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How do rail defects develop?

Rail wear is caused by a combination of static and dynamic loads as vehicles travel along the track. Determination manifests itself in a number of ways: changes to the material's structure, mechanical stresses, and solidification that can lead to the formation of cracks. Such defects negatively impact the service life of rails. The In2Track studies confirmed that the most common rail defects in the light rail sector differ from those affecting the flat-bottomed rail sections that are commonly used in heavy rail applications. These factors within the microscope range. A working speed of 30 km/h means that this method can be used during service hours, with the grinding device operating between passenger-carrying trains.

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E nter the ATMO. The prototype ATMO rail grinding trailer developed for urban rail applications is currently being tested on the Wiener tram network.

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which began in 2016 was therefore to look specifically at the challenges of rail grinding on urban networks.

The result has been the development of the Automatic Track Machine Oscillator, or ATMO, a rail grinder trailer designed for deployment on tram and light rail tracks. Completed during 2020, the machine has been designed and built by Plasser & Theurer as part of the In2Track project consortium.

In order to meet the specific requirements of tram systems, the ATMO has a minimum working radius of less than 17 m. This required a redesign of the grinding units, as the frequency and amplitude of the grinding motion are generated in a completely different way from a conventional oscillating drive.

Because of the constrained track geometry, the grinding saddle had to be designed in such a way that the grinding stones do not deviate from the ideal path in tight curves while still providing for optimum grinding of the rail surface (Fig 3). The machine can also be deployed using the whetstone method, offering maximum flexibility in terms of both working speed and the amount of material removal.

High flexibility was also very important in terms of propulsion. The prototype trailer is designed to be towed by either conventional rail or road-rail vehicles. In order to allow stand-alone operation independent of the tractor, the grinding units have their own power supply. The prototype uses a diesel generator, but the intention is that the series build will include an electric option powered from an onboard battery storage unit.

With a length of slightly more than 8 m and a total mass of 18 tonnes, the trailer is ideally suited to urban rail applications. To facilitate wet grinding, a 2600 litre tank is provided. This holds enough water to cover a shift of approximately 6 h, but it can be easily refilled from a hydrant as needed.

Fig 3. The grinding units of the ATMO oscillating rail grinder have been configured to cope with tight curve radii.

Following the development of the prototype ATMO, the consortium has embarked on a programme of in-depth field testing to demonstrate the viability of the process and further optimise the grinding technology.

The first functional tests with the prototype were undertaken in conjunction with Wiener Linien. On average, 0.011 mm of steel was removed from the rail surface for each grinding pass. Fig 4 shows a typical section of rail before and after a grinding pass. The experience gained from this initial test phase in terms of grinding behaviour in tight curves, crossings, and turnouts will be used to further optimise the technology and improve the grinding output.

A second test programme will also be carried out on the Wiener Linien tram network, in order to acquire more experience with track in service and to identify the optimum parameter settings for frequency, amplitude, load, grinding stone composition and grinding speed. Straightness measurements will be used to assess rail grinding quality, while noise measurements will be taken before and immediately after each pass to demonstrate the effect of rail grinding on noise reduction.

Another plan for keeping track of further developments entails additional noise measurement at regular intervals after rail grinding. Following the successful completion of the second phase, the machine will be deployed for routine surfacing work during regular tram operation.

Fig 4. A section of rail surface before (below) and after (right) oscillating rail grinding.

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The Shift2Rail research project described in this article has been conducted by Plasser & Theurer and received funding from the European Union’s Horizon 2020 Programme Research & Innovation action under grant agreement No 730841.