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Laboratory evaluation of the performance of top-of-rail lubricants

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Top-of-rail friction modifiers and lubricants began to be utilized to managing friction in the wheel/rail interface in rail transport. A wide range of products and application strategies are available, while an appropriate quantity and replication interval are essential for the proper function of the system. This work proposes an experimental approach for assessment of consumption time for oil-based ToR lubricant based on rate of increase of CoA. This rate strongly depends on applied quantity of lubricant and slip velocity. With increasing slip velocity and decreasing amount the rate increases and this effect can be modelled as an exponential.

Keywords: Top of rail, friction modification, wheel/rail interface, friction management, rail transport

1. Introduction

Friction modifiers and lubricants began to be utilized to managing friction in the contact between the wheel tread and top of the rail (ToR) in rail transport. Nowadays, a wide range of products and application strategies are available and several methodologies for the evaluating their performance were proposed [1-3]. Recent findings suggest that oil-based products show an almost linear increase in coefficient of adhesion that can be used for the prediction of reapplication interval based on laboratory results. The aim of this contribution is to propose a methodology for an evaluation of the performance of oil-based ToR lubricants based on operating conditions and applied quantity.

2. Methods

This experimental study utilizes a twin-disc machine to produce 8 mm wide line contact between 80 mm discs and to evaluate coefficient of adhesion (CoA). Maximum Hertzian pressure of 0.8 GPa and rolling speed of 0.5 to 2 m/s were used. Three types of oil-based ToR lubricants were applied in a quantity of 0.5 to 15 µl.

3. Results and Discussion

Fig. 1 shows typical evolution of noise level, CoA and disc surface after the application of a given quantity of oil-based ToR lubricant. After the initial drop in noise and CoA, the variables increase, accompanied by a widening

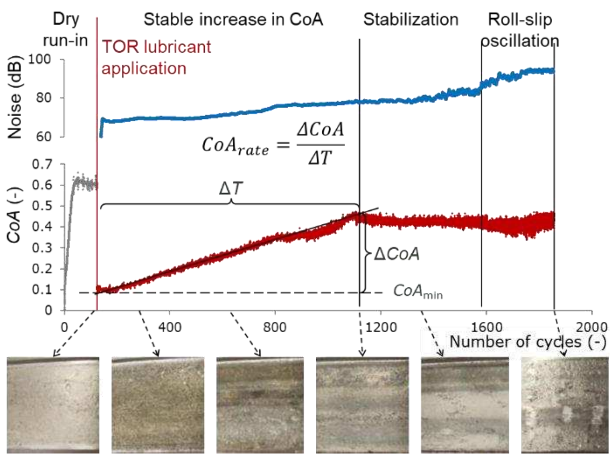

Figure 1: Evolution of parameters after the lubrication.

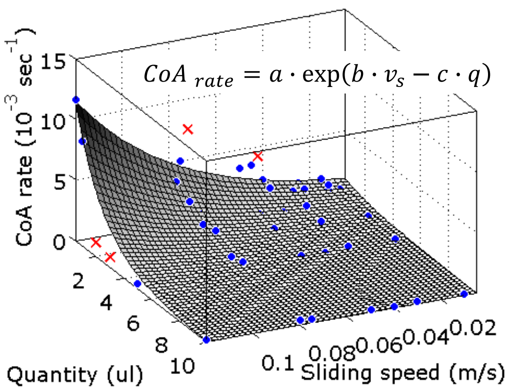

Figure 2: Experimental results and their fit.

the area of wear on disc surface. Then CoA stabilizes, while wear process continues. After some time, roll-slip oscillations accompanied by squealing noise and severe wear on contacting surfaces occur. The presented approach utilizes the area of the increase as an effective period to calculate the rate of CoA increase.

The same test procedure was repeated with variable rolling speed, slip ratio, lubricant quantity, and type of lubricant. In a range of operating conditions, the effect of rolling speed and slip can be reduced to the effect of sliding speed. Fig. 2 summarizes the data that can be fitted with a function of two variables representing the influence of CoA rate on slip velocity and applied quantity of lubricant.

This function could be used for evaluation of various ToR lubricants and for the prediction of reapplication interval based on operating conditions.

4. References

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