Desalination and Water Treatment
www.deswater.com

doi: 10.5004/dwt.2020.25833

193 (2020) 251–265
July

Investigation of effective chemical flocculation conditions for the treatment of reverse osmosis reject water from coal power plant: a case study

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Received 14 August 2019; Accepted 10 March 2020

ABSTRACT

Power generation processes generate wastewater that is rich in scale-forming agents and which, therefore, requires suitable pre-treatment prior to further treatment with an RO system. In this study, Rheofloc5023 was used as a coagulant, while Rheofloc5414, ARFloc100, and Genefloc were the selected flocculants applied after the pH adjustment with lime and NaOH to alter the solubility of the ions in the water. The tests were conducted at 40°C and 60°C to observe the effect that temperature has on the treatment process. Four parameters were considered during the optimization process, namely, conductivity, turbidity, total hardness, and alkalinity. When lime was used, it was found that the treatment was superior at 60°C with ARfloc100 as flocculant. A coagulant dosage of 0.5 mg/L, a flocculant dosage of 0.2 mg/L, and a lime dosage of 220 mg/L were found to be optimal for a conductivity removal of 36%, a turbidity increase of 59%, a total hardness removal of 54%, and an alkalinity removal of 71%. When NaOH was used, Rheofloc5414 at 40°C was found to be optimal with coagulant and flocculant dosages of 5 and 0.5 mg/L, respectively. This yielded a conductivity removal of 1.26%, a turbidity removal of 58.75%, a total hardness removal of 20.3%, and an alkalinity removal of 50.6%. Thus, lime treatment was more efficient for the removal of scaling agents from the water. However, it was found that settling occurred faster at 60°C with both lime and NaOH and that the latter had a better settling velocity characterized by the formation of more stable crystals. This finding was confirmed with a scanning electron microscopy, as the treatment with NaOH and Rheofloc5414 at 60°C had larger and more densely packed crystals. From the above findings, it is suggested that lime should be used for treatment, as it removed more scaling agents and it is less expensive and more readily available than NaOH.

Keywords: Crystallization; Flocculation; RO-reject; Scalants removal; Temperature effect

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