Remaining Life Prediction for Corroded Gas Pipeline Management in the Era of Industry 4.0

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Abstract

In modern industry, metal pipelines are an important means of transporting energy. However, the pipe can corrode with time elapsed. Corrosion is one of the major causes of failure in gas pipelines. The purpose of this paper is to present a probabilistic approach to predicting the residual life of gas pipeline with corrosion defects. The proposed method consists of three steps. First, instead of deterministic one, a stochastic model is adopted to deal with the variability in corrosion growth rates. Second, the failure probability of the pipeline is obtained by using PCORRC, one of widely used codes to calculate the pipe failure pressure. Third, the remaining pipeline life is predicted by using ISO 16708, a global standard of limit state method on pipeline reliability. The feature of the presented method is that it accommodates the probabilistic behavior of corrosion growth and deals with the uncertainty of various pipe parameters. This makes it possible to obtain more realistic prediction results. An illustrative example is given by using an inline inspection data. Finally, based upon the residual life prediction, a future framework is provided for the pipeline prognostics management required in the era of Fourth Industrial Revolution.

Keywords
Remaining Life, Pipeline, Corrosion Defects, Stochastic Model, Fourth Industrial Revolution

Biographies

Seong-Jun Kim is a Professor of Industrial and Management System Engineering, Gangneung-Wonju National University (GWNU), Korea. He received the B.S. degree in applied statistics from Yonsei University, Seoul, Korea, in 1989, and the M.S. and Ph.D. degrees in industrial engineering from the Korea Advanced Institute of Science and Technology (KAIST), Taejon, in 1991 and 1995, respectively. He was a Visiting Scientist at the Texas A&M University, College Station, in 1999 and a Visiting Scholar at the University of Tennessee, Knoxville, in 2006. Dr. Kim has also participated in Six Sigma programs for Samsung Electronics and LG Chemicals. His research interests include reliability engineering in gas pipeline system, quality management, and machine learning. Dr. Kim won the Back-Am Award from Korean Institute of Industrial Engineers in 2006.

Woosik Kim is currently a chief researcher of Gas Research Institute, Korea Gas Corporation. He received B.S., M.S, and Ph.D. degrees in metallurgical engineering at Seoul National University, Seoul, Korea, in 1985, in 1989, and in 1993 respectively. He has been working at Korea Gas Corporation since 1993. His main research areas include gas pipeline design, construction and maintenance technologies.