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Mathematical Modeling of Deposition of Carbonaceous Material from Heavy Hydrocarbon Vapors

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Abstract

A two-dimensional mathematical model was developed to predict the deposit formation from hydrocarbon vapour products in a straight tube with either constant and uniform wall heat flux or constant and uniform outside wall temperature, assuming physical condensation as the mechanism. A single condensable pseudo-component is modelled to transport, condense and form the deposit layer on the wall. Two cases corresponding to different physical situations are simulated. In the first case the model was used to simulate deposition results in a long tube downstream of a bitumen coking reactor. Experimental results of effects on deposition of vapour temperature, addition of secondary steam, and vapour residence time or vapour velocity compared favourably with model calculations. The second case modelled a single transfer line exchanger (TLE) tube, which is characterized by highly turbulent flow. The temperature profiles of quenched vapour and tube skin, vapour pressure drop, and the thickness of the deposit layer are predicted.

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