



Evaluation of a polymaleic-based scale inhibitor (HPMA-AEO-9) against calcium carbonate scale

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ABSTRACT

Hydrolyzed polymaleic anhydride (HPMA) is widely used as a scale inhibitor, but it is easy to form insoluble gel with alkaline earth ions. To overcome this shortcoming, a fatty alcohol ethoxylate (AEO-9) is introduced into HPMA to obtain a maleic acid-based copolymer HPMA-AEO-9. HPMA-AEO-9 is characterized by FT-IR, ¹H NMR and GPC. The effects of HPMA-AEO-9 on CaCO₃ scale are studied in several aspects (such as dose, Ca²⁺ concentration, temperature, inhibition time, pH, and the relative supersaturation of CaCO₃ solution) by static experiments. The effect of HPMA-AEO-9 on the scaling process is studied under dynamic conditions. The impact of HPMA-AEO-9 on morphologies of CaCO₃ is investigated using SEM and XRD. The results show that the presence of AEO-9 group can significantly improve the resistance of HPMA-AEO-9 to high alkalinity, high hardness and high temperature. Compared with additive of HPMA, the presence of HPMA-AEO-9 can obviously inhibit the nucleation rate at the induction region, accelerate the growth of nuclei at the rapid growth region, and reduce the scaling rate at the stable growth region; HPMA-AEO-9 changes calcium carbonate crystal from stable calcite to unstable aragonite and vaterite. HPMA-AEO-9 is a threshold inhibitor with excellent performance in inhibiting CaCO₃ scale.

Keywords: Circulation cooling water; Calcium carbonate scale; Maleic acid; Antiscalant; Fatty alcohol polyoxyethylene ether (AEO)

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