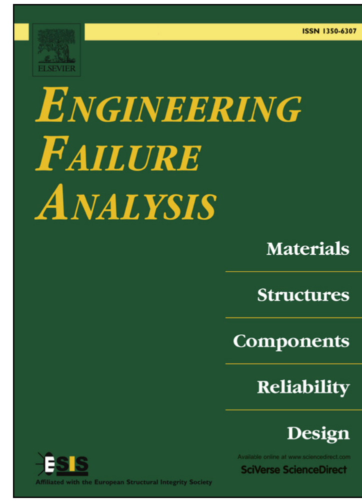

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Diesel Engine Crankshaft Journal Bearings Failures: Case Study

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Abstract: Wear as a tribological process has major influence on the reliability and life of engine crankshaft bearings. The importance of field examinations of bearing failures due to wear is very well known. They point to the possible causes of wear and to the necessary treatment for its reduction or elimination. The paper presents the results obtained by examining 616 crankshaft bearings, damaged by different mechanisms. The bearings were installed in high-speed diesel engines, and were gathered for two years, during general repairs of the engines (overhaul), i.e. after 3000 to 5000 working hours. After the examination of the bearings, the fault tree analysis (FTA) was performed to determine the root causes for engine bearing failures. Each type of damage that was identified was illustrated with an appropriate hi-resolution photograph. The investigations show that the basic and most conspicuous types of damage which cause bearing failures are abrasive, adhesive and surface fatigue wear. The paper also considers the effects of the place of installation and type of bearing material in respect to each type of wear.

Keywords: diesel engine bearings, bearing failures, wear type statistic, fault tree analysis (FTA).

1. Introduction

Reliability of diesel engines and other machinery is the function of faultlessness of its moving parts, from which bearings are certainly among the most important elements. An analysis of 410 recorded defects, occurred in industrial diesel engines during one year, showed that bearing class of defect takes 7 % of total occurrence [1]. Another study of diesel engine failures, which was based on experience of over 800 cases of damages during a period of four years, shows that 12 % of all damage cases are located in engine bearings [2]. The third study shows the distribution of internal combustion engine failures and their cost by parts failed first. Bearing failures head the list in both the number of engine failures (with 24.4 % of all incidents) and cost [3]. The analysis was based on the population of 180 engines, during the period of four years.

According to the ISO standard, failure is defined as “termination of the ability of an item to perform a required function” [4]. Any damage or failure of the engine bearings results in a partial or complete functional failure of the engine and can cause significant economic losses and even legal liability. Although, as a rule, the price of the plain bearing is relatively small, a bearing damage that reduces the function of the system or results in its failure can cause a lot of overhead costs. Plain bearing failure involves the following categories: catastrophic failures which result in an immediate inability of a system to achieve its function; performance failures associated with a reducing performance of the equipment; reliability failures associated with a reducing reliability of the equipment [5].

In practice, damage of a bearing may often be the result of several mechanisms operating simultaneously. It is the complex combination of many influencing parameters which often causes difficulty in establishing the primary cause of damage. There are many publications dealing with plain bearing damages and failures. They are focused on damages and failures classifications and appearances [6-8], possible causes [9-11] and appropriate corrective actions [12-14], as well as on the effect of lubricants [15] and diagnostic procedures and examination tests [16]. The relevant literature and practical experience show that the plain bearing damages are mainly caused by wear, either as a direct cause or as a result of various irregularities in design, manufacture, assembly, operation and maintenance of the engine and bearings. Wear itself is a very complex process initiated by the action of different mechanisms, and can be manifested by different wear types which are often related: adhesive wear, abrasive wear, surface fatigue wear, erosive wear, cavitation wear, fretting wear, oxidative wear and corrosive wear [17].