Electrochemical corrosion of cast iron pipes in reclaimed water containing disinfectant

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The corrosion characteristics of cast iron pipes in reclaimed water containing 1, 2, and 4 mg/L NaClO and ClO₂ were investigated using potentiodynamic polarization curves (PPCs) and electrochemical impedance spectra (EISs). Scanning electron microscopy (SEM) was also used to evaluate the morphology of the corrosion scales. The results showed that NaClO and ClO₂ utilization changed the electron-transfer pathway and corrosion-product characteristics significantly. In reclaimed water containing NaClO at 1, 2, and 4 mg/L HClO could take precedence over dissolved oxygen (DO) to react with Fe and enhance the corrosion process at 4 days. However, the consumption of NaClO caused a shortage of HClO reacting with iron and induced the re-passivation of previously eroded areas at 30 days in the 1 mg/L NaClO experiments. Furthermore, high concentrations of NaClO (2 and 4 mg/L) also enhanced the corrosion process at 30 days. In the 1, 2, and 4 mg/L ClO₂ experiments, the ClO₂ molecule could take precedence over DO to react with the Fe and formed iron chlorides, enhancing the uniform corrosion throughout the whole experiment. Additionally, iron oxides or iron hydroxides usually showed a compact, needle-like structure in the control experiments, while flocculated iron chlorides were the main components in the disinfection experiments. Moreover, the acidification caused by H⁺ accumulation initiated distinct localized corrosion after 4 days of immersion in the 2 and 4 mg/L ClO₂ experiments, earlier than that in NaClO experiments (30 days). Thus, from a corrosion control perspective alone, NaClO is a better disinfection choice than ClO₂.

Keywords: disinfectant; electrochemical corrosion mechanism; cast iron; reclaimed water; corrosion scales;

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