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# Analyzing the Causes Behind Gas Turbine Blade Failure: A Comprehensive Case Study

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**Abstract :** This research is dedicated to exploring the failure of a turbine blade within a gas transportation plant, with a primary focus on conducting a comprehensive examination through advanced metallurgical and mechanical analyses of the identified failed blade. Crafted from the nickel superalloy Inconel IN738LC, the turbine engine had accumulated approximately 61,000 operational hours before the blades failed, causing severe damage to the transportation plant and necessitating a prolonged shutdown. The investigative procedure commenced with an in-depth visual inspection of the blade surfaces, succeeded by fractography analysis of the fracture surfaces, microstructural investigations, chemical analysis, and hardness measurements. The findings unveiled distinctive fatigue marks on the fracture surface. Critical microstructural changes were identified as a consequence of the blade's operation at high temperatures. The investigation determined that the crack initiation resulted from coating damage at the leading edge, subsequently propagating through fatigue. Ultimately, due to a reduction in cross-sectional area, the fracture was completed. This comprehensive analysis sheds light on the intricate factors contributing to turbine blade failure and offers valuable insights for enhancing operational reliability in similar environments.

**Keywords :** gas turbine, blade failure, TCP phases, fatigue, quantitative analysis
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