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EFFECTS OF TEMPERATURE AND LOAD ON SLIDING WEAR BETWEEN WHEEL AND RAIL STEELS

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KEYWORDS
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INTRODUCTION

Sliding wear test in the pin-on-disk configuration reproduce the conditions of pure sliding between the wheel flange and the rail gauge corner, a typical characteristic of wheel-rail contact on railways with smaller radius curves [1]. The study of wheel-rail contact at high temperatures is essential to understand the behavior in situations such as wheel heating due to braking, delimiting the temperature limit to maintain flange wear at acceptable levels, avoiding catastrophic wear regime. Thus, the objective of this work is to simulate the contact between the wheel flange and the rail gauge corner, through the pin-on-disk test, evaluating the effect of temperature on the friction coefficients, on specific wear rates and seizure phenomena.

MATERIALS AND METHODS

Hemispherical-ended pins made from a high-resistance AREMA TR68 rail, disks made from AAR Class C (cast) and AAR Class D (cast and forged) wheels were used. Sliding wear tests were carried out in a PLINT TE67 tribometer (Phoenix Tribology Ltd., Kingsclere, England), in the pin-on-disk configuration, without lubrication, at two temperatures (25 °C and 300 °C) and two different loads (300 N and 600 N, corresponding to initial contact pressure of 2.3 GPa and 4.4 GPa, respectively). The sliding speed of the tests was 0.1 m/s, with a standard duration of 600 s.

RESULTS, DISCUSSIONS AND CONCLUSIONS

The wear tests carried out at a temperature of 300 °C showed lower friction coefficients when compared to those tested at 25 °C, as illustrated in Figure 1. The high temperature in the tests allowed the surfaces of the disks to undergo an accelerated oxidation process. These oxides act as solid lubricants in the pin-disk contact, reducing the friction coefficient. Furthermore, the friction coefficients show high peaks at the beginning of the tests at 25 °C, up to $\mu = 2$. Due to the tribological characteristics of the pair and the operating conditions, plastic junction growth phenomena are common, generating seizure between the surfaces, specially under the higher load (600 N).

In relation to the specific wear rates, as shown in Figure 2, higher values are found in the pins and disks tested at 25 °C, showing greater severity in wear in that contact. The efficiency in material removal is due to the metallic contact of the pair at 25 °C, which does not happen at 300 °C due to the oxidation of the disk. The oxides formed act as a protective layer against wear. Therefore, higher temperature (300 °C) are not a limiting variable in terms of sliding wear of railway steels.

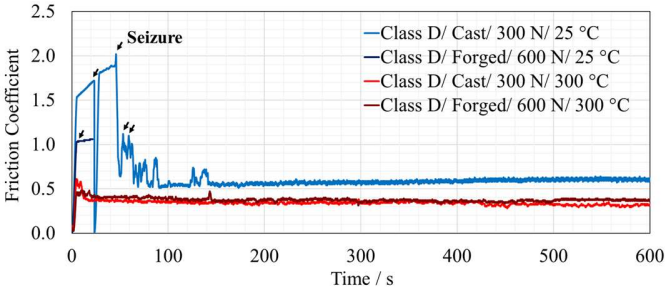

Fig.1 Typical friction coefficient curves

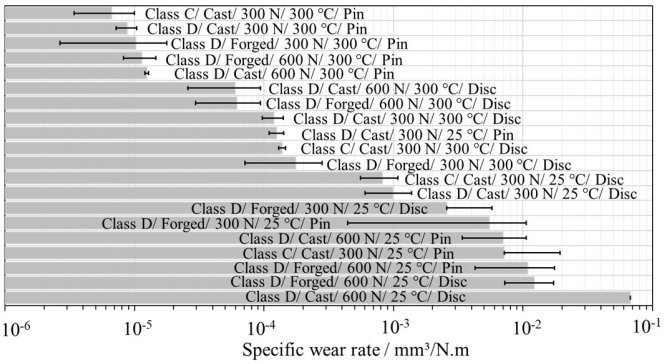

Fig.2 Specific wear rate of pins and disks

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REFERENCES

[1] LEWIS, R.; OLOFSSON, Ulf. Mapping rail wear regimes and transitions. Wear, v. 257, n. 7-8, p. 721-729, 20