Friction and Wear Behavior of Escalator Step Auxiliary Wheels

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Abstract. The friction and wear behavior of escalator step auxiliary wheels were investigated through friction-wear test. The rotational speed is 60 r/min. The loads applied to the auxiliary wheels are 1000N and 1800N, respectively. The test time is in the range of 0-250 h. The wear mass loss is recorded at different points in time. The main wear mechanism of auxiliary wheel is analyzed.

1. Introduction
Escalators are widely used in public places such as shopping malls, subway and hotels. The step wheels of escalator include main wheel and auxiliary wheel. During the no load operation, auxiliary wheel mainly bears weight of escalator step. During the operation of transporting passengers, auxiliary wheel mainly bears weight of passengers and escalator step. In the running process, the escalator step auxiliary wheel is subjected to friction and wear. This can greatly affect the life and safety of escalator. Thus, the investigation about friction and wear is getting more and more attention in the society.

Gunda et al. [1] developed a novel environmentally friendly solid lubrication technique. The results show that the solid lubricants of low particle size increase anti-wear ability of sliding surfaces. Rahaman et al. [2] studied the influence of sample size on the friction and wear behavior of a bulk metallic glass. The results show that the fracture strength and plasticity play an important role in wear mechanism of bulk metallic glass. Sonber et al. [3] studied the friction and wear properties of the hot-pressed Zirconium diboride against tungsten carbide ball at different loads and frequencies. The results show that the load enhancement decreases the coefficient of friction of ZrB2 with WC ball. Llorente et al. [4] investigated the tribological performance of silicon carbide/graphene nanoplatelets composites. The results show that the tribological behavior depends on the formation and destabilization of a solid lubricant carbon-based tribofilm. Wang et al. [5] investigated the friction properties of castor oil with the addition of modified hBN particles and wear resistance enhancement mechanism. Theiler et al. [6] investigated the tribological behavior of polymer composites in liquid hydrogen. The results show that the sliding performances depend on cryogenic properties and transfer film formation. Ji et al. [7] studied the influence of mullite phase contents of whisker on the friction stability.

In this paper, the friction and wear properties of escalator step auxiliary wheel were investigated using the friction wear test machine. The effects of different parameters on the friction and wear properties were analyzed.
2. Experimental
The friction and wear properties of escalator step auxiliary wheel were conducted using friction wear test machine. The friction wear test machine is shown in Fig. 1. The rotational speed is 60 r/min. The loads applied to No. 1 and No. 2 auxiliary wheel are 1000N and 1800N, respectively. The test cycles for No. 1 and No. 2 auxiliary wheel are 250h and 10h, respectively. At the early stage of the test, the data acquisition is relatively frequent because that the mass loss and macro appearance changing of samples are obvious.

![Friction wear test machine](image)

Figure 1. Friction wear test machine.

3. Results and Discussions

3.1. Analysis of the friction and wear test data
The load-time-coefficient curves of No. 1 and No. 2 escalator step auxiliary wheels are shown in Fig. 2. It can be seen that the coefficients are about 0.012 and 0.038, respectively. The applied loads are 1000N and 1800N, respectively.

![Load-time-coefficient curve](image)

Figure 2. The load-time-coefficient curve.

The friction and wear test data of escalator step auxiliary wheel No. 1 and No. 2 are shown in Table 1 and Table 2, respectively. When the test time is 10h, the mass loss ratio are 0.1106% and 0.1568%, respectively. It can be inferred that the mass loss ratio increases with the applied load increasing.
The actual weight-time-mass loss curves of No. 1 and No. 2 escalator step auxiliary wheels are shown in Fig. 3. The mass loss increases with the time consuming.

3.2. **Observation of the macro appearance of escalator step auxiliary wheel**

The macro appearance of No. 1 and No. 2 escalator step auxiliary wheels at different test time are shown in Fig. 4 and Fig. 5, respectively. After the friction and wear test, the wear phenomenon is very obvious. During the friction and wear test, a large amount of furrows and scratches are found in wear scar. Thus, it can be inferred that the abrasive is the dominant wear mechanism.
Figure 4. The macro appearance of No. 1 escalator step auxiliary wheel at (a) 1h, (b) 8h, (c) 75h and (d) 175h.

Figure 5. The macro appearance of No. 2 escalator step auxiliary wheel at (a) 1h and (b) 5h.

4. Conclusion
The friction and wear behavior of escalator step auxiliary wheels has been investigated by friction-wear test. The mass loss ratio increases with the applied load increasing. The dominant wear mechanism is abrasive.

References
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