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INFLUENCE OF AMINOALCOHOLS ON CORROSION IN INTERACTION WITH BORIC ACID

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Annotation: This thesis presents a study on the anti-corrosion properties of the reaction products of aminoalcohols and boric acid. The research highlights the high effectiveness of the synthesized inhibitor in protecting against atmospheric, water-salt, and neutral media corrosion. The use of boron-organic compounds in inhibitor formulations not only enhances corrosion resistance but also reduces production costs due to simple synthesis conditions. The developed combined inhibitor demonstrates reliable protection for equipment and components made of ferrous and alloyed steels, offering a cost-effective and efficient solution for industrial corrosion control.

Key Words: Corrosion inhibitors, aminoalcohols, boric acid, boron-organic compounds, atmospheric corrosion, water-salt corrosion, neutral media, metal protection, synthesis, anti-corrosion efficiency.

Currently, the protection of equipment from corrosion damage is a key task in various industrial sectors. Equipment corrodes under the influence of aggressive environments during storage and operation. As a result of corrosion exposure at industrial facilities, accidents occur, leading to the loss of transported or extracted products, the need to stop production and replace technological equipment, and consequently, an increase in the production cost of products. Furthermore, there is a negative impact on soil and the atmosphere due to spills of process media. To reduce the corrosive activity of process media, it is necessary to introduce corrosion inhibitors, the addition of which significantly reduces corrosion without affecting the composition of the corrosive environment. Significant progress has been made in the Republic's investigation of the impact of inhibitors on metal equipment corrosion, as well as in the creation and application of novel import-substituting, export-focused, competitive inhibitors, thanks to scientific research conducted on an industrial scale. These inhibitors are safe to use as all-purpose anti-corrosion agents, meet international standards, and exhibit high efficiency even at low concentrations. The literature claims that metals' thermodynamic instability in a variety of settings under specific external conditions is the primary cause of metal corrosion. The simultaneous occurrence of the cathodic reaction of ion or molecule reduction on its surface and the anodic reaction of metal ionization is a prerequisite for the corrosion process. When the equilibrium anodic potential is greater than the potential of at least one potential cathodic reaction, this requirement is met.

Even with the wide range of corrosion inhibitors currently on the market, more needs to be done to increase their diversity by creating new inhibitors that are more affordable and have better protective qualities. Research is currently focused on amine-based corrosion inhibitors and organic compounds with phosphorus, oxygen, and sulfur heteroatoms. Modern literature claims that despite their high inhibiting effect, broad spectrum of action against different types of corrosion (atmospheric, hydrogen sulfide, water-salt), reagent availability, and mild synthesis conditions, boron-containing corrosion inhibitors have not been thoroughly studied.

Conducting an analytical review of corrosion inhibitors that contain boron-organic compounds is the goal of this study. Because of their ability to prevent corrosion in the atmosphere, boron-organic compounds are used as ingredients in preservative oils. The lone pairs of electrons on nitrogen atoms and the vacant d-orbitals of iron ions are thought to be responsible for the formation of aminates, which is linked to the anti-corrosion effect of diethanolamines. The OH group also makes it possible for chelate cycles to form. On metal surfaces, oxoborates create compounds that are poorly soluble. The development of a more potent protective ferrohydroxyaminoborate film on the metal surface, which is produced by donor-acceptor bonds involving nitrogen atom lone pairs, OH groups, and the chemisorption of borate ions, is probably the cause of the increase in the inhibiting ability of ammonium polyborates.

The condensation product of oleic acid with diethanolamine and boric acid, modified with sodium, was examined for its anti-corrosion qualities. Two steps were taken in the synthesis of the corrosion inhibitor. A reaction mixture comprising oleic acid, diethanolamine, and boric acid (in a molar ratio of 2:3:1) was heated to 200°C while stirring until the water release stopped in order to produce an intermediate product in the first stage. In the second step, NaOH was added to the reaction mixture while stirring at 160°C to modify the intermediate product that was produced (for instance, 5 g of NaOH per 100 g of the first stage product). Following condensation, three distinct corrosion environments were used to test the product's inhibiting qualities. In this instance, 0.01 mol/L was set as the inhibitor concentration in acidic, neutral, and alkaline media. No corrosion was found in neutral, acidic, or alkaline conditions during the one-day test at room temperature.

The tests revealed that this inhibitor forms a multilayer protective chemo-adsorption film and has a high penetrating ability. According to tests, after 24 hours, the product's penetration depth between two steel plates (steel No. 3 and No. 5) was 87–94 mm and 96–103 mm, respectively.

The following absorption lines were found in this compound's infrared spectrum. Lines representing Me–O fragments were found in the 667.47 cm^{-1} region. The primary corresponding signals in this region were NH, OH, and H2O. Ammonia's deformation vibration occurred at 1765 cm^{-1}, while aromatic (heterocyclic) and C=C ring vibrations were observed between 2088 and 2400 cm^{-1}.

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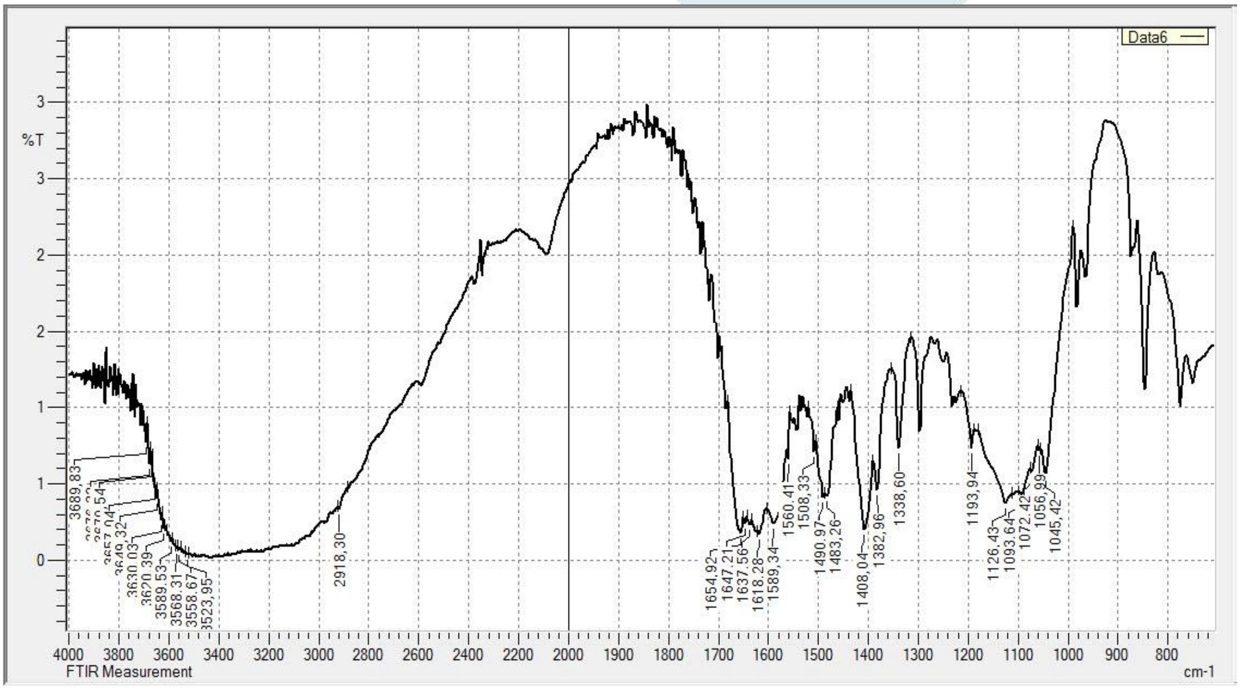

The following conclusions can be made from the analysis that was done: the reaction product of boric acid and aminoalcohols has strong anti-corrosion properties against corrosion in neutral environments as well as corrosion in the atmosphere and water-salt. Because of the low costs associated with the synthesis process, the use of boron-organic compounds as components of corrosion inhibitors allows for the enhancement of the composition's protective effect while also lowering the inhibitor's cost.

Equipment and spare parts composed of alloyed steel and ferrous metals are reliably protected from atmospheric corrosion by the suggested combined inhibitor.

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