Laser Precision Solutions

Eradicating slippery railway tracks

What is slipperiness?

To get a train in motion a force is required. This tractive force between the train wheels and the rails determines the level of acceleration and deceleration of a train. This wheel-rail friction is defined as 'the friction between a driven wheel and the surface it moves on'. Both a train's acceleration and its deceleration are limited by the so-called 'Coefficient of Friction' (CoF or μ) available, defined as the ratio of the maximum available friction force (F_f) and the normal force (F_N):

$$\mu = \frac{F_f}{F_n}$$

When leaves or other contaminants stick to the track and are crushed by train wheels they become a layer of oil acting as a lubricant that makes railways slippery. Train drivers cannot accelerate as quickly as normal, resulting in longer acceleration and deceleration times. Figure 1 shows various causes of slippery railway tracks.

LEAVES BLOSSOM GRASS WASTE RUST POLLUTION OIL

Figure 1: Slippery tracks are caused year-round by several distinct factors, each creating their own contamination layer

A study carried out by R. Popovici in 2010 (using a basic tribology meter) is one of the few conducted studies on the slipperiness of railroads. In autumn 2008 a series of tests were conducted on the Dutch railroad. At least 65% of the tracks measured had a µ lower than 0.15. Railway companies indicate a minimal µ of 0.15 to schedule trains efficiently. At lower levels of µ the track is too slippery and attaining the operational speed is problematic. Studies indicate that in the autumn of 2008 an astonishing 40% of the measured tracks had a µ below 0.10 causing severe safety concerns.
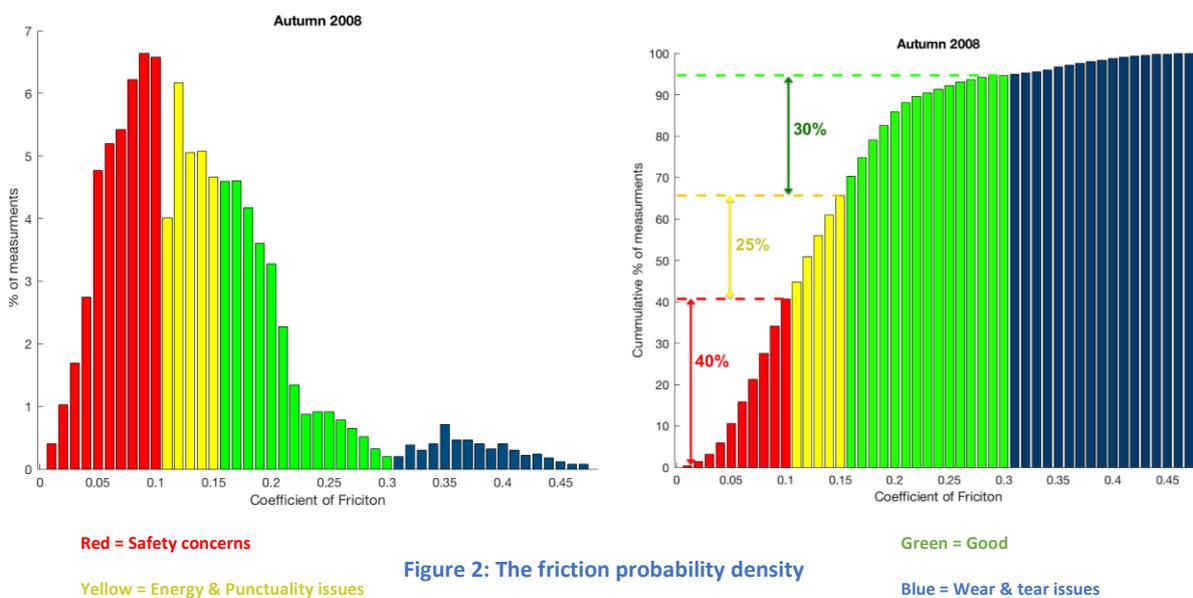
Red = Safety concerns

Yellow = Energy & Punctuality issues

Green = Good

Blue = Wear & tear issues

Figure 2: The friction probability density

The impact of slipperiness

As the study by Popovici shows, a low μ during the autumn season is not an isolated incident, but a rather serious issue that happens within the entire network. We can group the issues arising from slippery tracks into five areas that align with the most important KPIs for railway operators:

Safety

Maintenance

Capacity

Punctuality

Energy

- *The contamination layer on the railway track causes undetectable trains and the inability to break at sufficient rate.*
- *Low μ levels on railway tracks cause the wheels to slip and slide resulting in flat spots, which in turn damage railway tracks.*
- *Low average speeds on railway tracks and extra maintenance on rolling stock decreases employability of rolling stock.*
- *The undesired μ on the railway tracks causes poor acceleration and deceleration schemes, lowering the punctuality of trains.*
- *An undesired μ results in wheel slips and inefficient acceleration and deceleration schemes, wasting heaps of energy.*

The Autumn cycle

During autumn most train operators adapt their capacity, either directly or as the result of imposing speed restrictions in the network. These actions are necessary in the autumn period, when the number of passengers hits its yearly peak. The common autumn cycle that follows in visualized below.
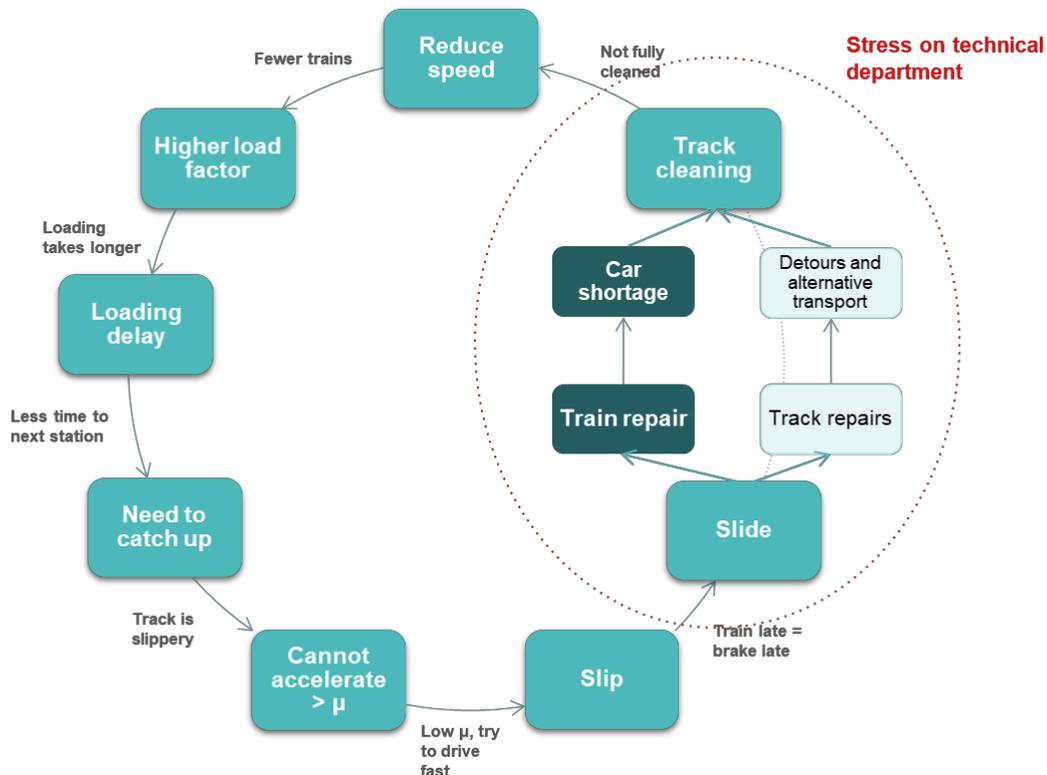

Figure 3: A common autumn cycle for railway operators

How can we help?

Our Tribometer maps the available traction in an entire network and our LaserTrain is the most efficient way to clean entire railway networks. Together, our Tribometer and LaserTrain identify the areas where slippery tracks are problematic and bring these areas back into the optimal state of friction.
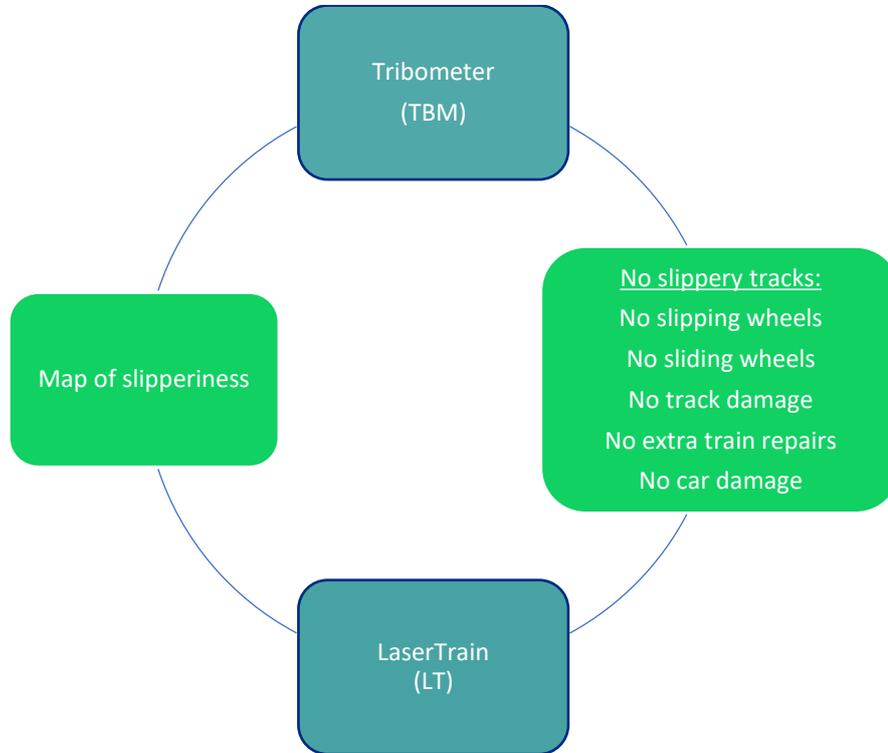

Figure 4:The LPS autumn cycle for railway operators

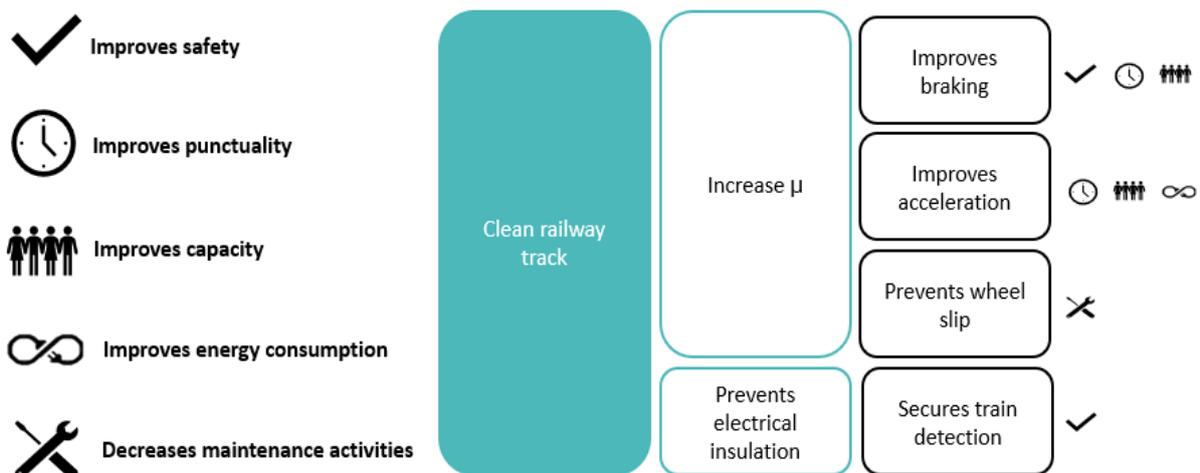The effects of this cycle can be grouped into the 5 most important KPIs for railway operators:

Figure 5: The effects of cleaning railway tracks

Curious? Contact us!

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