

11-12 October 2012, Riga

**Riga Technical University
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Dedicated to the 150th Anniversary and
The 1st Congress of World Engineers and
Riga Polytechnical Institute / RTU Alumni

DIGEST

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Non-destructive Monitoring Methods for an Oil Pipeline

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Keywords – acoustic emission, oil pipeline monitoring.

I. INTRODUCTION

The aim of the research is to design an acoustic emission (AE) monitoring system for an oil pipeline. To achieve this aim, a number of work tasks were identified: to carry out the analysis of other non-destructive monitoring methods and reveal their advantages or disadvantages from the point of view of developing an oil pipeline monitoring system; to investigate the method of AE testing, the required tooling equipment and methodology as well as to reveal the advantages and disadvantages of this method from the point of view of developing an oil pipeline monitoring system by making a comparison with other non-destructive monitoring methods; as a result, to develop an effective oil pipeline monitoring system.

II. MONITORING OF THE CONDITION OF AN UNDERGROUND OIL PIPELINE USING THE ACOUSTIC EMISSION METHOD

A test was carried out to monitor the technical state of oil products pipelines using the AE method. The AE method was chosen due to a large number of essential advantages for the monitoring of oil pipelines. The AE method makes it possible to detect fluid (gas) leakage through cracks and holes, and record the mechanical deterioration of existing faults (the consequences of critical deterioration of such faults are shown in Fig. 1). The method is characterized by high susceptibility and, when compared to other non-destructive monitoring methods, has fewer restrictions related to the features and structure of construction material. The AE method can also be characterized by integrity that provides monitoring of the whole object with a comparatively small number of sensors which help to detect not only faults or leakages, but also their position coordinates. This method also allows to classify faults by the degree of danger and by detected and identified AE sources. It helps to make an objective evaluation of the technical condition of tested objects.



Fig. 1. Leakage from an underground oil pipeline

III. 4.5. ACOUSTIC EMISSION METHODOLOGY

Portable dual channel device PAC Pocket AE-2 (USA) with an internal amplification of 0, 14, 40, which allows recording the parameters of AE signal within the frequency range from 1 kHz to 1 MHz, was used as AE equipment (presented in Fig. 4.2.). There are several AE systems intended for the monitoring of oil pipelines. Therefore, there is an opportunity

to choose the best and most effective monitoring system for each individual oil pipeline system. This work deals with the development of a wireless acoustic emission monitoring system for the above described 4.2 km long oil pipeline section.

AE sensors were placed at the distance of 50-80 m from one another. AE signal taken in by the sensors was amplified with the help of preamplifiers built in the sensors, after which the signal passed through an AE cable to the wireless transmitter placed above ground. The transmitter sequentially passed the received AE signals to a nearby transmitter until the signals had travelled along the whole oil pipeline section and been taken in by a receiver connected to the AE equipment via USB. AE equipment registering these signals was connected to alert and status equipment which was in its turn connected to an internal computer network and the Internet (in the form of software visible to users who have a computer with Internet access). Every time one of the AE sources caused some amount of emission with a certain level of alert, the system operated in the alert mode and displayed alert messages visible to all users. Such a system ensures effective and continuous monitoring of oil pipelines. The system in general is schematically represented in Fig. 2.

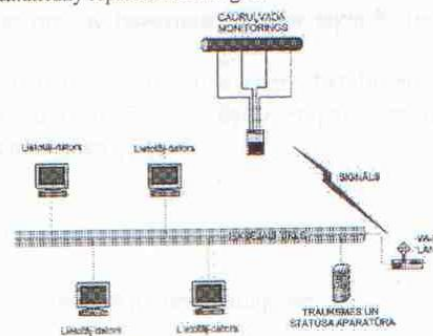


Fig. 2. Leakage from an underground oil pipeline

IV. CONCLUSIONS

Although other non-destructive monitoring methods offer many different types of testing for machine parts, they are not suitable for the creation of an oil pipeline monitoring system. It is mainly related to the fact that these methods require direct access the surface of an object or at least the area near the surface.

In comparison to other methods, this method has fewer restrictions related to the features and structure of construction material, it has high susceptibility (which is good for detecting small leakages) and it is passive. However, the most important point is that this method is characterized by integrity which ensures the monitoring of the whole object with a comparatively small number of sensors and provides for the possibility of continuous oil pipeline monitoring.