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Ecological Degreasing Agents for the Cleaning of Metallic Surfaces

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Abstract

The paper presents a study concerning the cleaning capacity of a few ecological degreasing agents to remove used lubricants from metallic surfaces. The need of degreasing agent was determined depending on the metallic surface nature for seven different types of ecological degreasing agents, establishing the optimal degreasing degree. One main parameter influencing the degree of degreasing is temperature; this aspect is studied for both cold and warm seasons.

Key words: *degreasing agents, ecology, cleaning, metallic surface*

Introduction

The metallic surfaces of the installations working in dynamic regime are protected by lubricants. Their degradation during the action of technological conditions needs to remove the residues using degreasing agents. In revision stages of the installations it is necessary to remove the lubricants that lost, while functioning, the properties imposed by the specific working conditions. The degreasing technique is chosen depending on the complexity of the installation and of the metallic surfaces [1, 2]. Generally, the cleaners for metal surfaces may be classified as solvent-based or aqueous. The degreasing operation is done by wiping out, immersion, by using a spurt of solvent or applying the most efficient method of degreasing with organic solvents vapors [3]. To degrease the metallic surfaces, chloride organic solvents were used (in some Gas Exploitations Companies), such as per chloride ethylene or other inflammable organic solvents: ethers, gasoline etc.

New regulations [4] regarding measures to reduce VOC (volatile organic compounds) emissions, due to the use of organic solvents in some activities, prohibit the use of per chloride ethylene and other volatile solvents to degrease metallic surfaces.

In order to perform an ecological degreasing on metallic surfaces, it was initiated a study on the efficient removal of grease traces, both from the small and medium size equipments, as well as from the non-disassembling ones using ecological degreasing agents.

Experimental Data

The study of the degreasing action of various types of degreasing agents was done to remove the GMC40 lubricant, supplied by S.C. Lubrifin Braşov, from two types of metallic surfaces having different adherence. The main characteristics of the lubricant were determined [2]. The metallic samples, 40x20x7mm, on which the lubricant was applied were made from steel X52 and OL42. The chemical composition of those is known [5]. The OL42 steel contains Si, Mn and less carbon than the X52 steel. The X52 steel is used to manufacture pipes and tubes, while the OL42 steel is used to manufacture high stress exposed equipments like frames [6].

The study focused on the testing of the degreasing action of five ecological degreasing agents, compared to the degreasing action of agents containing 15% per chloride ethylene.

To following symbols were used to name the tested degreasing agents (table 1).

Table 1. Symbols of the degreasing agents

Symbol	**D_1**	**D_2**	**D_3**	**D_4**	**D_5**	**D_6**	**D_7**
Composition	65% DMG 25% DMS 10% DMA	Super 100	F.B.	L.W.	P.	15% PCE 85% EP	15% PCE 15% B 70% EP

Note: The symbols in table 1 refer to:

- D_1 contains 65% dimethyl glutarate (DMG), 25% dimethyl succinate (DMS) and 10% dimethyl adipate (DMA) at pH = 7;
- D_2 – Super 100 high concentrated at pH = 9.5 – 10, contains ionic emulsifiers, sodium hydroxide and green dye;
- D_3 – FORECOURT BIO (F. B.), concentrated product containing bacterial cultures, surfactants, organic solvents and nutrition at pH = 5;
- D_4 – LIGHT WATER (L.W.), uninflammable ecological fluid containing surfactants at pH = 7.7;
- D_5 – PROFAROM, non-volatile ecological fluid at pH = 8.2;
- D_6 –15% per chloride ethylene and 85% ether at pH = 8.5;
- D_7 –15% per chloride ethylene, 15% benzene and 70% ether at pH = 8.5.

All commercial degreasing agents used in this study are products of BioSol psi SRL. Ploieşti.

The composition of degreasing agent D_1 was determined after several try outs in order to obtain an optimum degreasing degree.

To establish the degreasing action, the metallic surfaces were covered by brushing with the GCM40 lubricant and left this way for a period of time between 5 minutes and 24 hours. The lubricant quantity that covers the metallic surface was determined weighting the metallic plate before and after applying the lubricant. The removal of the lubricant from the metallic surface was performed using the degreasing agents by cleaning, immersion and by the dynamic technique of solvent spurt. These techniques can be performed to clean the mobile and fixed components of installations. The standard procedure for these operations is presented in literature [3].

The degreasing degree was qualitatively established with the water spurt method under light, consisting in the observation, in the presence of a light source, of the degreased surface, that has to form a continuous watery film after washing. For the non-disassembling equipments, it was used the method of liquid absorption on the metallic surface with a porous paper. The efficiency of the tested degreasing agents was studied under the influence of temperature, so that it will not exceed the values of the inflammation point in closed areas (ISO 1523), nor the freezing point.

Results

From the experimental data it is possible to evaluate the need for degreasing agent to clean each metallic surface. This quantity is expressed through the ratio between the volume of degreasing agents used, mL, and the quantity of removed grease, g. Knowing the need for degreasing agent is an essential element to estimate the cost of the cleaning operation of the installation during the revision stage.

The experimental data are presented in table 2.

Table 2. The need for degreasing agent on the surface of X52 steel, at 20°C in dynamic regime

Degreasing agent	Grease mass, g	Degreasing agent volume, mL	Need, mLg^{-1}	Degreasing degree
D_1	0.2801	14	50	very good
D_2	0.2805	12.6	45	very good
D_3	0.2602	13.5	51.9	good
D_4	0.2701	10.8	40	very good
D_5	0.2602	11.4	43.8	good
D_6	0.2604	9.1	35	very good
D_7	0.2703	10.2	37.7	very good

Table 3. The need for degreasing agent on the surface of X52 steel, at 50°C in static regime

Degreasing agent	Grease mass, g	Degreasing agent volume, mL	Need, mLg^{-1}	Degreasing degree
D_1	0.2801	12.6	45	very good
D_2	0.2805	11.7	41.8	very good
D_3	0.2602	12.2	46.9	very good
D_4	0.2701	10.3	38.1	very good
D_5	0.2602	8.3	31.9	very good
D_6	0.2604	7.8	30	very good
D_7	0.2800	9.2	32.8	very good

Table 4. The need for degreasing agent on the surface of OL42 steel, at 20°C in dynamic regime

Degreasing agent	Grease mass, g	Degreasing agent volume, mL	Need, mLg^{-1}	Degreasing degree
D_1	0.4903	12.8	26.1	very good
D_2	0.4810	12.7	26.5	very good
D_3	0.4802	12.9	26.9	good
D_4	0.4902	12.8	26.1	very good
D_5	0.5001	13.7	27.4	good
D_6	0.4905	13.0	26.5	very good
D_7	0.4810	13.1	27.3	very good

Table 5. The need for degreasing agent on the surface of OL42 steel, at 50°C in static regime

Degreasing agent	Grease mass, G	Degreasing agent volume, mL	Need, mLg^{-1}	Degreasing degree
D_1	0.4903	11.5	23.5	very good
D_2	0.4810	11.3	23.5	very good
D_3	0.4802	11.8	24.6	very good
D_4	0.4902	11.4	23.3	very good
D_5	0.5001	12.5	25	very good
D_6	0.4905	12	24.5	very good
D_7	0.4801	12.2	25.4	very good

Conclusions

The nature of the metallic surface influences on the thickness of the lubricant layer and on the volume of degreasing agent needed for the cleaning.

The need for degreasing agent is bigger in the case of the metallic surfaces made of OL42 steel.

The degreasing agents PROFAROM and FORECOURT BIO, less efficient at low temperatures, insure an optimal degree of degreasing by increasing the temperature.

The ecological degreasing agents D_1, D_2, D_3, D_4, D_5, without any chloride compounds or volatile compounds, have a degreasing degree similar to those containing per chloride ethylene. In this case, to clean the metallic surfaces, per chloride ethylene can be replaced, as well as other solvents with volatile compounds, by ecological tested degreasing agents.

The use of per chloride ethylene for degreasing involves risks when used in conditions of high temperature due to phosgene forming, an extremely toxic gas.

A large part of the degreasing agents tested have a pH greater the neutral one, which leads to reducing the risk for corrosion phenomena, a very important aspect during the functioning of the installations.

The surfactants contained in the ecological degreasing agents that were used adsorb onto the metallic surface, insuring even an anti corrosive protection.

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Degresanți ecologici pentru curățarea suprafețelor metalice

Rezumat

În lucrare se studiază capacitatea de curățare a unor degresanți ecologici pentru îndepărtarea lubrifianÎn lucrare se studiază capacitatea de curățare a unor degresanți ecologici pentru îndepărtarea lubrifianților uzați de pe suprafețele metalice. Se calculează necesarul de degresant în funcție de natura suprafeței metalice pentru şapte tipuri de degresanți ecologici, stabilindu-se totodată gradul de degresare optim. Un parametru determinant asupra gradului de degresare este temperatura, acest aspect fiind studiat atât pentru sezonul cald, cât şi cel rece al anului.