High-performance milling. Mobile rail milling of the next generation

Constantly growing metropolises, such as Berlin and New York, demand ever higher requirements on the metro systems.

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Constantly increasing numbers of passengers lead to a continuous reduction in the cycle times of trains for many metro operators, which in turn leads to an increasing load on the rail network. Conventional rail maintenance concepts are increasingly reaching their limits in this case. As a result, the metropolis of New York is seeking sustainable alternatives to traditional maintenance concepts. Linsinger developed the MG11 mobile high-performance milling machine especially for use in metro tunnels, which is excellently suited for use in narrowest clearance conditions. The milling machine has the tried and tested high-performance milling technology combined with new, innovative approaches. The MG11 makes a significant contribution to extending the life of the rail and can significantly reduce lifecycle costs.

Requirements of the metros

The numbers of passengers are constantly increasing in the metros. In order to meet this ever-increasing demand, the cycle times must become ever shorter, which leads to increased wear on the track. The resulting increase in the load on the rails causes flaws such as corrugations, squats / studs, plastic deformations of the rail head and head checks. Maintenance work on the track should therefore be designed in this way that there are no restrictions for the passengers. Especially long blocking periods, soiling and odor nuisance in tunnels after maintenance work are the main problem factors.

Maintenance strategies

In order to control rail damage and noise development or to have them under control, the infrastructure owner has various optimized and adapted maintenance concepts at his disposal.

A preventive maintenance strategy aims to remove damage shortly after emergence with minimal material removal, thus keeping the surface of the rail virtually free of damage. For this purpose it is necessary to be able to measure the state of damage of the rails.

However, if such a measurment assessment of the damage status is not available, a modification of the preventive approach can be applied - the cyclical maintenance strategy. Here, the maintenance is not carried out on the basis of the actual damage condition, but on the basis of operational experience with regard to damage and / or wear within a defined time or load interval.

For errors with medium to high error depth, a corrective maintenance strategy is suitable. As soon as the corrective maintenance threshold with regard to the error depth has been reached, the rail must be serviced or exchanged. The position of this intervention threshold depends on safety-related specifications and local maintenance options.

A regenerative maintenance strategy represents a new extension of the corrective strategy. In doing so, the surface of the rail is gently regenerated (setting a new state), almost independently of the initial state (damage, wear). In addition, it is also avoided to introduce new defects or starting points for damage in the rail surface.

Since due to the circumstances described above (higher loads, dense traction frequency) rail faults can reach significant depths within a very short time and, on the other hand, the time frames for maintenance are becoming ever shorter, infrastructure owners are increasingly forced to resort to the previously used and proven ones Deviating strategies. The high-performance milling technology provides a flexible and reliable maintenance technology that can cover all maintenance strategies, including the regenerative strategy.

Heavy duty milling with the MG11

With the MG11 mobile high-performance milling machine, it is now possible for the first time to use the technology of rail milling in narrowest light profiles. With high-performance milling, the rail profile can be restored within narrowest

Fig. 1: Delivery of the MG11 in the container to a NYCTA depot (MTA New York City Subway)

tolerances by means of circumferential milling. The removal of the surface defects can be done in one pass and the collected chips are recycled after the workingshift. Since high-performance milling involves dust-free machining, no cleaning work is required after re-profiling. This is a decisive advantage, especially in metro tunnels, as costly and costly reworking is eliminated.

With the mobile high-performance milling machine, it is possible to adjust the machining depth variably from 0.1 mm up to 1.2 mm. This individually addresses rail defects and unnecessary material removal on the rail head can be avoided. Since large parts of the New York metro are run above ground, elevated noise emissions after maintenance are a particularly critical issue. However, the polishing process after the milling process makes it possible to significantly minimize the noise development of the trains and to avoid future rail defects.

The MG11 mobile high-performance milling machine was specially designed for use in inner-city operation, with a size that is even suitable for the narrowest clearance gauge. This makes it possible for the first time to use high-performance milling technology in metro tunnels. This size also makes it easy to transport the machine on a low loader or in a standard 40-foot container, which makes it much easier to transfer the machine and significantly increases the flexibility with regard to different job sites. The MG11 is equipped with one milling and polishing unit per side and can handle up to 1.2 mm rail material at the rail head center. On the running edge, up to 5 mm material removal can be achieved at the same time, depending on the damage condition of the rails. Depending on your needs, the high-performance milling machine MG11 possible to machine Vignol rails, grooved rails and turnouts. This means that all applications of rail reprofiling can be covered with one machine. For machining with the MG11, neither track switching means or components of the switch must be removed, nor are cleaning or fire protection measures necessary after processing. This circumstance leads to an increase in productivity and to a significant reduction in the total cost of reprofiling the rails.

Fig. 2: Milling machine MG11 in a 40-foot container just before the railing in the depot of NYCTA

High-performance milling technology in New York

New York City Subway opened at the end of 1904 and is one of the oldest subways in the world. Most of today's route network was built from the beginning to the middle of the last century. The metro has 25 lines, 472 stations and 380 kilometers of track. New York City Subway daily carries nearly 5 million passengers and is one of the longest and most complex metro networks in the world. Although NYCTA (New York City Transit Authority, the operator of the MTA New York City Subway network)

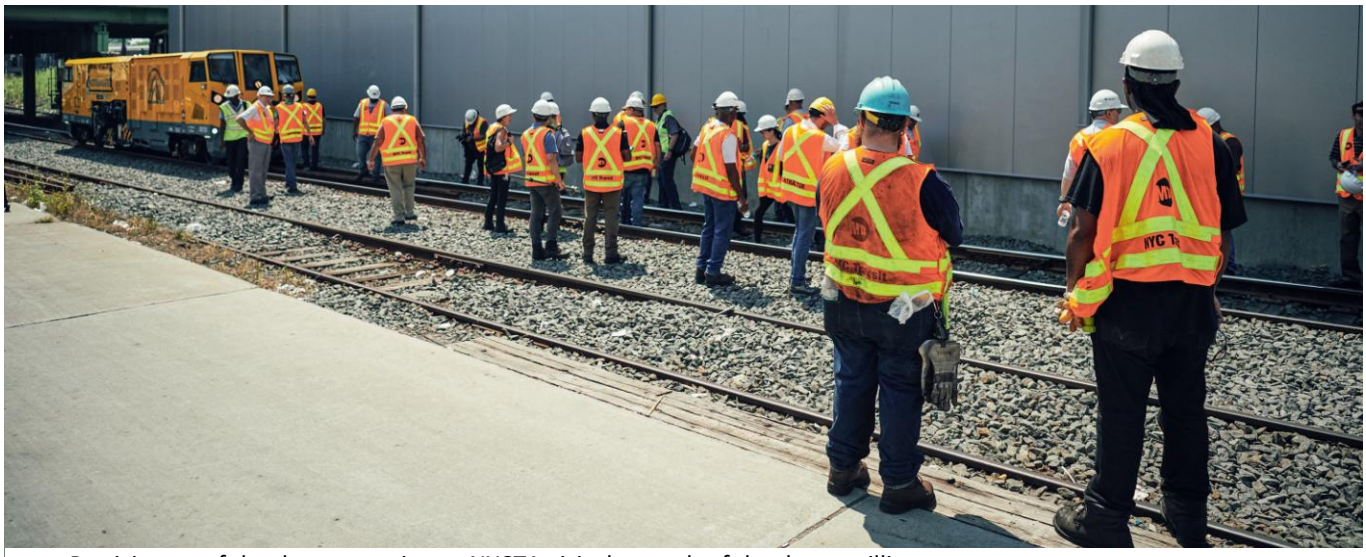

Fig. 3: Participants of the demonstration at NYCTA visit the result of the demo milling.

has been using conventional maintenance methods for decades to handle the tracks, it was not possible to keep up with track damage as a result of the high loads in this system to keep.

On the one hand, NYCTA is interested in a procedure that eliminates rail faults more effectively than before, as conventional maintenance methods with their low removal rates have reached the limits of what is possible due to ever shorter cycle and lock times. On the other hand, a process is being sought that does not require any cleaning work in the stations or in the tunnel, since these cleaning operations are very costly and time-consuming. In addition, Linsinger's high-performance milling technology also makes it possible to carry out other maintenance activities in the tunnel at the same time, as there is no environmental burden from dust and smoke.

In 2018, it was possible to use the MG11 mobile high-performance milling machine in the NYCTA metro network for presentation purposes.

The mobile high-performance milling machine was delivered by ship in a 40-foot container.

(Fig. 1). Since the container is a standard container, the transport was uncomplicated. Unloading and one-way ironing in NYCTA's depot in Brooklyn was done by truck crane. The rerail process itself lasted only a few minutes and took place by means of a track ramp (Fig. 2).

The most important rail defects in the NYCTA metro are corrugations and spinning points with in part significant material hardening and height differences of the tracks in the area of the fishplattes of the rail joints. Likewise, classic roll contact fatigue damage (RCF), profile wear and plastic material deformation can be found throughout the entire network. Particularly in the case of corrugations, spin points and deformed rail joints, conventional maintenance methods often provide insufficient results. What is needed, therefore, is a process which makes it possible on the one hand to completely eliminate the unwanted (periodic) hardening (and thus completely eliminate the damage) and, on the other hand, to produce a homogeneous transition of the rails in the area of the fish platters . In order to achieve this, a variable delivery of the processing tools is absolutely necessary. Since the high-performance milling process is used to deliver the machining depth via CNC axes, it is possible to machine and smooth these transitions or to completely remove material hardening in the area of the corrugations and spin points.

Before the actual processing, the machine parameters were set on a test track and test cuts were made.

Fig. 4: The rail surface after only one pass - complete removal of the damage and exactly set target profile

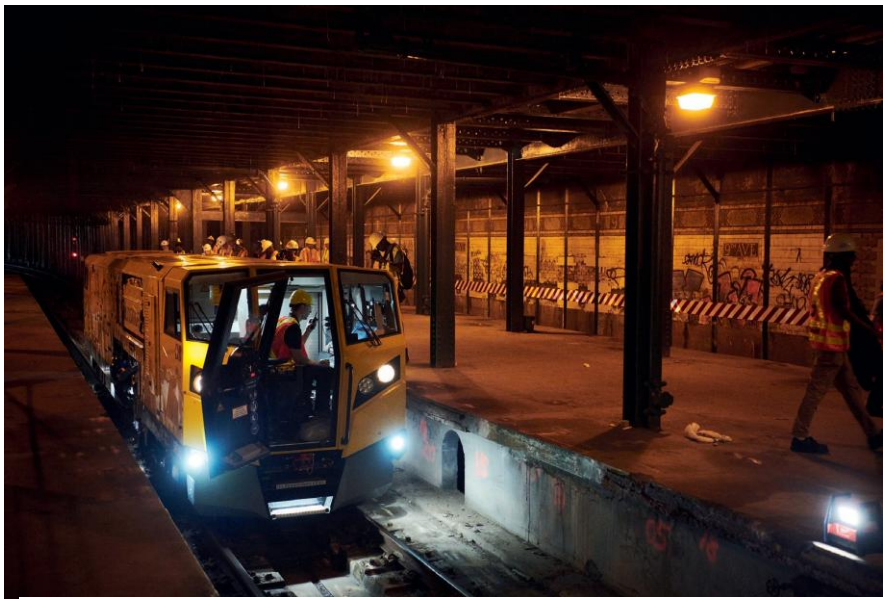

Fig. 5 The mobile high performance milling machine in use in a NYCTA station.

Presentation mission itself sections were selected, which have, among other things, massive corrugations . Milling took place on the one hand above ground, in order to be able to better evaluate the processing result, and on the other in the tunnel in order to be able to better evaluate the real emission development, possible sparks and dirt development under actual operating conditions.On the day of the presentation, representatives from major US cities traveled to NYC to see high-performance milling technology for the first time in North America.

Processing in the above-ground track section

When machining in the above-ground track section, material removal was selected in the area of the massive corrugations in such a way that even the deformed structure beneath the corrugations could be removed. Another task was to remove all rail faults in one pass and to restore the setpoint profile. In addition, there were several lash rail joints in the section, which showed different levels of damage. Since these processes can not be realized with the currently used process, the interest among the visitors regarding the processing results in the above-ground area was extremely high (Fig. 3).

At the very beginning of the processing, visitors were surprised by the fact that they were able to observe in close proximity to the MG11 mobile high-performance milling machine how the process steps of rail milling proceeded. The material removal was chosen to be 0.8 mm in order to remove the wringing spots along with the damaged structure. Dust-free machining at this excavation depth is impossible with conventional technology.

All the more surprising was the fact for the visitors that after processing no chips or impurities were visible on the track. The first visual inspection of the rail showed a perfectly reprofiled rail head, the spin points were in only one

Crossing away. The surfaces of the rail head had a much lower surface roughness compared to the methods used up to now (Figure 4).

Despite the tightest radii of curvature, poor track position and a large number of points in the depot of NYCTA, the compact size of the MG11 mobile high-performance milling machine meant that there were no problems with the transfer to the underground tunnel to the second processing section.

Processing in the tunnel

Since the contamination of the tunnels after rail machining is one of the main problems of the NYCTA metro, the excavation depth of 1 mm was selected for this section at a feed rate of 12 m per minute.

In the case of such a large amount of material removal, in the case of conventional reprofiling, with several passes, extensive cleaning and fire protection measures must be taken.

The fact that no extended protective equipment (eg respiratory protective measures) was required when using the machine in the tunnel surprised all participants. The visitors stood in the metro station right next to the working rail milling machine and thanks to the Linsinger milling process, the extraction system and the filter system of the mobile high-performance milling machine, there

was no dust load. All that the MG11 left after machining was a perfectly reprofiled and faultless rail.

Regenerative Maintenance to Extend Rail Life

With the use of high-performance milling technology in the New York Subway, the benefits of this innovative technology have been demonstrated under challenging surface and underground application scenarios. It was thus also possible to eliminate a widespread misconception regarding rail milling. Corrective maintenance and the associated high material removal are often associated with a shortening of the service life. However, this can be prevented with the help of the high-performance milling technology. With the application of a regenerative maintenance strategy, it is possible to achieve a significant extension of the rail laying time by means of specifically adapted material removal in specific areas of the rail head and to avoid premature rail exchange and the associated high costs.

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