

CHARACTERIZATION AS A TOOL FOR FAILURE INVESTIGATION: TATA STEEL EXPERIENCE

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ABSTRACT

Failure of different industrial components can have varying impact on production, safety and morale of the employees. Tata Steel, being an integrated steel plant has components operating in vastly different environment, temperature and magnitude and nature of stresses. This inevitably results in different modes of failures ranging from mechanical fatigue, thermo-mechanical fatigue, brittle and ductile fracture, hydrogen embrittlement and different forms of corrosion like uniform, pitting, stress corrosion cracking and galvanic corrosion. The correct determination of the mode of failure is of paramount importance in deciding right recommendation(s) to prevent the recurrences. Failure mode determination requires collection of information regarding operating parameters followed by selection of suitable characterization tools based on the type of components and the preliminary observations. In the present paper, utilization of visual observations, stereo microscope and fractography using scanning electron microscopes coupled with energy dispersive x-ray spectroscopy (EDS) is shown to determine the mode of failures. The uniqueness of each tool is demonstrated for failure analysis of different components including foundation bolts, shear bolts, shafts, heat exchangers, boiler tubes, hood tubes, valves, etc. In special cases such as case carburized gears and non-ferrous aluminium alloy's fixture, the application of x-ray diffraction and electron probe micro-analysis have proven to be of immense importance in pinpointing the root cause of failures by determination of the fraction of retained austenite and showing carbide network formation in the case and the presence of undesirable intermetallic phase in FCC matrix. These characterization tools have helped not only in determination of root cause of failures but also in extending the service life of critical components which are presented in this work.

Keywords: Failure analysis, materials characterization, fracture, corrosion, life extension.

