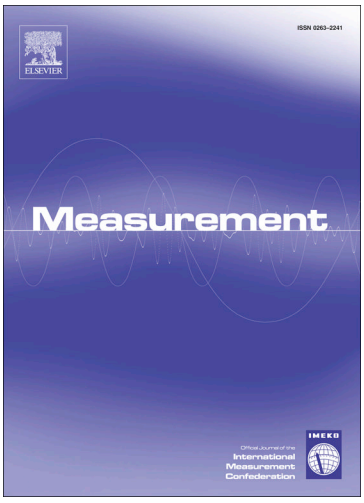

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PII: S0263-2241(18)30194-5
DOI: https://doi.org/10.1016/j.measurement.2018.03.018
Reference: MEASUR 5337

To appear in: *Measurement*

Received Date: 28 July 2017
Revised Date: 24 January 2018
Accepted Date: 5 March 2018

Please cite this article as: L. Ren, T. Jiang, Z-g. Jia, D-s. Li, C-l. Yuan, H-n. Li, Pipeline corrosion and leakage monitoring based on the distributed optical fiber sensing technology, *Measurement* (2018), doi: https://doi.org/10.1016/j.measurement.2018.03.018

Pipeline corrosion and leakage monitoring based on the distributed optical fiber sensing technology

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Abstract

Pipeline is an important structure to transport oil and gas through long distances. However, pipeline also suffers from many threats especially corrosion and leakage. Therefore, it is necessary to conduct pipeline safety monitoring. With the advantage of high precision in distributed strain measurement, the optical frequency domain reflectometry (OFDR) technique is more suitable for pipeline monitoring. In this paper, a new application of the OFDR technique is introduced to monitor both corrosion and leakage. In order to verify this method, simulation tests of corrosion and leakage were conducted. In the corrosion test, several optical fiber sensors were bonded to the pipe surface with the same interval, forming a sensor array. Based on the sensor array, a hoop strain nephogram was created to show the corrosion level and corrosion location. In the leakage test, the results indicated that pipeline leakage can be detected by the distributed optical fiber sensor (DOFS). All the test results demonstrate that it is possible to monitor pipeline corrosion and leakage based on the hoop strain theory and the DOFS.

Key words: pipeline; optical fiber sensor; corrosion; leakage; monitoring

1. Introduction

Underground pipelines constitute one of the most important ways to transport large amounts of oil and gas through long distances [1, 2]. Leakages in pipelines are very dangerous since they may lead to significant pollution of the environment [3, 4], even severe safety accidents. Many factors, such as corrosion [5, 6 7], vibration [8], and external impacts [9, 10], may cause pipeline leakages. Among these factors, internal corrosion is one of the major problems that contribute to accidental events in pipelines since all pipelines are associated with the chlorides and sulfides in the products they carry [11]. Traditional pipeline internal detection mainly depends on the periodical inspection conducted by the pipeline inspection robot [12, 13]. However, the periodical inspection does not provide real-time monitoring of the pipelines. As a result, a leakage may not be found in time and may cause much larger economic loss and environmental pollution [14]. Therefore, it is important to monitor the pipeline infrastructures in real time. Recently there are many methods developed for