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A new life for dead leaves in the wheel-rail contact

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The presence of leaves in a steel-on-steel contact between tracks and train can be the source of wheel slipping and wheel sliding events. The work presented in this paper consists in reproducing and understanding the rheologicals and mechanicals properties of one type of third body responsible for adhesion losses and adhesion recovery.

Keywords : Wheel-rail contact; Adhesion; Third body layer; leaves; Tribology

1. Introduction

The use of train transportation systems is becoming more and more popular each year in France and are probably the most sustainable mean of mass transportation available today. In autumn, security and regularity issues touch several rails networks because of the presence of dead leaves on the head of the rail.

These dead leaves create a third-body [1] responsible of the degradation of the available adhesion in the wheel-rail contact. This phenomenon is usually recognizable through the presence of an adhesive black layer on a rail surface. Ishizaka [2] made several hypothesis regarding the creation and the bonding mechanism of this layer to a rail. Chen [3] recently described the creation of the dead leaves layer causing adhesion loss. Thus, using these works, the purpose of this study is to introduce a new approach allowing describing, understanding and potentially mitigating adhesion loss caused by dead leaves on a rail.

2. Method

Between October and December 2020 dead leaves layers causing adhesion loss were identified and sampled in specifics areas of the French railway network. From these samples, various measures and observations regarding their rheology and their composition helped to begin the description of one type of 3rd body formed by the leaves crushed by the contact. However, in order to get as close as possible to the wheel-rail contact conditions in which adhesion loss occurs, experiments were done on a test bench reproducing at a smaller scale the wheel rail contact.

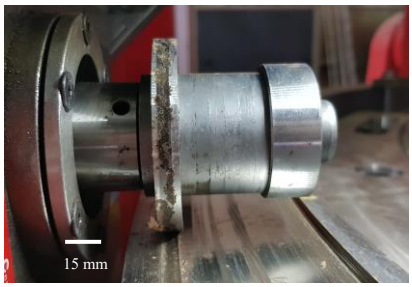

Figure 1: Roller-Ring contact reality with dead leaves on the tribometer "*Triboring"*

The aim of these experiments is to be able to describe the tribological circuits existing at the beginning, during, and at the end of a phase of adhesion loss. In order to manage this description, several data (torque, loads, and adhesion coefficient) are used to monitor the evolution of the third body obtained and responsible for the decrease of adhesion both quantitatively and qualitatively. Here, several tests are done with two types of leaves used with three types of hygrometry.

3. Discussion

Our study allowed us to identify criteria used to validate the reproduction in laboratory condition of one type of third-body responsible for adhesion losses. Moreover, the results gathered previously, enabled us understanding the influence of the component obtained through the experiments done with the aim of mitigate adhesion loss.

Finally, three main parameters regarding adhesion losses and adhesion recovery were found in this study. Hygrometry, thickness, and rate of decomposition of crushed leaves by the wheel-rail contact are essential for understanding and describing the three steps leading to the loss of adhesion and its recovery.

4. References

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