

# **New technology for the Detection and Sizing of Carburization Damage in Plant Furnace Tubes**

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There are a variety of Fired Heaters (Coker furnaces, Catalytic reformers, Crude heaters, Vacuum heaters etc.) in industry today. They may be of various configurations with different operating parameters, but they all are prone to carburization damage in tubes over time. Tubes are mostly made from 2-9% chrome steel and are susceptible to carburization. Many refineries have delayed coking units for upgrading reduced crude as well as other heavy bottoms to more valuable distillate byproducts with a coke byproduct. The charge is fed directly to the bottom of the fractionator where light hydrocarbons are flashed off and heavy residue is passed on to a furnace. The heated residue is then introduced into coke drums where the residence time is enough to form coke product. A vital part of this process is thermal cracking which is provided by Coker furnaces. The Coker furnace is probably one of the most prolific units to be found in refineries. These furnaces operate in a carburizing environment at a design pressure of approximately 250 psi. Tube life expectancy strongly depends on the level of severity of service induced damages. A typical failure can be caused by stress rupture (combination of pressure related stresses and internal stresses) caused by carburization and coke on the inside surface of the tube. Sometimes local heat affected zones are developed that cause premature stress rupture failures. In other cases, embrittlement caused by carburization leads to a premature tube failure, causing forced outages. In this service, 9 Cr alloys are also susceptible to metal loss caused by oxidation on the external tube surface. Oxide build-up (on the outside of the tube) can also lead to less efficient heat transfer with an increase in fuel costs. Provided a preventive maintenance plan is in place, tube retirement is usually based on: - level of carburization - metal wall loss caused by oxidation. A new, fast technology offered by Russell NDE Systems Inc. allows the detection and sizing of carburization without extensive preparation of the tube surface. An inspection procedure has been developed to detect, and later size the depth of carburization damage present without the requirement of any destructive tests. This paper talks about the inspection methodology and a case study.