ANALYSIS OF THE POSSIBILITIES OF TRANSFORMATION A USED INDUSTRIAL OIL IN GENERAL USE GREASE

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The theme of this article aims to solve a very important problem for the industry of regeneration of petroleum products, namely: the reuse of oil products and greases so that their loss is minimized simultaneously with the reduction of the beneficiaries(1 expenses by regenerating at least three times the used oils. both for cooling the machine and for thermochemical treatments. In this way the neutralization of the mentioned petroleum products must be considered as a last resort.

The paper has the methodological and theoretical-scientific support in the specialized literature, both regarding the current stage of industrial oil regeneration and for obtaining general-purpose greases with a high degree of applicability.

Keywords: industrial oils, greases, environmental protection, saving resources

1. Introduction

The oils used in machinery during the production process become impurified with metallic and non-metallic inclusions.

In these mineral oils are found soap dispersions of light metals called greases or oily liquids. The light metals whose soaps are used in the thickening of oils or oily liquids are sodium (Na), calcium (Ca), aluminum (Al), barium (Ba), lithium (Li), lead (Pb), etc.

Greases belong to the category of plastic or solid fluid media [1,2]

Greases are used, above all, for the lubrication of frictional torques at low speeds. The use of greases is limited by the operating temperature of the friction joint which must be lower than the drop point by 15-25 ° C.

Greases are used not only for lubrication, but also for sealing and protecting metal surfaces, reducing the effects of vibrations, shocks or sudden changes in speed.

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The composition and structure of the greases determine their general properties, of which we can mention:

-viscosity of the base oil;

-thermal stability;

-penetration;

-ash content,

-drip point represents the temperature at which the first drop of grease heated under certain conditions falls; this point represents the transition temperature of the grease from the semi-solid state to the liquid state;

-flash point: the minimum temperature at which the oil vapor mixture becomes flammable;

-lubrication point: the minimum temperature at which vaseline continues to flow.

A classification according to the domains of use is presented schematically in the Fig. 1, where in parentheses is given their symbolization according to the Romanian standards.

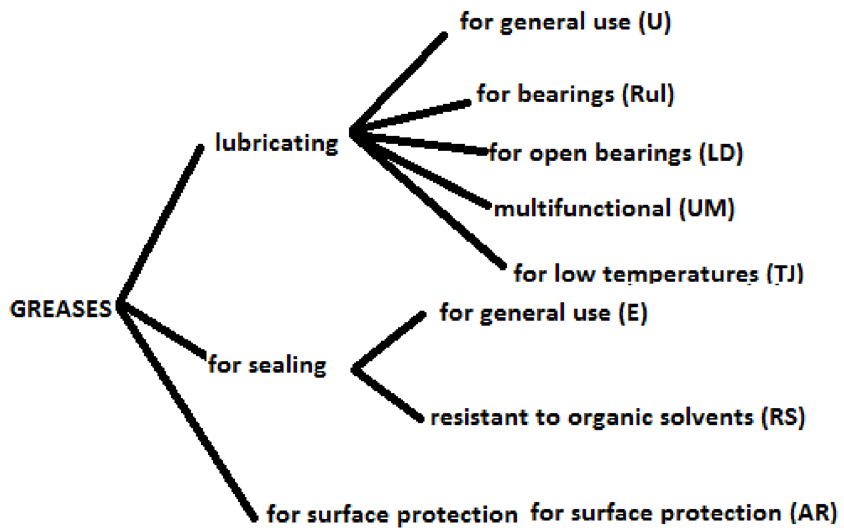

Fig. 1. Grease classification

The grease marking contains, next to the word "Grease", the symbol of the field of use, the drip point, the base of the soap, the consistency, through the symbol (digits) of the penetration, in tenths of mm, of a cone for five seconds in the grease table at 25 ° C and additives.

The following are some examples of grease scoring.

- grease Rul 165 Na 4, lubricating grease for bearings, with min. 165 ° C, based on sodium soap, with consistency 4;

- lubricant LD 170 Na 7, lubricating lubricant for open bearings, with min. 170 ° C, based on sodium soap, with consistency 7;

- lubricant LD 170 Na 7, lubricating lubricant for open bearings, with min. 170 ° C, based on sodium soap, with consistency 7;

- lubricant UM 185 Li 2 EP, multifunctional lubricating lubricant, with min. 185 ° C, based on lithium soap, with consistency 2 added for extreme pressure.

The classification of oils by consistency, according to NLGI (National Lubricating Grease Institute) is shown in table 1.

Table 1.

Classification of greases by consistency

Class - NLGI	Penetration at 25'C, mm/10	Structure
000	445 to 475	Fluid
00	400 to 430	Semi-fluid
0	355 to 385	Extremely soft
1	310 to 340	Very soft
2	165 to 395	Soft, ductile
3	220 to 250	Medium
4	175 to 205	Hard
5	130 to 160	Very hard
6	35 to 115	Extreme hard
7	Sub 70	
NGLI class according to DIN 51 SIS penetration according to DIN 51 804 part 1		

Sodium-based greases are water-resistant [3,4], it is recommended not to be used in humid environments, and lithium and calcium-based greases reject water and have potential for operation at high temperatures. It is necessary not to exceed the limit temperature used for the grease because it oxidizes and with it greatly reduces its durability (an excess of 100 C causes a reduction of the durability of the grease by about 50% [5,6,11].

2. Experimental

Obtaining the multifunctional greases from waste oils in order not to be transformed into toxic waste is carried out with the help of a technological process of transforming them into industrial greases with multiple applicability [7,8,12].

Tthe experimental installation that was used is shown in Fig. 2

Main vacuum emulsifying machine, with the following components:

-capacity: 5L-50L;

-customized service: to offer and design a total solution according to the customer requirements of the URS (User Requirement Specification);

-slow mixer 0-40 rpm with PTFE scraper;

-homogenizer 0-3500rpm (rotor and stator can adjust the space);

-heating with steam or electricity;

-pressure: chamber-0.093Mpa to 0.1Mpa, jacket 0.3Mpa for steam (standard type);

-lifting the hydraulic top cover;

-safety limiter for safety operation;

-upper cover connection: liquid feed intake with stainless steel pipe filter, solid material inlet, vacuum inlet, compressed air intake, vacuum inlet, break, CIP cleaning head, discharge port, heavy duty respirator the dust;

-vacuum system, containing water ring type vacuum pump or oil type vacuum pump and safety valve to protect the ring type vacuum pump;

-hydraulic system;

-control system.

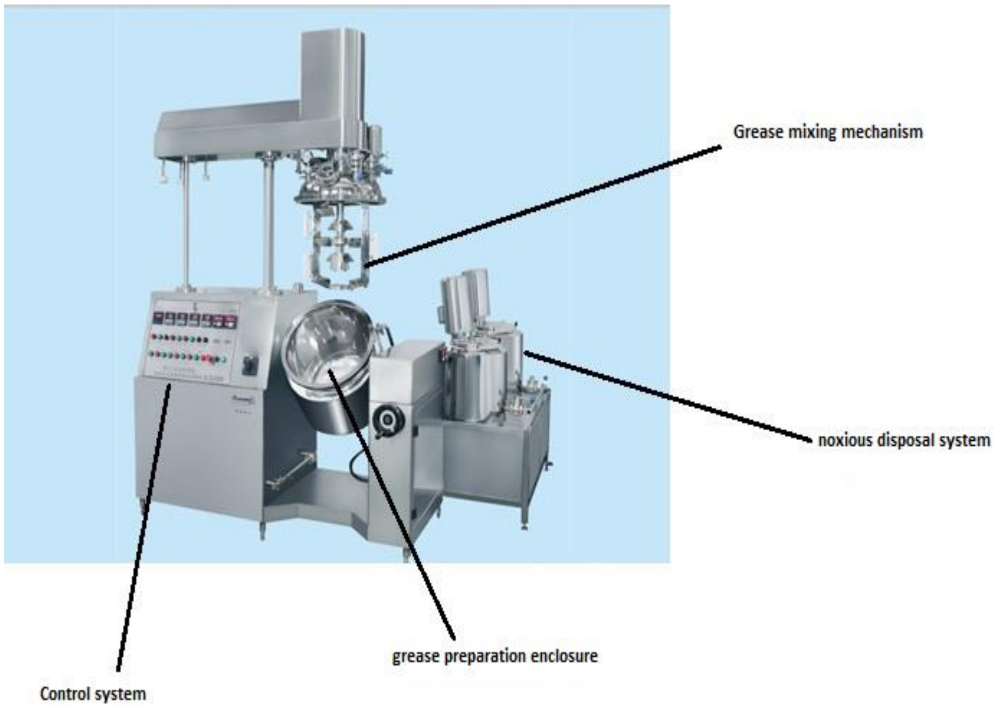

Fig.2 Experimental installation for obtaining greases from waste oils
Vacuum emulsifying mixer, Model: NO.ZRJ-50,Layout:Type Verticle, Mixing Drum:Shape Drum, Additional Capabilities: Milling, Operating type: Continuous Operating, Heating Type: Electrical Heating or Steam Heating, Machine Type: Zrj-750L, Size: 3780*3200*3050/4380mm, Weight : 3800kg, Voltage: 220V/380V, 50Hz/60Hz, Origin country: Zhejiang Wenzhou, China

The technology for transforming used oils into multifunctional greases is subject to the application of the OSIM Registered Invention Patent published in BOPI no.2 / 2019 with no. A201700593133091A2.

This technology follows the principles of the Paris Conference of December 2015, where the foundations of the circular economy were laid, which consists in transforming a waste into raw material for a new product similar to similar or different properties, in order to save the planet's resources by capitalizing on waste. oil and reducing pollution [9,10].

The technical problem solved by this technology, which is the subject of the invention mentioned above, was the transformation of a waste oil (hazardous waste) into a new product with different properties, multifunctional grease.

In this regard, to confirm the validity and industrial applicability of the procedure presented in this work, some practical technological variants are presented below.

The experimental procedure for the technological variant 1

Take a quantity of oil from the collection and filter through a cascade filtration system of metallic and non-metallic impurities and also remove the water, the installation being provided with a heater for water vaporization and fluidization of the oil. After this process of filtering the impurities and removing the water (the initial oil from the collection was found as purity in the purity classes 10-12, (the oil being waste) after the process of filtering and removing the water, reaching the purity classes. 4-6 (purity standard NAS 1638 or ISSO 4406), the grease is manufactured.

In the chamber with a volume of 40 liters, equipped with a heater, mixing system and thermocouple for measuring the temperature, take 10 liters of filtered oil, adding 400 gr. Of calcined soda, 600 gr. Of stearin and 1 kg of bentonite. . The mixture is homogenized, and the heating and mixing system is started. The heating is done gradually so that when the temperature reaches 140°C, the industrial dye 0.026 kg is introduced. stirring continuously until the mixture reaches 170°C.

It is maintained at this temperature by stirring continuously. After that, the heating system is stopped and stirred for about 10 minutes, after which the mixing system is stopped.

After the mixture has cooled (after 24 hours), the chamber is emptied, packaged and sent to the beneficiary.

The experimental procedure for the technological variant 2

Take a quantity of oil from the collection and filter through a cascade filtration system the metallic and non-metallic impurity and remove the water, the installation being provided with a heater for water vaporization and fluidization of the oil.

After this process of filtering the metallic and non-metallic impurities and removing the water, the grease is manufactured.

Take 10 liters of oil and place it in a chamber provided with a heating, mixing and thermocouple system. Then add 1 kg of calcined soda, 1 kg. of stearin, 2 kg. bentonite.

The mixture is very well homogenized, the heating and mixing system is started at 140°C, and 0.028kg is introduced. Industrial dye, mix the mixture, continue heating slowly until it reaches a temperature of 2100C. At this temperature the mixture is kept for 10-20 minutes, after which the heating is stopped, the mixture is left for another 5-10 minutes, after which it is stopped.

After 24 hours the mixture was cooled, mixed again, packaged and shipped.

The experimental procedure for the technological variant 3

Take 10 liters of oil that has been filtered through a cascade filtration system from which the water has been removed and enter a chamber provided with a heating, mixing and thermocouple system. Over 10 liters of oil, 1 kg of calcined soda, 1 kg of stearine and 2 kg of industrial talc are introduced. The mixture is homogenized, and the heating is started.

It is gradually heated to 140° C when 0.028 kg of industrial dye is introduced, homogenized and raised to 230° C and maintained at this temperature for 10-20 minutes.

Then the installation is stopped, the mixer can work for 9-10 minutes, after which it is stopped, and the mixture is allowed to cool for 24 hours. After it has cooled, mix again and pack.

The experimental procedure for the technological variant 4

Take 10 liters of oil that has been filtered through a cascade filtration system from which the water has been removed, enter into a 40-liter enclosure provided with a heating, mixing and thermocouple system. Another 1 kg is placed in the enclosure. calcined soda, 1 kg stearin and 2 kg. colloidal graphite, stir, raise the temperature gradually until 190°C keeping at this temperature 10-20 minutes stirring continuously, turn off the heating system, continue mixing for another 10-20 minutes, then stop.

Leave to cool for 24 hours, then mix again and pack.

The experimental procedure for the technological variant 5

Take 10 liters of oil with a viscosity index of 220 to 400C which was filtered through a cascade filtration system from which the water was removed, it is introduced into a 40-liter chamber provided with a heating system, mixing and thermocouple add 0.4 kg. calcined soda, 0.7 kg. stearine and 0.8 kg. industrial talc mixes the mixture formed and start heating gradually, at 140° C, add 0.024 kg. industrial coloring.

Warm up further and at 170°C, keep for 10-20 minutes stirring continuously, turn off the heating system, continue stirring for another 10-20 minutes, then stop. Leave to cool for 24 hours, then mix again and pack.

The experimental procedure for the technological variant 6:

Take 10 liters of oil that was filtered through a cascade filtration system from which the water was removed, put into a 40-liter chamber provided with a heating, mixing and thermocouple system, add 1 kg. calcined soda, 1 kg of talc, 1 kg. stearin and 0.5 kg.grafit mix the mixture and start the heating and mixing system.

3.Results and discussions

The experimental results are summarized below. Physical-chemical laboratory results for the technological variants of the experimental research carried out were**:**

Experimental results of the technological variant 1

-appearance: homogeneous;
- penetration: at 25°C after 60 kneading (0.1 mm: 360);
- high pressure resistance on the 4-ball machine (mm: resistance);
- drip point: 153°C;
- corrosion on the steel blade at 100°C for 24 hours: it resists;
-course EMCOR (grd.): 0;
-resistance to static action of water (grade): 1-90;

Experimental results of the technological variant 2

-appearance: homogeneous;
- penetration: at 25°C after 60 kneading (0.1 mm: 195);
- high pressure resistance on the 4-ball machine (mm: resistance);
- drip point: 193°C;
- corrosion on the steel blade at 100°C for 24 hours: it resists;
-MCOR test (grd.): 0;
-resistance to static action of water (grade): 1-90;

Experimental results of the technological variant 3

-appearance: homogeneous;
- penetration: at 25°C after 60 kneading (0.1 mm: 180);
- high pressure resistance on the 4-ball machine (mm: resistance);
- drip point: 227ºC;
- corrosion on the steel blade at 100°C for 24 hours: it resists;
-MCOR test (grd.): 0;
-resistance to static action of water (grade): 1-90;

Experimental results of the technological variant 4

-appearance: homogeneous;
- penetration: at 25°C after 60 kneading (0.1 mm: 210);
- high pressure resistance on the 4-ball machine (mm: resistance);
- drip point: 217°C;

- corrosion on the steel blade at 100°C for 24 hours: it resists;
-MCOR test (grd.): 0;
-resistance to static action of water (grade): 1-90;

Experimental results of the technological variant 5

-appearance: homogeneous;
- penetration: at 25°C after 60 kneading (0.1 mm: 380)
- high pressure resistance on the 4-ball machine (mm: resistance);
- drip point: 144ºC;
- corrosion on the steel blade at 100°C for 24 hours: it resists;
-course EMCOR (grd.): 0;
-resistance to static action of water (grade): 1-90.

Experimental results of the technological variant 6

-appearance: homogeneous;
- penetration: at 25°C after 60 kneading (0.1 mm: 190);
- high pressure resistance on the 4-ball machine (mm: resistance);
- drip point: 205°C;
- corrosion on the steel blade at 100°C for 24 hours: it resists;
-MCOR test (grd.): 0;
-resistance to static action of water (grade): 1-90.

The morphological aspect of the resulting samples is presented generically in the Figs. 3 and 4.

Fig. 3. Grease made experimentally from waste oils (experimental research 1)

Fig. 4. Grease made experimentally from waste oils (experimental research 4)

4. Conclusions

Following the use of an oil 4 times (once new and three times regenerated) it has been established that the oil can no longer regenerate and will be transformed into general-purpose grease.

This process will help the economic agent in the collection / neutralization process to be executed by another external economic agent who will ask for a fee for rendering the collection and neutralization service of the waste.

By manufacturing general-purpose greases from waste oils, it has been established that these "wastes" can be reintroduced into the production circuit without having to neutralize them, applying the concept of circular economy.

The greases that have been created have a wide range of use (from greases of general coverage to greases for bearings).

The advantages of transforming waste oil that do not regenerate into general-purpose greases are:

-low costs of supplying a new grease;
-environment protection;
-saving natural resources;
-stability of jobs;
-financial savings by reducing the expenses of supplying with greases;
-decreased carbon footprint.

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