SULPHAMATE IONS ENHANCE THE CLEANING OF THICK MILK DEPOSITS

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ABSTRACT

The fouling layers in falling film evaporators processing milk products are often many millimetres thick and appear to result from the thickening of milk concentrates. The surface temperatures are lower than 70 °C which is often considered to be the temperature required to cause protein denaturation with resulting heat transfer fouling. To mimic this process, concentrated skim milk was prepared from powder and was then concentrated in a rotary evaporator. The concentrate was gelled by heat onto a disk producing a 3.5 mm-thick layer with about 60% total solids. The spinning disk method was then used to test the cleaning effectiveness of a commercial caustic based cleaner (Resolve, Orica Chemnet, NZ) and additives.

Solutions of Resolve with an alkalinity equal to 0.87% NaOH (0.22 mol L^{-1}) were prepared and to these were added an EDTA-based additive (Eliminator), sulphamic acid (0.103 mol L^{-1}) and sodium sulphamate (neutralised sulphamic acid). The disc was rotated at 64 rpm, and liquid samples were removed and analysed for protein by absorption at 280 nm UV light.

The EDTA-based additive did not enhance cleaning in this system. The addition of sulphamic acid increased the cleaning rate by a factor of 4.1. When neutral sodium sulphamate was added at concentrations of 0.05, 0.10, and 0.20 mol L^{-1} the cleaning rates were increased by factors of 4.3, 3.0 and 2.3, respectively, showing that sulphamate ions enhanced cleaning.

Because previous studies had shown the calcium solubilisation aided cleaning, the calcium content in the liquid was also tested. No significant change in calcium was detected when sulphamate was added. Further tests were carried out to see if sulphamate enhanced the swelling on whey protein isolate gels. It was found that an aqueous solution 0.1 M NaOH with 0.03 M sodium sulphamate did not increase swelling but increased mass loss when compared with 0.1 M NaOH alone.

The mechanism for the effect of sulphamate ions was not determined. It is likely that there is an interaction with proteins that led to a breakdown of the bonds that cause age thickening, this allowing easier penetration of hydroxide ions.