Fatigue analysis of used welded impeller for determination of critical threshold before remanufacture

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Abstract

Centrifugal compressor is one of the key equipments in the petroleum, electric power, and chemical other industries. The prediction of the remaining fatigue life of the used impeller in compressor is very important for the determination of the critical threshold for the remanufacture. Remanufacture is an important method for the recovery of the remaining value of the used welded impeller [Zhang et al. (2013)]. The impeller is the core component of the centrifugal compressor and consists of a series of curved blades. The reliability of the blades directly affects the normal operation of the whole compressor unit [Sorokes et al., (2011)]. The fatigue life of the blade is determined by both of the mean stress and the alternative stress. Alternative stress is generated from aero-dynamic load. The fatigue cracks are usually generated at the root of the blade [Ejaz and Salam (2007)].
Paris formula is used in the simulation of the fatigue crack propagation. The fatigue life of the impeller of the centrifugal compressor can be predicted by use of the Monte Carlo (MC) method and the Probability Fracture Mechanics (PFM) with consideration of the uncertainty and the randomness. Results indicate that the standard deviation, the fracture toughness, and the initial crack length can significantly affect the remaining fatigue life of the impeller. With the increase of the crack length and the coefficient of variation, the fatigue life can be decreased. Compared to the traditional theoretical method, the MC with PFM method is more safe and reliable for the design of the impeller.

Keywords: impeller, fatigue life, crack, Monte Carlo method

Acknowledgements:

This work was supported the National Key Basic Research Special Foundation of China (2011CB013401).

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