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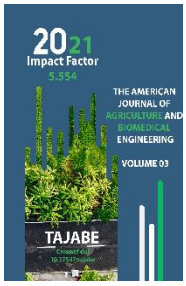

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Research Of Anti-Corrosion Properties Of Engine Oils When The Engine Is Running

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ABSTRACT

The article studied the protective properties of engineoils against corrosion of metal surfaces. The corrosive properties of oils are enhanced when there is an aggressive compound in it, as well as with an increase in humidity and air temperature. It is established that the protective layer on the path of aggressive products to metal surfaces is corrosion inhibitors, which contribute to the formation of adsorbed or chemical pellicle on metal surfaces. The results of the solubility of additives depending on the heating temperature and recommendations for their use are presented.

KEYWORDS

Corrosion, Wear, Concentration Of Additives, Anti-Corrosion Additives, Surfaces Of Parts, Viscosity, Sulfur Compounds, Alkalis, Mineral Acids.

INTRODUCTION

In recent years, petroleum oils for various purposes have increased requirements for protective properties. One of the functions of the oil is to protect the surface of parts from corrosion.

Corrosion increases with increasing humidity and air temperature in the presence of aggressive gases. Corrosion becomes especially intense when the engine is operated or stored in humid hot climates.

Oil in this case plays a double role: on the one hand, it protects the surfaces of parts from the aggressive influence of the external environment; and on the other hand, the oil itself causes corrosion due to the presence of substances with a corrosive effect in it.

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The reason for the corrosive properties of oils is that they contain peroxides of organic and inorganic acids and other oxidation products, as well as sulfur compounds, alkalis and water. Natural motor acids and sulfur compounds are present in fresh engine oil, and the presence of stronger acid agents is accumulated in the working oil.

In the process of using the oil, the acid content in it increases by 3 - 5 times, which depends on the chemical stability of the oil, the content of antioxidants and its working conditions.

THE MAIN FINDINGS AND RESULTS

The presence of organic acids in fresh oils and their content of 15 ... 20% sulfur compounds in the form of sulfides and components of residual sulfur, which at high temperatures lead to the release of hydrogen sulfide, mercaptans and other active products. At high temperatures, sulfur compounds become particularly aggressive with respect to silver, copper and lead. Particularly dangerous is the corrosion of non-ferrous metal bearing shells, which can be caused by acidic oxidation products, sulfur compounds.

In the process of using motor oil, depending on the conditions of its operation, chemical stability and the content of antioxidants in it, the acid content in the working oil increases by 3-5 times. An indicator of the corrosion resistance of the oil is the acid number, which should not exceed 0.4 mg of potassium hydroxide KOH per 1 g of oil. Corrosively, this concentration is practically not dangerous. Due to the high molecular weight, the acids in the fresh oil dissociate weakly, and the acids formed during the oxidation of the oil become the most dangerous, since their low molecular weight has increased corrosiveness due to good solubility in water and better dissociation.

The protective properties of oils are determined by the creation of a barrier - a protective layer on the path of aggressive products to metal surfaces. The lower layer is the result of the interaction of the chemical components of the oil with the metal, the middle layer is the adsorption of surfactants. Top layer - a bulk oil layer does not adequately protect metal surfaces from moisture and gases penetration. Therefore, the main barrier in their path is surfactant and chemically active substances - corrosion inhibitors that promote the formation of adsorbed or chemical films on metal surfaces.

When oil burns, high molecular weight organic acids are formed, which in the presence of oxygen adversely affect metals. Oxygen is a part of peroxides; therefore, in the presence of oxygen and water, the metal undergoes electrochemical dissolution. The combined action of air oxygen and water present in the lubricating oil causes rusting of the steam turbine shaft, crankshaft, liner walls, cylinders of an internal combustion engine. Corrosion is especially aggravated after the engine stops, since when it cools, moisture condenses on the parts, lubricating oil draining from the lubricated surface is not able to protect the metal from corrosion.

In this case, the corrosion process occurs in the form of a chemical reaction:

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$$Me + H_2O + 0{,}5O_2 = Me(OH)_2$$

$$Me(OH)_2 + 2RCOOH = Me(RCOO)_2 + 2H_2O$$

Where: M_e- is metal.

In organic acids are absent in fresh oil. However, if sulfuric SO_2 and sulfurous SO_3 anhydrides enter the engine crankcase along with water vapor, then sulfuric or sulfuric acids are formed as a result of a chemical reaction, which become corrosive to non-ferrous metals and alloys.

In order to combat corrosion, special additives are added to the oils. The protection mechanism is the formation of a protective pellicle and the neutralization of acids. For this purpose, zinc dialkyl dithio phosphate and other sulfur and phosphorus compounds are used. Corrosion inhibitors are mainly polar substances that are easily adsorbed on metal surfaces.

The protective properties of oils are determined by the creation of a protective layer on the path of aggressive products to metal surfaces. This layer is surface-active substances - corrosion inhibitors that promote the formation of adsorbed or chemical pellicles on metal surfaces.

We have studied the infineum 1240 and 1243 containing complex and internal esters as an anti-corrosion additive. The mechanism of their action is to create a protective monomolecular layer on the metal, preventing the action of acidic and other active agents on the metal. Under laboratory conditions, the anticorrosion properties of M-$8B_2$ engine oils with different additive contents were evaluated by the weight loss of lead plates (per 1 m^2 of their surface) during the test at a temperature of 140 ° C.

Additive compatibility is an important factor in its use. To establish the compatibility of oil additives, 4 samples of engine oil of 100 ml each were prepared and different additives with a concentration of 5% were introduced into them. To dissolve additives in oil, the experiment was carried out by heating different temperatures.

Additive solubility results versus heating temperature

Additives	Solubility Additives		
	Not dissolved	Medium dissolved	Full dissolved
Infineum 1240	30 °C	40°C	60°C
Infineum 1243	30 °C	40°C	65°C

Additive compatibility results versus heating time

Additives	Compatibility		
	Not	Medium	Full

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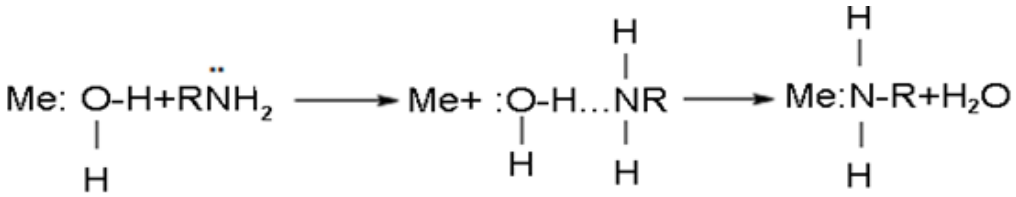
	compatible	compatible	compatible
Infineum 1240	35 min	1,0hour	1,9hour
Infineum 1243	35 min	1,0hour	2,2hour

The study showed that the anticorrosive activity of the additives is associated with the ability of a strong bond with water, and the hydrocarbon radical remains in the oil. Water is displaced from the metal surface by the following mechanism:



Moreover, the activity of inhibitors is greater, the more hydrocarbon atoms the radical contains. The activity of water molecules adsorbed on a metal surface will be significantly reduced. Based on the studies, it can be assumed that corrosion inhibitors, displacing water from the metal surface, form strong adsorption-chemisorption pellicleson it that prevent metal from contacting with the electrolyte.

Having determined the dissolution of additives in motor oil with additives, we determined the physic chemical parameters of M-8B$_2$ oil.

No	Name of indicator	Experience results	GOST norm	Test method
1	Viscosity mm^2 / s at t = 100°C at t = 0°C	 14 1180	 13,5-16,5 1200	GOST 33
2	Density at 20°C, g / cm^3	0,878	No more than 0,905	GOST 3900
3	Flash point, °C	210	Not lower than 207	GOST 4333

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5	Water content, not more	-	traces	GOST 2477
6	Solids content, %	0,008	No more thano,015	GOST 6370
7	Alkaline number	4,5	Not lower than 4,2	GOST 11362

CONCLUSION

Corrosion processes in engines are suppressed in the following ways: by neutralizing acidic products; slowing down the oxidation processes; the creation of a protective film on the metal.

In the future, these oils can be admitted to the next stage - to performance tests on special equipment.

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