

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

PP Coetzee\*, M Yacoby, S Howell and S Mubenga

*Department of Chemistry and Biochemistry, Rand Afrikaans University, PO Box 524, Johannesburg 2006, South Africa*

## 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  $0.06 \times 10^{-3}$  was required for Zn to cause measurable effects. At  $[Ca] > 300 \text{ mg}\cdot\text{dm}^{-3}$  addition of Zn of up to  $100 \text{ }\mu\text{g}\cdot\text{dm}^{-3}$  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  $\text{Fe}_2\text{O}_3$  caused a decrease in induction time. The direct effect of Zn on scale reduction in laboratory tests amounted to about  $77 \pm 6 \%$  and was achieved with  $300 \text{ mg}\cdot\text{dm}^{-3}$  Ca solutions to which  $200 \text{ }\mu\text{g}\cdot\text{dm}^{-3}$  Zn was added.