

**Case Studies (FIS-204)**

## **Crude Furnace Revamp and NO<sub>x</sub> Reduction**

An Ohio refinery has a Crude Heater in their Crude Unit. The Crude Heater is a balanced draft, box type, horizontal tube radiant heater that has a common convection section on top. The heater was originally built in 1968 for 423.2 MMBtu/hr heat duties. The convection section is designed to preheat oil feed and superheat steam from 371°F to 450°F.

The flue gas temperature leaving the convection section as per the original design was 550°F. The refinery was experiencing stack temperatures as high as 810°F to 850°F.

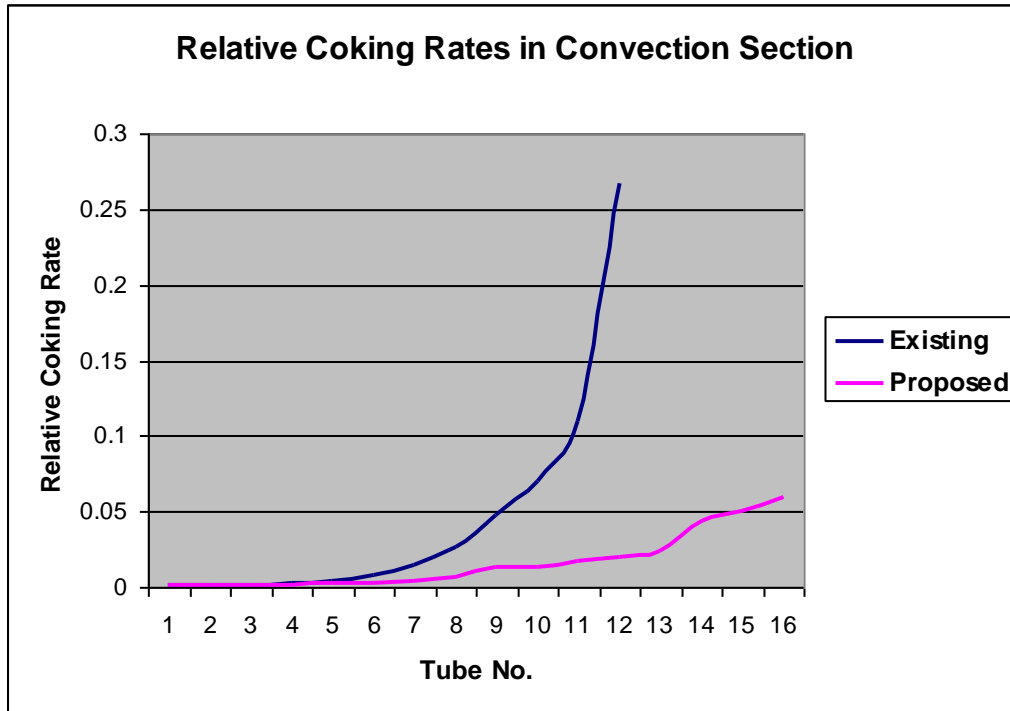


Furnace Improvements Services (FIS) performed an engineering study for NO<sub>x</sub> reduction on this furnace and modeled the furnace with Ultra Low NO<sub>x</sub> Burners. It was found that the radiant tubes in this heater had been suffering from high tube metal temperature and flame impingement. The convection section was inefficient and the air preheater operating temperature was reaching its metallurgical limits.

Furnace Improvements Services (FIS) modified the convection section and reduced relative coking rates. The relative coking rates in the existing convection section and the proposed retubed convection section are shown in the graph below. They accepted our recommendations and immediately assigned the NO<sub>x</sub> reduction and performance improvement project to FIS.

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This furnace had 84 up-fired burners having a total heat release of about 500 MMBtu/hr. These were replaced with Ultra Low NO<sub>x</sub> burners to achieve targeted NO<sub>x</sub> emissions of about 0.05 lb/MMBtu.

This project consisted of retubing the convection section, modifying the radiant section, and installing low NO<sub>x</sub> burners. We developed the detailed engineering and fabrication drawings for this revamp. We also developed the detailed specifications for tubes, finning, tube supports, burners, burner supports, fabrication, and erection. We floated enquiries, evaluated vendor proposals, and made recommendations for placing a direct purchase order to the vendors. We carried out testing on the burners and checked the parameters while the heater was running with full capacity.

The heater was commissioned in April 2004 and has been running successfully ever since. The client can now process more throughput than the design. The tube skin temperatures are very low.