



Analysis of the axle fracture of the bucket wheel excavator

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ARTICLE INFO

Article history:

Received 4 May 2010

Received in revised form 27 September 2010

Accepted 28 September 2010

Available online 27 October 2010

Keywords:

Bucket wheel excavator

Bucket wheel axle

Failure analysis

Experimental testing

ABSTRACT

The common design of the bucket wheel drive mechanism in some bucket wheel excavators (BWE) consists of a gearbox and a hollow shaft, while the bucket wheel is supported by the axle passing through the hollow shaft. Improper maintenance and inadequate elimination of axis misalignment of the hollow shaft and the bucket wheel axle are the main causes of excavator failure and axle fracture. The paper examines the causes of bucket wheel axle fractures.

Experimental testing of the chemical composition and mechanical properties of the material used to make the bucket wheel axle and metallographic inspections of the fracture surfaces in the bucket wheel axle by means of electronic and light microscope carried out in the first part of the paper have shown that there are no significant inhomogeneities and errors in the material of the axle.

The second part of the paper presents the FEM analysis of influences of disturbances on the manner of support of the bucket wheel axle on the fracture. It shows that the negative influences of support of the axle reflected through the increase in the stress concentration and occurrence of the initial crack are the main causes of the axle fracture.

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1. Introduction

Digging and depositing of layers of materials in open pit mines are most frequently performed by bucket wheel excavators (BWE). BWE SRs 2000.32/5.0 + VR92 (Fig. 1a) is used in the open pit mine in “Kolubara” – Serbia. After more than 40,000 h of exploitation of the BWE SRs 2000.32/5.0 + VR92 (Fig. 1a) during a period of ten years, there occurred a fracture of the bucket wheel axle (Fig. 1b and c), which caused the failure of the BWE.

Since the digging drive in the BWE represents a subsystem of vital importance for the reliability in operation and stability of the BWE, research into the cause of the fracture of the bucket wheel axle is of particular significance [1].

For the mentioned BWE, the largest diameter of the axle is 550 mm, the length is 4500 mm, the mass is 5934 kg and the frequency of rotation is 4.394 min^{-1} . The bucket wheel axle was made by forging. The gearbox of the mass $\cong 51,000 \text{ kg}$ is connected to the bucket wheel by means of the hollow shaft. Additional support of the gearbox on the bucket wheel axle through the hollow shaft is accomplished through the sliding bushing (Fig. 2).

After the BWE had been exploited for more than 10 years, at the end of 2006 there occurred pronounced misalignment between the hollow shaft and the bucket wheel axle, which was most noticeable in the zone of the hollow shaft ending. Without prior analysis of the cause of misalignment between the hollow shaft and the bucket wheel axle, the user, wishing to solve the problem that had arisen, inserted a split bronze bushing in the zone of the hollow shaft ending (Fig. 2).

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