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Research on In-situ Microscopic Observation of Dynamic Contact and Reciprocating Sliding Friction of GM-3 Lining Interface

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Abstract: This paper, based on the real-time in-situ observation of white box test, aims to investigate the micro-contact characteristics and the friction and wear mechanisms of the GM-3 lining material on the rubbing interface. The results show that the friction coefficient is positively correlated with the actual contact area at different contact pressures and sliding speeds. When the sliding speed reaches 5mm/s, there is a phenomenon of sticky slip fluctuation with the friction noise. The process of dynamic viscoelastic friction can be divided into four stages. And when it is worn, the viscoelastic lining material is easy to produce reel-like debris.

Keywords: GM-3 friction lining; in-situ microscopic observation; actual contact area; stick-slip friction;

1 Introduction

The multi-rope friction hoist system delivers coal, lifts and lowers materials and staffs [1]. The friction hoist mainly relies on the friction between the lining wheel and the wire rope during work [2]. Therefore, the tribological property of lining is directly related to the lifting capacity, work efficiency, safety and reliability of friction hoist [3].

The friction lining is a viscoelastic material whose viscoelastic properties are closely related to the tribological property. Moore [4] put forward the theory of adhesion friction of rubber materials. He pointed out that the friction of viscoelastic materials mainly comes from the adhesion friction and hysteresis friction, and mostly the adhesive friction. In recent year, many researches found that the viscoelastic properties of materials were related to temperature, contact pressure and experimental frequency [5-8]. And the loss of energy caused by viscoelastic deformation during sliding was the main cause of friction [9-11]. Zhang et al [12-13] found that the increase of lining's static viscoelasticity and the loss modulus were beneficial to increase the friction coefficient. And when the load was large, adhesive friction dominated. Peng et al [14] pointed out that the viscoelastic material affects the sliding friction by changing the true contact area (AT). The adhesive points between the contact surfaces and the hysteresis loss of the material are the main cause of the sliding friction. Payne [15] investigated that the filler was prone to aggregate and form the three-dimensional network structure in the polymer. When the deformation of the material was to a certain extent, its internal network structure would be destroyed and the storage modulus greatly reduced. The appearance of the "Payne" effect affected the friction performance.

The friction between the lining and wire rope is less stable than that of the metal friction pair. The tribological property of lining depends mainly on the combination of various factors,

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