Scale Detachment: Why, How, and Where

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Crystallization fouling significantly impacts industrial systems by reducing efficiency and increasing operational costs. In this work, we investigate the critical role of detachment processes, which are often ignored in traditional fouling models.

We present a detailed review of detachment mechanisms and propose a conceptual three-regime model that links fouling behavior to hydrodynamics and surface properties. We show that fouling processes span three regimes (i.e., transport-limited, reaction-limited, and adhesion-limited) based on fluid dynamics and fouling layer adhesion. This framework provides valuable insights into optimizing fouling mitigation strategies through controlled surface engineering and the manipulation of fluid shear properties. By incorporating these insights, more accurate predictive models can be developed, enabling efficient fouling control across various industries.

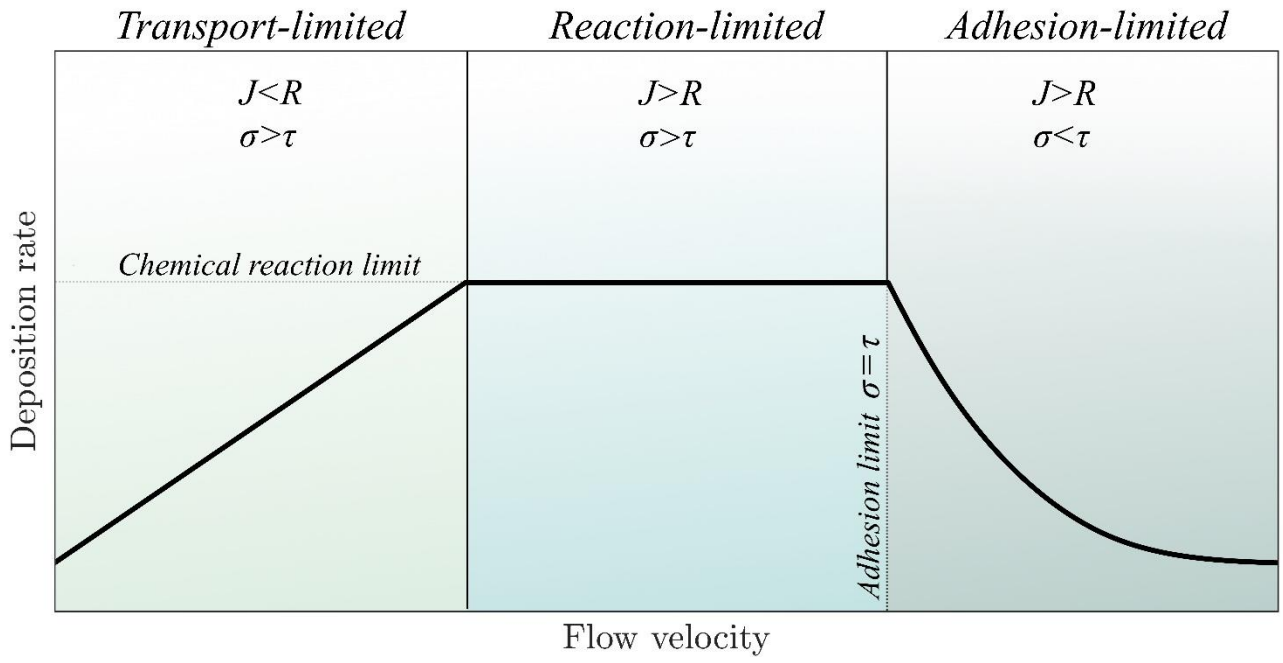

Figure 1: A conceptual three-regime model of crystallization fouling. The model presents a general behavior of deposition rates as a function of flow velocity. Reproduced with permission from Løge et al.[1]

References:

1. Løge, I. A. & Anabaraonye, B. U. The importance of detachment processes in modelling crystallization fouling. *Chem. Eng. J.* **497**, 154642 (2024).