

# Electro-mobility, railway infrastructure and E<sup>3</sup> technology

Report on how Plasser & Thurer is leading the way with alternative power methods for on-track machines.

A great deal of progress is being made in electro-mobility. This progress goes beyond the automotive industry and extends to track maintenance machines. A few years ago, the concept of e-mobility was misinterpreted as a buzzword companies used for image building. The benefits of e-mobility for companies, operators and the environment are clearly obvious today as there is no doubt about the ecological and economic benefits the machines offer. This is a significant contribution towards meeting the EU's climate targets.

Electric travelling and working reduces both noise and CO<sub>2</sub> emissions. Plasser & Thurer, manufacturer of track maintenance machines, headquartered in Linz, values green technology. The name of the Austrian market leader's E<sup>3</sup> machines stands for 'Economic, Ecologic, Ergonomic'. In short, the three Es are an innovative technology solution based on electro-mobility. This technology contributes to climate protection and the cost-efficient operation of on-track machines, and it also benefits operators.

So far, so good, but this technology also continues to change. Markus Schnetz, Project and Regional Sales Director at Plasser & Thurer, first described the basic principles of the innovative, hybrid-driven E<sup>3</sup> machine concept in *Rail Infrastructure* Issue No: 108 (November/December 2015). Since then, much progress has been made with 11 machines already put into operation in Austria, Italy and Switzerland.

## Technology in action

In 2015, E<sup>3</sup> technology was introduced to an expert audience for the first time. The four-sleeper tamping express introduced back then and the E<sup>3</sup>-design BDS ballast distribution system were either supplied with the energy from the overhead line or powered by the time-tested diesel engine.

A year later, at InnoTrans 2016, Krebs Gleisbau received a universal tamping machine for tracks and turnouts equipped with E<sup>3</sup> drive technology. Krebs Gleisbau was the first contractor to use the new technology. The company operated the Unimat 09-32/4S Dynamic E<sup>3</sup> in Switzerland, where environmental protection is a key priority. In addition to ecological considerations, an



**Above: The Rete Ferroviaria Italiana Unimat Combi 08-275 E<sup>3</sup> tamping in operation in Italy.**

economic aspect was crucial, too. The machine gave the company an advantage in the competition for tamping jobs.

Italy, a leading nation in rail systems, is relying more and more on the new technology. This is particularly true on the lines in Southern Italy, which feature many tunnel sections. The E<sup>3</sup> technology is very beneficial there as, when in electric operation, machines emit few pollutants. Therefore, the Italian Railway Rete Ferroviaria Italiana (RFI) has also taken the lead by the forward-thinking concept for its machine fleet. With a focus on spot maintenance, the company received its first machine in the special E<sup>3</sup> design zero a Unimat 08-275 Combi. Its 25kV alternating current or 3kV direct current make it suited to dual operation. This makes it possible to work on main and secondary tracks with different power supply systems. Another company that relies on Plasser & Thurer's E<sup>3</sup> technology is Francesco Ventura Costruzioni Ferroviarie. Using the Unimat 09-32/4S Dynamic E<sup>3</sup> attests to its high degree of mechanisation and in Southern Italy, this makes the company unique.

## Working and travelling electrically - E<sup>3</sup> can do more now

So, what is new about the E<sup>3</sup> technology? Does Plasser & Thurer's new modern industrial design live up to technological expectations?

Electric travelling was already possible in the past. The drive systems, however, are new. Electricity is supplied to the drive system without almost any losses. Electrical drive motors at the axles of the power bogies transfer the power on to the rail. In line with the principle of electric operation, Plasser & Thurer has electrified tamping units without changing time-tested key tamping parameters. Electric motors power rotary motions. All linear cylinders work hydraulically. The squeeze cylinders of the tamping unit or the cylinders of the lifting and lining unit are two examples.

The optimised E<sup>3</sup> technology has an electric travel mode and an electric working mode. What is the added value of this and how does it benefit machine-operating companies? Johannes Max-Theurer, Chief Executive, Plasser & Thurer, shares his view on the development of tamping technology. 'In my opinion, the benefits of our optimised E<sup>3</sup> technology are obvious. Machines equipped with the E<sup>3</sup> technology consume less fuel, even in working mode,' said Johannes. 'Further, our E<sup>3</sup> technology also benefits our customers by lowering maintenance and machine-servicing costs. In addition, the pressure to lower both noise and CO<sub>2</sub> emissions during maintenance and on worksites is increasing. With the new machines in the E<sup>3</sup> series, our customers are perfectly prepared to tackle these challenges.'

## Get to your worksite in a flash - all-electric and diesel-electric

At Plasser & Thurer, there are currently two different modes of operation for transfer and working that control the interaction between the power source and the drive system. There is the fully electric travel and working mode as well as the diesel-electric powered travel and working mode.

**Left: Krebs Gleisbau was the first contractor to use Plasser & Thurer's E<sup>3</sup> technology and has been operating a Unimat 09-32/4S Dynamic E<sup>3</sup> in Switzerland since 2016.**



**Right: The two-part Unimat 09-32/4S Dynamic E<sup>3</sup>, owned by Francesco Ventura Costruzioni Ferroviarie, consists of the tamping machine and the hybrid drive car with the stabilising units. It was one of the first machines with the new modern and ergonomic cab design, in keeping with Plasser & Theurer's modular customising approach.**

In the first mode, the transformer and power converter supply the machine and the drive with electricity from the overhead line. An electrically-operated hydraulic unit supplies power to the hydraulic components - the lifting and lining unit or the squeeze cylinder of the tamping unit. Since the end of 2019, the Austrian company Bahnbau Wels, which is part of Rhomberg Sersa Rail Group, has been using the fully electric E<sup>3</sup> technology. In the diesel-electric powered travel and working mode, the 600-kW diesel engine generates the power that supplies electricity to the drive components via the transformer and power converter. The diesel engine acts as a generator. During working operation, the work units run the same way they do during electric mode. The two-sleeper tamping machine with a focus on turnout maintenance is perfectly supported by the BDS 2000-4 ballast distribution system in the E<sup>3</sup> design.

**More than tamping - OLE maintenance with battery power**

There is more to track construction and maintenance than tamping. In addition to the positive features mentioned above, Plasser & Theurer also aimed to use the benefits of the E<sup>3</sup> technology for other machine models. Another machine for the installation and maintenance of overhead lines is a new prototype in the E<sup>3</sup> series - its drive technology, however, is different. In addition to the Unimat 09-4x4/4S E<sup>3</sup> introduced earlier, Plasser & Theurer presented an 'exciting' vehicle at iaf 2017 - the HTW 100 E<sup>3</sup>. During work, the HTW 100 E<sup>3</sup> motor tower car is powered by batteries that supply power to both the hydraulic power packs for the work units and the electrical drive unit.

While developing the machine, from the beginning, the company's design engineers faced the challenge of finding the right drive solution. During transfer, the machine must travel at high speeds to reach the worksite as fast as possible. During work, there is the crucial issue of lowering the machine's noise



and CO<sub>2</sub> emission levels, particularly when working in tunnels, residential areas or at night.

The HTW 100 E<sup>3</sup> offers an innovative holistic approach that meets these requirements. The machine's classic 480-kW diesel drive brings it to the worksite as fast as possible. During the journey, the generator charges the battery system. In addition, electric braking generates energy during working travel. On the worksite, the HTW 100 E<sup>3</sup> is powered electrically using state-of-the-art battery technology. It is designed for two six-hour shifts. The battery capacity can be extended using modules. Sophisticated thermal management, combined with an outside-air heat pump, provides a consistent

**Above: Based on the experience with the electric-diesel hydraulic drive of the Unimat 09-32/4S Dynamic E<sup>3</sup>, the BDS 2000 E<sup>3</sup> and the Dynamic Tamping Express 09-4X E<sup>3</sup>, the idea was expanded to fully-electric drive.**

output, independent of the ambient temperature. During assembly works by Europten in the Ceneri Base Tunnel in Switzerland, the HTW's work was much quieter and caused zero emissions in the tunnel.

**New standards in ergonomic design and operational safety**

The performance of the HTW 100 E<sup>3</sup> is emission-free and quiet, be it in tunnels or in densely-populated urban environments. Apart from increasing energy efficiency, the development of the HTW 100 E<sup>3</sup> focused on improving ergonomic design without neglecting the 'ergonomic' aspect of the E<sup>3</sup> technology present in the other machines. The modern cabin's interior is systematically arranged. The operating controls for travelling and working are clearly separated. The driving desk is easy to operate. Equipment such as the platform, contact wire holding devices, the crane, etc, can be preselected using the new, central control box.

**Left: The HTW 100 E<sup>3</sup> during operation in the Ceneri Base Tunnel. 'The hybrid drive increases working comfort. It runs quietly and does not release emissions in the tunnel. In addition, the exact control of the machine's working speed improves installation quality.'** Rudolf Wank, Project Manager.

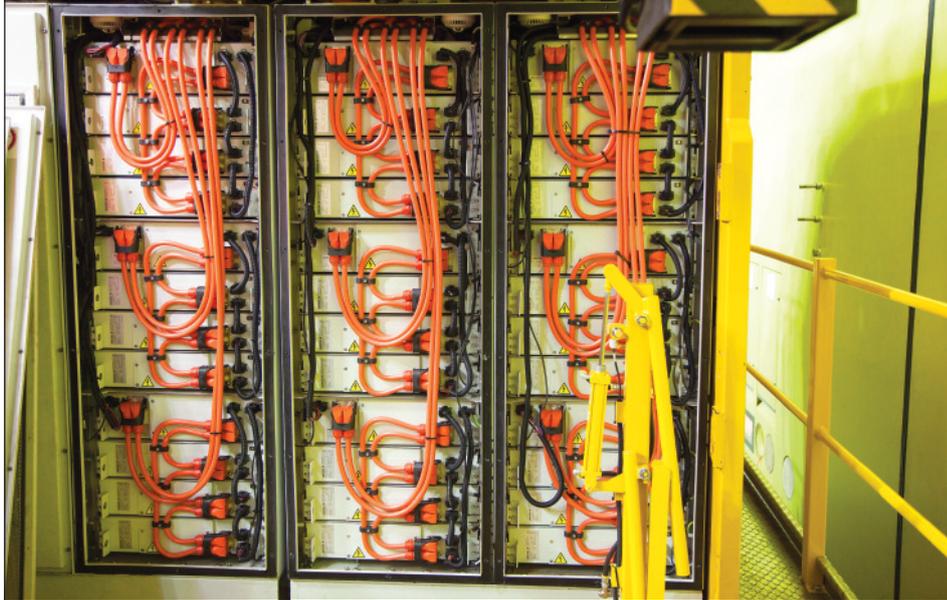


## New Equipment

**Right:** The heart of the HTW 100 E<sup>3</sup> is its innovative battery system which allows it to work fully-electric on the worksite, making it emission-free and quiet. This is an extremely valuable feature, particularly in urban environments or tunnels.

The AFB automatic drive and brake controller, a speed controller, can be used to control the machine from the crane during working operation. It controls uniform working travel, so that the operator does not have to use the radio remote control all the time. During measuring runs, it ensures more precise results. In addition, the system increases the service life of the batteries.

Thanks to their design, the working areas provide an increased level of safety. The operating staff does not need to leave the



machine. This prevents accidents and avoids unnecessary risks during work. In other words, the HTW 100 E<sup>3</sup> is ushering in a new era in overhead line maintenance.

### Benefits of E<sup>3</sup> technology

- Redundant operational reliability.
- Increases contract volume thanks to new fields of operation, such as in urban areas and tunnels.
- Electrical efficiency of up to 94% - saves €100 per operating hour.
- Noise reduced by 10 dBA.

**Left:** Innovative achievements in electromobility significantly contribute to greener railways. They ultimately promote climate goals and benefit the ecosystem.