

Study of Silicone Dioxide: Sodium Oxide (SiO₂:Na₂O) Ratio as a Corrosion Inhibitor for Mild Steel in 0.5 M HCl

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Structured Abstract

Background: In recent years, the search for eco-friendly alternatives to conventional corrosion protection methods has gained significant attention due to the hazardous and carcinogenic nature of hexavalent chromium-based protection. Sodium silicate has shown promise as a corrosion inhibitor in several studies. This research aims to extract silica from rice husks and utilize it to prepare a green silicate-based corrosion inhibitor. The study will investigate the corrosion performance of this inhibitor using the weight loss method on mild steel exposed to 0.5 M hydrochloric acid (HCl). The objectives of the research include characterizing the extracted silica, examining the impact of different SiO₂:Na₂O ratios of silicate solutions as inhibitors, determining the optimal conditions of silicate solutions as corrosion inhibitors, and comparing the corrosion rate of mild steel with and without the silicate-based inhibitor. This research contributes to the development of eco-friendly corrosion protection methods and expands the understanding of the potential of silica-based inhibitors for mitigating corrosion in various fields.

Methods: In this study, silica was extracted from rice husks by the basic extraction method using NaOH. Then, rice husks silica (RHS) and commercial SiO₂ were characterized by ATR-FTIR. Next, RHS and commercial SiO₂ were used to prepare sodium silicate solutions with different SiO₂:Na₂O ratios (Ratio = 1.00, 2.00 and 3.00). The concentration of the solutions (500 ppm) was used as the constant parameter. Mild steel coupons were polished, rinsed, and dried. For the weight loss test, the coupons' dimensions and weights were measured before being immersed in 0.5 M HCl added with sodium silicate with different ratios. Immersion time was set at 6 hours. Triplicate samples were used in this test. Coupons were weighed after immersion and corrosion rate (CR) and inhibition efficiency (IE) were calculated.

Results: ATR-FTIR data showed that the compound extracted from rice husks was silica by the presence of Si-O-Si asymmetric and symmetric stretching peaks respectively at a range of 1120 to 1050 cm⁻¹ and 800 cm⁻¹. The highest IE were observed at the ratio of 3.00 where sodium silicate prepared from RHS yielded 68.72% while commercial SiO₂ yielded a higher percentage which was 96.88%.

Conclusion: RHS can be used to prepare sodium silicate solution. SiO₂:Na₂O ratio of 3.00 with 6 hours of immersion time was the optimum condition to inhibit corrosion of mild steel in 0.5 M HCl.

Keywords: Sodium silicate, Corrosion inhibitor, Rice husks silica, Mild Steel, SiO₂:Na₂O

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