils amount to 2.0% (vol.).

III. CONCLUSION

Of all the existing areas of utilization of used motor oils in Uzbekistan, the most promising is their processing, which allows, on the one hand, to reduce the amount of harmful, environmental-poisoning waste, on the other - to obtain valuable and relatively inexpensive energy resources.

Using the proposed scheme of complex processing of used motor oils, it becomes possible to obtain valuable raw materials for the most important processes of the petrochemical and coke chemical industries.

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ISSN: 2350-0328

International Journal of Advanced Research in Science, Engineering and Technology

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