

STUDY THE ENVIRONMENTAL IMPACT OF LUBRICANTS USED IN MECHANICAL SYSTEMS

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Abstract: The production, disposal and application of lubricants have to cover the best possible protection of our nature and the environment in general and of living beings in particular. For all cases of direct contact between lubricants on the one side and human beings and nature on the other, their compatibility has to be checked.

The increasing need for environmental compatibility tests has to be understood by all those working in the fields of production, disposal and application of lubricants.

In this paper using the some examples “Coolants and Metal Working Lubricants”, “Engine Oils”, and, “Fast Biodegradable Lubricants and Operational Fluids” some of the most important aspects of environmental damage will be presented.

Key-words: environmental damage, toxicity, lubricant, biodegradability

1. INTRODUCTION

A significant quantity of the total consumption of mineral oil is generally used as a lubricant for lubrication. Production, stockpiling and use of lubricants must be made accordance with the rules of nature protection, environmental protection and generally protection of all the living beings. Most of the times, the risk of disease of the human population does not appear directly but only through contact with contaminated surrounding environment. In all cases needs to be watch carefully the direct contact between the lubricants compatibility on the one hand and nature and human beings on the other. It is necessary that all persons involved in the production, storage, transport and use of lubricants to be trained on the compatibility tests between them and the environment. In other words, it is necessary that the risk of disease and of contamination of water and the environment should be minimized.

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2. ENVIRONMENTAL IMPACTS BY USING THE LUBRICANTS

An illustration of global market expansion in lubricants is shown in figure 1, where it notes that the almost a third of total volume worldwide lubricant products are intended for consumption in Europe, America and Asia respectively [1].

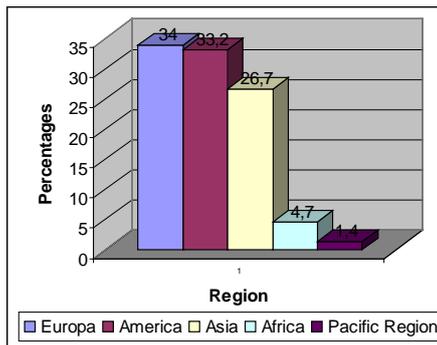


Fig. 1. World consumption of lubricants

It is found that about 13% of quantity of lubricants used in European countries and 32% of that used in the United States returns to the environment properties with structure and appearance more or less modified. Much of these lubricants is used for the lubrication with loss of the friction contacts (about 40,000 tons annually in Germany), and another part is the lubricants used in circulation systems are not collected and not stored after use. In addition, the quantity of lubricants lost through leaks and the remaining in the filters, containers and

packaging is worthy of consideration.

Generally, the environment is returned as spent lubricants a large volume of mineral oils (e.g. in Germany about 150,000 tons annually).

Application fields for accepted lubricants the terms of the environmental protection are:

- two-stroke engine oils;
- chain saw and sawmills oils;
- lubricants for rolling stock of railway;
- lubricants for centralized lubrication systems;
- hydraulic oils for machines, drillings and underground use;
- hydraulic oils for forest and agricultural equipment;
- lubricants for sewage treatment installations for the hydroelectric power plants installations and for the sluice gates mechanisms;
- lubricants for the food industry machines;
- lubricants for various snow equipment;
- lubricants for various cutting processes;
- internal combustion engine oils and for hydraulic systems in general.

If considered the proportion achieved by Germany from world consumption of lubricants, and that in some parts of the world collection and recycling rates of the lubricants using is lower than in Europe or Germany, total quantity of lubricants returning into the environment can be estimated as having a order of magnitude of approximately 12 million tonnes per year [3].

For these reasons, it is necessary to take all measures to reduce environmental pollution and maintaining it at the lowest possible level.

To evaluate the admissible environmental impact effects of the use of the

lubricants must be considered, on the one side, the advantages of their use of economically, and on the other side, the risks caused by their use, ecological the properties of lubricants having a great importance in this case [4].

3. DIRECTIONS TO REDUCE THE ENVIRONMENT POLLUTION

The ways and means to reduce the environmental impact of the lubricants use are generally initiated in the following directions:

- realities of the environment;
- awareness of the population;
- government directives and regulations;
- market globalization;
- economic incentives.

Environmental realities and issues related to awareness of the population were presented in the foregoing. The eco-toxicity and biodegradability of lubricants problems especially are manifested when they return the environment after use. The basic idea is that of reduce the toxicity and increase bio-degradability of the lubricants who return to the environment. Generally, the biodegradability is the tendency of the lubricant to be ingested and metabolized by microorganisms. The total biodegradability is the complete return of the lubricant in nature, while partial biodegradability indicates that one or more constituents of lubricant are not degradable. Eco-toxicity is the toxic effect of a lubricant on the plant kingdom and the animal [3].

4. ENVIRONMENTAL LAW AND REGULATIONS

Regulations or legislation on the environmental protection in terms of pollution resulting from the use of lubricants is in countries like Austria, Canada, Hungary, Japan, Poland, USA and generally EU countries, they are too few compared to the large geographical areas on which is their extended use. Austria is the only country that has legislated prohibiting the use of mineral oil based lubricants the anointing of mechanical systems for example chain saws. The other countries mentioned above have some regulations only to establish the types of lubricants and their effects on the environment [1], [3].

European Community (EU) issued a Directive with regard to dangerous substances, Directive that establishes criteria for the classification of products posing a potential risk to aquatic life. This potential risk is appreciated depending on of a certain level of aquatic toxicity, biodegradability and bioaccumulative potential.

Criteria for risk assessment of dangerous substances are presented in Table 1.

Notations were used:

R50 - Very toxic to aquatic organisms;

R51 - Toxic to aquatic organisms;

R52 - Harmful to aquatic organisms;

R53 - May cause long-term effects various aquatic environments.

Table 1. EU Directive with regard to Dangerous Substances - Criteria for marking [3]

Aquatic Size limit (LC ₅₀)	Biodegradability	Potential biodegradability	Tree-fish symbol	Risk Expression required
If solubility product exceeds 1 mg/l				
>1 mg/l	Not	>3,0	Yes	R50, R53
1/10	Not	>3,0	Yes	R51, R53
10/100	Not	n/a	Not	R52, R53
>100	n/a	n/a	Not	None
If the solubility product is less than 1 mg / l				
n/a	Not	n/a	Not	R53

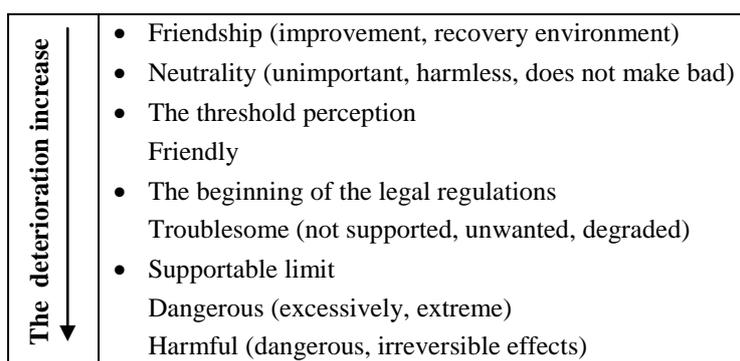
5. ISSUES IN THE LUBRICANTS FIELD

In an attempt to define and classify the lubricants in terms of their polluting effect on the environment have been established a series of terms, but this subject is not completely clarified. [1]

Some of these terms are those listed below:

- positivity to the environment;
- friendly to the environment;
- sociability to the environment;
- attention to the environment;
- justification for the environment;
- neutrally for the environment;
- protection of the environment;
- compliance with environmental

A hierarchy of these terms that express the lubricants impact on the environment is as follows [1]:



In relation to this hierarchy, none of lubricants can be environmentally friendly, the more it can be neutrally to the environment.

Generally, the polluting effects of the lubricants on the environment refer:

- risks of disease;
- risks of water contamination.

It is considered that lubricants are acceptable from the point of view of environmental protection if they meet the following requirements:

- possess a rapid biodegradability;
- not toxic to human beings;
- not toxic to fish and aquatic living creatures;
- not toxic action on bacteria etc.

6. LUBRICANTS WITH FAST BIODEGRADABILITY

Biodegradability is defined by the period required for degradation of a certain percentage of a lubricant. Several test methods have been elaborated for assessing biodegradability of the base oil as well as of the additives of lubricant.

Thus can be used as base oils three distinct groups of substances corresponding for achieving of the fast biodegradability lubricants that can be used as hydraulic oils (hydraulic fluid work). These substances are divided into the following classes:

- water miscible oils;
- vegetable oils;
- the ester based synthetic oils.

For obtain the oils with fast biodegradability are mainly used synthetic ester oils. The advantages of these oils are characterized by a good miscibility with mineral oils, through good behaviour at low temperatures and very good oxidation stability.

One of the main disadvantages is caused by a weak hydrolytic stability that leads to the need for special protective measures from corrosion.

7. TOXICITY OF THE LUBRICANT

In terms of the potential toxic oils must be taken into account both the base oils and additives. For human beings are not known negative consequences for short-term dermal contact. Testing of base oils of different provenances and levels of refining has demonstrated that oils can have carcinogenic effects in case of repeated application and lengthy.

In conclusion, it can be said that conventional mineral oils present a low toxicity by inhalation or absorption through the skin. In addition, irritation of the eye does not constitute a special problem, skin irritation and dermatitis occurrence can occurs if into prolonged contact with the lubricants and for a short time inhaling of vapours or fine drops of oil of may cause a slight irritation of the respiratory mucosa.

Generally, additives for lubricants present physical risk very reduced or not at all risk. Due to the low toxicity potential for mammalian, most additives are not considered as hazardous. Of the most important types of additives are considered just a few irritating.

Experience has shown that the toxic properties of the lubricants are given by

those of the base oil and of the additivation of components.

Measuring the toxicity of the mixtures led to the idea that this is equal to the arithmetic average of the toxic components of the mixture.

Due to of the different lubricants behaviour, during the use, e.g. gasoline mixture and combustion products where oils for internal combustion engines, the toxicity of oils used in the mixture can be significantly different from that of oils used as such.

8. CONCLUSIONS

In conclusion, for manufacture, storage and use of the lubricants, the risk of disease, water pollution and the environment must be minimized [2]. For this will be taken into consideration:

- for the environmental protection are important the lubricants that are more acceptable in this regard;
- environmental aspects relating to usage the lubricants refers to the risk of disease, and water pollution and the environment;
- the miscible and immiscible fluids with water are used as base oils are generally accepted of the medium;
- it is becoming increasingly difficult to find a balance between economic opportunities and the environmental protection requirements.

Toxic and inorganic products must be disposed in the future in the manufacture the lubricants. On the other hand, must be taken account that the technological level of the lubricants will be affected if they will imposed improper restrictions

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