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The magazin for large **Plastic Pipe Technology** (up to DN/ID 5000mm)
No.18 / 2018
ISSN 2626-4366 (Online)

IMPROFIL

50 years of Krah
The history of success

Boracay
Krah helps making paradise great again!

Important Update
The new DIN 16961 is published

Rebuilding of Boracay

Krah Pipes are used at Philippine island

Content

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Dear Reader

Now, where here in Westerwald/ Germany fall is slowly coming closer, business is also getting more active again. The summer months, especially July and August, are always very “quiet”. Here in Germany, we have had what you call “a summer of the century” (good that this century has only had 18 years so far – so we can wait for more) with a very long period of hot weather, exceeding the 30° C mark for several weeks, which was hard for humans, animals, and the nature.

Neither we North Europeans are used to such a hot weather, nor our homes and offices were prepared for it – nobody has air conditioning systems in their homes – and the nature is suffering a lot, being used to moderate temperatures with rainfalls during summer as well. Worldwide the climate change is affecting peoples´ life’s and we should all try to alleviate the long-term effects by building sustainable fresh water, drainage and sewage systems that we also help the next generations to live safely on this planet.

Talking about generations, this leads me to two of our topics for this issue: The DIN Standard 16961, existing since 1977, publishes a new edition in German, soon also available in English. Finally, the standard regulates also the possibility of inside pressure, which is highly interesting for Krah pipes and gives the producer and end user the possibility for enormous products developments. 50 years ago, in 1968, my father, Karl-Heinz Krah, has founded the company, that has developed over the years to the today´s existing group. We would like to invite you to a small review over the last 50 years.

Another very interesting article is the one regarding the complete sanitation of the sewage and drainage system on the island of Boracay, in the Philippines. This beautiful island, very well known as a paradise for tourists, is at the moment completely closed for tourism to remove incredible environmental pollution and failing pipe systems. Our customer Krah Manila, is supplying the complete new pipelines and we are always live at site!

Last, but not least, this magazine is now a real publication, with its own ISSN-number (International Standard Serial Number). **For the online version of the magazine the number will be ISSN 2626-4366.**

Have fun in reading this edition!

Alexander Krah

Many bridges over troubled water to be crosse

Once upon

Once upon a time, in the early 1960's, a German engineer in his early twenties became very courageous and went from a small village called "Niederdreisbach" in the mining region of the Westerwald to, formally known as Persia, today Iran, to work for a Swedish company.

While Karl Heinz Krah was getting settled in Iran and was busy with his challenges in a foreign country, far away from home, his wife and his first son also moved to Iran to live there together. After several years of commitment in the Middle Eastern country, family Krah decided to come back to their home village in Westerwald, bringing a lot of engineering experiences and cultural influences with them.

Upon his return in 1968, Karl-Heinz founded his own engineering company with a small workshop, situated in a former old mill in Niederdreisbach – in the house where he was born, as one of five children. With simple engineering and development services for the local metal and machinery industry he started.

With an increasing demand and more production space was needed. Thus, he bought some land directly on a river – called "Daade", in the neighbour village: "Schutzbach", a small town of approximately 500 inhabitants. The first production hall was built in 1970 as a first step to an international operating company.

It was in the early 1970`s, when the company Bihler from Bavaria, Germany, the world's leading system supplier for stamping and forming, welding and assembly technology, was looking for a reliable partner and producer of special tools for their systems. They found the

Hildegard und Karl-Heinz Krah

Panorama of Daaden

Start of building

ed in the last 50 years

right supplier in Karl-Heinz Krah and they entered a long-term cooperation, lasting into the 21 century. With this cooperation, the business was growing and the company was able to invest in, at that time, sophisticating and most modern machines. With this being the only company in this region that could offer those kinds of works and services, it was obviously quite well-known and successful.

In the 1980`s the company "Karl Heinz Krah" focused on the development and manufacturing of machines and big tools. During this decade, they have started to deliver tools for the plastic pipe production in Germany. Bauku, a former German pipe manufacturer approached them as they were looking for a reliable supplier for tools and machines for the plastic pipe production.

The company dedicated itself more to this industry, earning itself a good reputation by high-quality works and innovations in this sector. During those years, the plastic pipes where still a niche product, but Karl-Heinz Krah fell in love with it and concentrated on the spiral wound production system for plastic pipes, which strongly helped this product to gain worldwide recognition and success over the coming years. The first CAD-system was already installed in the 80'. With the growth of his business, he started developing new solutions in machinery and tools for the plastic piping industry. This was the birth of the company Karl-Heinz Krah GmbH, Werkzeug- und Vorrichtungsbau in 1991.

In the last decade of the 20 century, after several years of experience and developments, the next milestone of the company was set by deciding to keep the focus and concentration on the field of pipe production technology.

During those times the business relations between Krah and Bauku came to an end, but even in difficult days, Krah strictly kept the idea of developing a unique pipe production technology.

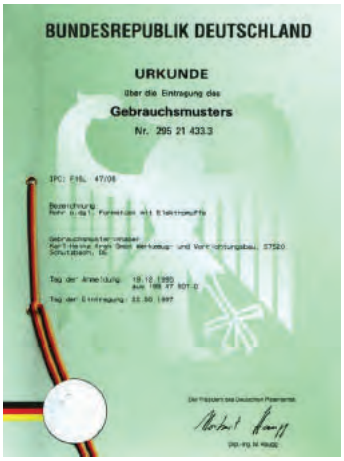
Thus, Krah has developed the double die head technology for the production of the profiled large diameter pipes and increased the variety of pipe designs to cover more market segments and application areas. Furthermore the production process was optimized and the first spirally wound pipe production technology with a defined workflow was born – both single pipes as well as series of pipes could be manufactured on one and the same machine.

The pipe production technology based on this innovative solution was already able

A team of the early Krah employee group

to produce large diameter profiled pipes with only one machine for the diameters of DN 300 up to 3000 mm in polyethylene and polypropylene material.

First, Krah was laughed at and the market didn´t take the new development too serious, but with those developments it became more attractive to pipe end users and finally was a great success for Krah and the first machines with this brand-new innovation were soon sold and installed for example in Iran and China, followed by many other orders worldwide. Krah pipes became quickly famous worldwide and the key player in the world´s pipe market.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Certificate of patent protection

Beside the machine manufacturing, Krah company entered the partnership with the Frank Company, which is a well-established pipe producer in Germany with a great market infrastructure, to have a second mainstay and stay close to the end product. This partnership, the pipe production company Frank & Krah Wickelrohr GmbH, started to produce profiled pipes in the Krah headoffice in Schutzbach and delivered the pipes to all different kinds of pipe projects throughout central Europe.

Together with the company Frank the integrated Electro Fusion socket and spigot were developed and implemented in countless projects. The integrated Electro Fusion socket and spigot became very popular and a lot of international pipe manufacturers were interested to produce Krah profiled pipes.

Furthermore the unique co-extrusion inside layer was invented to guarantee an inspection friendly inner pipe layer, which since those days has been an indispensable condition for modern pipe systems.

The continuous growth and development of the company caused the extension of the product range, which also required more space at the head office in Germany so that another new hall was built.

A new generation

In the Millennium year 2000 a new generation of Krah entered the company. The youngest son, Alexander Krah, who had always been engaged in the company before, finally became, together with his father, the general manager of the Krah company. Alexander Krah has graduated at Siegen University in Business Administration and developed the marketing and product strategy of Krah group to a complete turn key product.

Due to the constant growth of the industry and the lack of space, Frank&Krah decided to move out of Krah premises in the early 2000 and moved to Wölfersheim. Krah remained to be a shareholder for some more years.

In 2008 Krah developed the technology to produce pipes from DN 300 mm up to DN 4000 mm. That year, the annual turnover reached more than 20 Mio EUR. Over the years, the performance of the machine was steadily improved, starting with approximately 200 kg/hr, having, for now, reached 1500kg/hr for a pipe DN/ID1000 always optimizing the pipe weights.

Electro-fusion jointing of big pipes

Furthermore, the Krah profiled pipe manufacturers established the Krah Community together with the Krah Group, to strengthen and develop their knowledge in large diameter pipe production and application. A tight network of pipe producers was built, and annual meetings are being held, each time in another Krah pipe manufacturing location worldwide.

In 2015/2016 the company group was re-organized and re-structured in small units. This was a result of the unfortunate insolvency of Krah GmbH, caused by single effect of a judgement of an arbitration court.

So the Krah company is not a “one-man ship” any more, but a fleet of small but strong and quick boats now. Employees were offered the chance to purchase shares in one of the companies, which was willingly accepted and even created a feeling of shared commitment and belonging.

krah community - innovative pipe solutions

The network of specialists and world-wide well-known pipe experts

The Krah Community is an open network, where pipe producers and industry experts can communicate with each other. In different ways technical know-how, application and machinery experiences can be exchanged. Furthermore, the community provides technical papers, guidelines, manuals and illustrations, related to the Krah technology.

Krah Community Meeting in Tallin - 2014

Time travels ...

19

First production hall and office building - look at these cars ...

"Here develops a fabrication for the company K.H. Krah - Werkzeug - Vorrichtungsbau"

1968

Krah through

1987

First groundbreaking for the new factory facilities in Schutzbach in 1970

First development of the factory - an additional hall and a second floor were built

early machine

2008

998

Extension of warehouse and fabrication hall

2018

n the years...

2018

Building the last hall - our plant construction

During those difficult days we were very happy to have our house bank, the Sparkasse Westerwald Sieg, who supported us and trusted in us and our products.

Registered Trademarks of Krah

Beside the machine making part a new division was founded: “Krah Pipes” as a connecting link between the machine manufacturing and the pipe producers. A lot of new developments Human skilled staff is the success for the group in the future.and patents in the pipe field are made there. Krah Pipes is a registered trademark and is now already used by several Krah pipe producers worldwide.

In the past 50 years, Krah Germany has successfully installed and commissioned around 50 pipe production plants worldwide, on all continents (except Antarctica yet), having created long-term customer relationsips and partnership with well known and local market leading pipe producers like Dainippon Plastics in Japan, Polypipe in the UK, Polyplastic in Russia, Frank in Germany, Firat in Turkey, System Group in Italy, just to name a few.

The company itself has a total area of 33.300 m², whereby the production halls make up 7500 m².

Today, the Krah Group Germany has a total staff of around 60 people, employing all different kinds of skilled people, from toolmakers, metal workers, mecatronic engineers, electricians, engineers, technical drawers, salesmen, secretaries, accountants, purchasers, just to name a few. We place high value on in-house training and eduction of our future skilled workers, as we have made the experience that those former trainees will develop to highly skilled people with a special relation to the company, its products and customers. A lot of our employees are working with us for more than 10, 20 or even 30 years.

As an internationally-active company, we set high value in multicultural understanding and cooperation, as every culture and nationality brings its very individual styles and advantages. Thus we can count with people from different countries all around the world working in Krah, like Turkey, Poland, Russia, India, Iran, Czechs, Italians, Libanese and Kazakhstan, just to name a view, being able to communicate in 15 different languages.

Beside our periodical newsletter, we have also published a book “the handbook on lager plastic pipe”, of which the second version will be published soon.

With an eye to the future, we attach great importance to making the world a little better for our children and grandchildren, by producing a long-lasting, environmental-friendly and sustainable pipe system. Hopefully one day all people on this planet will have unlimited access to the most precious good we have: water. Both fresh drinking water, as well as a reliable sewage system are crucial for a good and healthy life and we hope that we can do at least a very little part to make this happening.

As much as the fresh and sewage pipe systems have developed and improved during the last years, we also find it very remarkable, how communication systems have changed during the last

Team Krah 2017- Headquarter Schutzbach

50 years. First, there was the telegram and the normal letter, than, there was the great – and incredibly expensive invention of the telex, which already brought the world a little closer and give us the possibility to communicate with our customers abroad “live”, even with only few words and at high costs, it made it a lot easier to exchange information quickly. The fax machine was then the next big step before the internet with its emails and then the mobile phones changed everything! Nowadays everything is focused on social media, we are communicating with our customers and partners via email, phone, messenger services, internet platforms like linkedin, youtube, twitter and Instagram. There are so many ways to exchange information now, and everything is moving so fast, that sometimes you have to control yourself in not losing the real life by only concentrating on the virtual life.

Handbook on large plastic pipes - issue 2.0 will be published 2019

We hope that this basic idea will last and we are very much looking forward to for a long time improving the world a little together with YOU!!

...and they lived happyily ever after!

Krah pipes fit best for the sewer and drainage system application in Boracay since the profiled Krah pipes had been used for more than 35 years in many countries around the world.

Boracay will be great again!

How Krah Pipes are helping to rebuild a paradise island

A paradise

History to reminisce of the Famous Tourism Island

Boracay Island about 40 years ago was a very virgin and pristine place. It is located off the northwest tip of Panay Island in the Western Visayas Region in the Philippines. The island is approximately seven (7) kilometer long, in a dog-bone shape with the narrowest spot being less than one (1) kilometer wide and a has a total of 10.32 square kilometers. On the east coast of the island, strong winds make the Bulabog a hub for water sports. Offshore, coral reef and shipwrecks are home to diverse marine life.

In the 1970s, Boracay had been discovered to be a great destination for local tourists and some foreign nationals who had been brought to the island to relax after enjoying the Ati-Atihan festival in Kalibo, one of the municipalities in the Panay Island noted for the Sto. Niño Festivities. Even in 1970s, the place had been one of the locations for filming movies, best choice for budget backpacker tourists and location area for TV Ads filming. In the 1990s, the Boracay beaches were acclaimed as the best in the world and this was the beginning of Boracay's full tourism development under the Management of the Tourism Infrastructure Economic Zone Authority of the Department of Tourism.

The ill effects of the full tourism destination development in Boracay

The influx of several developments like bars, restaurants and hotels in the island paved the way of its worsening condition as it is today. In 1997, the island was invaded with coliform bacteria primarily because of the poor sewage and septic system which led to the installation of potable water supply system, a sewage treatment plant and a solid waste disposal system operated by the Philippine Tourism Authority. Unfortunately, the environmental concerns persisted and worsened due to the noncompliance of several business establishments surging and mushrooming in the Island and along the 50 meter easement zone area. During the Presidency of Gloria Macapagal Arroyo, she declared Boracay a Special Tourism Zone in 2005 and in 2006; she gave Philippine Tourism Authority full administrative control over the island while mandating the agency to coordinate with the provincial government of Aklan.

Alexander Krah - on site

However, the continuous entrance of more and more business establishments discarding local ordinances on the proper drainage, sewer and solid waste management systems made the island more of a chronic sanitation concern. It was no less than the present administration of President Duterte that gave more attention and focus on the sanitation of the island to protect and preserve the place, more so protect the health of the tourists. In February 2018, the President ordered the Department

Public Announcement

of Environment and Natural Resources (DENR) to resolve the issue and order the full closure of the island for about six (6) months to rehabilitate thereby resolve the environmental issues surrounding Boracay for the health benefits of the local folks and the tourists.

In August 2018, many national and international newspapers and magazines had titles like “Boracay rebuilds drainage system with latest technology. The department of Public Works and Highways (DPWH) is using German technology in building the new drainage system of Boracay Island”. And yes, it the latest system for this application and the origin is Germany – but produced in the Philippines by Krah-Pipes Manila, Dasmarinas, Cavite. The DPWH Secretary Mark Villar was very proud presenting the main advantages to the newspapers; like short installation time, long life time, resistant against earth movement, etc. So Krah faced this great challenge to fulfill the high expectations to do a proper drainage, sewer and waste disposal systems is a great very short time with Krah Pipes. This is one major milestone where Krah pipes will be fully tested by the local government to address this worsening condition of the island and preserve as the best beach haven in the world.

Krah pipes fit best for the sewer and drainage system application in Boracay since the profiled Krah pipes had been used for more than 35 years in many countries around world and recently, Krah offers modern sewer pipe system, the best business solution system for Boracay. The pipes can be installed in long length and in very narrow roads, the light weight system can be handled and installed easy all over the islands.

The long-lasting jointing is done by the integrated electro-fusion joint. In the case of Boracay where the closure is limited to six (6) months only as mandated by President Duterte, the works in progress must likewise be quick and fast which Krah pipes can guaranty because, the production of the pipes and installation will not give so much inconvenience to the public and expose the ground

Little streets with big pipes

Production of Krah pipes at the Krah plant in the Philippines

excavation works longer, no curing time is required before back filling the excavated area. Krah´s delivery scope are pipes larger than DN/ID800 mm. These pipes can be pre-fabricated up to 18 meters before installing.

Where are the pipes produced?

In the year 2016 a complete new plant for Krah-Pipes where setup in Dasmarinas / Cavite, Philippines. It is one of the newest and most modern plants worldwide. Visitors a positive surprised how clean and environmental friendly pipes can be produced and how important the quality of the products is. Krah-Pipes manila Inc. got approved from many authorities and the BRS. All pipes are produced out of 100% virgin material called polyethylene high density PE100 (black), and the material is checked continuously.

Today, the plant can produce 2.500 tons of Material per year in pipes from the diameter DN/ID500 up to DN/ID2500 mm, in the 2nd Quarter of 2019 the production capacity in Cavite will be doubled. And the maximum pipe diameter will reach DN/ID4000mm. Starting in 2019, the pipes will all have a yellow – inspection friendly co-extruded inside surface.

Beside the pipe production itself, the company has an extensive fabrication area, where all kind of fittings and manholes are produced. Also, large storage tanks for chemicals, water, etc. can be produced – but the main application is still drainage and sewage system.

The barge for Krah pipes

Boracay is an island – how do the pipes reach the island?

Dasmarinas, Cavite is in the mainland with no direct sea port, so all pipes where send by truck to Papangas and loaded to a barge – the complete barge is pulled to the island of Boracay.

Then after the pipes reached the island, the pipes are transported by little, “not heavy”, trucks to the construction site. Here the big advantage of light weight pipes and a high toughness of them is priceless for this place. Not even 1% of the pipes are damaged before installation. No other pipe material can beat the fantastic resistance of Krah Polyethylene Pipes. The pipes can be unloaded and transported by light weight equipment directly on the shore site. After the pipes reached the site, the installation starts immediately – to keep the very narrow time frame.

The customer is controlling, continuously. The end client, the Department of Public Works and Highways (DPWH) is controlling continuously the construction site, but also the pipe production itself – in Dasmarinas – to be sure that the project is done properly.

Unloading of the barge

Two district engineers are checking the quality control (stiffness test) at the plant and the production itself. During the very extensive check of the QC-system, the engineers were impressed of the very strong pipe. They saw even an untypical deformation test of 40% ! The pipes will not be installed under these conditions on Boracay, but it showed how strong they are and that they are made also for the “big one” – in Europe the pipes passed several test for ground movements and earth quakes.

During the company tour, they saw a very clean and “quite” production, with low waste and no emission – so it is a very green technology. We saw the advantage of a long life-time product for infrastructure, compared to plastic waste.

Manholes

Today in Boracay, still the manholes are produced out of concrete – but Krah Pipes has already presented a solution in PE, what is worldwide successfully used since decades. But we are still convincing the engineers to consider this solution. Already several manholes are installed in the Philippines, with good results (especially the installation speed).

The installation time of a concrete manhole is approx. 2 days, so our solution is a very good alternative with a jointing time of 30 min.

Conclusion

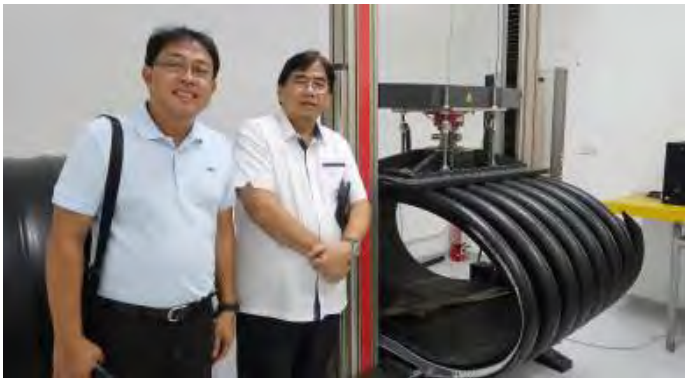
For time critical projects – like the one in Boracay – all components should be done out of Krah-Pipes. Krah Pipes are available from DN/ID400 mm up to DN/ID5000 mm, including all fittings, manholes and a superb and worldwide proved jointing method. We are proud, to be a part of the rebuilt of Boracay, to give back our social responsibility to the nature and to create a sustainable paradise island and income for the Philippines.

Remember: Not every large diameter polyethylene Pipe is a Krah-Pipe! If you want good quality, take Krah-Pipes for your projects and you will have no headaches!

The tourist can come back – happy and safe

Transporting large Krah-Pipes with light equipment

Eng. of DPWH - checking the Krah pipes production



Eng. of DPWH - during checking of the QC

Krah Pipe with a concrete manhole

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Krah Marine Pipes

Is there still a reason why some clients and engineers are still sceptic about tangential extruded pipes in the marine environment?

Today it is still a reality that, despite the continuous developments in the technology of tangential extrusion on mandrels, some clients, engineers and contractors tend to prefer axially (conventional) extruded, solid wall PE pipes for the marine projects. They are probably not aware, that Krah can present many global successful projects where Krah Marine Pipes (KMP) have been used. We carried out marine projects for desalination plants, power plants, sewage treatment plants and other intake/outlet pipelines. Here we used Krah Marine Pipes with a structured wall and with a solid (pressure) wall.

Outfall pipeline DN/ID 3400 mm

Obviously, nothing speaks against solid wall conventional axially extruded pipes, which have been familiar for many years – as they were the state of art for many years. “Familiarity” means that, in general, no big effort is needed for the design and installation of this well-known “stuff”.

But unfortunately still until today, we,“Krah Pipe Producers, worldwide” need to convince engineers that our pipes are suitable for this application. Especially on the cost point of view we are a very attractive solution – not only for the pipe, but for the complete project including ballasting and sinking. So, we must improve our marketing and technical documentation to move from a niche market-player to a main player.

History

Tangentially extruded pipes theoretically and practically should be equally familiar – companies like KWH, Bauku, Henze (including Chinese copies) and others have been producing several types of ribbed/profiled pipes, low pressure, high ring stiffness, destined mostly to land lines, fittings, manholes and storage tanks application, since the 70s.

In the 80s it was tried to use ribbed/profiled pipes for a few outfall projects, but the pipe available at that time proved

to be unsuitable for the use and the prices used to be too high. The main reason was the missing homogenous water way wall thickness and a proper melting of the profiles, a proper high-quality jointing and a cost-effective price (high extrusion output and the extrusion technology itself).

On the matter, there has been a continuous development of the structural design, covered mostly by the DIN Standards, but basically, until the late 90s, we were speaking of single wall pipes with ribs/profiles.

Since the end of the 90s Krah has developed a new kind of pipe, homogenous, a correct water way wall thickness and a proper jointing. Together with a high production output the pipe was, and still is, a very successful solution for all kinds of marine pipes. Many large size projects were realized worldwide by companies like PPA&KRAH, Krah-Pipes, HENZE, FRANK, Krah Estonia, Krah America Latina, Krah Chile, Krah Egypt, Polyplastic, Polypipe, UGPM Oman just to name a few. The largest diameter since today is in Argentina with an internal diameter of DN/ID 3600 mm – all jointed by electro fusion and deployed into the water. Until this time usually axial extruded PE-pipes where used up to DN/OD1600 and always with SDR17 – due to limits in the production and engineering.

Today

Today conventional axial produced pipes are used up to DN/OD3000 and due to new engineering skills a SDR of 33 can

left: A closed profile for Krah Marine Pipes (double chamber wall, super high stiffness)
right: KMP - wall structure

be used. For us Krah pipe producers, the relevant standard – DIN 16961, last update 2018, is still the base for the standard technical approach. Many other intl. standards used the “old” DIN for a National Standard like ASTM F894, IRAM 13414, JIS K 6780. The normal double wall pipes, which are covered up to DN/OD 1200 by EN/DIN 13476 or ISO 21138, can´t be used for marine pipe application.

A few engineers started to implement the possibility to use structured wall pipes for marine application, by using the geometrical and mechanical properties of the structured wall (moment of inertia, waterway wall thickness, buckling resistance).

For the installation in the marine environment, the axial load capacity and bending resistance are more important than the ring stiffness only. It is therefore intuitive why the real double wall structure (KMP) sections are more suitable for the marine use.

A double wall structure well calculated can be designed with a requested equivalent SDR (eSDR) and a ring stiffness can exceed the SN values of a solid wall pipes with that typical SDR. It is also possible to produce exactly the ring stiffness or pipe stiffness which is needed. The waterway wall thickness can be produced exactly according to applied working pressure.

Today a Krah Marine Pipe (KMP) is a tailor-made solution to realize marine pipelines very economically.

The developments started to follow two directions: pipe wall construction with single or multi-layer profiles or walls with square or round chambers. Both extruded on mandrels with spirally applied layers (“tangential extrusion” is the technical term in the standards – here Krah production technology).

Many additional aspects and properties of the pipe (KMP) can be found in DIN/PAS 1065:2007-11 “Spirally wound pipes made from polyethylene (PE 100) - tangentially extruded - Dimensions, technical requirements and test”.

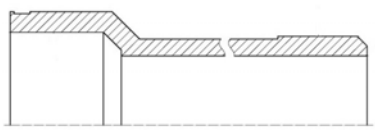
As the Krah Group, we have decided to proceed on a relatively new way, defining a structured wall which can be easily

dimensioned to obtain the characteristics necessary for marine projects.

The KMP – Krah Marine Pipe – is a “real” double wall pipe, meaning that it presents two thick, continuous layers and internal chambers/profiles alternatively circular and rectangular (or combination of both). Today corrugated pipes (produced on a corrugator, not on Krah production technology) are also called double wall, but they are not “real” double wall pipes, they have not the availability to handle internal working pressure, they have no pressure resistant joint and their bending characteristic are not homogenous.

The Krah-Marine Pipes (KMP) are always with a homogenous and smooth inner layer, it is not a pipe welded by prefabricated square profiles and always has a socket and spigot and is not ending in an open profiled spiral.

The pipe is weldable and fittings and manholes with the same wall structure are easily producible.



Every pipe has a solid wall electro-fusion socket, and double wall area and a solid wall spigot

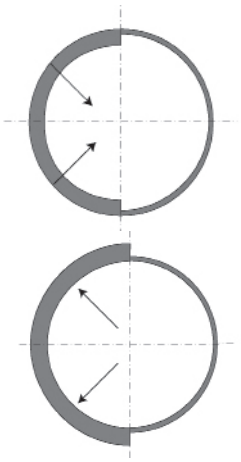
Krah Marine Pipes (KMP) are available from DN/ID800 mm up to DN/ID5000 mm, the standard pipe length is 6 m, but the pipes can be pre-jointed at the production facility, to increase the installation speed. Depending on the client, all pipes can have an inspection friendly inside surface. Krah Pipes in general are available from DN/ID300.

Calculation

Our standard calculations are based mainly on the following approaches, according to existing standards and covered up by references and experiences. A third-party engineering company can and should always check our proposals.

Hydraulic capacity

All Krah Marine Pipes are calibrated on inner diameter – so nominal diameter DN is the internal diameter ID. That means the inner diameter is not changing if wall thickness increases. Very often we are faced with misunderstandings in consideration of the nominal diameter and the meaning for inner and outer diameter. Our nominal diameter is the hydraulic diameter.



Tangential and axial extruded pipes and the effect on the hydraulic diameter.

For example:
A Krah Marine Pipe (KMP) DN/ID 2000 provides an inner diameter of 2000 mm for all stiffness and pressure classes!

A conventional direct extruded pipe DN/OD 2000 provides always a significant lower inner diameter than 2000 mm and is related to SDR class / wall thickness:

DN/OD2000, SDR 21, PE 100
(stiffness approx. SN 12, PN 8)
→ hydraulic diameter of ID 1808 mm

DN/OD2000, SDR 26, PE 100
(stiffness approx. SN 6, PN 6)
→ hydraulic diameter of ID 1846 mm

That means to be competitive in hydraulics to a Krah Pipe DN/ID 2000 a much bigger DN/OD pipe must be considered:

DN/OD2200, SDR 21, PE 100
→ ID 1990 mm
DN/OD2200, SDR 26, PE 100
→ ID 2030 mm

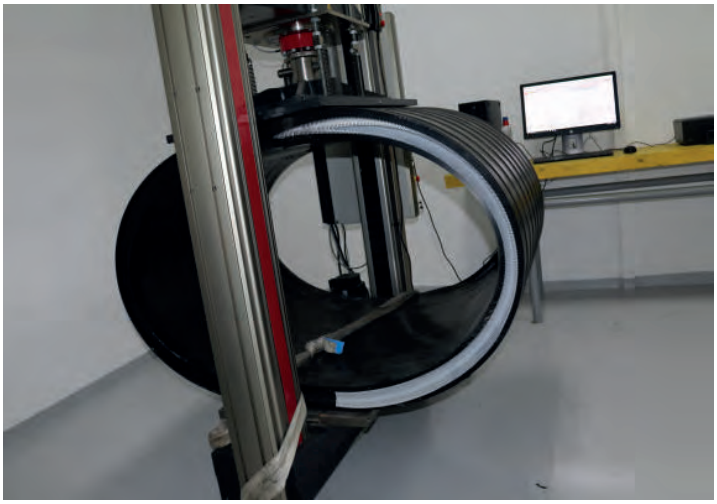
A difference in inner diameter is affecting directly the velocity and flow characteristics. Together with the quality of the inner surface, the diameter defines the pressure loss for volume flow rate.

Working / Operation pressure

Krah Marines Pipe (KMP) are standardized for pressure load capacities according to DIN 16961 and DIN PAS 1065. For decades Krah Pipes have been used for pressure load applications and now finally

SDR (SDR')		11	17	21	26	33	41	51	65	101	161	[-]
SIDR		9	15	19	24	31	39	49	63	99	159	[-]
Material	SF											
PE 80 (MRS 8)	1,25	PN 12,5	PN 8	PN 6,3	PN 5	PN 4	PN 3,2	PN 2,5	PN 2	PN 1,25	PN 0,8	druckloser Betrieb
	1,6	PN 10	PN 6,2	PN 5	PN 4	PN 3,1	PN 2,5	PN 2,0	PN 1,6	PN 1	PN 0,6	
	2,0	PN 8	PN 5	PN 4	PN 3,2	PN 2,5	PN 2,0	PN 1,6	PN 1,25	PN 0,8	PN 0,5	
PE 100 (MRS 10)	1,25	PN 16	PN 10	PN 8	PN 6,3	PN 5	PN 4	PN 3,2	PN 2,5	PN 1,6	PN 1	
	1,6	PN 12,5	PN 7,8	PN 6,2	PN 5	PN 3,9	PN 3,1	PN 2,5	PN 2	PN 1,25	PN 0,8	
	2,0	PN 10	PN 6,2	PN 5	PN 4	PN 3,1	PN 2,5	PN 2,0	PN 1,6	PN 1	PN 0,6	
DN/ID		Mindestinnenwanddicke e_{min}[a] [mm]										
150		16,7	10	7,9	6,3	4,9	3,9	3,1	3,0[b]	3,0[b]	3,0[b]	3,0[b]
200		22,3	13,4	10,6	8,4	6,5	5,2	4,1	3,2	3,0[b]	3,0[b]	3,0[b]
250		27,8	16,7	13,2	10,5	8,1	6,5	5,2	4	3,0[b]	3,0[b]	3,0[b]
300		33,4	20,0	15,8	12,5	9,7	7,7	6,2	4,8	3,1	3,0[b]	3,0[b]
400		44,5	26,7	21,1	16,7	13,0	10,3	8,2	6,4	4,1	3,0[b]	3,0[b]
500		55,6	33,4	26,4	20,9	16,2	12,9	10,3	8,0	5,1	3,2	3,0[b]
600		66,7	40,0	31,6	25,0	19,4	15,4	12,3	9,6	6,1	3,8	3,5
700		77,8	46,7	36,9	29,2	22,6	18,0	14,3	11,2	7,1	4,5	4,0
800		88,9	53,4	42,2	33,4	25,9	20,6	16,4	12,7	8,1	5,1	4,5
900		100,0	60,0	47,4	37,5	29,1	23,1	18,4	14,3	9,1	5,7	
1 000		111,2	66,7	52,7	41,7	32,3	25,7	20,5	15,9	10,2	6,3	
1 100		122,3	73,4	57,9	45,9	35,5	28,3	22,5	17,5	11,2	7,0	
1 200		133,4	80,0	63,2	50,0	38,8	30,8	24,5	19,1	12,2	7,6	
1 300		144,5	86,7	68,5	54,2	42,0	33,4	26,6	20,7	13,2	8,2	8,0
1 400		155,6	93,4	73,7	58,4	45,2	35,9	28,6	22,3	14,2	8,9	
1 500		166,7	100,0	79,0	62,5	48,4	38,5	30,7	23,9	15,3	9,5	
1 600		177,8	106,7	84,3	66,7	51,7	41,1	32,7	25,4	16,3	10,1	
1 700		188,9	113,4	89,5	70,9	54,9	43,6	34,7	27,0	17,3	10,7	
1 800		200,0	120,0	94,8	75,0	58,1	46,2	36,8	28,6	18,2	11,4	
1 900		211,2	126,7	100,0	79,2	61,3	48,8	38,8	30,2	19,2	12,0	
2 000		222,3	133,4	105,3	83,4	64,6	51,3	40,9	31,8	20,3	12,6	
2 200		244,5	146,7	115,8	91,7	71,0	56,5	44,9	35,0	22,3	13,9	
2 300		255,6	153,4	121,1	95,9	74,2	59,0	47,0	36,6	23,3	14,5	
2 400		266,7	160,0	126,4	100,0	77,5	61,6	49,0	38,1	24,3	15,1	7,0
2 500		277,8	166,7	131,6	104,2	80,7	64,2	51,1	39,7	25,3	15,8	
2 600		288,9	173,4	136,9	108,4	83,9	66,7	53,1	41,3	26,3	16,4	
2 700		300,0	180,0	142,2	112,5	87,1	69,3	55,2	42,9	27,3	17,0	
2 800		311,2	186,7	147,4	116,7	90,4	71,8	57,2	44,5	28,3	17,7	
3 000		333,4	200,0	157,9	125,0	96,8	77,0	61,3	47,7	30,4	18,9	
3 400		377,8	226,7	179,0	141,7	109,7	87,2	69,4	54,0	34,4	21,4	
3 500		388,9	233,4	184,3	145,9	113,0	89,8	71,5	55,6	35,4	22,1	10,0
3 600		400,0	240,0	189,5	150,0	116,2	92,4	73,5	57,2	36,4	22,7	
4 000		444,5	266,7	210,6	166,7	129,1	102,6	81,7	63,5	40,5	25,2	

Extract DIN16961:2018, Attachment D



Testing of the pipe stiffness and flexibility test (30% deformation)

got respected and described also in the standard. Instead of mentioning only a "design pressure" we highly recommend differing between operating pressure and real stiffness. The real stiffness must be the result of technical calculations and not only a "choosing" of stiffness class according to ISO9969. It makes no sense to large-scale old realized projects with small pipe diameter. The difference in prices are huge and technically a large-scaling has no positive effect. Reduce the project costs by calculating and not by copy-paste! The inner (waterway) wall of Krah Marine Pipes is designed according to the real operating and pressure conditions. For intake lines we face no inner pressure, for outfall lines the Maximum Operating Pressure (MOP) is decisive! We can design the Krah Marine Pipes for any inner pressure, there is no limitation. But with increasing pressure resistance, the wall thickness of inner wall is increasing, and this makes it less efficient.

Remember:

he increasing of the wall thickness of KMP is not affecting the hydraulic diameter of the pipe!

It is commercially and technically recommended to design the inner wall regarding the real working conditions. Don't ask for a high "design pressure" when you have special needs for the sinking process or backfilling of the pipe.

Pipe stiffness

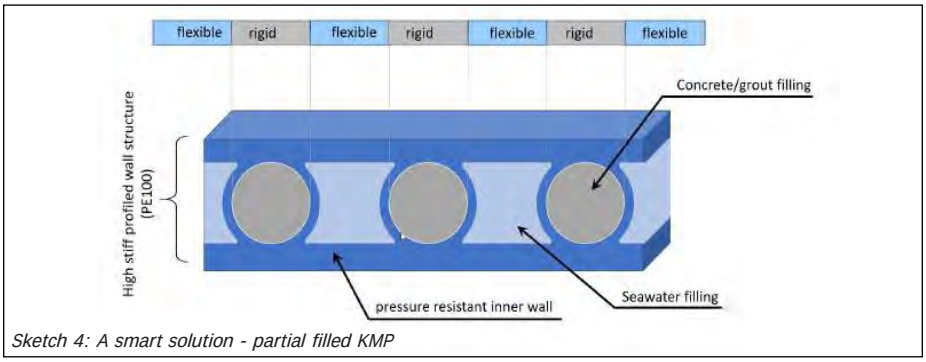
In the past we realized many projects where complete pipe-system have been installed underground, with very difficult ground situation and very complicated backfilling. We can, and we do consider the backfilling and installation of the pipeline after the sinking process. We provide full structural calculation of the pipes, according to international standards.

Buoyancy

To avoid buoyancy, it is typical to use concrete ballast blocks for Polyethylene Pipes. Of course, this is also available and standard for Krah Marine Pipes. Normally the concrete blocks are positioned every 6 meters. An advantage to direct extruded pipes is the slightly profiled outer wall, especially at the joint. That reduces the risk of slipping to zero percent, even at big changes in temperature and because of that a shrinking of pipe diameter. Cheap blocks without any screws can be used, the

A very cost-effective solution, for the blocks

Concrete blocks, mounted in the pipes



Sketch 4: A smart solution - partial filled KMP

blocks are linked to the pipe-structure by using concrete.

Another smart and patented solution is the partial filling of profiles with concrete/grout (sketch 4). The Krah Marine Pipe structure gets filled with concrete/grout in the second spiral. That means that the pipe is still semi-flexible and can be bent easily, whilst at the same time the pipe is heavy, to reduce or to eliminate concrete blocks. The second “load” spiral can be filled partly. The filling can be done at the factory or short-time before installation.

The bending radius is depending on the wall structure and filling, but reaches values of 2 times of the unfilled Krah Marine Pipe profile. In case that all chambers are filled (a one spiral solution) the pipe has to be handled as a fix and rigid beam. Because of the partially filling with defined distance the Krah Pipe stays still semi-flexible and provides all the benefits for typical S-curve installation.

Bending

Krah Marine Pipes are designed for a bending radius of 50 x pipe diameter. In design we consider strain of outer fibre as well as buckling resistance. Because of the very stiff pipe wall structure, Krah Marine Pipes provide the highest safety against buckling. Many finite element analyses where carried out – including the bending behaviour on the joints.

Krah Marine Pipes are produced out of high quality PE 100 with best characteristics in strength and stability, so these proven values are used in all our calculations.

Our nice combination of flexibility and stiffness will give to the Krah Marine Pipe line a perfect behaviour to seismic ground movements – often happens after installation. Several tests are done, details and independent test reports can be requested at Krah-Pipes in Germany.

Allowable pulling forces

At Krah Pipes the axial wall thickness gets jointed homogenously by an electrofusion process. The joint is designed for the same load as the pipe wall itself. There is no weak point in the complete pipe string and no separate reduction factor must be considered. For the pulling force only, the minimum axial connected wall thicknesses are considered, even because a “spiral” in our case a double spiral can handle pulling forces too – so we consider this aspect as a special safety to our marine solution.

A bent Krah pipe

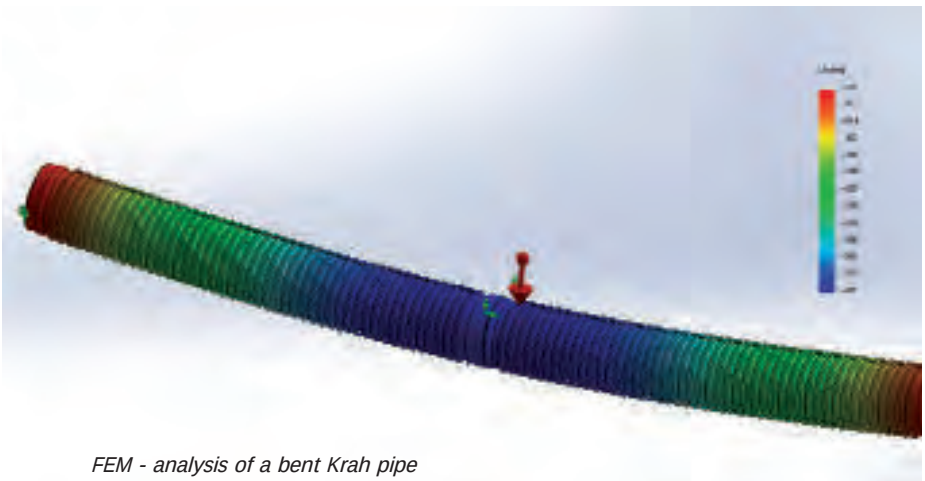
Jointing

The real Krah Marine Pipe double wall structure gets homogeneously jointed by integrated Krah electro-fusion process. The Krah Marine Pipe electro-fusion joint guarantees a strong connection between the pipes. Because inner and outer wall are joined by electrofusion a perfect load transition is assured for all occurring stresses/loads. Also, the stiffness of the jointing area is higher than the stiffness (requirements) of the pipe itself. Another large benefit of an integrated electro-fusion joint, compared to butt-fusion, is the aspect that KMP has no NO-sagging of pipe – to provide a better, safer and quicker installation.

As you can see on the picture above, the KMP joints need “only” little E-Fusion devices and no expensive butt-fusion machines. For every joint made the machine can print a detailed jointing report, to have a full set of QC-documentary.

It is funny, that Krah-Electro-Fusion fittings were used, to repair conventional PE-pipes – when the using of butt-fusion machines wasn´t possible. So, it seems,

Krah Welding equipment for large pipes.



FEM - analysis of a bent Krah pipe

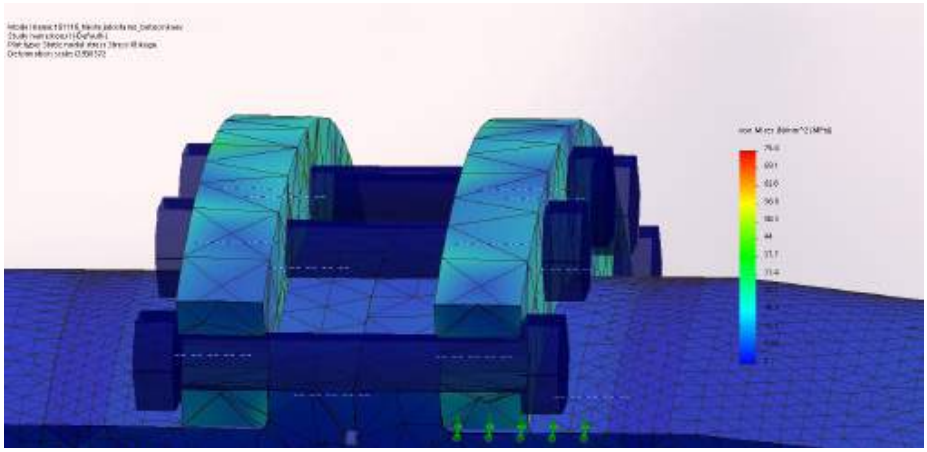
even our competitors are trusting our electro-fusion joint and they are happy.

Fittings and specialities

All kinds of fittings (bends, reduction, branches, diffusors, etc.) and manholes/ intake towers are produced with Krah Marine Pipes with the same technology and same jointing. This was one of the core businesses for these kinds of pipes since the 80s. To fabricate these fittings usually stronger wall constructions are used, to handle the welding factors and other needed properties. A stub-end (for flanges the pipe strings to each other) can be a direct part of the pipe.

It´s kind of funny that many conventional PE-pipe producers are using Fittings, Manholes, Stub-Ends produced by tangential extruded technology – mainly Krah pipes (and they don´t mention this in their specs). So even our competitors are trusting the homogenous wall structure of our fittings, for sensitive elements of the pipe strings.

Integrated stub-end for flange connection



Even the flanges can be designed by FEM

Sinking

During the planning and calculation of the sinking process, other effects in the design can occur, like string lengths, waves, currents, wind, speed of installation, using of floaters, etc. Basically this will affect the upper mentioned calculation conditions and will be considered there.

Production technology

By the way, the same Krah machines can also produce solid wall pipes in a maximum diameter of DN/ID 5000mm; with the same normalization – EN12201 – of axially extruded pipes, beside structured wall KMP pipes.

It is easy to reach a homogenous solid wall thicknesses of 200 mm to 300 mm (with no sagging, no voids and no blisters). The production technology can be extended to all interested Krah pipe producers who will produce Krah Marine Pipes under Krah supervision and license. The latest production line called KR800-max is controlling the homogenous wall structure continuously.

The needed area of a production area is only 20m x 30m x 6m– so it is quite easy to move or to set up a plant close to the project site. This will increase the speed of the installation, lower the transportation costs and the possibility of “forgotten” parts.

Summary

Krah-Marine-Pipes (KMP) are available from DN/ID1000 up to DN/ID4000 mm in length of 6m. The pipes are produced out of polyethylene PE100 and can have a co-extruded yellow inspection friendly inside surface. The jointing of the pipes is done by an integrated special electro-fusion joint. The pipes can be designed according to the project requirements in respect of working pressure, stiffness, bending ratio and pulling force – to guarantee the price and quality optimum for a marine project.

Price- and quality wise Krah Marine Pipes (KMP) are a very attractive alternative to other marine pipe materials, like GRP, steel, concrete and of course to conventional solid wall PE pipes. The market of large diameter pipes for marine application is huge, so the Krah Group will concentrate its network (today approx. 50 Krah-Pipe producers worldwide) to provide a good solution for the clients for their desalination-, power-, treatment-plants or any other marine application in the future. A complete design software for Krah Marine Pipes (KMP) should be available in the year 2019 and we will have a tight and close relation to several international engineering companies, to support the final customer and to build a solid fundament of technical experience and documents. We will join the experience and documents from our network partner and we will be more present in global projects.

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Production line KR800-MAX able to produce KMP up to DN/ID 4000 mm

Intake chamber design

Fittings (bend) for an outfall project)

Floaters used during the deployment by PPA&Krah in a project in Peru

Plastic Buffer Basin in Belgium

It's amazing what can be accomplished when a team of like-minded experts collaborate on a "first-of-its-kind" project. Wavin, alongside KRAH, Aquafin and were commissioned by Besix Infra to produce and construct a huge buffer basin to collect and retain the rain water around the playground in the Villermontstraat — for the municipality of Kontich in Belgium. Made entirely of plastic pipes, the basin has the capacity to collect a massive 840,000 liters of water!

The challenge — rain water retention and collection

The municipality of Kontich (in Belgium) needed a durable and dynamic solution to buffer the rain water around the playground in the Villermontstraat. The city needed a rainwater buffer to collect surplus water from the entire center area — to mitigate the challenge of heavy and long-term precipitation, so that excess rainwater can flow in a controlled manner to the water-sensitive area.

The solution — an example of how to future-proof a city

Two words: plastic pipes. The municipality decided on a design concept to create a gigantic buffer basin, made out of plastic pipes. The water will be collected in plastic pipes with a diameter of 2.4 meters. They are laid out in a construction pit of 55 meters long, 18 meters wide and 5 meters deep. It is the first time in Belgium that a buffer basin with plastic pipes has ever been built! Together, the plastic tubes will have a total length of 200 meters.

The water of the basin will be released to the Edegemsebeek, which is at a distance of 600 meters. To release the water to the Edegemesebeek gradually and controlled, a dam was placed between the buffer basin and the stream, to prevent the Edegemsebeek

from overflowing. According to Public Works manager, Willem Wevers, ““Next to the huge basin there are rain water retention solutions in multiple locations of the city centre — so excess water from the entire area can be collected, preventing water damage in the event of future heavy and prolonged rainfall periods. It’s a perfect example of future proofing the city by enabling controlled water release to the Edegemsebeek that is prone to flooding.”

The team of experts

A project is only good as the sum of its parts. And for this challenging project, the team was impeccable. Rudy Van den Boogaert, the senior project engineer for PlaatserThermopol has worked with Wavin for decades. His group was responsible for pre-installation — providing materials and calculations — whilst Wavin was in charge of the construction and installation. It was a very smooth project with excellent collaboration. The team was proud of the fact that all expected delivery times were perfectly met — thanks to an exemplary collaboration.

KRAH pipes, made from virgin PE100 materials, were the ones used for this project. Wavin has been collaborating with KRAH since 2014 and so we thought they would be the ideal supplier for this project. The requirement was for a 980m3 rainwater attenuation tank (ID2400) and the plastic pipes all needed welded connections.

Most importantly, the contractor for the project, Jeroen De Beleyr of Besix

“In the Netherlands, the system is already being applied in a few places with a positive result. The big advantage of this type of buffering is that the tubes are watertight. This is important to keep the groundwater up to standard. In addition, the pipes are accessible without any problems by maintenance workers and inspection.”

Willem Schrooyen , Account Manager/Wavin Belgium

Infra, was happy with the results. The logistics and technical implementation — together with all parties — were performed to everyone's satisfaction. The construction of the basin is part of the full reconstruction of the Edegemsesteenweg. The work began in October of 2017 and should be concluded by September of 2018.

And, yes, team work makes the dream work. We are happy to have been part of such a project and even more so, since it is the first of its kind in Belgium!

About Wavin: Wavin is part of Mexichem, one of the biggest producers of plastic pipes and connections worldwide and one of the largest chemical and petrochemical companies in Latin America. ww.wavin.com

"We asked Wavin for a full-service solution for this exceptional project -- from delivering the materials to welding the pipes -- all within a tight timeframe. The materials were of outstanding quality and the collaboration with all parties went smoothly. We are pleased with the results."

Jeroen De Beleyr , Assistent Projectleider Wegen & Riolering bij BESIX Infra

“Plastic pipes’ lifetime has already proven to be not less than 100 years, especially with pipes that are produced with only 100% virgin high end PE100 raw materials. Also, if you have electro fusion connections – this ensures that after the installation you have one big homogeneous unit and no risk of getting leakages from the connections (this happens quite often when the rubber seal connections has been used). Also with e-fusion You don’t have the risk of tree roots growing into the pipeline (which happens quite often with concrete pipes).”

Rene Aguraiuja , Commercial Manager/Krah Pipes

Design of electrofusion joints for PE100 pressu

Krah America Latina SA has faced the challenge of developing PE100 pressure pipes up to 10kg/cm2. Considering that the resulting stresses are proportional to the pressure load, we started by carrying out a finite element study on a DN800 NP8 pipe

Method: The socket - spigot joint corresponds to a pipe with nominal diameter DN = 800mm and 43mm thickness, subjected to an internal pressure of 8 Kg/cm2. The material of the union of the socket - spigot and the pipe is Polyethylene PE 100, Modulus of elasticity E = 2500 Kg/cm2 (long term), Poisson coefficient: 0.45.

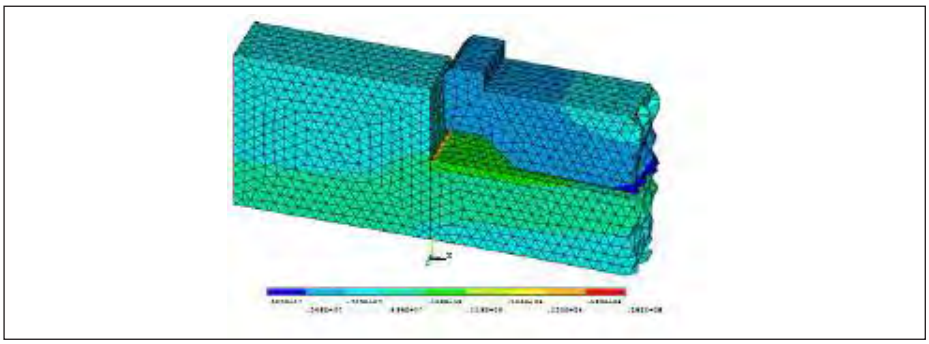
The study was carried out for the union by electrofusion, in three different positions of heating element, being the gap between the heating element and the bottom of the socket: case 1 40 mm, case 2 60 mm and case 3 20 mm. In order to carry out the study of stresses and deformations using finite elements, and given the revolution symmetry of the pipe, a model of π/2 of the pipe was made. A type of solid tetrahedral structural element was used. This element has quadratic displacement behavior and is suitable for models with irregular meshing. Each element is defined by ten nodes having three degrees of freedom for each node: translations in the nodal directions x, y, and z. The element also has capacities for large deformations, plasticity and creep phenomena. The mesh has been made with an element size of 3 mm, resulting in a number of 58,820 elements and 89,327 nodes.

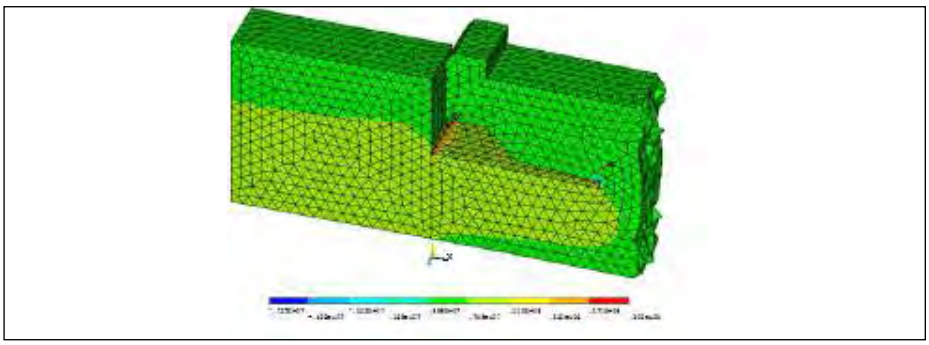
Results: The stresses in annular, radial and longitudinal directions were determined for the three cases, resulting in all the cases the annular direction the most important one. Consequently, their values are reported below.

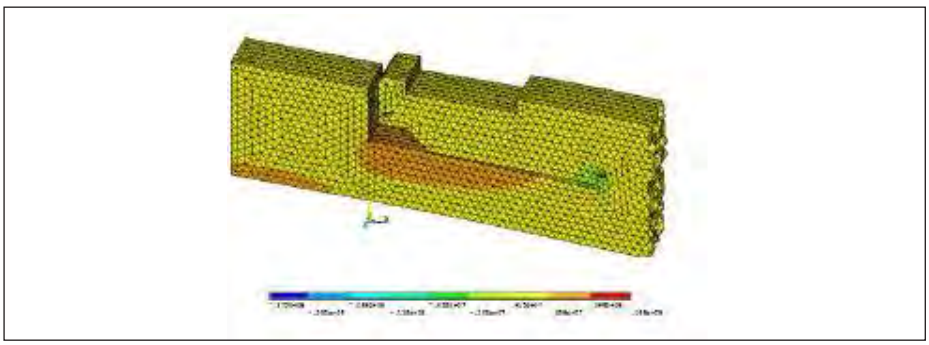
Analysis of results

For the analysis of results, the stress in the ring direction was taken into account.

For this purpose, elements of the spigot have been selected in three positions: in the inner radius, middle radius and outer radius of the spigot, for the three cases analyzed. These are summarized in the table 1.







ure pipes

	INNER Radius min/max STRESS [Kg/cm²]	MIDDLE Radius min/max STRESS [Kg/cm2]	OUTER Radius min/max STRESS [Kg/cm2]
CASE 1	75.8 - 79.7	89 - 93	101 - 104
CASE 2	73.1 - 77.7	88.7 - 93.4	102 - 105
CASE 3	79.6 - 83.3	90.4 - 93.7	102 - 105

Table 1: elements of the spigot, selected in three positions

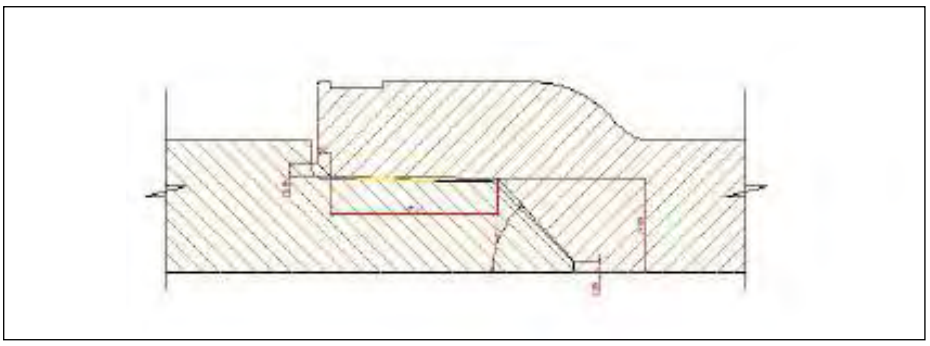
As a conclusion, configuration 2 was chosen for our pipe union design DN800 NP8 and a splicing radius between pipe and spigot was placed according to the following scheme in order to reduce the stress concentration in the spigot/ pipe interface. The exceeding socket length was cut out in order to reduce the couple in the longitudinal plane (see deformation in case 2 diagram).

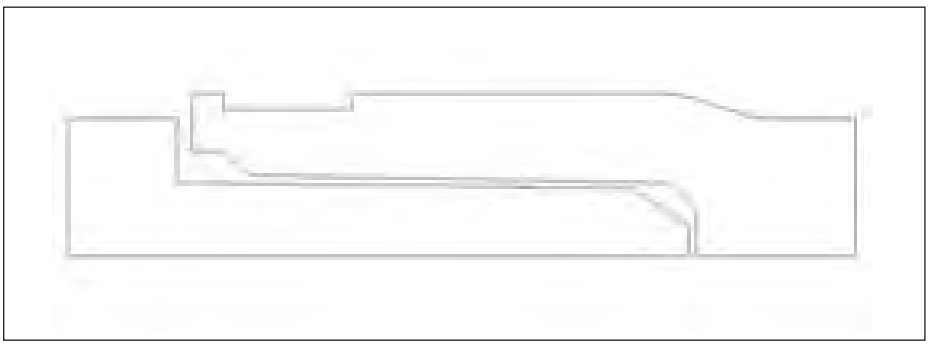
This couple occurs due to the lack of pressure applied to the surface of the spigot exposed to the atmosphere (as a counterpart of the other end of the spigot that has the water pressure applied to both inner and outer surface) and tends bend the spigot in the longitudinal plane and “flange” out the socket resulting in a more complex stress state.

Taking into account the linearity between stresses and loads and considering the geometric similarity of the stresses, we are able to extrapolate the results in order to design pipe joints of other diameters subjected to different internal pressures. This process was carried out for the design of the rest of our socket - spigot joints for pressure pipes up to DN1500 NP10.

We believe that the results obtained are useful in order to better understand the nature of the state of stress present in these sets of complex geometry and which are the possible zones of structural failure.

We consider it is a starting point for further studies that we are carrying out in which it would be interesting to include thermal and dynamic effects. With these concepts in mind, our socket - spigot assemblies for pressure pipes have been redesigned. The resulting geometries are detailed below and operation tests have been carried out with satisfactory results.





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An important update of DIN 16961
is published

The German standard DIN 16961 for thermoplastic pipes with profiled wall structure is looking back to a long and successfully history. The first edition had already been published in September 1977 and it was one of the first standards for plastic pipes. If we would have the chance to look into the old standard, we would find that in few pages only the basics are described. Part 1 "dimensions" had only 3 pages and part 2 "general quality requirements, test methods" had only 4 pages. Nevertheless, it was a very useful and helpful standard during that time.

A time, where still Polyethylene of first generation was used for pipes – not comparable with the modern, bimodal Polyethylene of third generation of nowadays! The company Krah was 1977 just 9 years old and in beginning of an impressive development! In this old standard we can find already defined ring stiffness classes SR24 - measured over 24 hours with the argument to reduce the spread of test results.

Still today many professionals worldwide prefer that test-procedure with constant load and 24 hour testing-time and that is the reason why it is still a major element of current issue of August 2018. Further, in the first issue of 1977, the diameter range was smaller and concentrated on ID pipes only. We find only very rough data for any technical requirements and for pressure application, just a simple comment stating that this matter has to be agreed between producer and user was sufficient. From the beginning this standard DIN 16961 is considered as a general standard, open for all applications. For more detailed application-oriented requirements in the meantime the European Standardization Committees of CEN are responsible. For example, you find the EN 13476 for simple sewage application, published first time officially in the year 2007. The DIN 16961 is since the beginning always reflecting the state of the art and it is considered and accepted worldwide as a basic standard for thermoplastic pipes with profiled wall and solid wall. It was also a blueprint for many other international general standards for profiled pipes worldwide – especially for JIS K 6780 and NBR7373. But also, many application standards like ASTM F 894, EN13476 and ISO 21138 have substantial similarities in many points. The DIN 16961 is the most important general standard for profiled wall pipes with smooth inner surface and finds worldwide acceptance!

So what makes this standard so special and what is the content of the last update August 2018? First of all, the DIN 16961 is configured as a general basic standard, not related to only one application! The standard is separated in 2 parts:

DIN 16961-1
Thermoplastics pipes and fittings with profiled wall and smooth pipe inside – **Part 1: Classification and dimensions**

DIN 16961-2
Thermoplastics pipes and fittings with profiled wall and smooth pipe inside – **Part 2: Technical delivery specifications**

In part 1 the classification according to pipe-stiffness and according to inner

7 pages of DIN 16961: 1977

Front pages of DIN 16961:2018

pressure capability is defined and also all main dimensions incl. tolerances for pipes are mentioned. Considered are inner diameter dimensioned pipes as well as outer diameter dimensioned pipes. The diameter range in the standard starts from DN 100 and ends at DN 4000. Bigger dimensions are explicitly not excluded, because of the continuously growing market and dimensions.

The standard includes explicitly (see paragraph 1 of DIN 16961-1) “helically wound pipes with profiled or solid wall structures”. To provide a better impression for the reader the standard contains many illustrations and examples for wall structures, fittings and joints. Regarding stiffness, two different test procedures are considered in the standard. On one hand we have the original ring stiffness SR_{24}, tested under constant load and for 24 hours to increase the precision and expressiveness. Originally because SR_{24} is the basic of DIN 16961 since beginning 1977.

On the other hand we have the stiffness class (SN) under constant speed, described in ISO 9969. The SN classes are very popular because of the short testing time. The test is done in a few minutes only.The results of both methods for testing SR_{24} and SN are used worldwide, but the results are not the same and not comparable, even if there are for some materials rough conversion factors between the results of both test methods. To avoid any misinterpretation, it must be clearly described which test method is used and requested.

Table 1 — Ring stiffness

Profiled pipe series RR	0	1	2	3	4	5	6	7
Ring stiffness S_{R24} kN/m²	< 2	≥ 2	≥ 4	≥ 8	≥ 16	≥ 31,5	≥ 63	≥ 125

Table 2 — Ring stiffness classes SN

Ring stiffness class SN	2	4	8	16
Ring stiffness S kN/m²	≥ 2	≥ 4	≥ 8	≥ 16

Extract from 16961-2:2018, paragraph 4.2.2 and 4.2.3

Important is, that for both methods intermediate values between two stiffness classes are permissible, if required by the project (paragraph 4.2.1). That is especially important for helically wound pipes, because due to the technology any stiffness can be produced. This provides for the mandated engineers and planers the possibility of tailormade design. For example, for marine application it makes no sense to define fixed stiffness- or pressure classes, much more important is the necessary load capacity!

To complete the standard, finally also pressure application is considered in the current issue. For decades pipe products according to DIN 16961 have been used for pressure but always the requirements were agreed between producer and customer plus third party so far involved. To handle it, often other standards for axial extruded solid wall pipes are used, like DIN 8074/8075, but that was an inacceptable situation, because the product differences and several technical properties are not

$$PN = 20 \times \frac{MRS}{C \times (SDR - 1)} \qquad PN = 20 \times \frac{MRS}{C \times (SIDR + 1)}$$

PN = Nominal pressure
MRS = Minimum required strength
C = design factor acc. ISO 12162
SDR = Standard Dimension Ration = Outer diameter / wall thickness
(SIDR = Inner diameter / wall thickness)

Extract from 16961-2:2018, paragraph 4.3.1

considered sufficiently. Now in paragraph 4.3 of DIN 16961 part 1 is mentioned that the classification of the resistance of pipes and fittings shall be according to their nominal pressure class and can be carried out for Polyethylene or Polypropylene components up to a nominal pressure of PN 16.

The pressure classes are mentioned in DIN 16961 part 2. Other pressures are technically possible, but are deemed as civil engineering works and are to be treated separately. Design rules and testing for nominal pressures greater than PN 16 shall be separately agreed between the manufacturer and user.

The part 2 of DIN 16961 furthermore describes other technical details like mechanical and thermal properties:

- **Ring-stiffness**
- **Creep modulus**
- **Tensile properties**
- **Inner pressure load capacity**
- **Thermal properties of material**
- **Density**
- **Weldability**

Regarding ring-stiffness there is included a link to DIN 16917, where the possibility of segment testing is described. The segment testing is especially for large dimensions an interesting test-method, because the handling is much easier and doesn't waste too much material.

Of course, the acceptance of such alternative testing has to be agreed.

Last but not least, in paragraph 7 the marking of the product is described and by attachment is integrated an example for calculation of ring stiffness SR_{24}. Further for pressure application the curves for hydrostatic strength and tables for pressure load capacity are mentioned.

Conclusion:

The „old" German Standard DIN16961 is still the state of art. The new version is extending the application purposes by implementing a working pressure for large structural wall pipes and is adapting international standards for stiffness and other pipe properties. The DIN16961 is a very interesting standard for everyone who is working with plastic pipes, especially in large dimensions!

Dipl.-Kfm. **Alexander Krah, Krah Pipes GmbH & Co.KG-** Betzdorfer Str. 8, 57520 SchutzbachGermany / T: +49 27 41 97 64 0, www.krah.net

Encouraging young talent

QUICKNEWS

"In which countries do you work?"
"How big is the biggest pipe you can make on the machine?"
"What flows through it?"

The Krah employees willingly answered various questions from a class of young people when they visited the headquarters in Schutzbach.

One entire morning, the technical school class of the vocational high school Kirchen had the opportunity to get to know all the machine production runs. Since a machine was fortunately ready at the time of the visit, the pupils were able to experience a KR800 plant in production. We hope that we will be able to make new specialists want to join our team and our business...

A new profile measuring device

No.: BS/561.0/017/000

This little tool will help the QC of the company to measure quickly and statistically correct the distance of profiles. This tool can be used during the production, thanks to the rollers, and also for a final product control. The gauge will show directly the correct value when three profiles are being measured. So no additional calculation is needed and no „guessing“ of the middle of the profile. The rollers at the measurement tools allow an easy and safe measurement during the production, while the mandrel is rotating and the material is hot, but also after the pipe has been cooled down, it can be carried out.

Introducing ... "HUSSI" - Mr. Hussein Tahmaz

Permanent grin or deep growl - our new colleague **Hussein Tahmaz** - called **"HUSSI"** is perfect in both disciplines :) Soft skills that will certainly be of use to him in his new challenges at Krah company...

The former industrial engineering student has been supporting the Krah sales team since 3rd October. He speaks 4 languages, German and Arabic as his mother tongue as well as English and Spanish fluently.

Many Krah customers will soon get to know Hussein personally, as there will be a lot of travelling to do in the near future. In November he will visit our partner Krah Pipes Estonia to get to know a Krah pipe production plant and the actual production process in detail.

> *"I am looking forward to finally getting involved myself and becoming more familiar with the Krah Pipes. Only in this way can I understand any questions and difficulties that may arise."*
>
> *Hussein Tahmaz*

During the next trip (January 2019) Hussein will support Krah America Latina in Argentina. He will accompany the installation of their new machine KR800 to see how a new machine is installed at the customer's site.

This is followed by a trip to Egypt to our partner Krah Misr. There, our new project manager will work closely with the team leaders and the production team to improve the production process.

Welcome to our team, Hussein!

Mitsch - Marketing Manager KAT GmbH

The long-time employees help Hussein to get to know the products and processes in the company.

Hussein Tahmaz "Hussi"- Project Engineer

Hussein´s Bio

Date of birth:
08.07.1993 (25 years)

Origin of family:
Lebanon

Joined Krah:
Oktober 2018

Favourite meal:
Italian - Tagliatelle con Scampi e Spinaci

Languages:
German, Arabic, Spanish, English

Why did you choose company Krah after your studies?

"Krah is world market leader and internationally active. Since I am very enthusiatistic about travelling, I like the opportunity to combine this with a very challenging job.

The Krah company made it possible for me to make a seamless transition from training to working life and the relaxed and informal interview with Mr. Alexander Krah and Mr. Thomas Bednorz made the people in the company seem likeable to me right away. And the first impression was confirmed. The working atmosphere and my colleagues - with their many different characters - are very cool and friendly. It is fun to get up in the morning and come to work.

I am very much looking forward to the tasks and challenges in Krah family.

What exactly are you doing at Krah Company?

As project manager I take over the project supervision (controlling) and support the sales department. Here I act as a link between sales and technology (industrial engineer). In addition, I prepare feasibility studies and project documentation as well as economic calculations.

Krah anniversary - let´s dance on the bench!

How do you celebrate a 50th anniversary appropriately? What´s better than with a tradition that has proven itself even longer... for exactly 208 years. Instead of an in-house party, we organized a company trip to the Oktoberfest in Munich, an event that is known and loved all over the world and that has now even many international imitators.

For the 7-hour drive from the company to Munich we rented a spacious bus, to be able to store the obligatory luggage: because in order to visit the Oktoberfest traditional clothing must not be missing. Even if the dress code is not an obligation to visit the tents - in fact, no Munich citizen would appear at the Oktoberfest without the traditional outfit.

So what did we have in our luggage? Men wear leather trousers and the ladies dress up with a dirndl. The right footwear is very important for a nice Wiesn experience. The area around the biggest folk festival is otherwise quickly a stumbling block. Also with the extensive dancing on the benches (dancing on the tables is taboo) heels are rather unfavorable. And one thing is for sure: Hardly anyone leaves the tents without having danced at least once on the bench... :)

Celebrations take place in large tents. The traditional beer tents. Fourteen large tents and a whole lot of small and medium-sized tents make it difficult to decide where to drink your “Mass”, the traditional mug of beer, containing 1 liter, or eat your snack. Even if the entrance is generally free and the tents - depending on the available space - are freely accessible, we have taken

precautions. We have reserved 3 large tables in advance in the Schottenhamel tent, the most suitable tent for our 50-year trip, because Schottenhamel is also pure tradition: Here, on the very first day of the yearly event, with the “O’zapfen” (piercing of the first beer barrel) the complete Oktoberfest is opened. Only then may the other tents start pouring beer.

On the trip to the Bavarian capital we have already prepared ourselves with some drinks and the right music. As a rule, hits are played in the tents. In each tent there are live bands playing mainly cover versions. Depending on the tent the choice of songs is different. One is however the same in all larger tents: It is celebrated what the stuff holds! Accordingly also party music is in demand: from traditional people and/ or blowing music over to disco hits, from rock to pop – most important is creating atmosphere and that it is suitable for singing along and dancing.

Our tables were booked for 3.5 hours. How much beer can you manage during this time? Enough to wash-down a traditional “Wiesn-hendle” (fried chicken) We had chosen the last “Wiesn”-weekend and even the last festival day. Thus not only a fantastic company event ended around 23:00 o’clock, but also the complete Oktoberfest 2018.

We are currently considering whether a 51-year company anniversary is also worth celebrating....

Mitsch - Marketing Manager KAT GmbH

- **A survey on the familiarity of German terms abroad, carried out worldwide by the Bates agency on behalf of the German National Tourist Board in February 1999, revealed that 91 percent of those surveyed knew the term “Oktoberfest”.**

- **More than 2.000 Munich-style “Oktoberfeste” are held around the globe. Of these, the largest take place in Blumenau (Brazil) and in Kitchener (Canada) with around one million visitors each, followed by Frankenmuth / Michigan (USA) with around 350.000 visitors. In China there are “beer festivals” of the superlatives: The festivals taking place in Beijing, Dalian and Quingdao in July and August have visitor numbers in the millions.**

- **In 1867 the Schottenhamel tent was still a small beer stand with 50 seats, today the large tent holds around 10,000 guests.**

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