Abstract

Generally, the safety levels of corroded pipes are evaluated using the nonlinear probabilistic model thus, an accurate probabilistic model is the important step in the structural reliability analysis of corroded pipelines. In this paper, three novel probabilistic models are developed for describing the burst pressure in low, mid and high-strength grades steels. The developed probabilistic models for corroded pipelines include three terms as 1) model errors, 2) burst pressure of intact pipes based on stress criteria improved by the plastic flow theory and 3) different remaining corroded strength factors. The best models for each steel grades category of corroded pipeline are selected using the confidence index based on three burst experimental database tests of pipes. The best distributions of model error for different probabilistic burst corroded models are given based on Anderson-Darling statistic from the Normal, Lognormal, Frechet, Gumbel, and Weibull distribution functions. An adaptive conjugate map-based first order reliability method is developed to assess the structural failure analysis of corroded pipelines. Six corroded pipelines with different grades strength steels are selected to demonstrate the applicability of the proposed probabilistic models in structural reliability analysis. It conducted that the average shear stress yield criterion is the best plastic flow theory for modeling the burst pressure of intact pipes, where the Gumbel, Frechet and Lognormal are respectively the best distributions for model errors of low, mid and high-strength grade steels. The reliability results of corroded pipelines demonstrated that the depth of corrosion defects is a sensitive variable, which reduce the safety levels of all corroded pipe examples compared to the length of defect and operating pressure. The safety levels of corroded pipelines reduce about twice less than un-corroded pipes for corrosion defect depth to pipe thickness (*d/t*) in the range from 0.4–0.5 for almost pipes grades.