World Academy of Science, Engineering and Technology
International Journal of Mechanical and Industrial Engineering
Vol:13, No:10, 2019

Root Cause Analysis of a Catastrophically Failed Output Pin Bush Coupling of a Raw Material Conveyor Belt

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Abstract : In integrated steel plants, conveyor belts are widely used for transferring raw materials from one location to another. An output pin bush coupling attached with a conveyor transferring iron ore fines and fluxes failed after two years of service life. This led to an operational delay of approximately 15 hours. This study is focused on failure analysis of the coupling and recommending counter-measures to prevent any such failures in the future. Investigation consisted of careful visual observation, checking of operating parameters, stress calculation and analysis, macro and micro-fractography, material characterizations like chemical and metallurgical analysis and tensile and impact testings. The fracture occurred from an unusually sharp double step. There were multiple corrosion pits near the step that aggravated the situation. Inner contact surface of the coupling revealed differential abrasion that created a macroscopic difference in the height of the component. This pointed towards misalignment of the coupling beyond a threshold limit. In addition to these design and installation issues, material of the coupling did not meet the quality standards. These were made up of grey cast iron having graphite morphology intermediate between random distribution (Type A) and rosette pattern (Type B). This manifested as a marked reduction in impact toughness and tensile strength of the component. These findings corroborated well with the brittle mode of fracture that might have occurred during minor impact loading while loading of conveyor belt with raw materials from height. Simulated study was conducted to examine the effect of corrosion pits on tensile and impact toughness of grey cast iron. It was observed that pitting marginally reduced tensile strength and ductility. However, there was marked (up to 45%) reduction in impact toughness due to pitting. Thus, it became evident that failure of the coupling occurred due to combination of factors like inferior material, misalignment, poor step design and corrosion pitting. Recommendation for life enhancement of coupling included the use of tougher SG 500/7 grade, incorporation of proper fillet radius for the step, correction of alignment and application of corrosion resistant organic coating to prevent pitting.

Keywords : brittle fracture, cast iron, coupling, double step, pitting, simulated impact tests
Conference Title : ICEFA 2019 : International Conference on Engineering Failure Analysis
Conference Location : Paris, France
Conference Dates : October 29-30, 2019