PLASMA TRACK

Leading the way in rail track cleaning technology.
Viewpoint 2022

Technology

PlasmaTrack \\ A truly next generation solution to low adhesion

Low rail adhesion in the autumn season is a perennial problem for rail services and dealing with the expense and disruption it causes extends way beyond the leaf fall.

Network rail work hard to overcome the challenges posed by autumn, with at least two weather forecasts a day, with leaf fall estimates, so it can plan its response. Running trains at lower speeds as a consequence of the problem requires special timetables in the autumn months, and the reduction in passenger and freight miles during the period has a profound knock-on effect on profits that has to be factored in to yearly plans.

Dealing with it is an expensive undertaking too. In the UK, Network Rail's operation to mitigate autumn leaf fall results in an annual cost of £355 million when penalties for service disruption are factored in. Add in the wider economic impact of delays and reduced timetables, and the cost to the larger economy is far greater.

But while the problem has existed pretty much since the first rails were laid, the methods used to deal with it have progressed remarkably slowly. Current solutions are expensive to operate, inefficient, have a profound environmental impact, and even use technology that was being deployed back in the age of steam. The rest of the rail network has moved on. It is time that dealing with 'leaves on the line' did too.

Leaves on the line \\ Where we are

Historically, sand dispensed from sandboxes in front of the wheels has been the primary method of dealing with the low-adhesion leaf layer, its use even pre-dating mechanical traction. In recent years its use has grown slightly more sophisticated, with systems relying on both variable rate application and the mixing in of gels, for example, to increase the traction developed, but the fundamental principle remains the same.

Sand has noted weaknesses, however. First, it is effectively adding more material to the leaf layer and needs to be reapplied constantly as its effectiveness diminishes rapidly over time. Secondly, it is expensive. Sand has to be sourced, stored, and transported, all of which raises costs, while the machinery used in its application has to be constantly cleaned and maintained. Its extraction and processing also fails to meet sustainability criteria.

In recent decades it has been increasingly replaced by water jetting. This sees a fleet of 61 specialist Rail Head Treatment Trains (RHTTs) equipped with large tanks of water scheduled to run over areas of low adhesion applying 1000 litres of water per minute at the railhead via targeted nozzles. The idea is that by applying the water at extremely high pressure to the leaf layer, it is effectively blasted away. They also lay an adhesion modifier of paste of gel, sand and steel filings to help trains grip and keep signalling systems working properly.

It works to an extent, but the system is now over thirty years old and comes with several issues that hinder its overall effectiveness. The process has to be done at slow speed to be effective, below 40mph, leading the RHTTs to have a further negative impact on already modified timetables. And there are considerable environmental negatives surrounding its use. As well as the high fuel consumption of the heavily-laden water jetting fleet, the runoff and spray from the process discharges 180 million litres of water carrying toxic by-products from the rail environment into the trackside ecology every year. This has a pronounced impact on trackside biodiversity and the local environment and imperils train operators from meeting increasingly stringent sustainability targets.

Leaves on the line \\ Where we are going

New technologies fit for a 21st century railway are being trialled and introduced to deal with the leaf litter problem, with one of the most effective solutions being the plasma-based system from PlasmaTrack. It is very different from laser-based solutions and offers some definitive advantages over other systems, both previous and currently under development.

It works by applying a high voltage direct current to a compressed gas — nitrogen, simply stripped out of the surrounding air. This turns it into a plasma jet comprised of high energy electrons and ions, which is then applied to the rail head at speeds of up to 60mph (95kph) at approximately 700°C. The plasma jet thermally ablates the compressed leaf layer and restores the track to a clean, dry, and uncontaminated state able to support summer braking conditions with a single pass. Unlike water jetting, it does this in a single pass.

It has an impressive range of benefits and impacts:

Speed of operation

The PlasmaTrack system works at up to 60mph (95kph), minimising disruption and delay to existing services.

Complete removal

All contaminants are removed as part of the ablation process, including leaves and organic debris, iron oxides and wear particles, as well as artificial contaminants such as sand, oil and salt.

Retardation

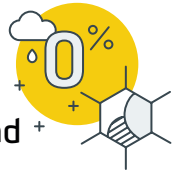
After treatment the rail head becomes a sterile surface, which helps mitigate against the future build up of more materials.

Reduced fuel costs

Nitrogen used to create the plasma jet is harvested from the surrounding atmosphere. Lack of consumable use makes the deployed solution lightweight and reduces fuel costs and emissions per treatment mile.

No negative environmental impact

The thermal ablation procedure vaporises the leaf layer, which dissipates harmlessly in the localised environment. It is non-toxic, with zero impact on the water table and trackside ecology.



No negative effect on railhead environment

Rigorous metallurgical testing has revealed that the plasma jet has no harmful impacts on the rail itself, while a waterless approach has dramatically less impact on the rail environment.

PLASMA\\TRACK

Leaves on the line
\\ The future

While its onboard advantages are many, the PlasmaTrack solution to ending low adhesion is about more than simply deploying train mounted systems. These are just the sharp end of a proposed ecosystem that also includes network-wide automated track sensing and data logging to both target problem areas and establish a predictive model to cost-effectively guide future operations.

Work is also being undertaken to develop a low-energy passenger train and freight train mounted solution that could be deployed on existing scheduled services. This uses lower energy heads along the length of the train that are active during braking and initial acceleration and thus provides a clean track for following trains and a cumulative effect for the entire network.

The end result will be the introduction of summer braking conditions all year round and the completion of a long journey that started with sand manually poured down chutes ahead of the wheels and finishes with high temperature plasma applied at close to conventional operating speed.

Low adhesion has been an issue for centuries of rail operation, but by implementing new technology and embracing the promise of plasma ablation it does not have to be for a single year longer.

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