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Automation and technical innovation allows significant daily production of concrete base pipe with integrated PE inliners

Introduction of Schlüsselbauer's Perfect Pipe at BAUMA 2010 attracted much attention and interest because it was the first time the market saw a sewage pipe that combined the advantages of a robust concrete pipe with a resistant, high-density plastic inliner in one product. It also received attention because Perfect Pipe also demonstrated a high static load capacity and durability, even under intensified chemical attacks. Since its introduction, Schlüsselbauer has worked hard to perfect the automation and manufacturing process, resulting in increased efficiency. The company's new, sophisticated and automated production process has made the manufacturing of Perfect Pipe considerably more cost-effective than pipe made of other materials, which has enabled producers to offer more attractive market prices. And since Schlüsselbauer's first Perfect Pipe machine was installed and commissioned at Müller's concrete plant in Breisach, Germany about a year ago, the system has been even further improved under actual concrete plant conditions.

Until the installation of Schlüsselbauer's Perfect Pipe in Breisach, Müller's main production focus had been in the manhole sector, where Müller was also one of the first producers to offer monolithic manhole bases using Schlüsselbauer's Perfect manufacturing process. When more and more of Müller's customers began requesting concrete pipe that correspond with their Perfect manhole bases, the company began thinking about getting into the concrete pipe business. Timing of Müller's consideration to enter the concrete pipe market happened to coincide with Schlüsselbauer's introduction of Perfect Pipe as a new cast concrete pipe, with or without inliners. With careful consideration, and already being convinced by Schlüsselbauer's manufacturing concept, Müller decided that producing Perfect Pipe would be their next logical step in fulfilling their customer needs and the company's next pillar for future growth.

■ Mark Küppers, CPI worldwide, Germany ■

Müller develops, manufactures and sells precast concrete products for civil engineering. To protect the environment, especially the soil and ground water, Müller produces high-quality, durable waste water treatment structures. These structures have been well established in the market over many years in the form of prefabricated manholes, household connection sewer manholes and special manhole structures. Müller also develops and produces rainwater retention and seepage systems for the sustainable use of water resources. These systems are available as tanks or retention tanks as well as soil or street water filters.

Müller has been in the market for 125 years and the business has been successfully built by family members over several generations. The most recent notable management change came 10 years ago when Joachim Strack joined the company as a second Managing Director and co-owner at the side of his uncle Siegfried Müller, who had been the sole Managing Director of the company until that time. Today, Müller operates three production sites and sales offices. The company's headquarters is located in Achern, Germany, about 50 km south of Karlsruhe, and is strategically located on the A5 motorway. Another plant is located in Breisach-Gündlingen, about 10 km west of

Freiburg, and is also close to the A5. The third site is located north of Stuttgart, in Kirchardt, on the A6, and is operated by the company's subsidiary MRB.

Müller acquired the Breisach-Gündlingen plant in 2006 and has used it exclusively to produce manhole elements. When the company bought the plant, one of the facilities on the premises was being leased to an external company who was using it to produce conventional concrete pipe. After the tenant abandoned production in the beginning of 2012, however, Müller took over the facility after deciding to employ Schlüsselbauer's Perfect Pipe manufacturing technology. All of the facility's equip-



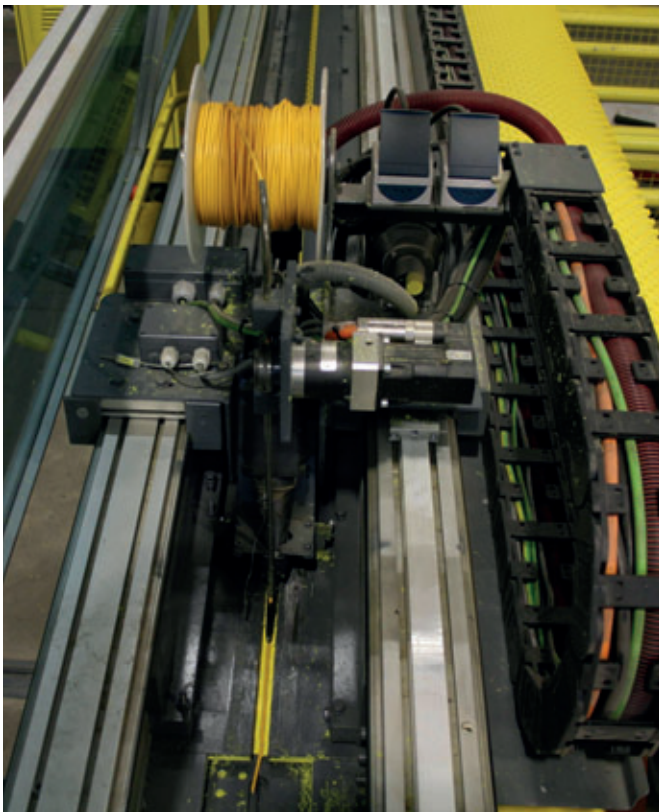
Perfect Pipe manufacturing at Müller in Breisach. The manufacturing process is almost completely automated throughout several stages.



A roll of PE film is cut to length for the production of inliners.



The PE film is precisely cut to length and is then pushed into the welding machine.



The cut ends of the PE film are welded together using PE welding wire.

ment was removed, except for the mixer and the moving floor system, and Perfect Pipe was installed. This was the birth of concrete pipe production at Müller.

Perfect Pipe – the cast pipe with an integrated PE inliner

The idea of Perfect Pipe was to fulfill the essential requirements for waste water disposal through a continuous connection of resistant inliners made from high-density and quality plastic (polyethylene) combined with durable concrete pipe. In essence, the idea was to provide pipe with great resistance to intensified chemical corrosion, a high static load capacity, even with heavy traffic loads, easy handling on the construction site and workplace safety throughout the manufacturing, installation and operational processes. Since the introduction of the Perfect Pipe in 2010, its concept has been fully validated by the interest it has generated globally, and



The tensile strength of the welded seam can be checked immediately after the welding process is complete.

Schlüsselbauer has been focused on further developing the economical manufacturing process of the new system.

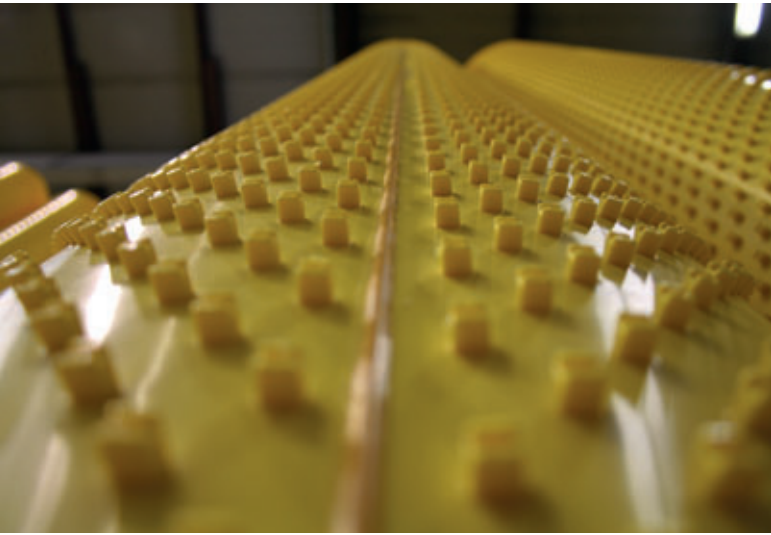
The inner workings of Perfect Pipe – the inliner

The first step in Perfect Pipe production is the manufacturing of the inliner, which is made of high-density and quality polyethylene (PE), a material resistant to chemical attacks up to a pH value of 1, and which is abrasion-resistant and weldable. The secure bond of the inliner to the surrounding concrete pipe is achieved by numerous small anchors on the back side of the inliner. The shape of the anchors enable a reliable connection, and the density of the anchors is tailored to the pipe such that there are considerably more anchors in the joint areas, where there is greater stress, than at the centre of the pipe. The pull-out resistance per anchor is more than 250 N. Depending on the requirements, available material strengths range from 1.65 – 2.00 mm.

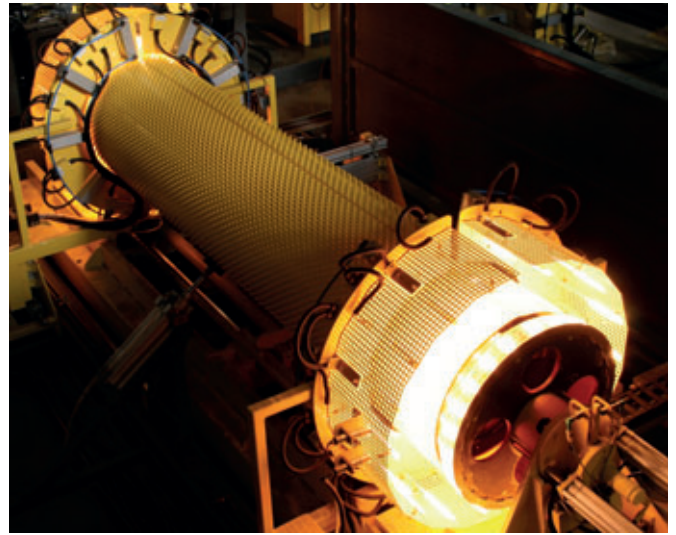
At Müller, 1.65 mm inliners are produced. Two PE rolls, with widths of 1 and 3 m, are mounted in front of a cutting table, from which the required material is taken. The rolls are designed for pipe with standard construction lengths and have the aforementioned anchor density in the pipe's joint areas. The area required for the desired internal pipe diameter (the internal lateral surface of the pipe) is gauged and automatically cut with a circular saw.

The PE film is then inserted into welding machines, which rotates the film in such a way that the ends of the cut surfaces meet. A welding robot then welds a seam using PE welding wire, securely connecting both ends of the film. Since there was no welding system available on the market that could accomplish this task according to Schlüsselbauer's requirements, the welding robot was also innovated by Schlüsselbauer.

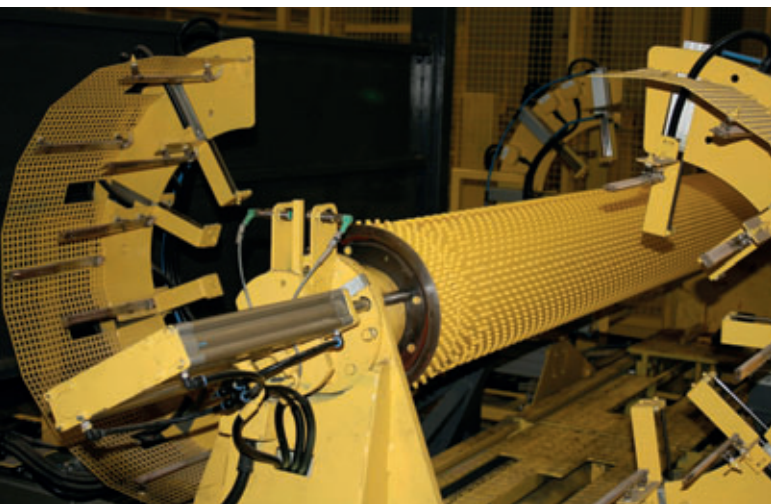
After the film is welded, the inliner is removed from the welding system and is ready for an immediate quality inspection. Both ends of the inliner's tensile strength weld are mechanically verified at a testing station by an employee. In addition to standard pipe lengths,



Finished PE inliners, with its numerous anchors, hook to the concrete to form an optimum composite concrete pipe.



The thermoplastic shaping process to form pipe joints



Forming a contoured pipe joint



A mould sits on a movable table during the concrete pouring process.

Müller also offers adaptor pipe at lengths of up to 2.50 m. Since the outer ends of the film cannot be cut arbitrarily, due to the density of anchors in the joint areas, wide roller conveyors cut PE sheets used for adaptor pipe in appropriate lengths of 1 and 3 m, which are required for custom-made pipe construction lengths, and the additional sectional areas are also welded together.

From the inliner to the finished pipe

Welded inliners are then placed on the production line by an employee. All steps from this point onwards are automatic, except for cleaning and oiling the moulds. At the first processing station, ends of the inliner are formed according to the contour of the pipe joint through a thermoplastic moulding process.

Thereafter, the inliner is secured onto a dimensionally stable steel core. To this end,

Schlüsselbauer has developed a patented shrinkable system that enables the circumference of the steel core to be quickly and easily reduced. The shrunken steel core is then pushed into the inliner and hydraulically reshaped to the desired shape, thus increasing the core's circumference and making the inliner fit tightly around the mould core.

The prepared core is then lifted by a crane from the station and taken to the next station, where an appropriately sized mould is waiting and which has already been cleaned and oiled by an employee. The crane then sets the core into the mould where it is automatically secured, after which the mould is closed and ready for the pouring of concrete.

Once the mould is ready, it moves into a buffer zone located in front of the concrete pouring station, which guarantees no idling

occurs. Moulds are then moved automatically into the concrete pouring station where they are individually and easily filled with a self compacting concrete, which is mixed by a Teka mixer that Müller had once used for pipe production. This casting process is gentle on all the components – inliners, moulds and cores.

The moulds have a small opening on the upper side through which the concrete flows. The outlet hopper under the mixing system is secured and the flow speed can either be automatically regulated or controlled by an employee at the concrete pouring station's operating console. The moulds are then placed on a movable tilting table located under the discharge hopper, which is adjusted to the length of the mould. The table moves backwards and forwards during the pouring process and ensures the concrete is filled uniformly. To provide better ventilation of the concrete, the



A full mould leaves the concrete pouring station.



The crane takes a freshly filled mould and places it on the curing area's moving floor system.

mould continually moves along the longitudinal axis of the table in slight pivoting movements.

Since the filling of the mould and ventilation only occurs through the narrow opening, Müller has adjusted the concrete pouring speed to achieve an optimal use of the product surface area. The average output at the concrete pouring station is approximately 8 - 10 moulds (of the 3 m category) per hour. This concrete pouring method is the result of intensive trials at Müller and it has been proven highly effective since finished products have smooth and sealed surfaces without any noteworthy imperfections.

When the mould is full, it leaves the concrete pouring station and is picked up by the next crane. The mould is then placed onto the moving floor system in the curing area, where the pipe is left in the mould to cure until the next day.

At the same time the moving floor system conveys freshly poured moulds from the pouring station into the curing area, the same crane that takes prepared moulds to the pouring station retrieves cured moulds from the curing station and automatically places them on the demoulding line. Moulds are then automatically opened at the demoulding station where the cores are shrunk and removed. When the cured pipe are removed from the moulds, the manufacturing process is complete and the mould equipment is cleaned and prepared for the next production cycle.

Before a finished Perfect Pipe is conveyed out of the plant for storage, the pipe moves through a testing station where each pipe is tested for leaks. When a pipe passes its inspection, it is labeled with a sticker that notes key product parameters and the pro-

duction date. It is then removed from the plant on a conveyor where it is placed in intermediate storage by means of a forklift. In contrast to Perfect manhole components where each manhole is unique and only manufactured to order, Perfect Pipe are mainly manufactured as warehouse goods and are, therefore, immediately available upon receipt of an order. In addition to the standard lengths of 1 and 3 m, adaptor pipe of 1.25 to 2.50 m, in 25 cm increments, are available in nominal widths of DN250 to DN600. Intermediate lengths are always available to order.

Müller is convinced of Perfect Pipe's potential

Until Müller began producing Perfect Pipe, the company had established itself in the market only as a specialist producing a wide range of concrete manhole products, while several other large concrete pipe manufacturers in the region serviced the concrete pipe market. Today the pipe market is tougher than ever and the price per meter, in general, is very competitive. It is for this reason Joachim Strack was not interested in entering into the conventional reinforced pipe market.

The risk of poor installation and the concrete's vulnerability to corrosive wastewater are well-known weaknesses of the classic concrete pipe (with a round outer contour). Perfect Pipe solves all of these problems. Perfect Pipe's design as a base pipe with a simple but effective connection system, using locking pins to withhold lateral force, ensures a secure and permanent placement of the waste water pipe. The risk of concrete corrosion internally is solved by the inliner.

"Together with Schlüsselbauer, we have been able to automate our cast pipe pro-

cessing perfectly. The bottom line is that almost all of the steps are now automated and we will be able to run the complete manufacturing process with two to three employees in future," said a pleased Joachim Strack. "Furthermore, we can now offer our customers pipe of the same quality as our Perfect manholes, which has been our goal for a long time. We are also able to offer them at reasonable prices."

Round shaped Perfect Pipe – mass production of high-quality pipe with short cycle times

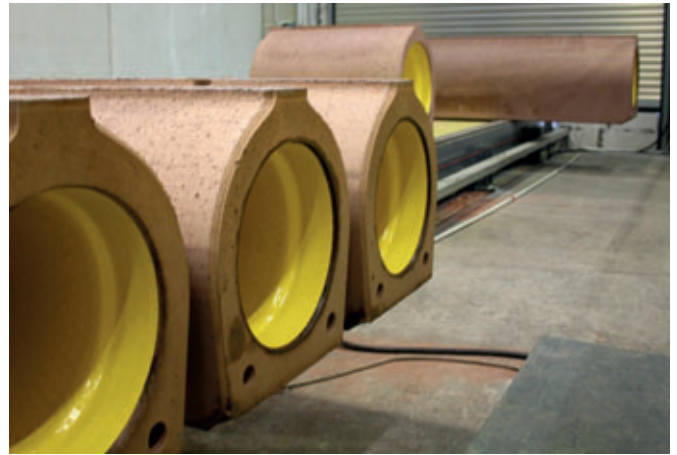
Production of base pipe is the main focus at Müller's plant, where concrete pouring



Demoulding a cured Perfect Pipe

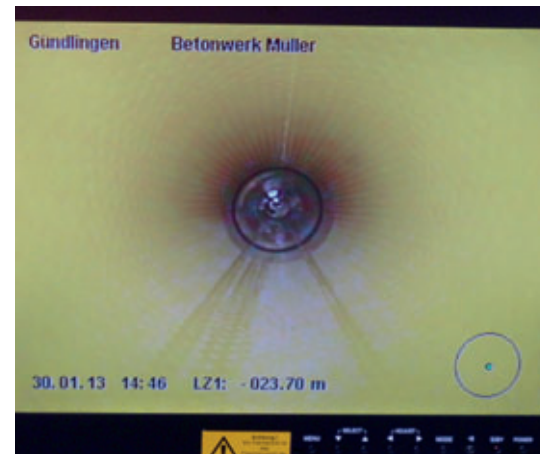


Before exiting the production line, each pipe is tested for leaks.



Inliner pipe are manufactured in different lengths and widths.

occurs with moulds aligned horizontally. Schlüsselbauer has an alternative system concept, however, where pipe can also be manufactured in a classic round shape or in various special cross sections. With this concept, moulds would be prepared almost identically to Müller's procedure, but they would be filled vertically rather than horizontally. The pouring of concrete would take place in a standing mould which could possibly allow production of future product shapes, depending on the product range, to exceed Schlüsselbauer's output target times of conventional pipe machines.



A camera inspection of this Perfect Pipe+ pipeline shows a continuous lining of corrosion-resistant PE inliners and PE pipe connectors.



A finished base pipe during transportation to the external warehouse



Shapes of the Perfect manhole and Perfect Pipe connections are designed to fit exactly.

FURTHER INFORMATION

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