Scale reduction and scale modification effects induced by Zn and other metal species in physical water treatment

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Abstract

The effect of Zn and other metal ions, released by some physical water treatment devices, on the nucleation rate and crystal morphology of calcium carbonate was investigated. Zn in particular caused a substantial increase in induction time and induced the formation of calcium carbonate in the aragonite rather than the calcite form. These effects were quantified. A minimum Zn/Ca mass ratio of 0.06×10^{-3} was required for Zn to cause measurable effects. At [Ca] > 300 $mg \cdot dm^{-3}$ addition of Zn of up to 100 $\mu g \cdot dm^{-3}$ had a negligible effect on nucleation rate and crystal morphology. Cu was found to be only half as effective as Zn while Mg required to be present at concentrations 1 000 times more than Zn to produce comparable effects. Colloidal Fe_2O_3 caused a decrease in induction time. The direct effect of Zn on scale reduction in laboratory tests amounted to about 77±6 % and was achieved with 300 $mg \cdot dm^{-3}$ Ca solutions to which 200 $\mu g \cdot dm^{-3}$ Zn was added.