KRAH™
krah-pipes.com PIPES

The magazine for large **Plastic Pipe Technology** (up to DN/ID 5000mm)

No. 30 / 2024
ISSN 2626-4366

IMPROFIL

DN/ID3500MM
FOR FLOODING PREVENTION LINE

E-FUSION
CONCEPT OF INTEGRATED KRAH ELECTRO-FUSION JOINT

REDUCING MICROPLASTICS
AND ENHANCING ABRASION PERFORMANCE BY CHOOSING HDPE

REVOLUTIONIZING INFRASTRUCTURE
THE IMPACT AND FUTURE OF PLASTIC PIPING SYSTEMS

Content

The magazine for large Plastic Pipe Technology
No. 30 / 2024

ISSN 2626-4366

Imprint
Krah Pipes GmbH & Co.KG
Betzdorfer Str. 8
57520 Schutzbach

www.krah.net

@derkrah

@KrahPipes

@KrahPipes

Dear Reader

Earthquakes, tropical storms, floods and droughts - every day we receive new horror stories in the news about extreme weather events and it feels like there are more and more of them. Everyone is trying to adapt as best they can so that these events cause as little damage as possible and people are preparing themselves for the fact that things will not get better in the coming years, but rather worse. One example of extreme weather conditions is the Philippines, which is considered to be one of the countries most threatened by climate change. The country is particularly hard hit by heavy, long-lasting rainfall with very high-water volumes.

It is therefore particularly important to have well-functioning drainage systems there. However, these are few and far between, which is why Krah Pipes Manila recently implemented a great drainage project in the Marikina and Sumulong area, which aims to make up for the poor planning of previous years and provide a good solution for a flood-proof area. An intersection has been created between the creek and the Marikina river to divert large volumes of water during heavy rains to save the areas from flooding. The PE 100 material Borsafe HE3490-LS-HP was used for the pipes to ensure especially reliable long-term stability and UV resistance. This project is unique in its form and there were a number of challenges to overcome. You can read a great report about it on page 7. There is also a very exciting report on the impact of plastic pipe systems on modern infrastructure and everyday life. A look into the future tells us that 2024 promises a wave of advances in plastic pipe technology that will take performance, durability and sustainability to a new level.

We can report in this issue that this is the 30th of its kind. We are very proud of this, because when an idea becomes a long-standing success story, you can assume that this idea has been well received and we are very pleased about that. Time and again we receive feedback on our imProfile and are asked when the next issue will be published. This fills us with joy and shows us that our work behind it is appreciated. We are always delighted when you send us project reports with beautiful pictures, which we are happy to publish here and do not want to withhold from other customers and interested readers. Find out more about the history of ImProfil on page 4.

Enjoy reading!
Dr. Alexander Krah

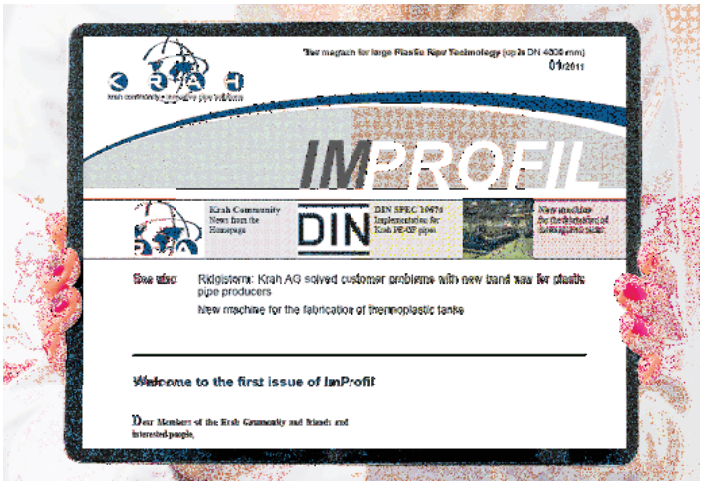
Celebrating 30 issues of ImProfil

From an idea to a strong magazine

In 2011, I had an idea: Creating a newsletter for Krah customers with all important developments, interesting projects and the ability to share experiences with each other. That's when ImProfil was born.

Initially planned as an online newsletter only, we have grown into a readership from 267 in 2011 to around 8000 in 2024, printing physical issues from 2013 on - with our very own ISSN number "ISSN 2626-4366". We have covered many technical issues, but also showed many extraordinary and special applications for Krah pipes which aren't common. We had to say goodbye to many people, but also welcomed many new faces and customers throughout the years. From the bustling streets of Tokyo to the serene landscapes of the Swiss Alps, „ImProfil" has traversed continents and cultures to bring you the most captivating stories.

Here's some highlights from our journey.



Innovation and Technology: We have explored groundbreaking advancements, from the latest tech startups in Silicon Valley to sustainable energy solutions in Scandinavia.

Our articles have highlighted how innovation drives progress and shapes our future.

Cultural Insights: Our cultural features have taken you on a journey through the rich traditions of India's festivals, the culinary delights of Italy, and the artistic renaissance in Berlin. We've delved into the heart of these cultures, offering a glimpse into the lives and stories of people from all walks of life.

Business and Economy: We've provided in-depth analyses of global economic trends, the rise of new markets, and the stories of entrepreneurs who are changing the world. Our business features have offered valuable insights into the dynamics of international trade, finance, and industry.

Environmental Stewardship: Recognizing the importance of sustainability, we've covered stories on conservation efforts in the Amazon rainforest, the impact of climate change on coastal communities, and innovative solutions for a greener planet. Our commitment to the environment is reflected in our ongoing efforts to raise awareness and inspire action.

Reader Engagement: Our success is not just measured by the number of issues published but by the engagement and loyalty of our readers. Your feedback, contributions, and enthusiasm have been the driving force behind our growth. We take pride in the interactive community we've built, where readers from different corners of the world come together to share their thoughts and experiences.

Looking Ahead: As we celebrate this milestone, we are more committed than ever to continuing our mission. The future holds exciting possibilities, and we are eager to explore new horizons. We plan to expand our digital presence, offering more interactive content and engaging with our readers through various multimedia platforms.

So, there's not much to say other than a big "Thank you!" to all of our readers of the past years. Your support and trust have been instrumental in making „Improfil" a success. Here's to many more issues filled with stories that inspire, inform, and connect us all. Should you have any topics you would like to read about more in "ImProfil", please let us know at **marketing@krah.net**.

Revolutionizing Infrastructure: The Impact and Future of Plastic Piping Systems

It is imperative to recognize the profound impact that plastic pipes have had on modern infrastructure and everyday life. From revolutionizing plumbing systems to enhancing infrastructure worldwide, plastic pipes have played a pivotal role in shaping our modern world.

As we stand on the cusp of further innovations and possibilities, it is essential to appreciate their historical contributions and future potential.

The Unsung Heroes of Fluid Dynamics

Plastic piping systems, often overlooked in the grandeur of engineering marvels, have left an indelible mark on modern infrastructure. These unsung heroes, crafted with durability against corrosion, lightweight flexibility, and ease of installation, are integral to the fluid dynamics that sustain our daily lives. They serve as conduits of innovation, managing the symphony of gases, the dance of chemicals, and the flow of water with remarkable efficiency. Their versatility and reliability have made them indispensable in reshaping the blueprint of fluid flow management.

Dispelling Misconceptions

A common misconception is that plastic pipe systems are akin to short-lived, single-use plastics. This could not be further from the truth. Plastic pipes are engineered products designed for longevity and strength. Unlike single-use plastics,

they provide essential services for at least 100 years, contributing to environmental sustainability. At the end of their lifecycle, plastic pipes can be recycled into new pipes, demonstrating a true circular economy in action.

Economic Landscape

The financial trajectory of the plastic pipes market is a testament to their growing importance. From 2018 to 2023, the global market for plastic pipes expanded at a commendable CAGR of 3.9%. This growth is projected to continue, with market value expected to rise from USD 37.34 billion in 2023 to an impressive USD 63.78 billion by 2034. This expansion is driven by increasing demand across various sectors, including water treatment, construction, and irrigation.

Innovations on the Horizon

The year 2024 promises a wave of advancements in plastic pipe technology that will elevate performance, durability, and sustainability to new heights. Key innovations include:

- High-Strength Plastic Pipes: Advances in polymer formulations and manufacturing techniques are leading to plastic pipes with unparalleled strength properties, suitable for a wide range of applications.
- Composite Plastic Pipes: The rise of composite plastic pipes, which blend different materials, is optimizing performance and resilience, ensuring longevity even in adverse conditions.
- Enhanced Resistance: Plastic pipes fortified with advanced engineering plastics are exhibiting superior resistance to chemicals and corrosion, promising longer lifespans and reduced maintenance needs.
- Smart Technologies Integration: Imagine plastic pipes equipped with sensors that monitor flow rates, detect leaks, and provide real-time data on system conditions. This integration heralds a new era of proactive maintenance and efficiency.
- Anti-Microbial Properties: To enhance hygiene and safety, plastic pipes are being manufactured with anti-microbial properties. These inhibit the growth of bacteria and other microorganisms, ensuring a cleaner and healthier water supply.

Highlighting HDPE Pipes

Among the myriad of plastic pipes, High-Density Polyethylene (HDPE) stands out for their remarkable qualities:

Unparalleled strength, flexibility, and resistance to corrosion, chemicals, and abrasion, HDPE pipes are synonymous with durability and reliability. Their adaptability makes them ideal for a variety of applications, from water supply to industrial usage.

Conclusion

As we celebrate the rapid advancements and emerging technologies in plastic piping, we pave the way for a future where innovation knows no bounds. The contributions of plastic pipes to modern infrastructure are monumental, and their potential for future advancements is limitless. By embracing these innovations, we can ensure a sustainable, efficient, and resilient infrastructure for generations to come.

Ramesh Parasuraman
Managing Director of Allied Solutions

Mr. Parasuraman has been our Indian representative for many years and was elected as President of Society of Plastic engineers, India (SPE) from 2021 to 2023.

Pipe DN/ID3500mm

for a flooding prevention line in the Philippines

Check out our YouTube-Video about this project

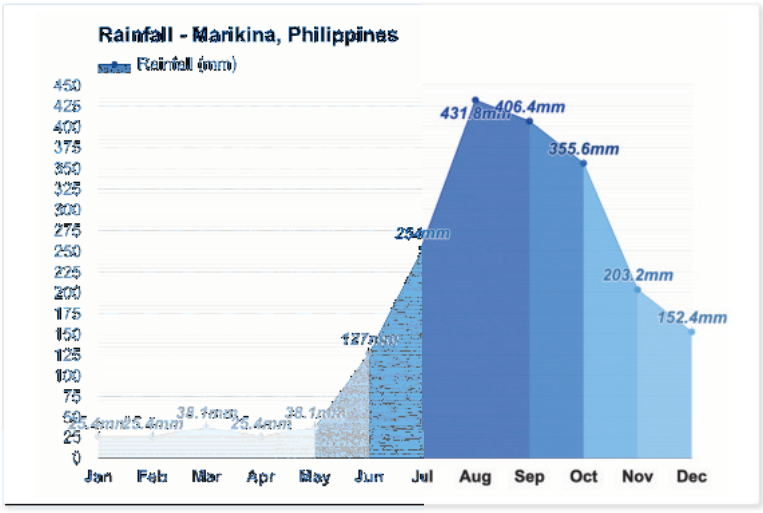
The Philippines is an archipelago of 7641 islands in the western Pacific Ocean. The country belongs to Southeast Asia and is the fifth largest island state in the world in terms of area. The thirteenth largest country in the world has around 110 million inhabitants, consisting of dozens of different ethnic groups and cultures. The main city of the Philippines is Manila, located on the main island of Luzon in eastern Manila Bay. Together with 16 other cities and municipalities, Manila forms the 636 square kilometer Metro Manila region. The majority of Manila's inhabitants live in coastal areas that are less than 10 meters above sea level. This makes Manila the megacity most threatened by climate change in the world, as the sea level there has risen by 80 cm since 1967. This is due to the fact that the terrain is sinking sharply as a result of water extraction and building development. The city of Marikina is located in the north of the capital region. The city is characterized by the lowlands in the southeast and the mountainous foothills of the Sierra Madre, the longest mountain range in the Philippines, in the northeast.

Natural Disasters: A constant threat

Geographically, the Philippines is part of the „Ring of Fire", a belt running around the Pacific Ocean that is frequently affected by typhoons, earthquakes, tsunamis and volcanic eruptions. The country is located in a seismically active zone and the more than 36,000 km long coastline and the humid climate make it one of the most disaster-prone countries in the world. No other country in the world is exposed to tropical storms as often as the Philippines, which has cost thousands of people their lives in the past. According to the Joint Typhoon Warning Center (JTWC), around 80 typhoons develop over tropical waters every year, with around 19 of them reaching the region around the Philippine archipelago.

How can Krah help here?

According to Maplecroft (2015), the Philippines is one of the countries most at risk from climate change. The Heat Stress Index, one of 20 indices published as part of the 2016 Climate Change and Environmental Risk Analytics, shows that economies such as Singapore, Malaysia, Indonesia and the Philippines could be up to a quarter less productive than they are today within a generation. For these reasons, it is very important that drainage



Rainfall in mm in Marikina throughout the year

The DN/ID3500mm Krah pipe „flying" over the construction site

facilities are installed throughout the land to protect it from flooding.

The Marikina-Sumulong Drainage Project

A project to install new pipes for a drainage system is presented in this report. The project is being carried out by Krah Manila, a company that manufactures large-diameter plastic pipes on Krah machines made in Germany. These pipes can be welded safely and 100% tightly using electrofusion thanks to the integration of a fusion wire. The Marikina-Sumulong Drainage Project aims to mitigate flooding and enhance stormwater management in the Marikina and Sumulong areas. By improving drainage systems, the project seeks to minimize flood risks, increase infrastructure resilience, and support sustainable urban development. The initiative aligns with goals of environmental protection, preventing soil erosion, and ensuring the safety of residents by reducing flood-related hazards. Through effective drainage solutions, the project contributes to a more resilient and sustainable community in the face of heavy rainfall and storm events. The project is now intended to compensate for the poor planning of previous years and provide a good solution for a flood-proof area. The goal is to create an intersection between the creek and the Marikina river and to redirect a big volume of water in case of heavy rain or floods, to protect the area. This project is unique to date and presented us with a number of challenges. One big one was that the rainy season starts in July, so there wasn't a lot of time from planning to production to implementation. Another difficulty was the location of the project, as the pipes had to be laid on one of Marikina's main roads, the „Sumulong Highway".

Calculating the project needs

For the pipe design, ASTM F894 was used, but in metric dimensions. So, the pipes had a structural calculation based on ASTM F894, backed up with the German ATV-DVWK-A-127 approach, because the

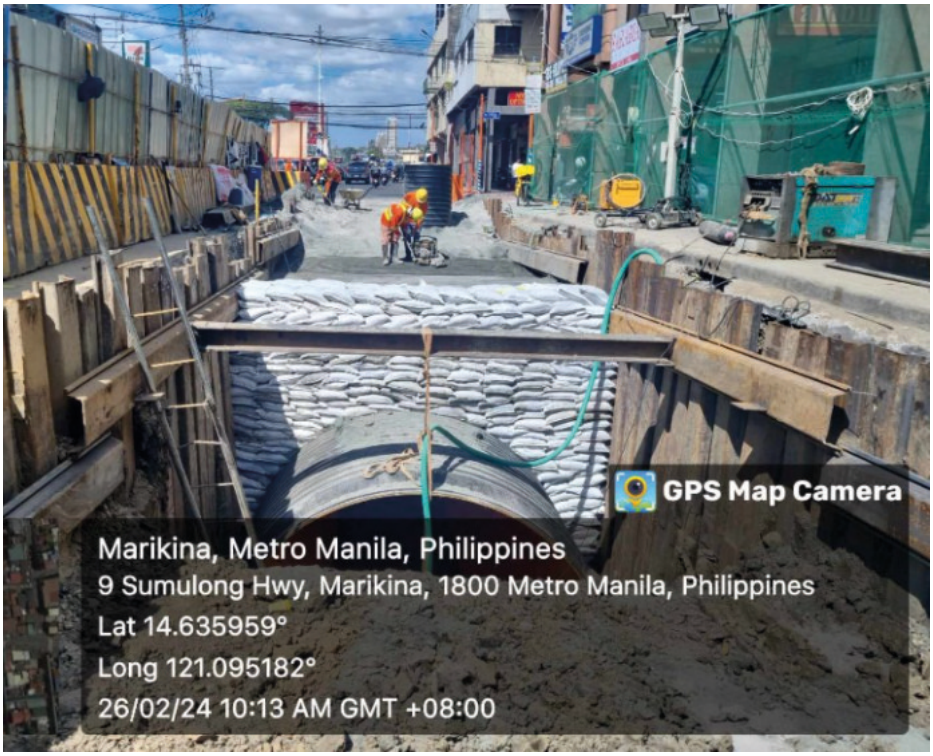
Tightening the chain around the pipe for electro-fusion

project conditions are not standard. The flow rate was set at: Q= 26 m³/sec (95% full, gradient 0.009 %). The entire project is to have a total length of 1 km - from the mouth (river) to Balanti/ Sapang baho creek. The spigot / socket is conical to facilitate the connection and create a better welding contact surface. At the beginning of the project, thoughts were given to which material and which way of laying the pipes would be the most appropriate and best solution. In the end, Krah plastic pipes were chosen because they have significant advantages over other materials. The alternatives were, for example, conventional, cast-in-place or prefabricated RCBC box culverts and concrete pipes. These were ruled out because pipes of this size are not available. Also, this would result in very slow installation, which would cause a traffic disaster as this is a very busy road. Another problem would be that a very wide space would be needed, which would also lead to traffic chaos. Another minus with this type of implementation would be that the hydraulic flow rate is much lower than with the method chosen at the end: the Krah pipes. In addition, the abrasion resistance of concrete pipes would be much lower than that of the Krah pipe, as a lot of scrap and hard components are expected. The cleaning aspect/maintenance costs were also a significant factor in deciding in favour of Krah pipes in the end.

Lowering the pipe into the trench

Production and installation

After Krah Pipes Manila was awarded the contract for this project, the production of the pipes could begin. The pipes were produced on a Krah KR800-max machine at the plant in Cavite, Philippines. A special project-specific wall design was chosen for this project, as the standard profiles were not suitable for this application. The pipe weight per pipe was approx. 3.2 tons (length 5.8m plus socket and spigot end), the pipes were produced in multiple layers, co-extruded (for ease of inspection), with integrated electrofusion wire. If the core pipe 110 is available, the pipe weight can even be reduced by approx. 10%. The production time of one pipe was 4 hours and the material used was PE100 material BorSafe™ HE3490-LS. BorSafe™ HE3490-LS-HP is a bimodal polyethylene compound produced by the advanced Borstar technology. The product is a high-density



Good overview of the deep trench and the started backfilling

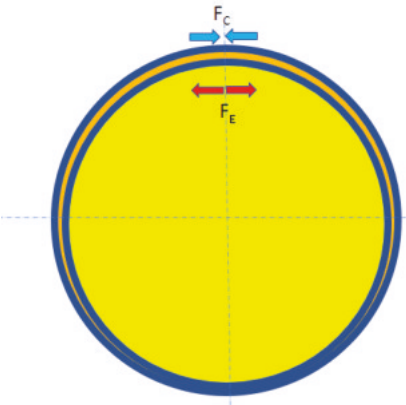
polyethylene compound in pellet form and contains a combination of stabilizers and carbon black to ensure a reliable long-term stability and UV-resistance.

Overcoming installation challenges

Due to the low weight of the pipes, a small truck with a special trailer could be used to transport the pipes to the construction site. It was not planned to install any support rings to hold the diameter, so a virtue had to be made of necessity - the pre-bent pipes were installed with a 90° turn so that a negative deflection was achieved during installation. There were a few special features that had to be taken into account when installing the pipes. A narrow, short trench had to be dug with a maximum length of 15 meters due to the heavy traffic on the road. A bedding was then used to prepare the trench for laying the pipes. The maximum depth of the trench was allowed to be 7 meters and the partially low groundwater situation due to the proximity to the Marikina River caused some concerns in advance. Another problem was that the trench was very close to the foundations of mid-rise buildings, which meant that special care had to be taken when installing the pipes. Contrary to all concerns, however, the laying of the pipes went smoothly, so that work on joining the pipes could begin quickly. The pipes were welded together using the well-known and proven Krah jointing technology. For this purpose, electric wires were integrated into the pipe during production so that they could be heated on site using an e-box and joined with the other pipe. After many tests beforehand, two wire strings (top and bottom) were used. Two Krah E-Box23+ (230VAC) were used for electrofusion, powered by two diesel generators. Due to the narrow trench, welding was carried out from the inside of the pipe. It can be said that in the future it is being considered to perhaps carry out both from the inside - it is easier if the pre-bend of the pipe does not match the position of the e-welded joint - so correct positioning is particularly important here.

Eliminating gaps by special welding

Due to the special process, simultaneous welding was possible here. This can be explained by the fact that the main effect here is on the expansion forces and not on the compression forces. In retrospect, it can be said that it would have been much better to use 4 strings here. This is because less tension/energy could be used here due to the resistance of the wire - and the welding time would also be shorter (but neither of these is decisive in this project). According to the ASTM F894 standard, the socket and spigot tolerances for a PE pipe may only be 1%. In this case, that would be 35 mm. This would make welding impossible - so what could be done? In the end, the sum of the tolerances results in a gap at the apex or sides of the pipe. To eliminate the gap, the Chillang procedure was used here. To eliminate the gap, the correct time [t] and tem-



Chillang procedure explained

perature [K] were used.) The figure shows the expansion force [FE] in red and the compression force [FC] in blue. From the outside, a strong flashlight was used to apply light and detect the gap. From the inside, the gaps were visually scanned and localized. Then the elimination of the gaps was started.

The tulip effect

Additional „bulges" at the sleeve ends could create a false image. But how do these bulges occur? These are due to the behaviour of the pipe ends of „radially extruded" (Krah pipe) as opposed to „axially extruded" PE pipes. The main reason for this is the principle of cooling and the frozen stresses inside the pipe wall. This effect mainly occurs on the socket side (with Krah pipes), as the spigot end is conically machined. This can be irritating at first, as the gap looks very large when viewed from the outside. The German word for this is „Auftulpung" - as the end looks like a „tulip flower" / „tulip effect".The local authority's regulation was that a manhole must be installed every 4 pipes. This should be arranged tangentially. The connection of the pipe to the fitting and the manhole (in height) was again secured by E-Fusion. Inside the manhole, a standard removable ladder was used - also to maintain the hydraulic capacity. The cover of the manhole is a concrete ring with standard parts, and the ring is placed not only on the „PE"-manhole but also on the surrounding soil, so that the load is also transferred to the soil. At the end, the manhole cover is embedded in the road with standard metal parts and a standard concrete ring. All parts of the manhole were produced using standard tools (mostly with wooden blades) and welded together using various extrusion welding machines. The rod (black and yellow) was made from the same material as the tube on a Krah welding rod production machine to ensure a homogeneous weld. The manhole is connected in the same way as all other pipes using the same electrofusion system. During the backfilling of the manhole, the customer wanted an 800 mm long inlet in the manhole. Due to the material properties, a DN/ID 800 mm inlet (solid wall pipe) was welded in within a very short time. Here, as always, the customer's wishes are the top priority. There were still some minor problems with the further installation of the pipes, but these were easily solved. For example, the first pipes, which had been stored for a long time and whose roundness was not supported, were now slightly bent. Here the pipes were turned 90° before installation so that the pre-bend could be used to our advantage.

Backfilling and compaction

Backfilling of the trench

The backfilling of the pipes began immediately after installation and welding. As the trench was very narrow, this was carried out using vibro-compaction. Vibroflotation, also known as vibrocompaction, is a soil improvement technique used to increase the density of loose, granular soils. Here's how it works: A vibroflot is inserted vertically into the soil. The Vibroflot generates vibrations that cause the surrounding soil particles to rearrange themselves and settle better. As the Vibroflot is gradually withdrawn, the aggregate particles settle and the soil becomes more compacted, reducing the voids between the particles. After this, the sheet piles were removed. Generally, a layer of lean concrete is applied directly after backfilling before the asphalt is applied. The asphalt was then applied in order to reopen the road to traffic as soon as possible.

This project report is a good example of how Krah pipes can be laid and the problems that can arise. These are briefly summarized here to give a good overview. The first major problem was the pre-bending of the pipes (due to the lack of support rings) - the solution was to simply twist the pipes by 90°. Even with high pre-bending, the hydraulic power is correctly designed and therefore does not lead to any problems.

Chillang process and vibro-compaction

Then there was the problem with the tolerances in the pipe diameter - these were large enough to join the pipes and small enough to weld them together. The solution here was the Chillang process, which was explained earlier. The compaction of narrow trenches was carried out using vibro-compaction, which turned out to be the ideal solution. We were able to give our partner in the Philippines a few more suggestions for the next project. For example, we were able to provide solutions for joining concrete with plastic, as this has long been possible in Europe. Integrating HDPE sewer pipes with old sewer lines is a challenge due to the different material properties, joining methods and construction specifications.

Ensuring material compatibility is critical to prevent degradation, and adapting jointing methods to the transition between HDPE and the existing materials is necessary for a secure connection. To maintain structural integrity and prevent blockages, differences in pipe diameter and design must be addressed and well-supported transition areas created. To overcome these challenges and achieve successful and compliant integration of HDPE sewer pipes into older infrastructure, professional technical expertise is essential. In our opinion, the distance between the shafts can also be longer, which could save shafts in the next project. When designing the manhole, inlets should be planned earlier so that they can be better pre-constructed and do not have to be worked on at the construction site.

Summary

In summary, our Krah pipes convinced the local operator that they were the right choice for this project due to the availability of the pipe, ease of handling, reliability, long service life, low maintenance costs, quick installation and low overall investment costs. The long service life of the pipes will also reduce the total cost of ownership. Thanks to a good technical support team, Krah Pipes Manila has managed to complete a wonderful project that everyone is happy with. We can say with a clear conscience that with these plastic pipes we have once again contributed to making the world a better and more sustainable place.

Dr. Alexander Krah / CEO Krah GmbH
Jenny Krämer / Marketing Krah GmbH

Inside the pipe in the trench

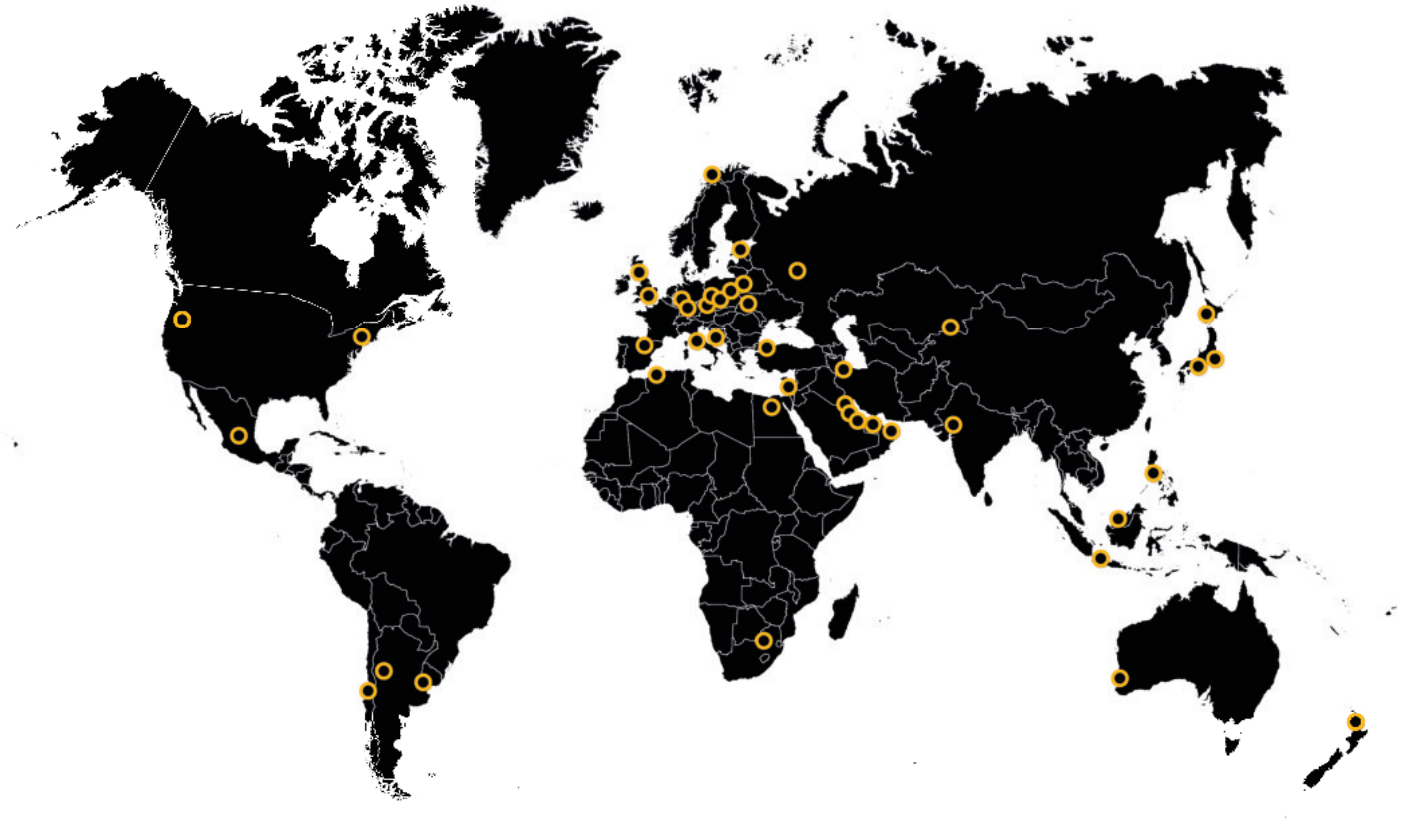
Which countries produce Krah pipes?

For more than 30 years, Krah has been selling the production technology to many customers around the world, for them to produce locally. This sounds very "green" and ESG-conform, and yes - we have been doing this for long. We are selling production technology including the complete Know-How to people around the world, so that they can produce locally and they don´t need to import from others. Today, we would say that we reduced our CO^2-footprint of transportation, but we gave our customers the possibility to employ people and to grow the economy. Also, we have been teaching them for years how they can reduce the material (to be more competitive against e.g. concrete pipes) but also to reduce material (first reduce, then re-use and then recycle – we have been preaching this for long). Basically, we also followed the concept of 3D-printing (in a wide view), we use PE-granule and produce exactly the shape of the pipe the customer wants. Great, for many years we were ahead of all mega-trends, but it seems we were not so successful in promoting it in the right way.

But some countries/clients could be convinced, such as South Africa, Argentina, Chile, Egypt, Australia, New Zealand, India and many more! If you want to have names of the local producers, please contact us and we will be glad to provide the information to you. If you can´t find a production facility close to you but you'd like to produce by yourself please contact us, too (to speak in the Agenda 2030 words – we don´t want leave anyone behind).

But know, we can happily say, we did nothing wrong, we have a good product and we are following the trends.

Dr. Alexander Krah / CEO Krah GmbH



Be a producer in your country and a member of our community!

The concept of the integrated Krah electro-fusion joint

For more than 20 years, Krah pipes come with a possible integrated electro-fusion joint. This technology is used very successfully worldwide.

The idea was to supply a pipe with socket and spigot (known from the concrete pipes) and at the same time to use the advantage of the Polyethylene material – the possibility of welding. In the old days, Polyethylene pipes were mainly jointed by butt-fusion, this technology came with high costs of jointing equipment and a good training before jointing. The butt-fusion was mainly designed for pressure pipes and solid wall pipe structures. The integrated electro-fusion joint was designed to be used by a regular construction worker at the construction site. The joint should provide a tough, rough system and the tolerances of the pipes (especial the large ones) should be taken. The pipe tolerances of the spigot and socket should be big enough for easily inserting the spigot in the socket and narrow enough to provide a good fusion surface. Further it was important that the stiffness of the joint is high enough. The integrated Krah electro-fusion will provide the possibility to joint structured wall pipes by using an easy fusion method, to create a pipe joint resistant against:

- Low working pressure
- In- and exfiltration
- Root penetration
- A shorter lifetime than the rest of the pipeline

Other big advantages are:

- Can be jointed in the trench
- Several joints can be done at the same time (super quick installation)
- No extensive training is needed
- Jointing quality is not depending on the mood of the jointer (barcode-controlled)
- One type of electro-fusion box can be used for all sizes (cost reduction)
- The electro-fusion-box can operate with 230 V AC

To make a good fusion/welding of Polyethylene (and Polypropylene) you mainly need:

- The right temperature for the material
- The right melting/welding time
- The right welding/fusion pressure

This is a triangle-party where each factor can be substituting the others, but only in a very limited way. In the butt-fusion technology or the extrusion welding procedure, the three factors are easy to determine, but with the integrated electro-fusion joint it is not too easy where and what the welding/fusion pressure is applied.

By the way: Fusion is a special variant of welding. While doing the standard welding procedure an additional welding material will be added, while in the fusion process the existing components will be heated up and they will melt together into a homogenous part. Questions many clients have had and their answers:

Why is the electrofusion joint integrated in the pipe?

No extra fitting is needed, basically the risk of a failure is reduced by 50 %, because one part is integrated in the component. A component can be a pipe, a fitting or a manhole. The risk of a wrong insertion of the spigot into the socket is not so high, because there is a physical lock at the end.

Why is the oxidation surface not scrapped of the spigot before fusion?

During the pipe production, the oxidation surface is grinded, and then covered by a film, to protect the spigot. Usually also the socket is protected against dirt by a film.

Grinded spigot

Why has the Krah wire its specific meander-form?

The main reason is to handle the tolerance issues of the large pipes, because this meander form has a spring behaviour. Another advantage is that the risk of a short circuit is minimized.

A detailed shot of the wire – Spring effect

On the photo above you can see, that the spring effect of the wire is able to support a changing of the diameter/circumference, due to applied forces and temperature changes, without having any negative (tightness) effects.

How is the fusion pressure built up?

The build-up pressure for the fusion is caused by the thermal expansion of the material during the fusion process. For PE, this is around 30 percent (Capt, L. and Kamal, M.R., 2000)[1]. The volume will increase from 1,05 cm³/g to approx. 1,35 cm³/g.

After the melted material filled the remaining little gaps (e.g. between the not embedded wire) the building of fusion pressure is starting. The created fusion pressure is approx. 100 bar according to the diagram. The limit is reached, when the mechanical locking of the ends is not strong enough anymore to keep the pressure inside. It is important that not too much material is able to move out of the fusion area (otherwise no / low pressure).

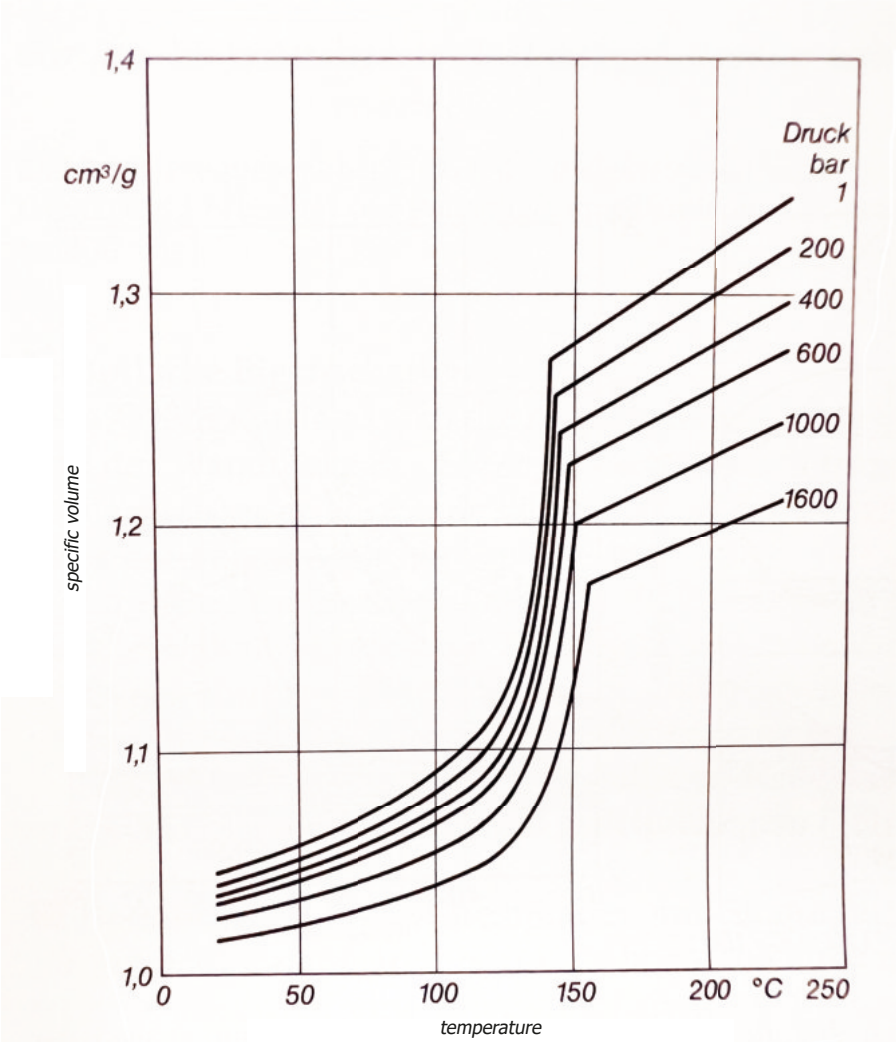


Diagram: Thermal Expansion of PE

Pressure-temperature relation for melted PE

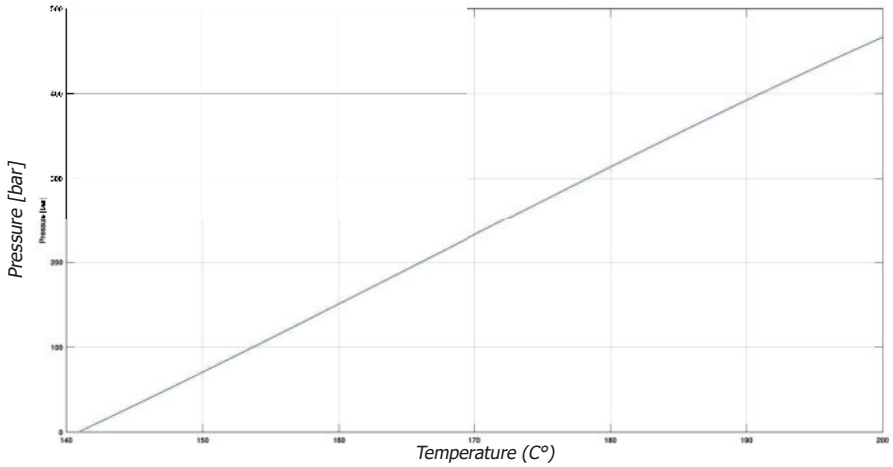
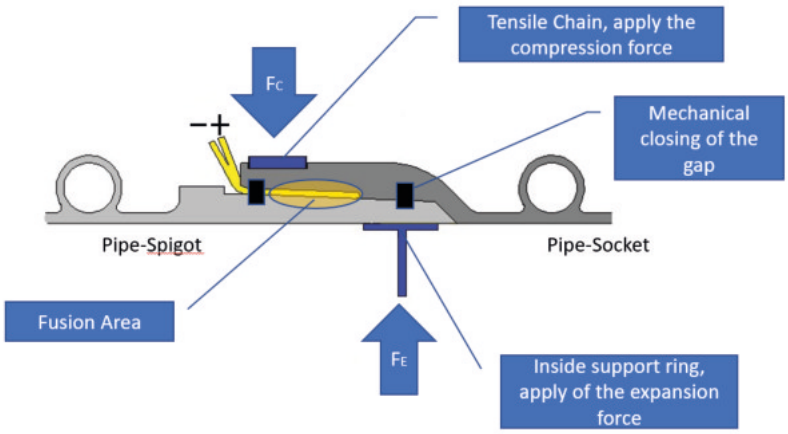


Diagram: Isochor of the Pressure, build up due to thermal expansion of PE

What is the purpose of the tensile band and the tension ring, while fusion?

We learned already on the point before, that the pressure is applied by the volume expansion of the material, so the purpose of the two elements is:



Sketch: Electrofusion with forces and pressures

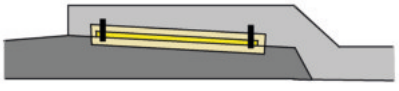
- Closing the gap between socket and spigot before fusion. Here we use the Chilang procedure (basically we talk about the slow adjusting of the inner ring, so the spigot is able to creep/ expand)
- Locking the ends of the welding area (where the material is not melted), so the material can´t move away (like in butt-welding) – so a kind of a melting pocket will be produced.

The two elements or better two tools are: A tensile chain with a wrench from the outside, this tool is compressing the socket (FC), it will be mainly adjusted during the fusion procedure.

The tensile chain also helps to reduce/limit the possibility that the socket-diameters expands. The position of the chain is on the outer side of the welding area. An inside tension ring (is not only a support ring), with screws from the inside, this tool is expanding (FE) the spigot, it will be mainly adjusted before the fusion/welding procedure. The position of this tool is close the visible jointing gap of the pipes.

Why is the electrofusion wire not embedded and held by anchors?

The not embedded wire has the advantage that both sides (the surface of the socket and spigot) are heated up equally and the heat is distributed in both ways in the same way. The main reason of using anchors was for it to keep the wire on the right position when the material is melted around, and the slightly conical socket/ spigot design and the applied pressure is designed to secure the wire in place. Thus, the end of the anchor is in the "not melted" area of the joint.



Sketch: Wire anchors during electrofusion

material is melted approx. 6 mm around the wire.

Why are there no welding seams visible inside and outside of the pipe?

Compared to the butt-fusion process, the melted material can not be pressed out of the fusion area, and don´t need to be cut off later, to keep the hydraulic capacity of the pipe.

Only little melt could be seen in the outside gap of the socket, it is a sign that the fusion pressure was even higher than the locking pressure and also the temperature/viscosity was ok (melted).

How can the fusion quality be checked and reported?

Quality control can and should happen in several ways:

- Visual check of the jointing
- Automated generated fusion report produced by the electro-fusion box. Here the main value is the used Energy (Photo of a test result above)

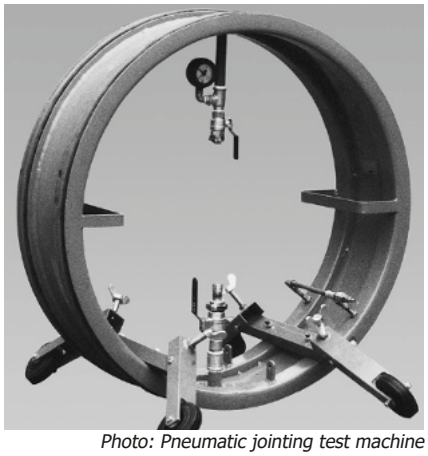
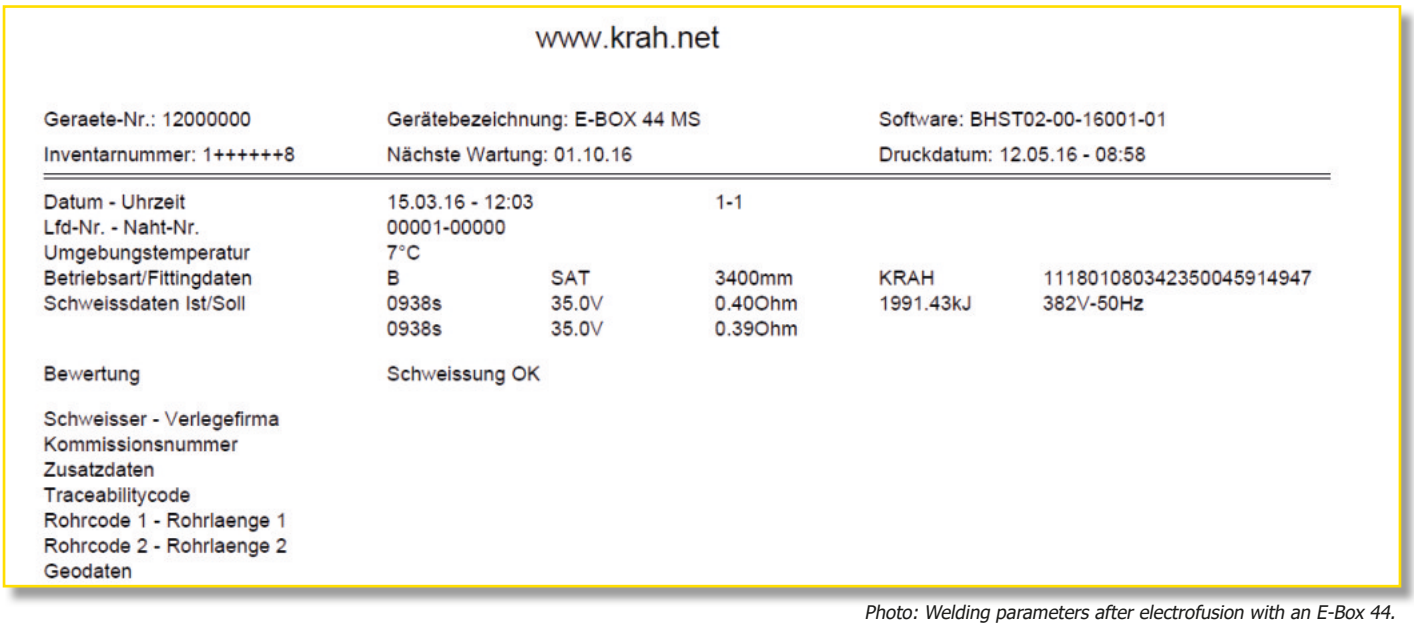


Photo: Pneumatic jointing test machine



www.krah.net

Geraete-Nr.: 12000000	Gerätebezeichnung: E-BOX 44 MS			Software: BHST02-00-16001-01	
Inventarnummer: 1++++++8	Nächste Wartung: 01.10.16			Druckdatum: 12.05.16 - 08:58	
Datum - Uhrzeit	15.03.16 - 12:03		1-1		
Lfd-Nr. - Naht-Nr.	00001-00000				
Umgebungstemperatur	7°C				
Betriebsart/Fittingdaten	B	SAT	3400mm	KRAH	11180108034235004591 4947
Schweissdaten Ist/Soll	0938s	35.0V	0.40Ohm	1991.43kJ	382V-50Hz
	0938s	35.0V	0.39Ohm		
Bewertung	Schweissung OK				
Schweisser - Verlegefirma					
Kommissionsnummer					
Zusatzdaten					
Traceabilitycode					
Rohrcode 1 - Rohrlaenge 1					
Rohrcode 2 - Rohrlaenge 2					
Geodaten					

Photo: Welding parameters after electrofusion with an E-Box 44.

Using a pneumatic jointing test machine - this test can only check the tightness and can not replace the total working pressure test.

- Filling the pipeline with water or air (and apply the needed testing pressure), according to EN1610.

What is the largest diameter of a pipe, where integrated electro-fusion has been used?

Until today, the largest pipeline, I saw jointed was DN/ID3500, the total length was 1 km, with many manholes – also jointed by the integrated electro-fusion joint.

What is the time for the fusion?

The electrofusion time is depending on the pipe diameter and the number of wire-strings are used.

Here is a table with the standard value, for selected diameters. These parameters are determined with a PE 100 Material from basell or Borealis. Should a different material may be used, the parameters are to adapt. Depending on the outside temperature, a pre-heating period can be added.

*These parameters are interpolated and must be tested before they are used on the site.

Socket	Voltage	Time in sec. if using one heating spiral	Voltage	Time in sec. if using two or more heating spiral	Number of welding machines you have to use
DN300	15 Volt	780			1
DN400	18 Volt	840			1
DN500	20 Volt	900			1
DN600	24 Volt	1020			1
DN700	25 Volt	1080			1
DN800	33 Volt	1020			1
DN900	36 Volt	840			1
DN1000	40 Volt	1080			1
DN1100	41 Volt	1200			1
DN1200	43 Volt	1260			1
DN1400			28 Volt	1020	2
DN1500			32 Volt	1020	2
DN1600			32 Volt	1080	2
DN1800			39 Volt	900	2
DN2000			39 Volt	1200	2
DN2200			41 Volt	1260	2
DN2300			42 Volt	1300	2
DN2400			43 Volt	1260	2
*DN2500			43 Volt	1320	2
*DN2600			44 Volt	1380	2
*DN3000			40 Volt	1140	3
*DN3500			35 Volt	840	4
*DN3600			36 Volt	840	4
*DN4000			41 Volt	1080	4

Standard values for selected diameters

After the successful fusion time, a cooling downtime of approx. 30-45 minutes, according to outside temperature, should be taken before moving the last jointed pipe or backfilling.

How are pipe tolerances handled in large sizes?

The big advantages of flexible pipe system made of a thermoplastic material like Polyethylene is a disadvantage in tolerances.

- Possible existing ovality, can be pressed round again (Chillang-procedure)
- Possible existing gaps, can be eliminated by expansion of the spigot and compression of the socket (Chillang procedure)
- The pipe spigot can/is machined to match the socket geometry.

How is the stiffness defined for the electro-fusion joint?

- The stiffness of the socket/spigot combination should have minimum the same stiffness than the pipe.
- Clamped beam, and stiffness of the welded socket/spigot end construction and reference to standard

What is the maximum pressure the Krah integrated electro-fusion can take?

Basically, the integrated Krah electro-fusion joint is designed for "low pressure" only. But what does "low pressure" mean? The answer is not that easy but can be calculated. Basically, the answer is depending on the pipe diameter and the water-way wall thickness (needed to resist a certain working- pressure). If you know the solid wall thickness of this, you can divide it by two (because the stress in axial direction is 50% of the stress in radial direction), e.g. the solid waterway wall needed for a specific pipe is 50 mm. The length of the integrated electrofusion joint welded is 60mm * Krah-Safety reduction factor of 0,8 – the useable length is 48 mm.

The usable length 48 mm is large than the needed length of 25 mm (50 mm / 2 mm) -> the electro fusion joint will handle the working pressure. (but the socket and spigot wall-thicknesses should be accordingly). Another positive aspect is that the outside surface of Krah pipes are not smooth, so – the pipe is a kind of anchored in the ground/soil – which will reduce the axial stress in the joint.

Can Polypropylene be welded with the same procedure like Polyethylene?

Basically yes, but the "welding window" is smaller than with Polyethylene, also the thermal expansion of the material is not so high (so less fusion pressure is built up). The viscosity of polypropylene is also lower than polyethylene, which will make a proper fusion more difficult. But clearly, we prefer to use Polyethylene instead of Polypropylene.

Hoping the insides of the integrated electro-fusion joint is clearer, in case you have any additional question – do not hesitate to contact us.

Dr. Alexander Krah / CEO Krah GmbH

[1)] Capt, L. and Kamal, M.R.: The pressure-volume-temperature behaviour Polyethylene melts, 2000; Intern. Polymer processing XV, Hanser Publishers, Munich.

Manhole design for the Krah pipe system

New Software upgrade for Mickey in June 2024

Usually, our customers ask me how to design a manhole and the question of the used standards. The manhole is an underground service access structure, which can access gravity pipelines (the design is not made for landfills, because the load behaviour is different). Here I want to present the American Standard ASTM-F1759 "Standard Practice for Design of High-Density Polyethylene (HDPE) Manholes for Subsurface Applications". The standard will provide the basic procedure related to the design (profile / dimension) of the manhole barrel / vertical riser / shaft. Always a third-party should re-check the design values (especially to add maybe needed safety factors), but for a quick design the results are suitable.

The design result is always a CPR-profile, which means a solid homogenous inner layer (waterway), a profile in the middle and a top cover solid layer. Open profiles should not be used, like PR-profiles. The Inlet/Outlet should be jointed by extrusion welding and the shaft by integrated electro-fusion jointing (to extend over 6m / 20'). The manhole cone (e.g. a concrete ring, with a standard cover) and manhole base / bottom (with protection against groundwater) can have several designs.

The considered loads are:

- The subsurface loading in the manhole (riser, shaft)
- Radial pressure
- Downdrag (axial shear stress)
- Groundwater effects
- Live loads
- Installation and bedding conditions

Other parts of the manholes are not part of this (but the software will continuously be updated). Other parts could be manhole ladders, manhole lifting lugs, anti-floating devices. Now, a new trial upgrade in Mickey will ease the design (or basically finding the lightest profile for an installation condition). The idea is to be able to provide a quick and easy structural calculation, with a weight optimized Krah-profile.

Dr. Alexander Krah / CEO Krah Germany


Designation: F1759 – 97 (Reapproved 2018)

Standard Practice for
Design of High-Density Polyethylene (HDPE) Manholes for Subsurface Applications[1]

Typical Krah manhole and screenshot of the American Standard ASTM-F1759

Soleno expands into the US

$22M Investment in Water Management System

Soleno - whose expertise is already well-recognized in Canada - is proud to announce construction of its new plant in Saratoga, New York. This expansion marks the official establishment of Soleno's emerging presence in the United States. The plant will bring sustainable water management to residents and businesses in the Saratoga community, along with job opportunities and state-of-the-art infrastructure. Construction for the plant has already begun, with the plant expected to open later this year. The $22 million investment in this project will enable Soleno to introduce its latest product line, KUSTOMFLO, leveraging the innovative German Krah Pipes technology acquired by the company in 2022. This initiative will enhance the ability to reach and serve customers across the East Coast of the United States and in Canada. KUSTOMFLO represents a pivotal step forward for the company, facilitating the production of custom-manufactured large-diameter pipes in high-density polyethylene. These pipes are meticulously crafted for water management infrastructures, heralding a new era of possibilities for Soleno. "It is with great pride that we announce the establishment of Soleno in the United States. Through this new expansion, thanks to our unique technology and the expertise of our team, we will be able to pursue our mission by offering the most ecological and sustainable solutions for water management," said Alain Poirier, President of Soleno.

Soleno will now be able to extend its field of expertise to sanitary water, waterworks, hydroelectric and high-pressure applications, sectors that are mainly served with traditional materials. Knowing that a high-density polyethylene

pipe has the lowest ecological footprint compared to other materials, the company now provides its customers and the local community with the most sustainable alternative for water management infrastructure projects.

The plant

With financial support from the Saratoga County Industrial Development Agency and the Saratoga Economic Development Corporation, the Saratoga plant will be built on a 22-acre site and will cover an area of over 45,000 square feet (including office spaces). An extra 25,000 square feet could be appended in a subsequent phase if deemed necessary. 'The Saratoga Economic Development Corporation (SEDC) welcomes Soleno Inc. to Saratoga County. "Our collaboration and partnership with the Saratoga County IDA, NYS Economic Development and Soleno Inc. are essential to the success of this project and demonstrate clearly that our Saratoga County is open for business and SEDC is prepared to help," mentioned Greg Connors, President of SEDC.

Construction of the plant has started with a scheduled inauguration set for 2024. The construction project is led by Munter Enterprise, a well-known general contractor in the region. "Over the past year and half, we've gotten to know Soleno's vision and values, which played a significant role in our desire to pursue them as a tenant at WJ Grande Industrial Park. I am confident that Soleno will prioritize social, community, and environmental involvement in its host community of Saratoga County. It truly makes our Team proud to be a part of this project," commented Mike Munter, Vice-President of Munter Enterprises.

Significant benefits for the region

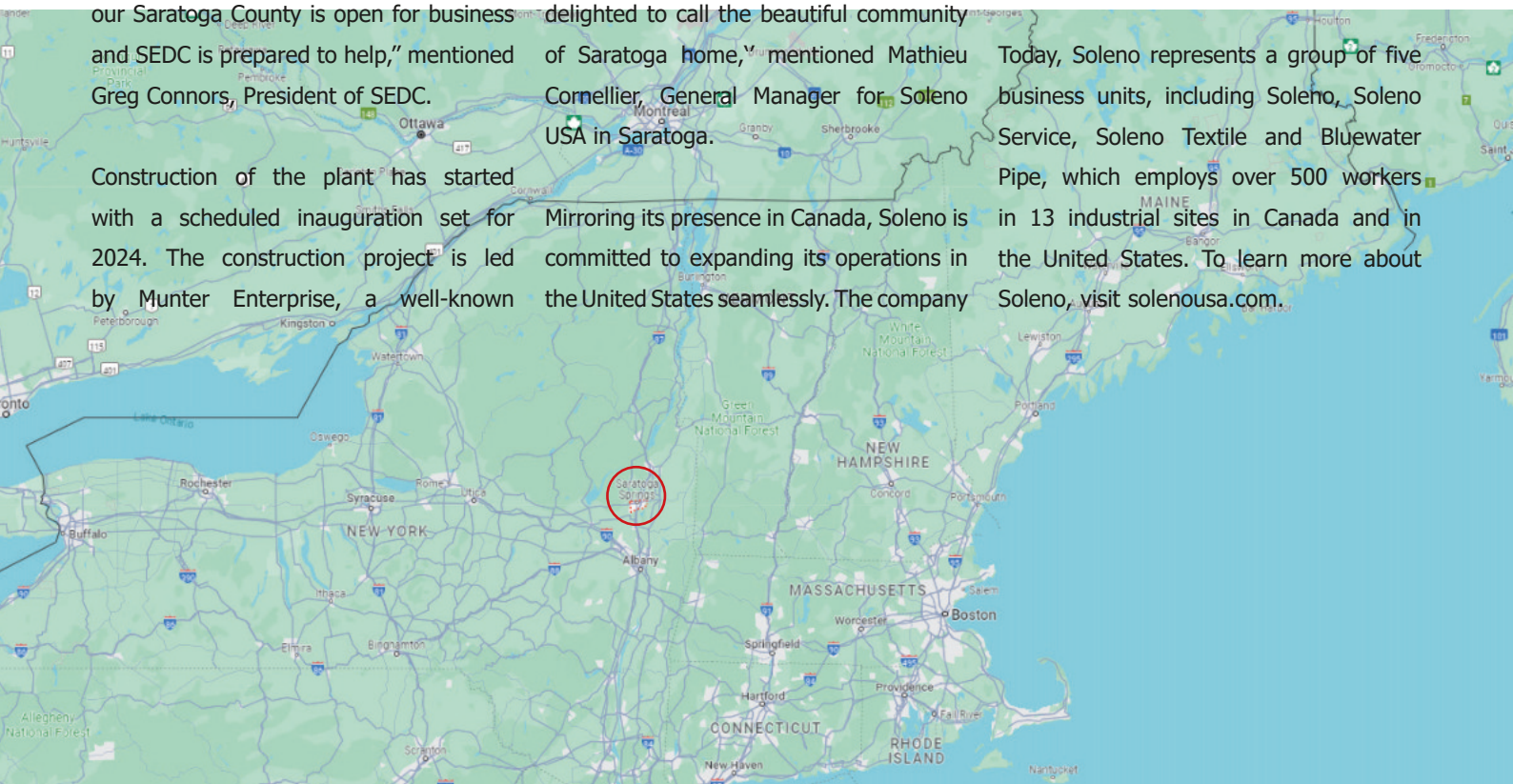
Soleno's entry into the United States and the Saratoga community, along with the export of KUSTOMFLO products, will yield substantial economic advantages. These include the generation of 35 to 50 well-compensated, skilled job opportunities and the infusion of valuable manufacturing expertise into the area. "Our new plant in the United States is a major project for Soleno and represents a turning point in the pursuit of our mission. We're delighted to call the beautiful community of Saratoga home," mentioned Mathieu Cornellier, General Manager for Soleno USA in Saratoga.

Mirroring its presence in Canada, Soleno is committed to expanding its operations in the United States seamlessly. The company is committed to actively engaging with the Saratoga community, attentively listening to its needs, and striving to become a fully integrated corporate citizen. Soleno is dedicated to fostering positive impacts on the local economy and community through our endeavors.

About Soleno

Soleno is a leader in the water management sector and one of the largest conditioners of high density polyethylene (#2 plastic) in Eastern Canada. Over the years, the company has developed a cutting-edge expertise in sustainable solutions. Soleno manufactures and distributes a wide range of products for the collecting, conveying, treating and storing water for the infrastructure, residential, natural resources and agricultural sectors. The majority of Soleno's products are made of recyled high density polyethylene, a light and resistant material that can last for over 100 years.

Today, Soleno represents a group of five business units, including Soleno, Soleno Service, Soleno Textile and Bluewater Pipe, which employs over 500 workers in 13 industrial sites in Canada and in the United States. To learn more about Soleno, visit solenousa.com.



Easy repair of damages on pipes

caused by landslides and debris after earthquakes

On November 17, the south of Mindanao was shaken by a 7.2-magnitude earthquake. There were several deaths and injuries in the Philippine region. The earthquake also caused part of the ceiling of a large shopping center to collapse, damaged many roads and houses and triggered power outages. The province of Sarangani, where the construction of a hydropower plant in Maasim is currently underway, was also affected. Krah pipes from Krah Pipes Manila are used there, which withstood the earthquake but were damaged by subsequent landslides.

The damage ranged from scratches and deformations to dents, which in some cases made it necessary to dismantle and rebuild the pipeline. The pictures of the damaged pipes illustrate the challenges faced by the construction project.

In order to continue the project and move forward with the construction of the waterworks, the pipes had to be repaired as quickly as possible and some of them had to be re-laid. To this end, the damage was initially divided into different categories. In the Lamlangil area, there was damage such as scratches and dents in the pipes, some of which had to be dismantled and new pipes laid. In the Datalnama area, some pipes could be restored, but some areas also had to be dismantled and re-laid because the damage was too extensive, as was the case in the pit area. There were only scratches and dents at inlet siphon 4.

A work plan was drawn up after the division. This initially included the removal of debris. Then the damaged parts of the pipe were to be cut off and reheated in order to be rejoined with new parts of the pipe. Minor scratches and dents on the outer layer of the pipe were repaired using a hand welding extruder. All the repair work was completed within 5 days thanks to the good preparation and the work plan drawn up beforehand.

On November 19, there was an aftershock at around 3 a.m., which caused further damage in certain areas due to another landslide. This damage was also quickly repaired in two days. It is noteworthy that the Krah pipes themselves withstood the earthquakes, which indicates their

Datalnama area - Damaged pipe

Lamlangil area - Damaged pipe

Siphon 4 Inlet - Repair works

exellent resistance to vibrations and pressure. The actual damage to the pipes was caused by the subsequent landslides and debris. Many of the installed pipes were not damaged and are ready for use. Thanks to the hand welding equipment, minor damage could be repaired quickly and easily, either by cutting out the damage and re-welding it tightly with plastic plates, or by repairing smaller holes directly with a weld seam.

It is to be hoped that the region will recover quickly from the effects of the earthquake and that the hydropower plant project can now proceed without further problems. Such events underline the importance of robust and resilient infrastructure, especially in earthquake-prone areas.

Jenny Krämer / Marketing Krah GmbH

AI-generated symbolic picture of a damaged house caused by an earthquake in the Philippines

A guide to choose HDPE pipes

Abrasion Performance and Microplastic Pollution

In industries requiring high abrasion resistance for media transportation, such as mining and beyond, the efficiency of pipeline is paramount. Slurry pipe transport, a method gaining traction, involves suspending finely ground solids in water for pipeline transport. This method offers advantages over traditional dry transport, but abrasion remains a significant concern.

Understanding Abrasion Challenges

Abrasion from solid particles in slurry can cause wear on pipelines, affecting operational efficiency and maintenance costs. Choosing the right pipe material is crucial to combat this issue and ensure the longevity of the transport system. Polyethylene (PE) pipes, particularly PE100, PE112, and advanced PE-VHAR, exhibit exceptional abrasion resistance, minimizing wear from slurry particles. These pipes also offer chemical resistance, ease of installation, and flexibility, contributing to overall system durability. By categorizing operations based on slurry conditions, operators can identify and select the most appropriate PE pipe solution. PE100 suits standard water transport, PE112 handles moderately abrasive slurries, while Advanced PE-VHAR excels in higher extreme abrasion environments.

Case Studies

The VHAR pipe material has been certified and tested to have excellent abrasion resistance properties, better than PE100, through certified lab tests and simulation tests that simulate real slurry conditions, conducted by IDIEM and SCGC internal simulation tests.

The circulated sand slurry pump test is conducted by SCGC internal laboratory. The test results graph shows that VHAR S999PC material has abrasion resistance better than PE100 by 2.3 times. This leads to the opportunity to extend the service life, reducing the frequency of pipe replacement and lowering project costs in terms of installation.

Material Compatibility

PE-VHAR S999PC is also proven according to HDPE pipe welding standard. PE100/ PE112 and PE-VHAR S999PC material are HDPE that can be completely joined to

	PE100	PE112	VHAR	PEX
Material Structure	HDPE	HDPE	HDPE	Crosslinked PE
Slurry conditions	Water, Fine particle or fine-grained ores	Moderate abrasiveness i.e. medium-sized ores	High abrasiveness i.e. heavy minerals	Extreme abrasive
Concentration	Low	Moderate	High	High
Particle size	Fine	Coarse	Coarse and Large	Coarse and Large
Velocity	Slow	Medium	Fast	Fast
Diameter	Upto 1600 mm	Upto 1600 mm	Upto 1600 mm	smaller
Abrasion	*	**	***	****
Pressure	*	**	*	*
Flexibility	Less flexible than PEX, but still flexible	Less flexible than PEX, but still flexible	Less flexible than PEX, but still flexible	Highly Flexible
Installation	Easy Butt welding, electrofusion welding	Easy Butt welding, electrofusion welding	Easy Butt welding, electrofusion welding	Difficult Crimping, compression fittings, expansion fittings
Price	$	$$	$$$	$$$$
Current PE pipe replacement period	Suitable for application that normal PE pipe is replaced >25 years	Suitable for application that current PE100's pipe life is around 5-10 years	Suitable for application that current PE100's pipe life is <5 years	Suitable for highly abrasive and in mountain terrain
ESG issue	Recyclable	Recyclable with thickness reduction	Highest CO2 reduction compared with other PE pipe's type	Difficult to recycle

Material performance

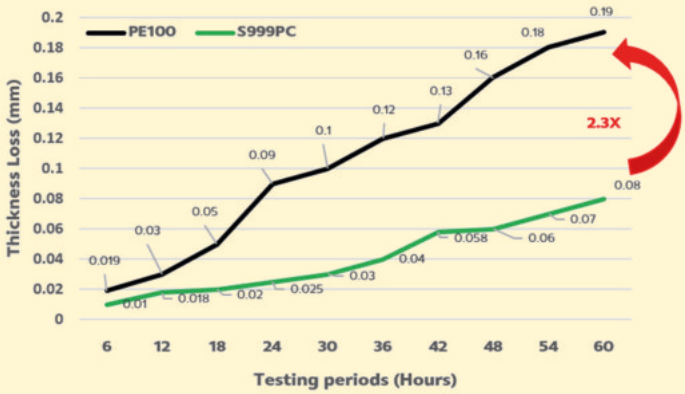
each other by showing in "Ductile" failure mode according to ISO 13953, as per the information shown in picture number 3.

Environmental Impact and Microplastic Reduction

PE pipe recycling initiatives showcase commitment to sustainability. Advanced action of micro plastic particles during the transportation of slurry. This reduction in microplastic pollution underscores the pivotal role that advancements in PE-VHAR pipe technology can play in fostering sustainable practices and minimizing the ecological footprint of slurry transport systems. These innovations address existing challenges while aligning with sustainability goals. Selecting the right PE pipe is crucial for efficient and reliable media transport in various industries.

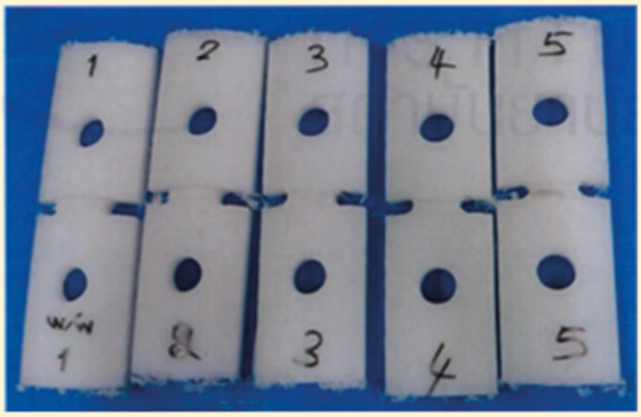
By considering factors like abrasiveness and particle size, operators can choose suitable pipes for their specific needs. Expert advice and tailored solutions can optimize mining infrastructure for longevity and performance. For personalized assistance, contact our experienced team at scgcpipe_compound@scg.com

Panida Wangtiprak / SCG Chemicals Thailand



Abrasion test result

VHAR S999PC-PE100



VHAR S999PC - VHAR S999PC

Sample characteristics

PE-VHAR S999PC pipes not only extend lifespan contributing to minimizing CO2 emissions but also reduce environmental impact. The positive environmental impact is further accentuated by the decrease in wear-related microplastic release into the environment. PE-VHAR S999PC's superior abrasion resistance diminishes the gener-

IFAT2024 - Emphasis on sustainability and a green future

The International Trade Fair for Water, Sewage, Waste, and Raw Materials Management, known as IFAT, took place again Mid-May in Munich, and it has truly become a global hub for innovation and sustainability. This year, the event has attracted over 150,000 visitors from more than 160 countries, highlighting its evolution from a predominantly German exhibition to an internationally renowned trade fair. We were delighted to see so many familiar faces and would like to thank every single customer who visited us during the week - it was a huge pleasure to meet you all and have a great time with you. The aim of a trade fair is usually to generate new customers and sell products. What is most important to us is to offer our existing customers a platform to get to know each other, meet up again and exchange ideas. After all, good cooperation and networking between our customers is very important in order to discuss problems, present new projects and exchange contacts with each other so that everyone can benefit. That's why we are particularly pleased about the great time we had with our customers, who travelled to Munich from all over the world and gave us a wonderful week. In addition to all the fun, there was no shortage of work either, and we were able to hold many good discussions with potential customers who came to our stand to find out more about our machines and products - with our big blue pipe of DN/ID3000mm, we drew significant attention from attendees. One of the most notable trends at IFAT 2024 is the clear emphasis on sustainability and green technologies. Exhibitors are presenting a wide array of solutions aimed at reducing environmental impact, from advanced water purification systems and efficient waste management technologies to renewable energy solutions and sustainable raw material extraction methods. The push towards a greener industry is not just a trend but a necessity, as businesses and governments worldwide recognize the urgent need to address environmental challenges, which we are able to contribute to with our sustainable and long-living products - plastic isn't always bad. Thanks to everyone who visited us at the booth or was there to support us during the fair - it was yet again a great experience!

Jenny Krämer / Marketing Krah GmbH
Lisa Bläcker / Marketing Krah GmbH

Krah pipe DN/ID3000mm on our booth

Remembering Moses Marole

With this article we would like to honour our business partner and, more importantly, good friend: Moses Marole, CEO of Pianoboard Pty. Ltd., who has sadly passed away.

Our collaboration with Moses Ndanduleni Marole for South Africa began in August 2017. He was not just a business partner but an inspiring figure who sought to achieve the best for South Africa and the community with his dedication and passion. As the first black South African with an MBA from Columbia University in the USA, he left an impressive legacy. Moses was not only an expert in his field but also a person who captured hearts with his humor and zest for life. His dedication to Krah Pipes was tireless. Together, we presented the Krah pipe across South Africa to water and wastewater authorities as well as construction companies, presenting it as a solution to the problem of leaking pipes. His commitment extended beyond the borders of South Africa. As a potential investor, he participated in the KCM in Argentina and eventually became a customer at the KCM in Malaysia.

The planned establishment of the facility in Johannesburg marked a milestone for the first Krah Pipe production in Sub-Saharan Africa.

With the passing of Moses Ndanduleni Marole, we not only lose a customer but a mentor, a visionary, and a friend. His legacy will live on in our hearts, and his contributions will be remembered.

KRAH™
krah-pipes.com PIPES

IMPROFIL