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Effect of Broken Wire on Bending Fatigue Characteristics of Wire Ropes

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Abstract: The life of damaged wire rope is difficult to judge and the damaged wire rope is prematurely replaced resulting in an enormous economic waste. This paper studies the effect of different distributions of pre-broken wires on bending fatigue behavior of wire ropes using a self-made bending fatigue test facility. The fatigue lives of wire ropes with different distributions of pre-broken wires were studied using both visual inspection and commercial non-destructive inspection technology, combined with electron microscopy. It is found that broken wires on the surface reduce the bending fatigue life of wire ropes. The broken wires increase the stress in the inner wire strands as well as the contact force between the wires. This leads to a concentration of severe wear, which accelerates the density of broken wires locally, leading to short fatigue lives especially in the case with the most concentrated number of pre-broken wires (1×4). After numerous wires fail by wear and fatigue, others fail by tensile overload, as evidenced microscopically by necking and ductile failure. The damage in the rope at failure defined by counting broken wires is nearly 50% smaller than the damage value given by the commercial non-destructive damage value, based on magnetic measurements.

Keywords: wire rope; broken wire; bending fatigue; failure mechanism

The multi-rope friction hoist system delivers coal, lifts and lowers materials and staffs. Its reliability directly affects mine's productivity and people's security. Once the rope is broken, it will lead to a serious accident [1-3]. To ensure the safety and reliability of the lifting system, a strict national standard for safe use and scrap of wire ropes was applied in China. During the operation, the effect of corrosion, wear, break and many other surface damages of the rope is inevitable [4-6].

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