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Study of the Effect of Ionic Liquids Containing Nitrogen on Steel Corrosion

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Abstract: Today, in various sectors of the economy of rapidly developing countries, the creation of inhibitory substances used to prevent and protect metals from corrosion is an urgent problem. In the world, compounds based on nitrogen-containing ionic liquids, 2-methylbenzolammonium dehydrogen phosphate, 1,2-diammoniumbenzene hydrogen phosphate, N,N-diphenylammonium dehydrophosphate, imidazole, triazole, thiazole, indole, pyrrolidine, ammonium, piperidine and pyridine are used to reduce the corrosion of metals, the inhibitory properties of compounds are being studied, and work is underway to create effective inhibitors. The use of nitrogen-containing ionic liquids as a corrosion inhibitor gives very good results.

Key words: Ionic liquid, corrosion, ortho-toluidine, imidazole, 2-methylbenzeneammonium dehydrophosphate, inhibitor, electrostatic attraction, physical sorption, chemical sorption.

Ionic liquids are salts of organic compounds and their melting point is below 100° C. Ionic liquids generally have high thermal stability, low vapor pressure, nonflammability, moderate polarity, high ionic conductivity, and nontoxic properties. There are the following types of ionic liquids: 2-methylbenzeneammonium dehydrophosphate, 1,2-diammoniumbenzene hydrophosphate, N,N-diphenylammonium dehydrophosphate, imidazole, triazole, thiazole, indole, pyrrolidine, ammonium, piperidine, and pyridine complex and basic ionic liquids. Ionic liquids are easily adsorbed and block corrosion processes occurring at the anode or cathode. Almost all ionic liquids have attracted many researchers due to their low toxicity and high efficiency. As a result of these studies, the properties and mechanisms of ionic liquids against steel corrosion in salt water were studied. Ionic liquids, whose electrons are connected to the negative part of the anode sites, lead to chemical sorption as a result of transition to the d-orbital of steel. Also, physical sorption occurs through electrostatic attraction between the positive part of the cathode sites and 2-methylbenzeneammonium dehydrophosphate.

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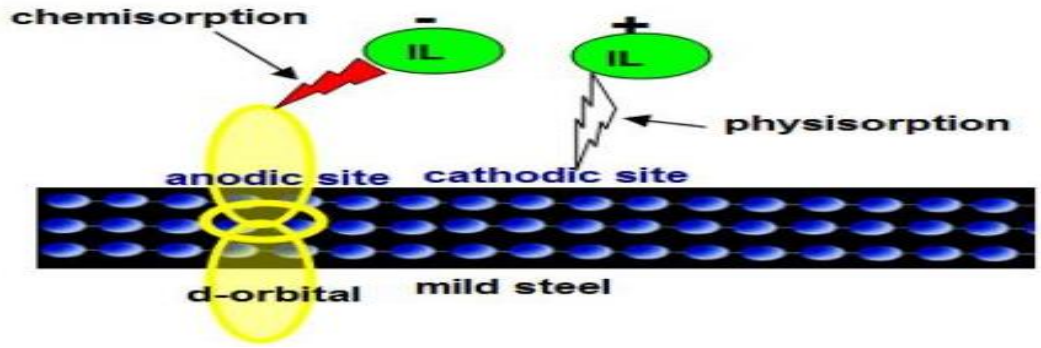
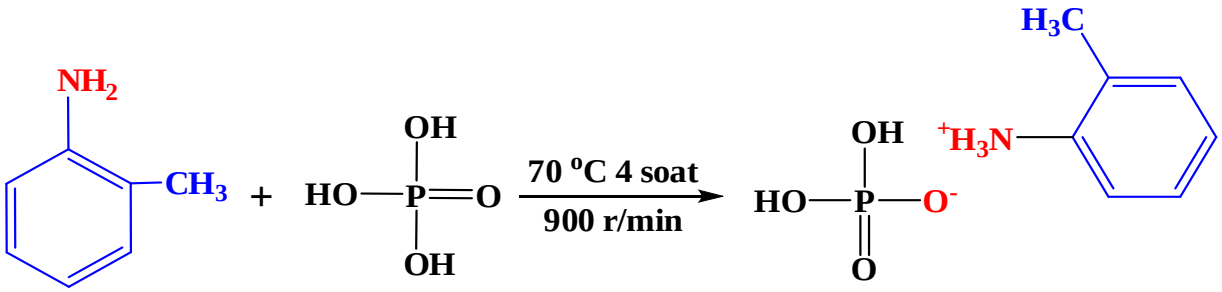


Figure 1. Chemical and physical sorption of 2-methylbenzeneammonium dehydrophosphate-based inhibitor on steel.

Ionic liquids are a protective layer of the metal surface. This, in turn, depends on the effectiveness of the inhibitors, the effectiveness of the inhibitor increases with increasing concentration and decreases with increasing temperature. At present, most of the studied studies are imidazole-based inhibitors, the use of phosphorous, tetraammonium, and pyridine-based ionic liquids and the application of their anti-corrosion activity are also stimulating the interests of scientists. It should be noted that the anti-corrosion effect of ionic liquids has been studied mainly for iron alloys, and their corrosion properties have been studied in electrolytes such as NaCl, HNO3, H2SO4, HCl. It is aimed to study the inhibitory efficiency of these ionic liquids in other electrolytes.

Synthesis of Ionic Liquids: Synthesis reaction of 2-methylbenzeneammonium dehydrophosphate ionic liquid based on ortho-toluidine and phosphoric acid (Figure 2).



2-methylbenzenaminium dihydrogenphosphate

A 0.5 M solution of ortho-toluidine in alcohol and a 0.5 M aqueous solution of phosphoric acid were reacted at 70° C for 4 hours at 900 rpm, after 4 hours the reaction mixture was cooled to room temperature, and the ionic liquid was filtered through the filter. The resulting ionic liquid was dried in an oven. It has been tested with several different methods (Figure 3)

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A B C

Figure 3.Ortho-toluidine (A), Phosphoric acid (B), Dry ionic liquid (C).

Conclusion:

The resulting ionic liquids are stable, cheap, environmentally friendly, non-toxic, highly soluble in water, and highly efficient. The resulting ionic liquids showed very effective corrosion inhibition of metals.

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