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Improving the Anticorrosive Properties of Motor Oils by Adding Additives

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Abstract. The purpose of this work is to study how to improve the anticorrosive properties of lubricants. With an increase in temperature, the combined action of oxygen, air and water present in the lubricating oil causes rusting of the crankshaft, the walls of the sleeves, the cylinders of the internal combustion engine.

We have studied anticorrosive additives as an additive to improve the anticorrosive properties of oils. dialkylphenyldithiophosphoric acid additive was used as such additives. The anticorrosive activity of these substances is associated with their ability to orient themselves on the oil-water surface so that hydrophilic groups bind firmly to water, and the hydrocarbon radical remains in the oil.

Key words: anticorrosive additives, hydrophilic groups, hydrocarbon radical, protective properties, corrosive effect.

Introduction.

In recent years, increased requirements for protective properties have been imposed on petroleum oils for various purposes. One of the functions of the oil is to protect the surface of the parts from corrosion. The corrosive effect becomes especially intense when the engine is operated in humid hot climate zones.

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

Corrosion is especially intensified after the engine is stopped, since when it cools, moisture condenses on the parts, lubricating oil, flowing down from the lubricated surface, is not able to protect the metal from corrosion. The reason for the corrosive properties of oils is that they contain organic and inorganic acid peroxides and other oxidation products, as well as sulfur compounds, alkalis and water.

In recent years, increased requirements for protective properties have been imposed on petroleum oils for various purposes. One of the functions of the oil is to protect the surface of the parts from corrosion. The high protective effect is based on the ability of oils to quickly displace active compounds from the metal surface, retain it in the volume of the lubricant and form strong adsorption and chemisorption films on it, preventing the development of electrochemical processes. Base oil oils are not capable of protecting metals from electrochemical corrosion for a long time.

Research analysis.

In addition to temperature, the nature of oil oxidation is influenced by the specific conditions of its operation in the engine: large oil-air contact surfaces (oil films, fog, oil foaming in the crankcase). Iron, copper, lead have a catalytic effect on the oxidation process. Oxidation is most intense in relatively thin layers of oil located on highly heated metal surfaces. Corrosion of bearing liners made of non-ferrous metals is especially dangerous, which can be caused by acidic oxidation products, sulfur compounds. At high temperatures, sulfur compounds become especially aggressive towards silver, copper and lead.

The corrosion aggressiveness of the oils in relation to the lead bronze from which the crankshaft bearing liners are made is assessed by a breakdown on a lead plate. At the same time, the loss of its mass is determined under conditions of its being in oil for 50 hours at 140°C.

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The temperature factor especially affects the rate of general corrosion. The study shows that an increase in temperature from 20 to 80°C at 5% water causes an increase in corrosion from 0.1 to 0.25 mm/ year. If we assume that the permissible corrosion rate is 0.2 mm / year, then this value is reached at a temperature of 80°C by 2%, and a further increase in the water content in the oil leads to a significant increase in the corrosion rate.

In order to combat corrosion, special additives are added to the oils. Anticorrosive additives are mainly polar substances that are easily adsorbed on metal surfaces.

Before giving recommendations on the use of any additives, it is necessary to study their mechanism of action, without knowledge of which their effective use is impossible. The chemical composition of petroleum products and additives contained in them determine the composition and corrosion aggressiveness of the electrolyte formed during operation.

During the combustion of oil, high-molecular organic acids are formed, which in the presence of oxygen have a detrimental effect on metals. Oxygen is a part of peroxides, therefore, in the presence of oxygen and water, the metal undergoes electrochemical dissolution.

An indicator of the corrosion resistance of the oil is the acid number, which should not exceed 0.4 mg of caustic potassium KOH (potassium hydroxide) per 1 g of oil.

In terms of corrosion, this concentration is practically not dangerous. Due to the high molecular weight, the acids in fresh oil dissociate weakly, and the acids formed during the oxidation of oil become the most dangerous, since their low molecular weight has increased corrosive aggressiveness due to good solubility in water and better dissociation.

Substances used as anticorrosive additives are salts of organic acids, metal phenolates, various thiophosphoric compounds. Anticorrosive additives are easily adsorbed on metal surfaces. Nitrogen containing compounds, aromatic amines $C_6H_5NH_2$, which are ammonia derivatives, deserve considerable attention as an anticorrosive additive.

Research methodology.

We studied a mixture of barium alkylphenolate and zinc salt dialkylphenyl dithiophosphoric acid containing complex and internal esters as an anticorrosive additive. We have analyzed motor oils M-10B2 and anticorrosive additives dialkylphenyl dithiophosphoric acid. After the introduction of such an additive concentration into the oil, we observed its dissolution. Having determined the dissolution of additives into the engine oil and the additive, we determined the physico-chemical parameters of the engine oil for different concentrations of additives.

The study showed that this compound has a number of advantages over other additives. The anticorrosive activity of these additives is related to their ability to orient themselves on the oil-water surface so that hydrophilic groups bind firmly to water, and the hydrocarbon radical remains in the oil.

The mechanism of their action is to create a protective monomolecular layer on the metal, preventing the effect of acidic and other active agents on the metal.

The wetting ability of surfactants can be manifested due to the formation of strong hydrogen bonds with water and the displacement of water from the metal surface. To achieve the desired effect, it is required to apply it in quantities of 2-5%. The greater the activity of inhibitors, the more hydrocarbon atoms the radical contains. At the same time, the activity of water molecules adsorbed on the metal surface will be significantly reduced.

Displacement of water from the metal surface can occur as a result of its binding: due to solvation by metal cations, inclusion of hydrophilic components of additives in the hydrate shells, as well as due to solubilization or emulsification and stabilization in the form of water - oil product emulsions.

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Conclusions.

According to the results of laboratory tests, when the additive was introduced into the engine oil, a positive result was given. From the results of the analysis, we selected the additive content of 3.5%, which shows the optimal value of the alkaline number.

It is known that with an increase in the neutralizing (alkaline) ability of the oil, the wear of the piston rings decreases sharply. At the same time, acidic products accumulate in the oil, which increase the corrosion wear of parts.

Based on the conducted studies, it can be assumed that the obtained corrosion inhibitors, displacing water from the metal surface, form strong adsorption - chemisorption films on it, which prevent metal contact with the electrolyte.

Thus, the mechanism of action of the proposed corrosion inhibitors based on dialkylphenyl dithiophosphoric acid is reduced to their ability to orient themselves on the oil-water surface so that hydrophilic groups bind firmly to water, and the hydrocarbon radical remains in the oil. At the same time, the greater the activity of inhibitors, the more hydrocarbon atoms the radical contains.

From the results of the analysis, we selected the additive content of 3.5%, which shows the optimal value of the alkaline number. At the same time, the alkaline number increased to 5.5.

Therefore, the main function of alkaline oil additives is to neutralize acids and protect the metal from corrosion. Therefore, one of the signs indicating the need to change the oil may be a decrease in the alkaline number.

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