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Antiscale magnetic pretreatment of reverse osmosis feedwater

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Abstract

Understandable controversy surrounds the use of antiscale magnetic treatment (AMT) though considerable published evidence suggests it can often be effective. Common factors in reported successful applications include continuous recirculation of a hot (and often supersaturated) process feed water usually including a high ionic and suspended load. Much less success has been claimed at preventing scaling in once through, cooler systems or in membrane desalination. AMT for prevention of RO scaling could represent an ideal solution, specifically in those cases where the membrane is liable to foul predominantly with crystalline material. If it could be proven to be both effective and reliable, the need for chemical antiscalants could be reduced and considerable cost benefits realised. The effects of magnetic treatment on low temperature crystallisation of $CaCO_3$ in a flow through system has been investigated. Magnetically induced changes were most apparent in sedimented scale provided that a significant magnetic field contact velocity (V_{mf}) had been obtained. This deposit, forming mostly as calcite under non magnetised conditions was modified to spherical grains displaying a characteristic form. Scale precipitating onto PVC pipe was also visibly altered, but only when a high strength magnetic field was applied to strongly supersaturated solution flowing with a sufficient velocity. Preliminary experiments were conducted using a magnetically treated feed in once through and recirculating RO systems operated under accelerated scaling conditions. The efficacy of the treatment was ascertained by analyses of flux and salt rejection decline during formation of the scale deposit with reference to a control system operating under the same physicochemical conditions. Destructive autopsy was also carried out on the membrane elements to deduce the nature and extent of the deposit. No change was evident in a once through system with a single magnetic exposure of the water. However under recirculation (and repeated exposure) the grain size of the deposit (precipitating exclusively as aragonite) was reproducibly increased. Improvements in salt rejection decline were occasionally evident due to this more porous deposit but no repeatable substantial improvement in flux decline was found. It was found that magnetic treatment was promoting enhanced precipitation (up to 10× more; depending upon experimental conditions) in the prefilter units. SEM analysis of the prefilter deposit indicated this had grown in situ rather than having been trapped by virtue of having increased particle size. Further work is needed to deduce if these effects can be applicable to RO engineering situations.

Keywords: Antiscale magnetic treatment; Calcium carbonate; Reverse osmosis; Scaling

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