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Calcium Sulphate Fouling in Plate Heat Exchangers

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Extended Abstract

Plate heat exchangers have been used in various industrial fields because it has a lot of advantages such as high thermal efficiency, small thermal size, and convenient maintenance. However, when it is used for a long time, fouling and unwanted materials on heat transfer surface are made by impurities in water. The thermal efficiency of plate heat exchangers decreases by the thermal resistance of fouling [1-2]. Therefore, it is necessary to study the factors that affect fouling in plate heat exchangers. Among various fouling mechanisms, crystallization fouling is dominant for the reduction in the thermal efficiency [3-6]. It takes places when water soluble salts, predominantly calcium sulphate, become supersaturated on the heat transfer surface. Therefore, in this study, the factors affecting calcium sulphate fouling such as chevron angle, concentration, flow velocity, inlet temperature, and flow direction are investigated. The tests were performed under accelerated concentration conditions and the scaling was made in the cold side to study crystallization fouling formed according to the temperature.

The fouling at the initial time leads to an increase in the overall heat transfer coefficient temporarily because of the increased turbulence level. However, as the insulation effect increases, the overall heat transfer coefficient decreases. After certain period, as the removal rate is similar with the deposition rate, the fouling resistance has asymptotic trends. The fouling resistance increases the pressure drop because of the decreased channel diameter.

As the chevron angle increases, actual scale on the plate increases because the resistance to fluid flow also increases. However, as the chevron angle increases, the initial heat transfer coefficient increases. Therefore, the fouling resistance that means the thermal resistance difference between the certain and initial time decreases as the chevron angle increases. As the concentration increases, the fouling resistance increases because the increased reaction rate with the increased number of foulant ions leads to a higher deposition rate. As the flow velocity increases, the heat transfer coefficient increases and the surface temperature decreases. As a result, the fouling deposition rate decreases. The removal rate increases because of increased shear stress. Therefore, the fouling rate that means the difference between the deposition and removal rate decreases. The increase of the inlet temperature in the hot side leads to an increase of the outlet temperature in the cold side and the supersaturated ions. The increase of the inlet temperature in the cold side leads to an increase of the reaction rate. Therefore, the increase of the inlet temperature in the both sides leads to an increased fouling resistance. The fouling resistance is higher in the parallel flow than that in the counter flow, because the higher initial temperature for the inlet accelerates fouling formation.

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