Laboratory-scale study of the advanced Fenton process for silica removal from brackish underground water in arid areas in Saudi Arabia

Fathi Djouider*, Mohammed S. Aljohani

Nuclear Engineering Department, Radiation Chemistry Division, King Abdulaziz University, P.O. Box 80204, Jeddah 21589, Saudi Arabia, Tel. +966 558822318; email: fathid@yahoo.com (F. Djouider), Tel. +966 545345000; email: mjohani@kau.edu.sa (M.S. Aljohani)

Received 12 April 2016; Accepted 27 November 2016

ABSTRACT

Silica scaling of reverse osmosis (RO) membranes in water desalination poses a worldwide problematic issue in the cost-effective operations in seawater desalination plants. Underground water is one of the main water resources in the Kingdom of Saudi Arabia. Most of the inland cities and remote villages rely entirely on this supply mode for their domestic, industrial and agricultural purposes. However, this water resource is characterized by its relatively high silica contents. Therefore, pretreatment for silica removal from the RO feed is crucial in a system running on high silica waters. In this preliminary work, we investigated the effectiveness of advanced Fenton process (using hydrogen peroxide and zero valent metal iron Fe° as source of Fe³⁺) for the silica pretreatment of water from the Buwaib deep aquifer by its co-precipitation with ferric hydroxide. The influences of several reaction parameters, i.e., iron powder dosage, hydrogen peroxide concentration, pH effect, were investigated. In the optimum conditions, up to 70% of silica was removed. This preliminary study showed that this environmentally friendly process is an effective silica mitigation strategy prior to the RO desalination.

Keywords: Silica removal; Advanced Fenton process; Hydrogen peroxide effect; Iron dosage effect; pH effect