Research and Development of Technical Means for Liquid Oil Cleaning

RESEARCH AND DEVELOPMENT OF TECHNICAL MEANS FOR LIQUID OIL CLEANING

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Abstract. This article deals with the problems of utilization of used oils, as well as ways of their regeneration. The methods as well as technical means for the regeneration of polluted oils were analyzed. Investigations were carried out on the researching the filtering materials and technical means for their implementation. Based on the conducted investigations, the authors propose to use a vibro-centrifugal unit for the regeneration of polluted oils.

Today, due to the increase in the number of cars, the consumption of oils is increasing all over the world, and as a result, the amount of waste in the form of usedoil is increasing, which is practically not utilized today, but is used as fuel or merges into water bodies and on the soil.
In Russia, averages of about 2-4% of used oils are processed. This is largely less than in most European countries, in which an average of 32 to 40% of used oil is processed. Therefore, the processing of used oils is relevant for our country [1].

The aim of the work is to analyze the existing methods and technical means of cleaning polluted oils to create a filtration unit.

An analysis of domestic and foreign literature shows that at present such methods as chemical-technological are widely spread where the polluted oil is treated in sulfuric acid [2]; The mechanical methods can be used forseparating solid particles (oil is passed through the filtering surface), passing oil through force fields and others [3]; Also there are electrostatic methods, which mean that in the unit oil is passed through an electric field (the process of electrophoresis). For better filtering, corrugated paper can be used [4].

To clean polluted oils, such units as the electrostatic cleaner ome-01-03, installations for the regeneration of foreign companies "PALL", and "Wotec", as well as filter presses of the "Saratov Plant of Technological Engineering" [5] are used.

In order to develop a technological scheme for the cleaning used oils, the main schemes for the processing and utilization of oils were considered.

Based on the investigations carried out, a plant was built for the regeneration of used oils. It is shown in Fig. 1.

Experimental studies of oil regeneration processes with the addition of adsorbent, sedimentation and subsequent filtration were carried out at this plant.

Before starting experiments with the adsorbent, experiments were carried out to find a filtering material for oil purification.

Semi-synthetic motor oil, SL / CF SAE 5W-40 [6], was used in the experiments.
In the course of experimental investigations, activated carbon, perlite, vermiculite, and cellulose were used as adsorbents. Various types of filters were tested, namely from perlite, vermiculite, activated carbon, paper, sawdust, wood flour and dust.

The search for a filtration element for the regeneration chamber was carried out. During the experiments, filtering elements such as perlite, vermiculite, activated carbon, crushed paper, wood flour were used [7].

At the first stage of the investigation, a method of static filtration (sedimentation) of polluted oils through various filter materials was used. The average filtration time of 200 ml of oil varied within 1.5-2 hours, and in the filtered oil an average of about 10-30% of the pollution was observed.

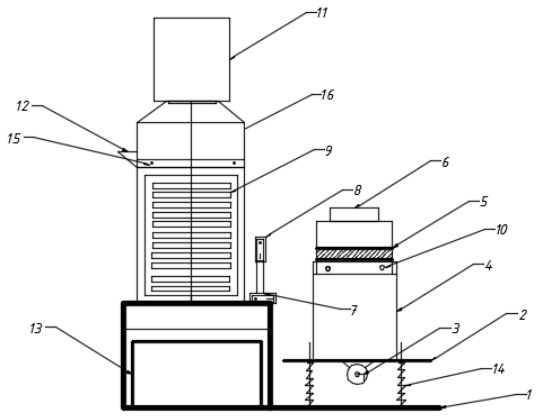

Figure 1. Scheme of the plant for the regeneration of used oils:
1 - bed; 2 - a vibrating platform; 3 - electric motor; 4 - the filter; 5 - filter elements; 6 - a jellied mouth; 7 - switch of the vibrating platform; 8 - the switch of the mixing plant; 9 - the blade; 10, 15 - flange connections; 11 - the electric engine; 12 - a receiving aperture; 13 –power supply block; 14 - springs; 16 - mixing capacity

In the future, in view of too long filtration time, vibration was used. At the same time, the number of turns of electric engine was about 2500-3000 rpm, and the amplitude of the oscillations was within (0.5-1) mm. A series of experiments showed that the filtration time decreased, on average by 30-50%, and was equal to about 50-90 minutes. The most effective filter elements were perlite, activated carbon, and pulp and paper wastes crushed in a hammer grinder and an increase of the pollutants number was observed in the filtered oil.

As the amount of pollution increased, we decided to use a double filter.

Filtering elements such as perlite and ground PPW (pulp and paper waste), vermiculite and ground PPW, activated carbon and ground PPW were used in the experiments. The average filtration time of 200 ml of working of averaged 120-140 minutes, but the amount of mechanical impurities and water decreased. As the filtration time increased, we decided to use the vacuum method. Three chambers were constructed, which are shown in Fig. 2. The average filtration time for each chamber (200 ml of oil) was about 10 minutes. In the first chamber, the greatest amount of mechanical impurities was observed but this number decreased. In the last chamber mechanical pollutions were practically not observed.

Figure 2. Filtration chambers

As a result of the obtained data, a 3-D model of the filter chamber was created for the vibration mixing unit whichhas the cranking speed was 250-400 rpm. The value of the crank eccentricity was 20 mm. The 3-D model of the chamber is shown in Fig. 3. Further, we created a special chamber for the model of this unit, we performed experiments on filtration with the use of vibration and vacuum methods. This model of the unit is shown in Fig. 4. After carrying out some experiments on a miniature plant, we obtained oil filtered from the mechanical impurities and water. The filtration time of 400 ml of the working of was an average of about 8 minutes, and according to the calculations, the average productivity of the unit for cleaning polluted motor oils was about 2.5 liters per hour.

The plant works as follows, the waste oil is poured into the filtration chamber (2), then the power is connected to the plant (5) and the vacuum cleaner (6)from the power supply unit(4), which functions as a pump, drawing air from the chamber through the hose (1).

Technical characteristics of the model:
shaft frequency ..... 10-300 rpm;
amplitude of oscillation ..... 20 mm;
pump power ..... 60 l / min;
created pressure ..... ~ 2-4 atm.

Figure 3. 3-D model of the chamber for cleaning polluted oils

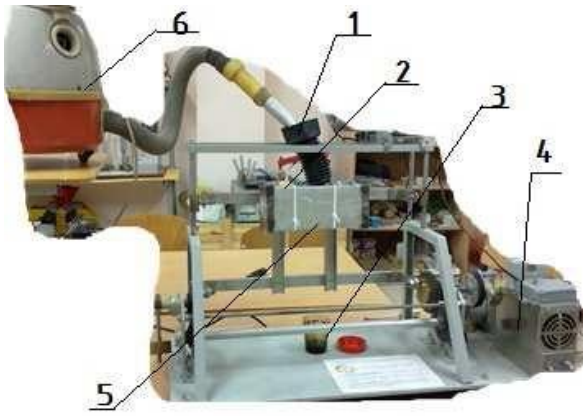

Figure 4. Model of the unit for cleaning polluted oils:
1 - a branch pipe of the pump; 2 - filtration chamber; 3 - container with filtered oil; 4 - control unit; 5 - installation of vibro-centrifugalcleaning; 6 - pump

Using this model, it is possible to design a filtration unit that will restore the original properties of the oils by mixing the working of with the adsorbent and, after several stages of filtration, the oil will restore its original properties, which will allow it to be reused. Such a process unit for the cleaning of used automobile oils is multifunctional and can be used not only for waste oil cleaning, but also in the future for other polluted liquid media of related industries [8]. The main purpose of this unit is the regeneration of polluted oils.

For Russia, the development of such technological equipment will allow reducing the use of valuable resources of the country because working of materials will be used, the price of which is several times lower than the new ones.

Acknowledgments
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