The New Way of Wasted Oils Regeneration

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Abstract *— It has been established the possibility of waste mineral engine oil regeneration with thermooxidative method. The influence of temperature, pressure and process duration on the basis of regenerated engine oil has been explored. It has been suggested the using of thermooxidative oil regeneration with absorption and hydrogenation methods.*

Key words: thermooxidative, regeneration, waste oil, mineral engine oil, influence of pressure.

While using the engine, transformer, industrial oils the accumulation of oxidation products, contaminations and other impurities are possible what reduce the oil quality. Contaminated oils must be substituted by clean oils for reaching an acceptable effect[1]. Waste oils are burned as a fuel or regenerated for saving valuable raw materials, what is economically profitable. For renewal qualities of waste oils the different technological operations are used which are based on physical, physico-chemical and chemical processes and consist in processing waste oils for removing condemnations and aging products. As technological processes the following methods are used: mechanical (for removing water and solid impurities), thermal (vacuum distillation), physico-chemical (coagulation, adsorption). If there is no required meaning of operating qualities of regenerated oils, then chemical methods are used with more complicated equipment, reagent and accumulation harmful for environment wastes[2].

It is explored the possibility of restoration technical and operational qualities of waste engine oils mixture.

During the research it was defined the influence of temperature, pressure, oxidant exploitation and duration of the process on the operational qualities of regenerated oil.

According to the optimal conditions that were provided the regenerated oil was got, what can be used as a constituent of basic oils for getting lubricants.

I. The starting materials

In this paper, as original waste petroleum oil was used waste mineral engine oils obtained from service inspection. For her, it was found: kinematic viscosity v50 = 21,38 mm2/s, v100= 5,38 mm2/s; viscosity index (VI) 122; acid number (AN) 6,98 mg KOH/g; saponification number (SN) 116,24 mg KOH/g; ester number (EN) 109,26 mg KOH/g.

II. Method thermooxidative process of regeneration of waste oils

The installation consists of a reactor unit, compression system and air cleaning, cooling and trapping gaseous reaction products and devices for regulating and measuring temperature, pressure, expenditure etc.

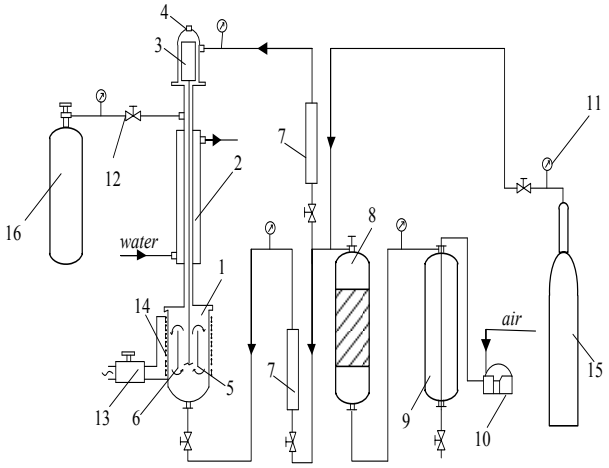

Fig. 1. Scheme of laboratory installation
1 – reactor 2, - refrigerators, 3 – electric motor, 4 – seal, 5 – thermocouple, 6 – tube, 7 – rotameter, 8 – adsorber, 9 – receiver, 10 – compressor, 11 – manometer, 12 – valve, 13 – laboratory autotransformer 14 – electric heater,
15 – balloon with nitrogen, 16 – to collect the gas balloon

To set the optimal conditions for regeneration method thermooxidative mineral waste motor oil necessary to examine the impact of several factors: temperature, duration of oxidation, pressure that will allow us to apply it to the regeneration of waste oils.

III. Influence of temperature on the process of thermooxidative regeneration of waste motor oil

Is well known that most of oxidative processes take place subject to the action of light or temperature effects, and therefore obligatory task is to study the effect of temperature on the process of waste oil regeneration thermooxidative method.

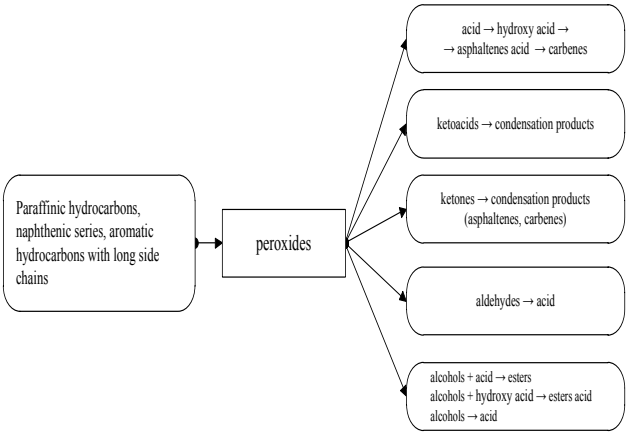

Fig. 2. Scheme of the main changes in the oxidation of hydrocarbons to molecular oxygen

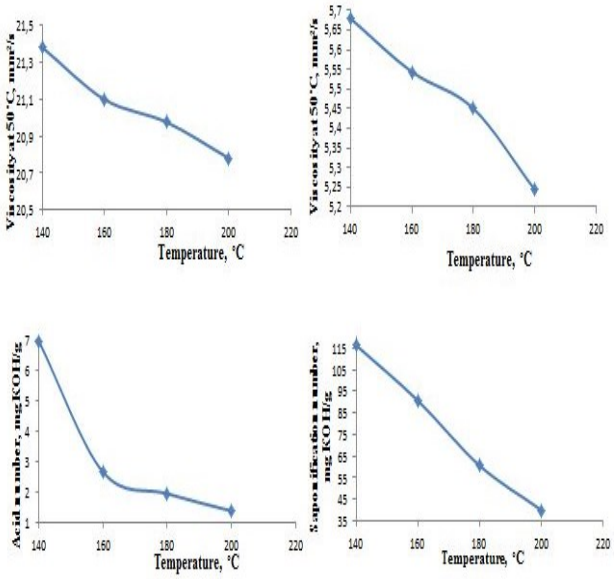

Fig. 3. Influence of temperature on technical - operational parameters of regenerated engine oil

As you can see from the results shown in the table. 1 with a gradual increase of temperature decrease viscosity, acid, ester numbers and saponification number. The least mentioned acid number reached 200 ° C and amounts to 1.41. This can be explained by the fact that the waste oil after using accumulated a significant amount of reactive primary products of oil oxidation (organic acids, hydroxy acids, aldehydes, ketones, resins, etc.), which are actively involved in the processes of oxidation, polymerization and seals. As a result, the flow of these processes leads to formation of seal products (asphalt-tar), and their removal during vacuum distillation reaction mass reduces the value of kinematic viscosity and VI.

Initial saponification number of high value, compared to the acid number indicates that basic part of acid is bound that when determining the acid number not interact with alkali. Reducing the value of this index indicates that during the thermooxidative regeneration bound acid converted into resin.

It was found that with increasing temperature the transformation of primary oxidized products in seal products. A further increase in temperature is not desirable because of its increasing more product accumulates seal and ultimately be close to the process conditions of the process of thermal cracking of hydrocarbons. Therefore, these research optimum temperature thermooxidative regeneration was selected 200 ° C.

IV. Influence of duration on the process of thermooxidative regeneration of waste motor oil

It is known that the duration of the reaction has weighty significance level of influence of temperature. Duration oxidation of motor oil in the engine combustion is an average of a few months to a year or more depending on the operating conditions of the vehicle. During this period, there is a constant converting hydrocarbon oils into products of oxidation: acids, hydroxy acids, resin. It is therefore necessary to establish the optimal duration thermooxidative regeneration process in which oil could be, to transform primary products of oxidation and polymerization seal products, remove them as sediment (residue) and get regenerated mineral motor oil with satisfactory performance.

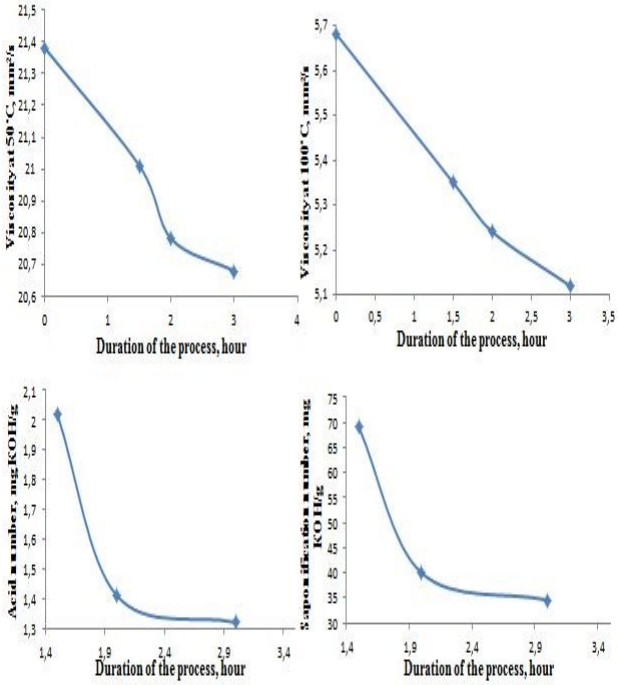

Fig.4. Influence of duration on technical - operational parameters of regenerated engine oil

As seen from the results given in Table 2, with increasing duration of the decrease kinematic viscosity, acid, ester numbers and saponification number. The least mentioned acid number achieved duration of 3 hours. and amounts to 1,32 mg KOH/g. This suggests that the increase for the duration of the constant temperature and pressure leads to conversion motor oil aging products (acids, hydroxy acids, ketones, aldehydes, resin additive decomposition products, etc.) to seal products (asphalt, tar, etc.). Created sealing product, including asphalt-resinous substances soluble in oil, and regenerative removed by vacuum distillation. With increasing duration of the process observed increase in seal products and sludge.

This once again confirms the fact that during the regeneration of waste oil thermooxidative oils primarily involved in the processes of oxidation, decomposition, polymerization and seal products "aging" motor oil. The growth duration of the process has to be a limited to a certain limit, due to process efficiency and reducing oil loss in its regeneration.

According to the results given in the Fig. 4, we can see that with increasing duration of the process

observed values improve operational performance motor oil regenerated. But further increase duration of process will lead to the desired changes oils components that have not changed over the duration of the use of motor oil.

V. Influence of pressure on the process of thermooxidative regeneration of waste motor oil

It's known that pressure has a significant influence on the course of chemical reactions in liquid and gas phases. Increasing pressure will promote better contact with the oxidant and waste oils directly accelerate the process of regeneration.

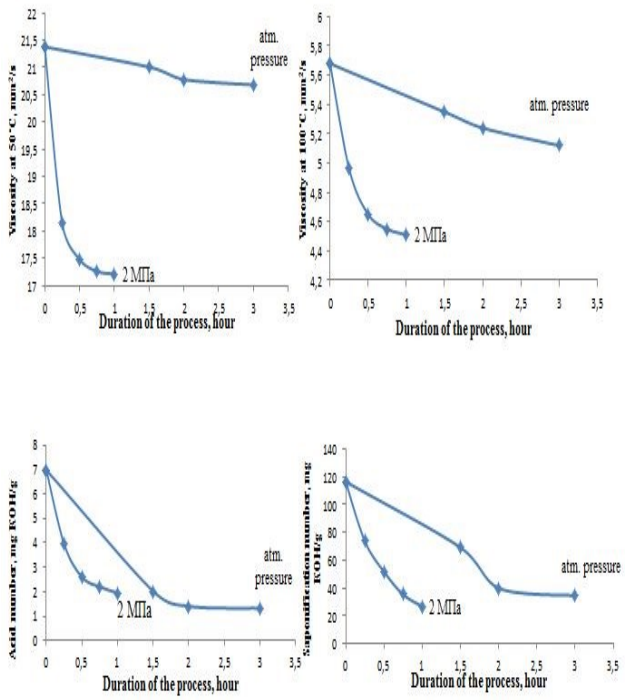

Fig.5. Influence of pressure on technical - operational parameters of regenerated engine oil

As we can see from the results given in Table. 3, the pressure has big importance on the process of thermooxidative regeneration of waste motor oils. This is confirmed by changes in viscosity reduction ester and acid number and saponification number. At the same time extracting oil regenerated from the reaction mixture by vacuum distillation was observed increase in waste residue. This fact suggests that due to excessive pressure is more fully dissolving oxidant in the thickness of the oil that enhances the conversion of primary products of oxidation condensation products. At the same time it was found that the change in pressure oxidant will intensify process only in homogeneous phase. In this case thermooxidative regeneration process most probably will take place in the liquid phase and less likely at the interface.

Conclusions

Investigated the process of thermo-oxidative recovery of certain operating properties of waste motor oil. Researched the influence of the main factors of process control (temperature, duration, pressure) on qualitative indicators of regenerated oil. Established that satisfactory values operational indicators of petroleum oil has regenerated 200 °C, duration of 3,0 hours and pressure of 2,0 MPa. Regenerated petroleum oil provided that additional processes of cleaning can be used in various industries.

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