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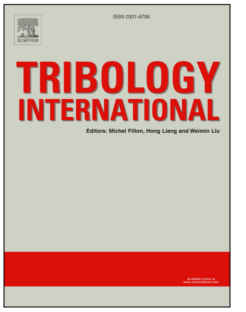

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Perspective approach in using anti-oxidation and anti-wear particles from oil to estimate residual technical life of a system

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Abstract: Indirect diagnostic measures have big potential for estimating a system condition. One of these are oil data. Since the oil is in direct contact with the observed system, oil data are of great importance and value. Usually the authors analyse its physio-chemical properties, or the concentration of selected wear particles. In our article, however, we take into account a completely novel attitude towards anti-oxidation and anti-wear particles (AOWP). Their great importance lies in the fact that the AOWP concentration depends on both an operation time and a calendar time. Due to the extensive oil field data the dependence on an operation time and a calendar time is available. The development of the AOWP particles concentration is modelled stochastically with the use of the Wiener process with drift, or generally with a diffusion process. The aim is to set the trajectory of oil or engine degradation, and set the probability of an engine soft failure. In order to compare our results obtained by using the diffusion process of Wiener type we apply the Fuzzy Inference System (FIS). The results are expected to help us to estimate the residual technical life of a system, optimize the maintenance and make life cycle costs more effective. The system is meant to be the oil itself and the combustion engine where the oil is used.

Keywords: Deterioration/Degradation, Condition monitoring, Failure physics, Diffusion Process

1 INTRODUCTION

Determining a technical system state is a great challenge of the present and different diagnostic measures play an important role in that. The most accurate form of determining the system state is direct measurement. Some properties, however, are by no means easy to measure directly. Dependability and its measures are definitely one of such properties. The magnitude of diagnostic signals, however, is one of the key input information for estimating dependability measures.

In technical systems we can find a lot of diagnostic signals which indirectly can help us to determine the values of reliability, availability, and durability measures. Numerous authors study systematically diagnostic signals, i.e. vibration signals, thermal emissions, chemical emissions, acoustic emission, a tribodiagnostic signal, etc. Fleet & Bone, for example, in [1] present the development of a fault detection and diagnosis (FDD) system which is applied in a diesel internal combustion engine (ICE) valve train. In the paper more methods for classification were conducted experimentally and consequently compared. He et al in [2] proposed approach for fault diagnosis of rolling element bearing. The authors discovered that the response signals are non-stationary which is caused by direction of sensors measurements plus load and distribution of other forces. They also discovered that the amplitudes of the impulse can drop to zero even if the defect is out of the force zone. Zhou et al in [3] address an approach based on shift-invariant dictionary learning (SIDL) and hidden Markov model (HMM) for machinery fault diagnosis. Chandra & Sekhar in [4] investigate rotor start-up vibrations to manage the defect identification problem using techniques based on time frequency. They performed numerical simulations of a rotor bearing system based on finite element analysis. This approach was applying both individual and collective combinations of defects. These approaches and many others are based mainly on acoustic signals, vibrations and oscillations.