Arrangement of Nondestructive Tests for Technical Inspection Process of Electrofusion Weld in Gas Polyethylene Pipe

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Due to the reduction of operational costs, non-corrosiveness, and ease of implementation, polyethylene pipes are a suitable replacement for steel pipes in gas distribution networks. Considering the irreversible events of gas leakage, effective and feasible nondestructive testing of electrofusion welding is an essential factor to avoid the hazards of gas leakage. Based on recent proposed nondestructive tests, to control the quality of welds, the nature of the electrofusion structure leads us to manufacture vacuum boxes, internal pressure devices, and tapping saddle connector for assessment of weld quality and testing polyethylene joint leakages. This article focuses on the sequence of these new nondestructive tests to monitor the health of polyethylene electrofusion joint structures under gas network project implementation conditions. To examine the testing chain and the proposed sequence of nondestructive tests, the data gathering process was performed, and with respect to the sensitivity of the electrofusion weld to the operator's skill, welding process, and the condition of the pipe and fittings, in each case the influential factors to find the key parameters were evaluated. The results of laboratory tests in cases of short tests and long-life tests using artificial defects such as slow crack growth with defective samples of on-site joints and defects reported in projects were compared. To validate leak detection, leak location, and leak measurement, weld simulation with finite element and computational fluid dynamics software (CFD), analysis conforming to real conditions was considered. The test sequence, acceptance criteria, and calibration method of the tools according to 7 parts of EN 1555 standard were argued for performing the final inspection steps. In this perspective, for each leak testing technique, the average type, pressure level, test duration, and finally the acceptance criteria were proposed. The main outcome is the technical specifications for electrofusion weld assessment and baseline risk-based inspection scheme in gas supply projects. In this regard, a database software based on the proposed Inspection and Testing Plan (ITP) has been developed, which is fundamental for monitoring the whole project from the first stage of polyethylene granule control, pipe and fitting manufacture, and gas injection to the final stage in network and commissioning and operations to determine failure causes and suitability for performance assessment. Another proposed idea is standardizing the recent technical specifications internationally. The importance of the results could be evaluate in physical asset management when we realize that arrangement of proposed nondestructive tests can lead transmission and distribution projects to cost savings, protection of humans and the environment, and furthermore it will improve and optimizes related codes and standards.