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INVESTIGATION OF CORROSION INHIBITION OF STAINLESS-STEEL GRADE 202 IN ACIDIC CHLORIDE MEDIUM BY CaO NANOPARTICLES

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Stainless steel (SS) Grade 202 holds immense significance among metals and alloys because of its high corrosion resistance due to the chromium oxide passive film forming on the surface of the metal. Nevertheless, SS 202 is prone to corrosion under aggressive environments, such as acidic chloride solutions. Although the deposition of polymer films and exposure to environments containing compounds of heteroatoms have been able to inhibit corrosion, there are many drawbacks to such systems, including environmental non-friendliness and cost factors. A novel approach combining the value addition of clamshells, a waste material, and characteristics of nanomaterials enhancing reaction rates is employed in this study concerning the corrosion of SS 202, which has widespread use from cookery to machines in industrial and automotive applications. Mass loss measurements of rectangular SS 202 specimens recorded in HCl solutions and mixed HCl and NaCl solutions indicate the corrosion-promoting ability of acidic conditions provided by HCl, which is strengthened by chloride ions. Nanoparticles (NPs) of CaO synthesised from clamshells through calcination at 1000 °C in a muffle furnace for 1.0 hr show an average diameter of 35.4 nm according to dual scattering particle size analysis. Further, X-ray fluorescence spectrophotometry and Fourier transform infrared spectroscopy indicate the presence of the Ca-O bond. Mass loss measurements, electrochemical impedance spectroscopy (EIS), and Tafel slope analysis of SS 202 performed in HCl and mixed HCl and NaCl systems in the presence of CaO NPs conclusively demonstrate the excellent corrosion inhibitory ability of CaO NPs. Both mass loss measurements and EIS lead to a decrease in the extent of corrosion of SS 202 of over 40% in acidic medium in the presence of CaO NPs. More importantly, low concentrations of CaO, such as 0.10 M, lead to superior corrosion inhibitory action towards SS 202 in extreme and aggressive environments, such as 0.25 M HCl solution. Nevertheless, the optimum level of CaO NPs to result in zero mass loss under the experimental time frame depends on the characteristics of the solution to which the SS 202 specimen is exposed.

Keywords: CaO nanoparticles, Corrosion inhibition, Impedance, Stainless steel