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Reliability Estimation of Cracked API 5L X70 Pipeline Steel

O. GHELLOUDJ, D. ZELMATI, D. BERDJANE, A. GHARBI, S. Achouri, C. E. RAMOUL, K. BOUHAMLA

Abstract: The aim of this paper is to estimate the reliability of cracked pipeline steel grade API5L X70 used for hydrocarbon transportation, by coupling a developed mechanical model, basedin one hand on the simulation of cracked specimen, and an experimental result of tensile and Charpy test, and in the other hand, based on a reliability model by using a first-order reliability method (FORM). These pipes are produced by the Algerian company of manufacture of welded pipes (ALFAPIPE Annaba). The experimental task such as resilience and tensile test were carried out on specimens taken from a pipe in the longitudinal and the transversal directions. The resilience tests are carried out at different temperatures in order to estimate the fracture toughness of the material, basing on a global correlation. Besides, tensile tests are performed to bring out the mechanical characteristics of the material. After, the stress intensity factor is assessed using the analytical model of IRWIN. In the reliability analysis, the limit state function is attributed to the moment when the stress intensity factor estimated by Irwin mechanical model, is equal tothe fracture toughness of the steel pipe. The basic random variables within the limit state function are assumed to follow a normal distribution in order to simplify the assessment. Then, the evaluation of the reliability index and the parameters sensitivities of the cracked pipelines steel are assessed.

Keywords : Reliability, Cracked API 5L X70, Pipeline Steel