Grinding made easy

New drive technologies and work procedures provide for better ergonomics and consistent quality in grinding

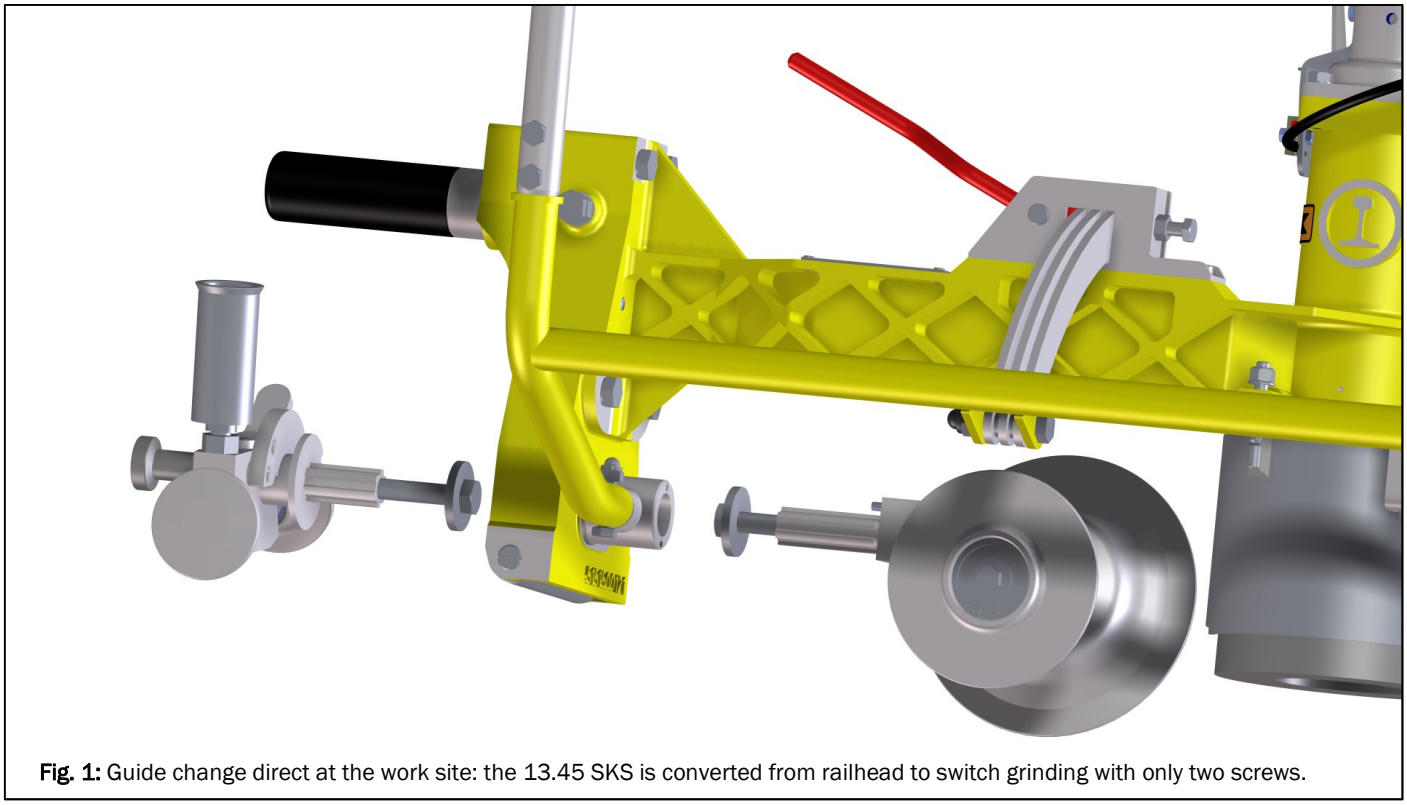

Fig. 1: Guide change direct at the work site: the 13.45 SKS is converted from railhead to switch grinding with only two screws.

Thomas Hölzlwimmer

Technological improvements in grinding with hand-guided machines increase and facilitate targeted fault removal and preventive maintenance of rails. The improvement in work quality extends the life of the rails, increases the availability of track and has a positive effect on staff satisfaction in the long term. The work procedures presented in this article illustrate solutions which lead to an optimum surface pattern with little physical effort.

Cost factor: service life of the rail

Steadily increasing rail traffic, high speeds of passenger and goods trains as well as high axle loads stress the track and lead to increased material wear which results in longitudinal and transverse rolling-surface defects in the rails. Head checks, squats, corrugations and other so-called rolling contact fatigue damage result in a shortened life of the rails, higher noise emissions and affect operation.

This results in increased maintenance requirements of the rails. In this context, planning of rail surface treatments by means of preventive measures is of particular significance, both operationally and economically. The savings potential is clearly shown on the most frequent type of surface manipulation - rail grinding: The more precisely the highly stressed rails are reprofiled, the longer the life of the rail and the greater the durability of the track geometry.

Where hand-guided machines are used for grinding - for weld joint grinding, deburring or for removal of individual faults on railhead profiles and switches - the years of experience of the operator have been important up to now. A high-quality grind is characterised by the lowest possible removal of material with a profile restored true to form.

But what happens if the best grinding machine operators are absent due to back problems, if the abrasives gum up or must be replaced continuously or if the work result is at most passable because the operator does not look at the grinding position or has not yet developed the right “feel”? The solution is clear: A machine is needed which is lighter, i.e. more ergonomical to use and which takes on the talent of the worker. With a range of hand-guided grinding machines for various

track-based applications, ROBEL provides proof that grinding doesn't need to be heavy work or based exclusively on experience and talent.

Targeted railhead grinding

The compact ROBEL 13.44 machine is used for reprofiling at weld joints and built-up welded running and side surfaces on plain lines as well as in suburban areas and in tunnels.

For grinding sides, the machine can be rotated by up to 90°. The operator locks the guide frame within a range of 59° in that position which provides an ergonomic work posture. The cup wheel does not have any upward play. Thus, for the infeed, any rotary movement of the handwheel is converted into a height adjustment, i.e. it reacts immediately to the finger-tip control required for finish grinding.

A locknut at the grinding spindle provides the depth stop for the grindstone. The spindle stiffness is adjusted individually so that the cup wheel does not rotate downward due to its own weight in combination with the machine vibrations, but so that the spindle still runs smoothly. The cup wheel can be replaced quickly and easily using the central nut on the grinding spindle.

A new drive concept has a positive effect on the work result: the engine in the 2-stroke or 4-stroke or 400 V electric version does not sit directly on the spindle but drives the grinding spindle via a V-belt pulley on separate bearings. This reduces the vibrations and the surface pattern is more homogenous. At the same time, this solution is easy on the grindstone and the drive which is no longer subject to shocks. A desirable side effect: the view of the grinding area remains free in all working positions.

The modular design of the machine makes it possible to adapt it to the individual working method for better operator comfort: the guide frame with soft grip can be fitted on the right or on the left depending on personal preference. An optional additional handle located centrally on the fan housing of the drive improves the guidance of the machine and optimises operator posture. The air filter guard supplied as an assembly kit improves the feed to the air intake and reduces the dust content of the exhaust air.

Fig. 2: Electric cup wheel feed: the PLC of the 13.48 controls the grinding position and the depth stop to a tenth of a millimetre.

The 13.45 SKS, which has almost reached commercial maturity, will extend the operational range of the universal grinding machine to work on switches. The appropriate guide system is fitted direct on site in next to no time [Fig. 1]; the adjustable spacing of the guide discs for various railhead widths make use possible on all common types of rail.

The revision has resulted not just in a total weight reduction to 60 kg, but also simplifies the grinding process: due to the larger handwheel, the grinder has better control of the machine. He only requires three fingers and a little bit of feel to adjust the angle for side grinding due to the infinitely variable angle adjustment and the new disc clutch. A digital operating hour meter and a digital rev counter control and record the work.

Deburring with a high grinding throughput

The ROBEL 13.48 Railhead Profile Grinding Machine reinstates the profile when a constantly high drive power is required, e.g. during deburring or after thermite and flash welding. Rails with various degrees of wear are reprofiled with the aid of a patented contour copying facility over a slewing range of 184°. A restraint rotates the rail guidance discs when the grinding unit is slewed. The machine does not skid, the contact pressure of the grindstone remains constant and the railhead is copied without deviation.

The design observes ergonomic principles. With its outrigger, the frame stands on the track on its own; the operator remains in an upright position during the whole grinding process. Only the grinding unit is swivelled by using a handwheel. The view of the grinding area is unobstructed – no matter whether the machine is operated from the right or the left - and it can be fully illuminated with the optional LED lights.

The cup wheel infeed is carried out by an electric motor via a programmable logic controller (PLC) [Fig. 2], allowing the grinding position and the depth stop to be set with a precision of a tenth of a millimetre. Thus, considerably less effort and also less grinding experience is required for an optimum work result.

Easy grinding

The operator touches the rail next to the weld joint. Pressing the button on the PLC defines the zero level or the depth stop - the grindstone can only move upwards from the zero level. Thus, “underflushing” is no longer possible. Now, the operator scratches the other end of the grinding area and, in case of deviations, corrects the zero level upwards, if required. He rough grinds the area in several passes. The backlash-free infeed of the cup wheel can be controlled by pressing the rocker switch.

A procedure patented by ROBEL is used for finish grinding: the zero level stored in the PLC corresponds to the dimensions of the original grindstone. If it wears, there will be a projection of the weld joint of 0.2 to 0.4 mm from the zero level. To compensate this, the operator sets the finish grinding program (between 0.1 and 0.9 mm in increments of 0.1 mm) via the PLC. When the button is pressed, the grindstone moves downwards to the set position and remains there. When the button is released, the grindstone returns automatically to the zero level with minimum lift. The result is a consistent surface pattern with uniformly tapering facets [Fig. 3].

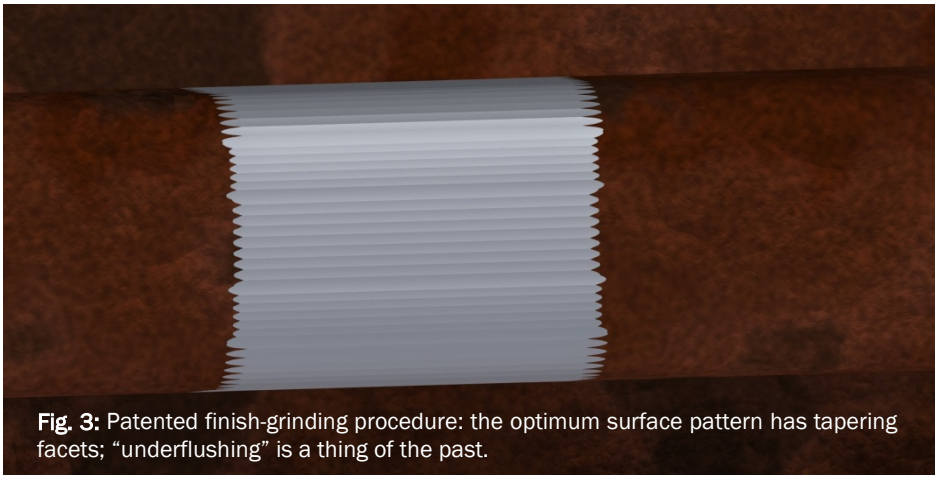

Fig. 3: Patented finish-grinding procedure: the optimum surface pattern has tapering facets; “underflushing” is a thing of the past.

The profile grinding machine can be used flexibly with a range of additional equipment. The outrigger which can be extended to 1435 mm makes grinding of rails possible which have not yet been finally positioned on the sleepers, but which are welded into an existing section of rail and positioned afterwards. In addition to a powerful 4-stroke internal combustion engine in a petrol and a diesel version, an electric version is available for grinding in an environment sensitive to emissions.

Grinding with additional energy

While searching for new lightness and precision in the grinding process, the ROBEL product development team faced a weighty topic: to make the grinding machine lighter, the engine had to become smaller and had to be separated from the work unit. However, this only provides the grinding power required if it receives an additional supply of energy.

During grinding of a weld joint, the grindstone rotates with a constantly high speed while the machine is continuously moved forwards and backwards. Full power is required only for the grinding itself. During the change of direction from feed to return, the machine does run at full throttle, but hardly any energy is required at the grindstone. Up to now it was not possible to use the energy provided by the internal combustion engine during this time. With the new hybrid process, this excess energy is collected and stored in compact electrolytic capacitors (Supercaps) directly from the generator.

In contrast to a battery, the Supercaps work irrespective of the ambient temperature down to -30°C and have a service life of about 10 years. This efficient storage is combined with a BLDC motor which is capable of providing this additional energy to the rail. The result: Instead of the GX270 engine the GX200, which is nine kilogrammes lighter, is now sufficient to provide the same grinding power and achieve an optimum work result.

Innovative hybrid drive

Having arrived at the solution to the energy question, nothing stands in the way of the aspiration to halve the weight of existing grinding machines: the internal combustion engine on the machine is replaced with an enclosed brushless DC motor,

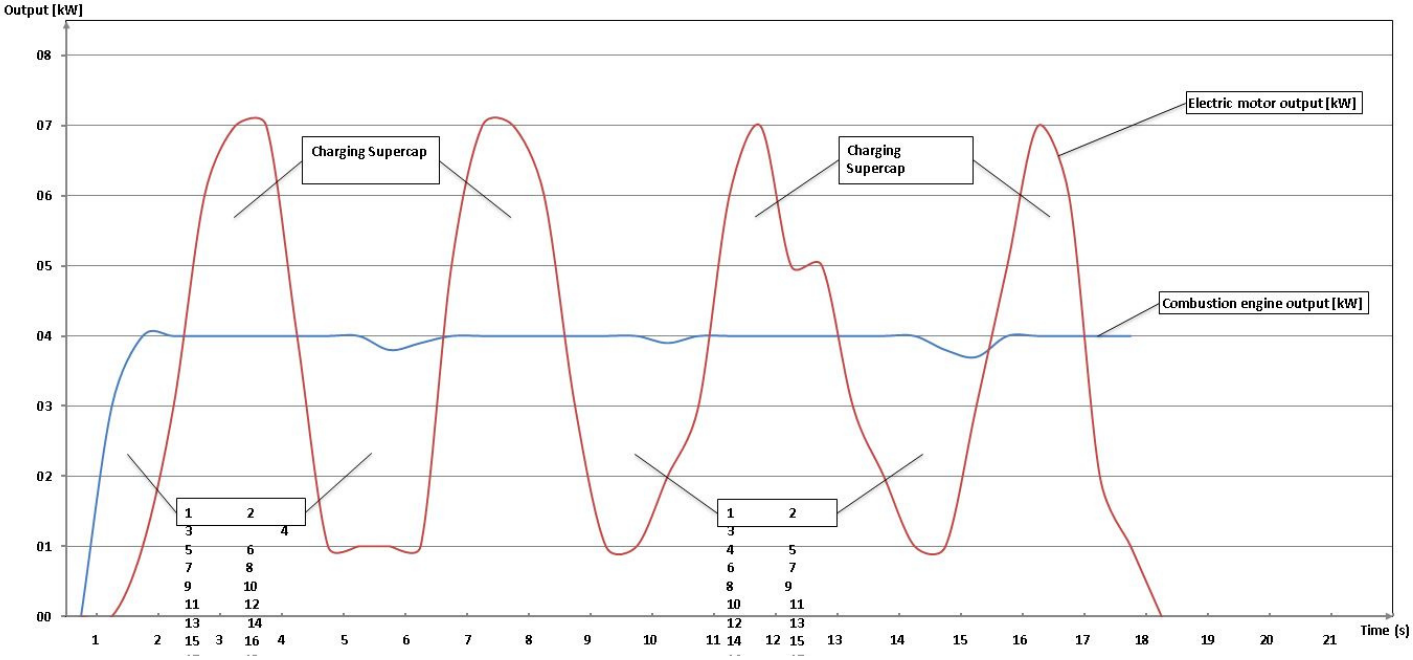

Fig. 4: Additional energy due to Supercaps: power curve of internal combustion engines and electric motors during grinding of a weld joint thing of the past

which is very small due to the neodymium magnets used and which has a significantly higher power density than an internal combustion engine or a conventional asynchronous electric motor.

The hybrid energy chain patented by ROBEL thus consists of an internal combustion engine, a wear-resistant generator, a charging controller developed in house and Supercap on the one side and a motor controller and electric motor on the other side. This provides a maximum power of 7 kW during grinding [Fig. 4].

Due to the compact motor positioned on the spindle axis, the machine appears light-weight, and the operator has a good view of the grinding area. As there is no internal combustion engine near the grinding equipment, this also saves on a gearbox and belts as well as its mass [1]. Exhaust gases, heat and vibrations are noticeably reduced. This results in a better surface pattern in a shorter time. Dust and sparks are directed downwards due to the intelligent air routing.

As there is no internal combustion engine on the machine, its centre of gravity is lower which means that the tipping moment in a superelevation is lower. Thus, the weight of the outrigger can also be reduced which has a positive effect on handling.

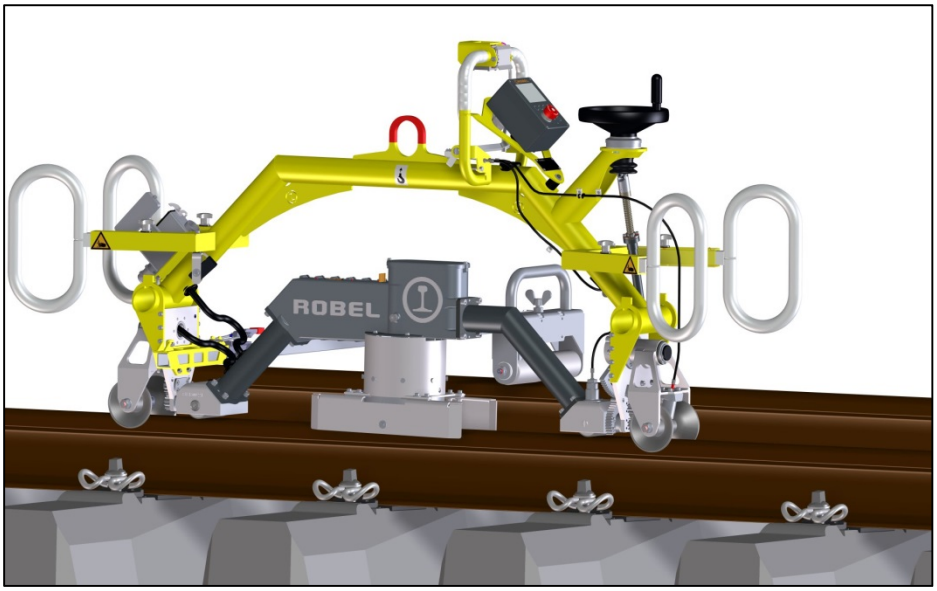

Fig. 5: Safety in every position: the deadman's brake on the side guide rollers is particularly effective for side grinding and on level ground.

Due to the optimised matching of speed and torque, the low weight of the machine itself is sufficient to convert the maximum power into grinding power. The electric drive, supported by the Supercap, keeps the speed largely constant which on the one hand improves the surface quality even more and, on the other hand, considerably lessens the danger of reduced grinding power due to gumming up of the grindstone. Wear due to the vibrations transferred by an internal combustion engine to the grinding spindle is reduced.

The petrol engine works at a distance from the operator, at the other end of the connecting cable which is protected from sparks. It is part of a separate portable unit (Powerpack 70.02) consisting of engine, generator and Supercap. The smaller engine is subject to fewer load fluctuations and works more efficiently, thus reducing the fuel consumption. The new drive solution also protects the internal combustion engine from grinding dust and the operator from exhaust fumes and noise. The greatest advantage, however, is

the reduction in weight and the accompanying ergonomic improvement. Two times 50 kilos are less than one time 100 kilos if they have to be carried to the work site, placed on or lifted off the track.

Hybrid Rail Head Profile Grinding Machine

With the ROBEL 13.49, which went into production in the summer of 2017, the first grinding machine with the new hybrid drive technology is already in operation in the United Kingdom for the reprofiling of weld joints. All new grinding technology developments are incorporated into this machine. The maintenance-free BLDC motor reduces vibrations to a minimum, the PLC controlled cup wheel feed and finish-grinding program provide for a precise surface pattern independent of the degree of experience of the operator who, on top of this, works faster: measurements in real operation have shown a time gain of 5 minutes per grinding area.

A cooling system developed by ROBEL further improves work conditions. The air flow required to cool the electric motor is generated by an impeller which is mounted above the grindstone. The cooling fins are located at the inlet area of the impeller. The cooling air passing over the grindstone directs the grinding dust and sparks downwards.

In contrast to the use of the significant physical strength required during standard grinding, with about 200 N typically being applied to push, the 13.49 is operated without exerting force and, due to the design with an outrigger, in an upright stance at all times. The light-weight aluminium construction of the frame grants a clear view of the grinding area, which is additionally illuminated with non-glare LED lights. For optimum braking on and next to the rail, side guide rollers, in addition to the copy rollers, can be fitted with a deadman's brake. [Fig. 5].

Conclusions

With these new technological solutions for rail grinding with hand-guided machines, ROBEL creates conditions which enable the track workers to achieve the best possible work result ergonomically and safely. From a company point of view, this leads not just to greater employee and client satisfaction, but also to a longer rail life and thus to noticeably reduced costs.

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Author:

Dipl.-Ing. Thomas Hölzlwimmer
Design, Hand-Guided Machines and Equipment
thomas.hoelzlwimmer@robel.info