High Performance Milling Technology for Effective Processing of Switches

Precise processing of switches with LINSINGER high performance milling technology reduces life-cycle costs.

WALTER KASTINER | RICHARD STOCK

The processing of rails has been essential in prolonging the lifespan of rails and improving driving comfort and safety for decades. Rail processing techniques, stationary or mobile, have been broadly used in the last 60 years and cannot be omitted in modern rail maintenance. Especially switches need precise maintenance as premature failure can have extensive consequences. The high performance milling technology developed by LINSINGER can prolong the lifespan of this crucial component.

Fig. 1: LINSINGER milling wheel on a high performance mill MG31. The milling wheel design is optimised for maximum productivity and tool life.

Damage in the System

Signs of wear on the rail head and roll contact fatigues are created by straining through wheel and rail contact. These signs of wear are lateral profile deformation, longitudinal profile deformation such as waves or rippling, as well as head checks, spalling, squat type defects, or belgrospi [1-4]. Other signs of wear such as WEL (white etching layers) or swerving spots can also occur. These phenomena are not limited to the "normal" railway, but can also appear in special components such as switches, crossings or road crossings. These damages can have a negative effect on the lifespan of rails, driving comfort and safety if not treated appropriately and therefore increase the life-cycle costs of rails, components and the entire railway.

High Performance Milling Technology

LINSINGER introduced the first stationary rail milling machine in 1959 and is building stationary and mobile rail processing machines for all uses since the mid-90s.

The foundation of LINSINGER rail processing technology are circumference mills (figure 1), which restore the lateral and longitudinal profile and eliminate surface defects in one overrun with a milling wheel in longitudinal direction. The LINSINGER milling wheel design is optimised for ideal productivity and tool life. In the same pass as the milling, the optical and acoustic modification of the surface takes place. The removal of material is done through mills, while the following grinding creates a perfect finish similar to polishing (figure 2).

The biggest advantage of rail processing with mills lies in the flexible depths of treatment of 0, 1 to 5 mm on the runway and 0, 1 to 7 mm on the gauge corner, which makes it possible to erase all rail damages in just one processing. With this, all maintenance work, such as preventative, cyclic or correcting maintenance is completed. LINSINGER high performance milling technology can also be used for processing of new rails or gauge correction. Because of the high surface quality (small profile tolerance, minimal longitudinal waves and surface roughness) the processed rails meet the requirements for noise reduction. Furthermore, the produced energy is mainly taken up by the milling chips and tools, which is preventing a possibly damaging temperature raise in the rails. The rail

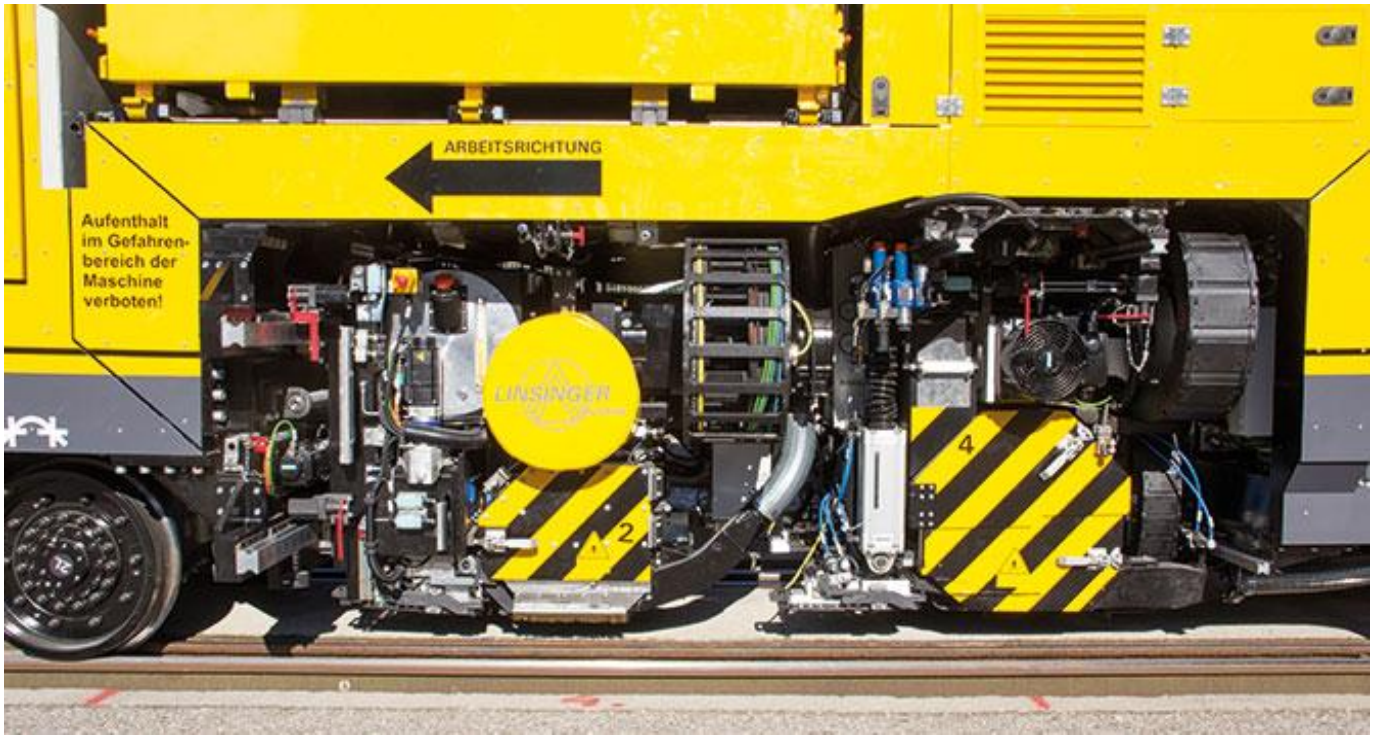

Fig. 2: Milling unit with in-line circumference grinders for highest surface quality after processing.

head is therefore treated thermally gentle which prevents the development of undesirable changes of the material (white etching layers) near the surface. These "white etching layers" that occur with conventional grinding are the cause of further rail damages [5]. Another advantage is the minimal environmental damage caused by flying sparks, grinding dust and noise (figure 3).

LINSINGER produce a great range of rail processing machines, from the compact power pack "MG11", used in underground trains and even fitting in a 40 feet container, to the flexible two-way vehicle, the rail-road-truck "SF02-FS-Truck", perfect for use on trams and small construction sections. Other processing machines are the specialist for public transport companies "SF02T-FS", and the extremely productive vehicles in use on railways worldwide like "SF03-FFS", "SF06-FFS plus" and "MG31". These different types of vehicles are optimised for different assignments, reaching a processing speed of up to 2 km/h depending on type and use.

LINSINGER rail processing vehicles are equipped with modern measurement technology monitoring and documenting longitudinal- and lateral profiles as well as surface quality of processed rails. This data is not only used for controlling the processing process and quality, but could also be a starting point for implementing a predictive maintenance strategy.

Development of Switch Processing

Thanks to experience with rail milling technology of the Deutsche Bahn between 1995 and 2006 and the fact that switches have the same signs of wear as normal rails, LINSINGER was motivated to optimize and develop specialised machines for switches (Abb. 4). The DB-guideline functioned

Fig. 3: Example picture of a fully restored rail surface after processing with LINSINGER high performance milling technology.

as a foundation for the construction and development of switch processing.

The first rail processing vehicle with included switch function was sold to the Deutsche Bahn in 2008. In comparison to the conventional grinding technology, no additional vehicle had to be built. The switch treatment can be added to each existing LINSINGER rail processing vehicle.

In order to fully enable the switch processing function some adjustments had to be made at the original processing machine:

- All processing machines now have additional copying systems for switch processing. With this, a correct lateral position especially in the area of jaw rails and therefore a continuous switch processing is guaranteed.
- All copying systems were equipped with appropriate controlling, in order to be able to take it off the rails if needed (for example in centrepiece gaps).
- A detection system for determining the position of the vehicle was installed to pass on the specific processing areas to the machine.
- Divers software adaptations were implemented to integrate necessary basic functions for switch processing and to secure correct exchange of signals with the machine, which detects and takes into consideration the control position (straight or bent branch) and the processing direction of the switch (pointed or blunt).

The first LINSINGER rail processing vehicle with included switch function needed a total of eight overruns to completely process a switch. First, the continuous outer rails and then the interrupted inner rails were processed in a straight line by mills in one overrun each. After that, the rail processing in a bent line was also done separately for outer and inner rails. Afterwards, the whole process had to be repeated with circumference grinders.

Fig. 4: Surface damages and signs of wear on the profile in the railway track of the bending branch of a switch (ARTC, Australia).

In a further development step in 2010 the number of overruns was halved by combining milling and grinding into one production stage. A year later LINSINGER even succeeded in processing both outer and inner rails in one continuous overrun so that only two overruns, one in a straight and one in a bent line, were necessary. Through all the steps mentioned above the processing time was reduced from 3, 5 hours to now only 45 minutes.

Milling Technology in Use

LINMAG Australia Pty. Ltd is operating two Rail-Road trucks SF02W-FS in Australia. A focus is on processing switches for the customer Australian Rail Track Corporation (ARTC) in New South Wales. ARTC is running the “Hunter Valley Coal Network” and is mainly transporting coal from the interior to the port in Newcastle. Due to a burden of 45 MGT to over 100 MGT (Million Gros Tons) per year, profile wear is happening faster and RCF damages such as head checks and squats develop. Even though ARTC has implemented a preventative grinding program, it is impossible to control damages and signs of wear with conventional rail grinders alone. LINMAG has been processing these problem zones and especially switches for some years now by removing damages up to 3 mm deep completely and restoring the profile (figure 5). LINMAG also performs processing of new rails (removal of decarbonised peripheral layers, removal of profile deviation and cold damages) for newly installed switches efficiently and with highest quality. With help of LINSINGER high performance milling technology the unplanned, premature removal of switches can be avoided and the life cycle of switches and rails prolonged. Because of the positive experience with LINSINGER rail processing machines the switch processing with mills at ARTC will be intensified this year. Switch processing with LINSINGER rail processing machines is also successfully used across Europe at a multitude of railways and public transport companies.

Fig. 5: The LINMAG two-way vehicle “SF02W-FS Truck” processing a switch in the ARTC network in Australia.

Purposeful Innovation

The latest development trends of switch treatment aim at the direction of centrepiece processing as well as further automation of the switch processing process, especially reducing change-over times, processing times. Other developing areas are continuous processing at transitions of straight rails to switches as well as processing of one switch after the other in one pass. LINSINGER even cooperates with local universities to work on milling technology, for example on reducing development times and increasing efficiency as well as productivity of this innovative processing method.

SOURCES

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DI (FH) Walter Kastinger

Head of Sales Rail Milling Department
Linsinger Maschinenbau Gesellschaft m.b.H.
A-Steyrermühl
w.kastinger@linsinger.com

Dipl.-Ing. Dr.mont. Richard Stock
Milling Technology Manager für die österreichischen Firmen Linsinger und Linmag GmbH in Vancouver/Kanada
r.stock@linmag.com