Effect of α-Methylbenzylphenol Derivatives on the Antioxidant and Anticorrosion Characteristics of Lubricating Oils

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Abstract

Lubricating oils and lubricating coolants are susceptible to oxidation during storage and operation. The substances formed during the oxidation process impair the useful properties of the oils: engine contamination, engine wear and corrosion of metal surfaces are increasing. Therefore, in most cases, oils are not used without prior stabilization by antioxidant additives.

We synthesized the functionally substituted derivatives of α-methylbenzylphenols (Figure 1), their antioxidant and anticorrosive efficacy was studied by chemiluminescence at 200° C and at the concentration of 0.025-1% in VO and M-11 oils. Basing on the obtained data, the relative antioxidant efficiency was determined by the formula $E=(1-J/J_o)*100\%$, where J/J_o is the ratio of peak areas of the total intensity of chemiluminescent emission during the experiment with inhibited and uninhibited oil oxidation. An industrial antioxidant additive, ionol, was investigated under similar conditions for comparison. The reactivity of S- and Se-containing sterically hindered phenols was evaluated by B3LYP/6-311G++(d,p) and MP4/6-311G++(d,p) methods and their mechanism of action in oils was studied using high-level quantum chemical calculations.

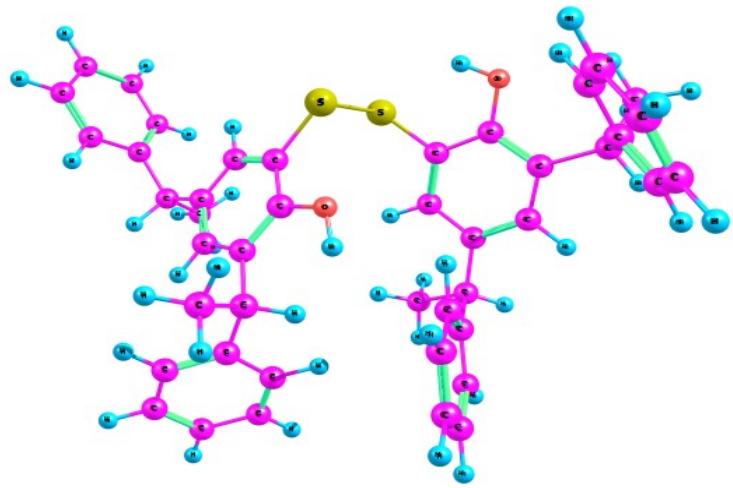

Figure 1. The structure of additives

The additives are effective due to the presence of bulky substituents in the o-positions that optimally shield the hydrogen of the hydroxyl group and, accordingly, due to the small activity of the phenoxyl radical formed from the inhibitor in the reaction with the peroxide radicals. Shielded phenols inhibit oxidation by breaking the chain process by reaction with peroxide radicals. S-containing organic compounds destroy hydroperoxides into molecular products.

S-containing sterically hindered phenols have high antioxidant activity due to the bifunctional mechanism of antioxidant action and the internal synergetic effect. It follows from the test results that the test compounds at a concentration of 1% significantly reduce the potential corrosivity of the base oil M-11.