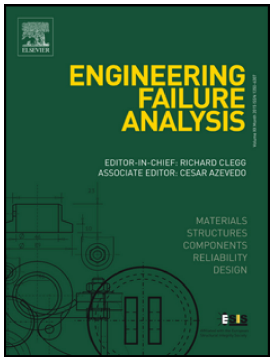

Fracture failure analysis of internal teeth of ring gear used in reducer of coal mining machine

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Fracture failure analysis of internal teeth of ring gear used in reducer of coal mining machine

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Abstract: A failure investigation has been conducted on a ring gear of cutting gear reducer used in coal mining. The fracture failure of this ring gear occurred in a trial run state after it was put into service within only 8 hours. Detailed examinations on the fracture part of this ring gear were conducted. The results indicated that no-metallic inclusions, machining tracks, network nitride and over brittle microstructures are combined acting as reasons for the cracks initiation under unstable load of using process. Typical characteristics of brittle fracture, such as the cleavage and quasi cleavage micro-morphology combined with river pattern and the fan pattern, were observed on the fracture surface. The fracture morphology reveals the fracture is resulted from rapid propagation of cracks due to the brittleness of material.

Keywords: Failure analysis; Ring gear; Fracture failure; Cleavage feature; River pattern

1. Introduction

With the wider adoption of thin coal seam shearer in coal mining, the reliable and safe use of it becomes a key factor influencing the mining efficiency [1-4]. The cutting unit, which including cutting head, cutting arm, cutting gear reducer and cutting motor, plays a key role in the process of coal mining.

The cutting head is the most important component among the ones constituting the cutting unit. The planetary gear was widely used in the transmission system of cutting reducer, due to its compact structure, large transmission ratio ranges and high transmission efficiency, to transmit the power from cutting motor to cutting arm and head. The failure of planetary gear transmission system is mainly caused by the periodical impact load resulted from the reacting force when the cutting shearer cuts coal-rock mass. Lots of work, such as dynamical simulation, wearing analysis and remaining useful life prediction, has been done on the gear transmit system of cutting reducer to guard the safe use of coal mining machine [2,5-7]. Some measurements, such as internal vibration monitoring and fault diagnosis, are also adopted to prevent the failure of transmission system of cutting reducer during the process of production [4, 8-9]. But the failure of it still occurs.

This paper presents a failure analysis case on internal teeth of a ring gear used in cutting reducer of coal mining machine. Based on the factors determined responsible for the failure of teeth of this ring gear, some suggestions for preventing these kinds of failures are proposed for subsequent production of this kinds of ring gear.

2. Backgrounds

The ring gear is widely used in cutting reducer of coal mining machine for transmitting the cutting torque during the cut process. The ring gear of transmission system in the cutting reducer fractured and fell into pieces after 8 hours of service in the trial run state. Emergency stop coal seam shearer was executed for maintenance and the results revealed fracture of ring gear. One of the fractured parts is shown in Fig.1 (a) and the corresponding position is marked in gray in the sketch of