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Coke formation in industrial furnaces

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Abstract

There are several thousand hydrocarbon furnaces located in world refineries and petrochemical plants. In general, these furnaces vary in size and style but each contains fired heating or reaction coils most often of a serpentine configuration commonly called furnace tubes, which transport the hydrocarbon charge stock being heated and processed. During normal operation a solid carbon material, commonly referred to as coke, is formed adjacent to the inner wall of the tubing. The formation, which is a result of continuous heating of the zero velocity fluid layers immediately adjacent to the fluid boundary, grows in thickness in a continuous manner with time. Eventually, removal of the coke deposits becomes necessary due to excessive pressure drop across the tubes, reduced throughput through the tubes, or reduction in thermal efficiency below some allowable minimum.

Understanding the relationship between the oil film temperature, heat flux, bulk oil temperature, mass flux, and oil residence time allows the designer to choose cost-effective solutions to minimize the rate of coking. Several methods for internal cleaning or decoking of hydrocarbon furnace tubes are currently employed, the most common of which are mechanical cleaning, hydro blasting, and steam-air decoking. But by good operation like suitable reflux, increasing flow of fluid in the coils and minimizing flame impingement can prolong run lengths and increase the period time between decoking and increase reliability and safe operation of furnaces.

Keywords: decoking, flame, refining, oil film temperature, hydrocarbon, furnaces

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