

Protection of Steel Against Corrosion in 4% HCl Solution Using Thyme Extract

Zaštita čelika od korozije u 4% rastvoru HCl-a primenom ekstrakta majčine dušice

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Abstract

In this paper, the efficiency of the thyme extract as a "green" corrosion inhibitor for two types of steel in a 4% HCl solution was investigated. Measurements were performed without inhibitors and at different inhibitor concentrations (0.5, 1.0 and 1.5 g/L) and different exposure times (2, 4, 6, 8, 24, 48 and 168h). The responses in the study - corrosion rate (Km^{-}), depth corrosion indicator (π) and inhibitor efficiency (z) were analyzed using the statistical software MINITAB 21. In the absence of inhibitors, the corrosion rate (Km^{-}) was significantly higher, while in the presence of the extract there was a decrease in Km^{-} and a proportional increase in the inhibition efficiency z . The maximum values of inhibition efficiency reached ~90–97% under optimal conditions (for steel 2 the inhibition efficiency reached 96.8% at a inhibitor concentration of 1.0 g/L and a time of 2h, while for steel 1 the inhibition efficiency reached 93.99% at an inhibitor concentration of 0.5 g/L and a time of 48h). Such a high efficiency suggests that a protective film has formed on the surface of the steel and that the thyme extract can be used as a corrosion inhibitor in aggressive acidic environments, such as HCl solution.

Keywords: ANOVA analysis; corrosion efficiency; green inhibitors; steel; thyme extract

Izvod

U ovom radu ispitivana je efikasnost ekstrakta majčine dušice kao „zelenog“ inhibitora korozije za dve vrste čelika u 4% rastvoru HCl. Merenja su sprovedena bez inhibitora i pri različitim koncentracijama inhibitora (0,5, 1,0 i 1,5 g/L) i različitim vremenima izlaganja (2, 4, 6, 8, 24, 48 i 168h). Odgovori u studiji - brzina korozije (Km^{-}), dubinski pokazatelj korozije (π) i efikasnost inhibitora (z) analizirani su korišćenjem statističkog softvera MINITAB 21. U odsustvu inhibitora, brzina korozije (Km^{-}) je bila značajno veća, dok je u prisustvu ekstrakta došlo do smanjenja Km^{-} i proporcionalnog povećanja efikasnosti inhibicije z . Maksimalne vrednosti efikasnosti inhibicije dostigle su ~90–97% pod optimalnim uslovima (za čelik 2 efikasnost inhibicije dostigla je 96,8% pri koncentraciji inhibitora od 1,0 g/l i vremenu od 2 sata, dok je za čelik 1 efikasnost inhibicije dostigla 93,99% pri koncentraciji inhibitora od 0,5 g/l i vremenu od 48h). Tako visoka efikasnost sugerise da se na površini čelika formirao zaštitni film i da se ekstrakt majčine dušice može koristiti kao inhibitor korozije u agresivnim kiselim sredinama, kao što je rastvor HCl.

Ključne reči: ANOVA analiza; ekstrakt majčine dušice, efikasnost korozije; zeleni inhibitori; čelik