KRAH™
krah-pipes.com PIPES

The magazin for large **Plastic Pipe Technology** (up to DN/ID 5000mm)
2nd 2017

IMPROFIL

Water hammer
Behaviour of Krah Pipes

Quality assurance
Standard procedure for
Krah Pipes quality control

Fake news
Our industry got effected

Philippines

Land developers are using Krah Pipes

Dear my 10.880 readers,

maybe you know it and practice it yourself, the daily dialog with myself-

especially when taking a look at today's news.

We have friends and customers in Mexico who are running Krah Lines. We are deeply concerned about the people in Mexico who are victims of the earthquake and express our heartfelt condolences to all victims and families who lost their loved ones in these destructive earthquakes.

We are also worried about our friends and people in Hokkaido, who are afraid of long distance rockets from North Korea crossing their airspace. We wish all those affected much strength for these difficult times.

I find myself wondering every day if I am doing the right things and taking the right decisions, not only as a human but also as a company. Are my products the right ones at right times on the right markets?

Is my being, my current behavior and lifestyle the right one for this moment? Am I taking the right path in life or shall I do something different? What is the meaning of my life? Do I leave sustainable footprints on earth?

As individual person it is very hard to face and answer this question, but as entrepreneur I can actually say that large pipe systems made out of PE or PP are needed more and more worldwide to protect the environment and create higher health standards for the people.

We develop and produce the vital lines for a continuous and fast growing civilization in our world. We help to find the most economical and technical solutions for various application areas like prevention of floodings, reduction or eliminating of soil contamination, production of food storage silos, power plants or modern waste water systems.

Our heterogeneous Krah team is ready to face the future. Our credo is it to transfer our know-how to the world in order to be able to solve local problems locally.

Again and again, during the years of hard working we have faced and solved problems with all their obstacles and I'm grateful to look forward to a great future for the welfare of all people.

Have fun reading this newsletter!

Alexander Krah

Opening ceremony of new Manila plant

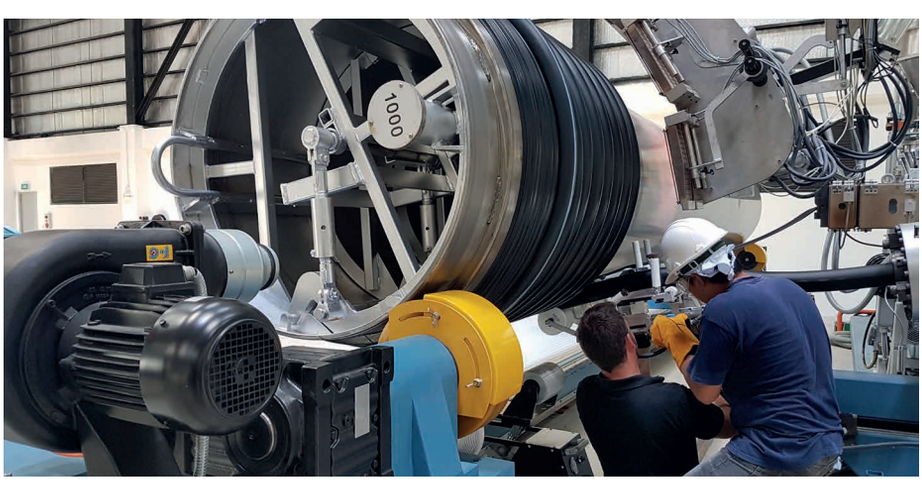
The ceremony was an interesting and joyful procedure for all those attending

Krah Pipes Manila, Inc. (KPMI) has finally rolled up its plant's doors during its inauguration ceremony last 13th May of 2017. KPMI plant is located in an 8000 square meters lot in First Cavite Industrial Estate, Dasmariñas, Cavite, Philippines which is approximately 2 hours drive from Manila.

The event was attended by various local and foreign partners, government officials and target customers with a Filipiniana themed dances and native cuisines.

Mr. Bülent Kuzkaya welcomed the guests with his opening speech which focused in the future of KPMI as it will cater the challenges that the Philippine government has been facing today, particularly in expanding drinking water distribution and containment, wastewater management, sewage treatment, flood mitigation and expansion of irrigation networks to the 7000 plus islands of the country.

Author:
Jeneleen Lansangnan,
Krah Pipes Manila, Inc.



Krah Pipes employees during their first production on the new machine

Krah Pipes Manila, Inc.

First drainage project

Photo 1: Loading of 800mm diameter pipes inside 1000mm diameter pipes, first delivery to Nuvista San Jose project site

Manila, 2017. The Krah pipes producer Krah Pipes Manila, Inc. has started its first drainage project in the Philippines.

Flooding nowadays, especially in the Philippines, has been one of the major problems of the country which threatens the life of individuals, greatly affects the livelihood of families and hinders the government's economic growth. Up to date, a lot of control measures and mitigation techniques are being performed by different local government units but unfortunately, most of the cities and provinces still experience these fateful events. On the other hand, private developers, as major providers of housing improvement and elevating the living experience of the Filipinos, have been eager in finding a solution in preventing flooding calamities to happen especially on residential areas that are about to be developed. With this goal in mind, the first ever drainage system project of Krah Pipes Manila, Inc. (KPMI) which is situated in NuVista San Jose, Del Monte City, Bulacan, Philippines of P.A. Alvarez Properties and Development Corp. undertakes. It is a multi-hectare development that was conceived not only to provide exceptional living units but to be a self-contained community that integrates commercial areas and institutional facilities. In providing high quality and sustainable living for its future inhabitants as their

Photo 2: Loading of 1000mm diameter krah profiled wall pipes in a flat bed truck (8 pcs of 1000mm diameter pipes and 4 pcs of 800mm diameter pipes of 6m length each)

Photo 3: Lifting of 6 meters length, 1000mm krah profiled wall pipe assisted by site workers on site

main objective, P.A. Alvarez decided to innovate from the conventional reinforced concrete (RC) piping system, that has been utilized by the local contractors and developers in the Philippines up to date, to Krah's High Density Polyethylene (HDPE) profiled wall pipes and manholes for drainage application. It is of major advantage on the client's part since Krah pipes are way longer and are lighter than RC pipes and other materials, thus eliminating the need of using heavy equipment and numerous manpower on site resulting to a considerable decrease of the installation duration and generates manpower cost savings. Krah pipes also have a guarantee of 100% tightness, no infiltration and no exfiltration even at joints which is one of the setbacks with RC pipes. Furthermore, as the Philippines has been preparing for the coming of a high magnitude earthquake, the Big One, the use of Krah pipes are very timely since they are flexible and with high impact strength, thus, making the drainage system earthquake proof as how it was evident in Japan.

KPMI plant which is located in First Cavite Industrial Estate, Dasmariñas, Cavite in the southern part of Luzon Island of the Philippines is now fully operational to provide a complete system of large diameter HDPE pipes ranging from 400mm to 4000mm of 6 meters standard length; which includes the accessories, fittings (e.g. bends, reducers, branches), jointing system and manholes that may be designed according to the specific project requirement. Since Krah pipes are produced with the use of winding system, customizing the pipe walls will make the whole piping system cost effective and sustainable for long term use. Moreover, with the help of the project engineers' necessary data like the soil type of embedment, overburden height, ground water level and traffic load if applicable, these data will help to calculate the best fitting wall design for the project. In this light, Krah's advanced technology will aid in innovating our country's infrastructure and development projects through manufacturing quality pipe systems that is tailor-designed with integrated HDPE manholes and flood control system.

The drainage project of P.A. Alvarez consists of various pipe sizes ranging from 400mm to 1200mm main lines. With an assurance of faster and one-time installation, P.A. Alvarez has opened its doors to Krah Pipes' technology of electro-fusion jointing technique. The first jointing

Photo 4: Delivered and staged 800mm diameter Krah profiled wall pipes

Photo 5: On-going alignment of 1000mm profiled pipes and preparation for electro-fusion jointing.

was made on site together with the engineers and site workers on 1000 mm diameter pipes. With a prepared site and an open trench, one jointing was made in less than an hour with a homogeneous and 100% tight connection. The supply of Krah manholes, which are prefabricated in KPMI plant, of around 150 units will significantly shorten the construction duration of the whole land development project as well.

With the use of Krah pipes that have very good hydraulic characteristics, tight connections and smooth interior surfaces, blocked pipes and leakages will be eliminated. Thus, giving a 100% working drainage system that will hold and convey stormwater runoff efficiently and effectively during the rainy season.

Now that Krah Pipes Manila, Inc. is in the Philippines, its product cost is considerably more competitive for not just the private developers but also the contractors and the government to utilize in their land development, residential projects, roads, power plants and other related undertakings in comparison to other existing HDPE pipe local suppliers. For

Photo 6: Pre-fabricated standard manhole of 1200mm opening with 600mm diameter pipe across, together with a socket and spigot ends

P.A. Alvarez, this is just the beginning of their new era of improvement in terms of drainage and flood control systems.

Author:
Jeneleen Lansangnan
Krah Pipes Manila, Inc.

Fake news about Krah technology

Social media has become a big thing today. We're enjoying the many possibilities like communicating the latest news or product information with the world. However, the increasing media activities do have a shady side as well.

Fake news are a considerable thread today. The biggest concerns of the affected companies are the number of people who are going to believe what they read or hear and then, spread the news in minutes over the whole wide world. Is the news-spreading someone a respectful personality in the industry, the news will be true for the next level of readers. We can imagine that a lot of working hours in marketing and sales need to be invested to identify fake news and arrange necessary correction requests to the editors. As a matter of fact, fake news and unauthorized brand use is causing additional costs and damages to the affected companies. Generally behind every well-known brand like Krah is a quality assurance which is manifested in their quality and performance procedures. A high level of quality is the assurance to avoid failures in the project or causing even high costs by occurred incidents during the production. A name and brand was built up during years with a good marketing strategy and a good sustainable product reputation.

So what happens when a company is affected by fake news, where ideas and developments which have been collected since decades are simply stolen? Indeed the false information have reached many recipients and prompt actions are needed to reduce the damage caused by the fake news. Which court can be used? Social media is global and spreading fake news is mostly done by private people. Even our company Krah Group was a victim of such fake news, which circulated right after the Chinaplas 2017 through their organization company. The press release of the organization company Adsale Ltd. published a report of a Chinese company, who announced to be a Krah machinery and Krah Pipe producer. Alexander Krah, the CEO of the Krah Group was sent a lot of e-mails concerning the fake news. The Krah team undertook quick decisions and has published a press release and requested for corrections in the magazines. Many respective magazines get back to us promptly with the advice that they have used the report from Chinaplas 2017/ Adsale Ltd. in good faith. Adsale Ltd. itself was also not immune of copying visitors to the Chinaplas. Even they are warning on their website that bogus companies are posing as Adsale and chasing payment for exhibition space at Chinaplas 2018.

Under the consideration of the seriousness of the issue and to protect the people in the industry, we informed the magazines about Krah, that we're only producing machinery in Germany and only manufacturers with Krah Lines supplied from Germany are able to produce Krah Pipes. The respective magazines made necessary corrections immediately and published a corrected version

of the report with the comment of Alexander Krah regarding the unauthorized use of our brand name in their magazines as well.

To protect people and companies from product piracy, fake news were converted into true news with the serious efforts of the magazines and respectful individual players.

Many companies are suffering from the unauthorized copy mentality of some companies from China and the law is unfortunately not able to provide an effective protection against brand piracy. Not only Krah faced these kinds of problems in Asia, big companies like Borouge made the same experiences. Mr Kum Hoon Lou from the raw material supplier Borouge reported a very serious and explosive case from the Gas industry. Pipe suppliers from China declared that their pipes are made of 100% virgin Borouge PE material. After some painful failures in the pipe system, the gas companies cut pipes and send some small samples to Borouge, where the lab is analyzing and determining if it was virgin Borouge PE material or not. Borouge offered the service for free and the percentage of fake pipes reduced drastically from 73% to almost below 10%.

Now we can imagine the estimated volume of the damage which is occurring for the companies and people, where all their hard work to create a brand by creating and developing technology are just stolen.

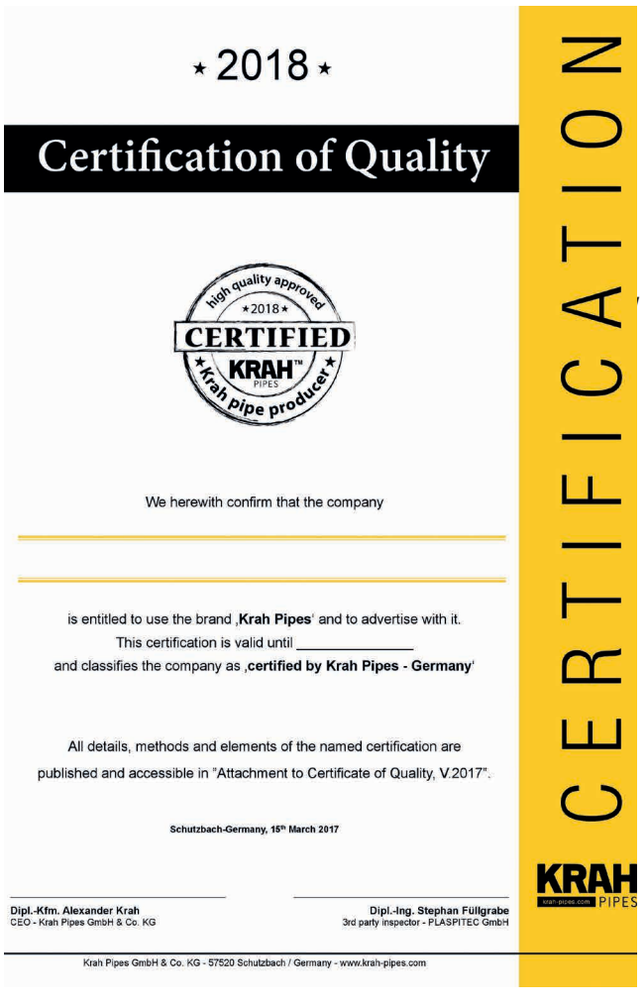
As a lesson we learned, brand piracy and copying is a serious issue and dangerous for people and companies. This behavior is absolutely not acceptable and ethically reprehensible.

So not everywhere where you read Krah it really is Krah! Our Team is now more present in the social media activities and investigates brand name violation through unauthorized third party people. We're very happy that magazines are now more sensitive by publishing press releases regarding unauthorized brand usage. Krah machines are produced only in Germany and Krah Pipes will only produce on original Krah machinery from Germany.

To avoid any confusion if it's a real Krah product or not, please ask us or the supplier for the Krah Quality Certificate, which will confirm that the supplier of Krah Pipes are producing with High German quality standards and performances of Krah. Please feel free to contact us should you detect any of these "news" under **improfil@krah.net**. Please see below an example of the Certification of quality for Krah pipe producers. This is the only way to guarantee that your product is a real **Krah** product.

There is no such thing like an authentication on Facebook, Twitter and so on.

Author:
Bülent Kuzkaya
KAT GmbH



The Krah Pipes Certification of Quality

Pipe materials in comparison
Cost saving factors

Photo 1: Handling of 24 m pipe string with excavators

For comparison of costs first of all it has to be considered, that the pipe costs are only 10-20% of the total project costs. The main part of project costs are caused by civil engineering works, disturbance of overground infrastructure and of course by soil and water management! That means the influence by using a cheap pipe system to the total project costs is very low. In fact, it should be paid more attention to the fact that for the owner the financial depreciation is responsible for around 30% of the annual costs, which means by using higher quality and reaching longer service life time the costs can be reduced significantly!

Pipe costs

The pipe purchase prices depend a lot from the local market situation. Who is producing local, what are the raw-material costs and how high are the transport costs. But usually all pipe systems are in a range of +/- 20%.

Photo 2: Manual unloading of a Krah pipe

Transport and pipe handling

For transport, uploading and moving small equipment and light vehicles at construction site are sufficient for Krah pipes. Excavator instead of big crane, 4x4 jeep with trailer instead of heavy weight truck. Because Krah Pipes can be telescoped during transport, the transport costs can be reduced significantly if different diameters are required. The Krah Pipe surface is not affected by telescoping-procedure – this is a big cost-advantage against all other pipe materials. Concrete, clay etc. cannot be transported in this way. Furthermore Krah Pipes are delivered in standard length of 6 m, but because of low weight the pipes can be installed easily and the contractor is quicker and increases the rate of laying – this saves money. Concrete pipes on the other hand are delivered in maximum length of 2.5 m and because of their high weight the lifting of large dimensions with a standard excavator is not possible.

Photo 3: Compaction according to international rules and standards

Photo 4: Handling of Krah manhole

Photo 5: Placing of a Krah pipe

But for Krah pipes even a manual handling to correct the final position and alignment is possible – see weight comparison table beside.

Diameter DN	SN 8 Krah pipe	Concrete pipe	GRP pipe
500	14	360	35
1000	60	1135	150
1500	140	1960	320
2000	270	3250	600

Weight [kg] comparison of DN/ID 500-2000 mm

Additionally Krah pipes are very resistant against impact loads by incorrect handling at construction site. The flexibility and crack-resistance are very good material properties to avoid serious pipe damages. The heavier and bigger the pipes and fittings are, the less impact loads during installation can be avoided totally.

Photo 6: Broken concrete cone

Jointing

The joint is just as important for the complete system as the pipe itself. But for the installation costs it is not decisive. In fact, the total costs are affected by the choice of jointing procedure!

"If the joint fails, the system fails!"

This is a clear statement for homogenously welded joints, because then the whole pipe string is uniformly constructed and provides in any point the same service life characteristic! No rubber gasket or other materials with reduced service life time is required. Usually for Krah Pipes a life service time of 100 years will be considered! Polyethylene and Polypropylene can be welded by an automatic welding process. Krah Pipes are delivered with spigot and an integrated Electrofusion-Socket. The Electrofusion-wire costs much less than a rubber gasket and the welding can be done parallel to already laying the next pipe. But also prefabricated pipe strings of 12 or 18 m can be shipped to reduce effort at construction site! At the end the contractor loses no time and money, but wins a lot by using the Krah Pipe Electro-Fusion!

A welded joint is 100% water-tight, which means no infiltration or exfiltration!

Infiltration, e.g. at sewers, is a big problem for the sewage treatment plant, because the treatment plant must also treat the infiltrated clean water. Exfiltration for potable water supply lines is also a big problem, because valuable asset gets wasted

Fittings

The flexible character of Krah pipes can avoid fittings for changing the laying direction. Krah Pipes can be bent in a diameter of approx. 50 x pipe radius. So, for small angles mostly no fitting is necessary – this saves money and time! Further complex fittings and manholes can be prefabricated in the factory and shipped to site, that saves a lot of installation time. Especially in

comparison with special concrete fitting, what has to be produced at site!

Photo 7: Krah pipe tailormade fittings

Photo 8: Krah tangential manhole

The possibility of using tangential integrated manholes saves a lot of time during installation and a lot of material costs. In comparison to standard solutions easily up to 50% can be saved!

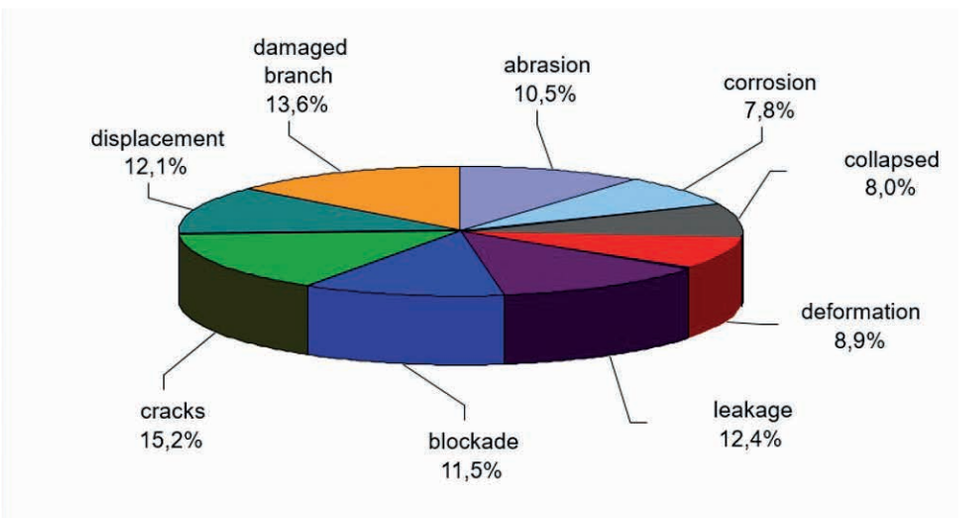
Diameter savings

A smaller diameter can be used, due to the very low roughness and the good hydraulic capacity of Krah Pipes, this means also, that the trench can be smaller.

Operation and Maintenance

For maintenance and operation, the operator spends around 25 % of the annual costs. Most of the mentioned damages [graph 1] can be avoided totally by using Krah pipes.

Photo 9: Prefabricated Krah manhole



Graph 1: Typical analysis of damages at public sewers

Advantages of Krah Pipes:

- No break and cracks, because flexible behaviour
- No corrosion
- No leakage, because welded
- No displacement, because welded
- No damaged branch, because welded
- Less blockade because better hydraulic and smooth surface

Cleaning Intervall

Very interesting for the operator is also that Krah Pipes provide much longer cleaning intervals in comparison to e.g. concrete pipes. Krah Sewer pipes are considered as self-cleaning under normal sewer conditions so far the slope is ≥ 1%. But also impact loads by using the Jet-cleaning-procedure is no problem for Krah Pipes – in opposite to several other pipe materials the inner surface stays unaffected.

Conclusion

The experience demonstrates that by using Krah Pipe System the contractor can save up to 20% of installation time because of easy handling!

Due to the life-service-time of >100 years, the operator can reduce the depreciation cost up to 80%. Also Maintenance costs can be reduced up to 50%.

Author:

Dipl.-Ing. Stephan Füllgrabe

written for Krah Pipes Germany

Photo 10: Jet cleaning process

Photo 11: Krah pipe inner layer

Photo 12: Concrete abrasion

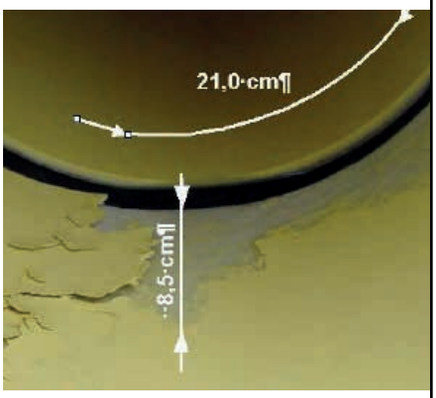


Photo 13: GRP abrasion

The source of these information and pictures is the Jet Cleaning Report of the IKT Germany from 2004

Introducing ....

Jochen Blickheuser

We have decided to restructure our series "ImProfil of.." and will from now on call it "*Introducing*....". **We have chosen our technical colleague Jochen Blickheuser to be the first one in the new layout. In the future we will also present members of our Krah Community.**

Jochen has been in the company since 1986. If anyone has seen almost every department of the company – he has. He started as tool manufacturer, a few years later he moved to the construction department. When there were some restructurings he was Quality Manager for "Frank & Krah" from 1998-2006. After that he became application engineer, and now he has been in the technical sales department for almost three years.

Jochen is our "frequent flyer". He knows the world like the back of his hand. The longest supervision journey was in Argentina in 2013/2014. He stayed there for 9 whole months. Obviously he returned home for a few days in-between to see his wife and at that time 6-year-old daughter. Travelling is his passion and he is always happy to visit our customers or partners to discuss new business or to supervise them with any technical questions. His speciality is our E-Fusion-Technology (for further information please visit **www.krah-pipes.de**).

This year he has also been "on the road" for quite some weeks. Check out our illustration below to track his route . During his travels he is always fascinated by the culture and hospitality of the different countries. This year the focus was laid on Manila and India. In India, our longterm representative Ramesh Parasuraman organized a legendary birthday evening for Jochen – including Cocktails and more. We at Krah always take care to keep a close relationship with our customers and pipe producers who want to become one. Regular visits to factories and plants all over the world are a big constituent in our company. Last but not least we had a few questions for Jochen on the next page, he has lots to tell after 31 years.

Author:
Lisa and Jochen
KAT GmbH

Jochen's flight route May / June 2017

Jochen in front of a huge Krah pipe

Jochen's Bio

Date of birth:
31 May 1964

Family:
Married to Andrea, one daughter Mia

Joined Krah:
in November 1986

Favourite meal:
Argentinian Steak and Indian food

How do you think has the demand for large plastic pipes changed in the past years?

In my personal opinion the pipe material PE is the future. The installation and durability is just so much more favourable than using other material like concrete. The problem is that concrete has been used for a very long time - although not very successfully - but people have a hard time actually believing in another material.

What do you do when you are not working for Krah?

I am married and have one daughter (9 years old), so I have to take care of them. I also like mountain biking and other sports.

You have seen so many places on earth. Which was your favourite?

That is a really good question. Although I would say that Argentina definitely is one of my favourite places. Asia is obviously also a great place to see - let alone the many spices, herbs and sauces you can find in India or Thailand.

You have been with Krah for almost 32 years now - what made you stay that long?

Krah is a very special company. In my opinion, it's more like a big family than colleagues. The work itself has always been incredibly interesting - you always get the latest information from the pipe market that you can use for new projects and inventions.

What are your thoughts on Chinese copies?

Generally, I don't like "wearing borrowed plumes". We invested the money, time, ideas and hard work to develop a complex pipe production plant like the KR800 for example. Obviously the copied machines don't provide the same quality and service as we do. As you know we don't just provide the machine and then you'll never see us again. We offer a full-on service, including marketing support, planning and financing support, special trainings for employees and additional machinery. Also part of the After-Sales-Service is regular maintenance, upgrade kits for older machines and spare part supply.

Quality control
For non pressure applications

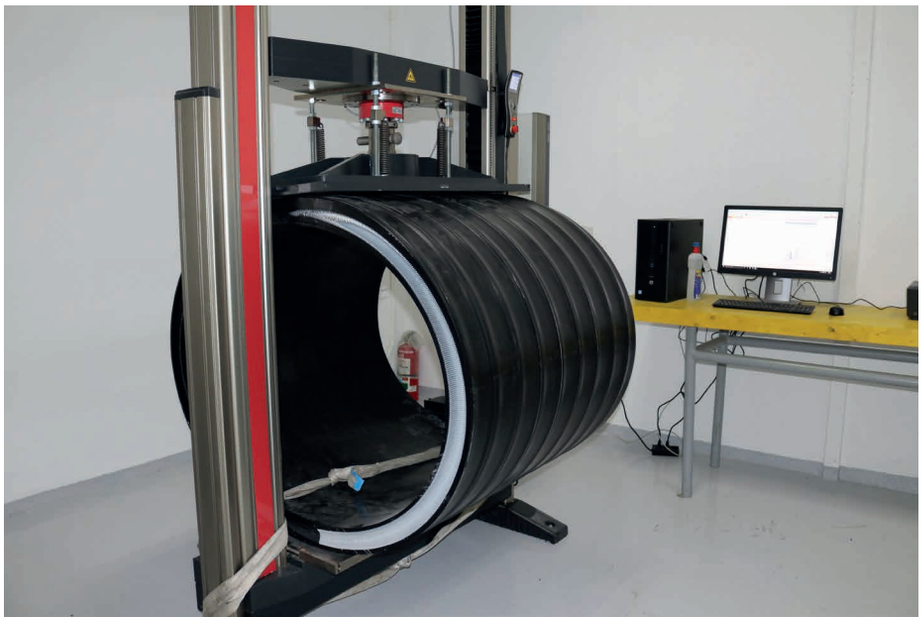


Photo 1: Pipe stiffness testing equipment

To provide a high quality pipe system, all Krah pipes have to pass the following minimum quality control requirements. In case of inside pressure applications, additional tests can be applied.

Additional to the own, in-house quality control a third-party, random inspection is recommended, to ensure a high quality product – the Krah Pipe System. The third-party quality control should take place twice a year. The company´s internal Quality Assurance department should provide a form for the checking. All samples checked shall be considered representative for the whole production. Raw material tests should be carried out before adding the product to the production cycle. Undamaged / non affected samples can be sold afterwards. Those tests made in Krah-Production Plants are exceeding the requirements of the international standards like DIN16961, ASTM F894, etc.

A. Tests with finished products

The following test, are carried out on produced pipes/fittings/manholes – the product is affected due to test-procedure and can´t be used anymore. These tests are made once per months and when there are major changes of the raw material supplier (change of supplier).

1. Stiffness class test according to ISO9969, to determine the pipe at deflection

Three pipe sections with a length equal to 2xDN (but not longer than 1m) should be deformed with a constant speed (constant speed method). The result of the applied force will provide the nominal stiffness of the pipe, called SN.

2. Ring stiffness test, according to DIN 16961, to determine the pipe

Three pipe sections with a length equal t2 x DN (but not longer than 1m) should be loaded with a test force for 24hr (constant load method). The test force is the result of a formula applying the ring-stiffness. The test force is calculated according to DIN16961. If the deformation after 24hr is less than 3% the applied test force (expected ring stiffness) was correct and the pipe fulfils the requirements. This test can be carried out with the equipment shown in photo 1.

The applied creep-module should be minimum according to the given table in the DIN16961, part 2. But according to the raw-material supplier higher values can be used.

3. Deflection test, according to DIN EN ISO13968

The deflection test will deform the pipe by 30%, and the test specimen will be visually checked for failures like:

- Break on the inside wall or the inside layer
- Break on the pipe wall
- Delamination of pipe wall
- Break of the sample
- Direction change of the bending of the sample (bum)

This test is very important to show the flexibility of the pipe. After the deflection the pipe should go back to

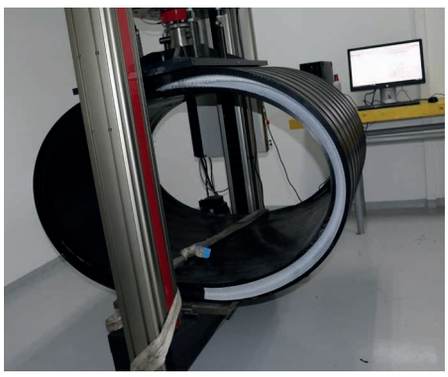


Photo 2: A pipe under deflection of 30°C

the original design for up to 95%. The test is done with the universal testing machine, and is basically carried out according to ISO9969, just with a maximum deformation of 30%.

If the pipe should be conform to ASTM F894, this test is called flattening test and the maximum deflection of the pipe should be 40% instead of 30%. This test shows the safety of a pipe against overload, especially to show the resistance against ground movements – e.g. earthquakes. Only good materials will fulfil this test. The report should contain photos of the test.

4. Tensile strength, according to DIN EN ISO 527 for test specimen in axial or circumferential direction.

This standard lays down the general

Photo 3: Preparing the test specimen from a pipe

principles for determining the tensile properties of plastics under specified conditions. The methods are used to study the tensile deformation behaviour of test specimens and to

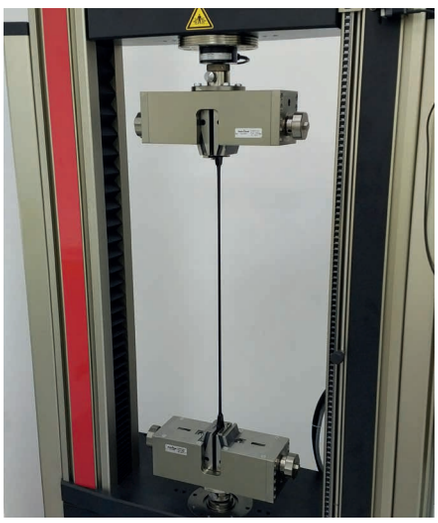


Photo 4: Tensile test of a prepared test specimen

determine tensile strength, tensile modulus and other aspects of tensile/ strain relationship under specified conditions.

The result of this test will give you information over the following points:

- Tensile stress
- Yield stress
- Tensile strength
- Tensile stress at x % elongation
- Tensile modulus
- Elongation of the tensile strength
- Nominal elongation

Photo 5: Test samples

B. The following tests are raw material tests, they have to be carried out and passed before using the raw material for production. These tests have to be carried out with „every" raw-material before the material is used. In case the material is supplied with a silo truck, this test has to be carried out before unloading the truck. If the material does not comply with the requirements it should be sent back. As an additional reference the supplied data-sheet of the raw-material supplier is given, for example to find out the "carbon black content". In case that the pipe producer is using master batch an additional special test should be carried out.

5. Melt-flow rate

The melt-flow-rate (MFR) shall be determined according to DIN EN ISO 1133, using a nominal mass of 5,0 kg at 190°C for Polyethylene high density. PE should have a MFR of 0,2 – 0,5 g/10min.

Photo 6: Krah Pipes laboratory for tests

Photo 7: Device for testing of the melt flow rate (5)

6. Density Test

Performed according to DIN EN ISO 1183-1. Generally, the immersion method (procedure A) is used to determine the density. However, the determination of density with the liquid pycnometer (procedure B) can also be used. The density (crystallinity) determines the flow behaviour, processing properties and quality of the later pipes. Density ρ belongs to the substance constants and is a physical quantity that characterises the substance of which a body consists. Its SI unit is kg/m3. It is determined solely by the material of the body in question and is completely independent of its size and shape. While the specific gravity describes the ratio of the weight force to volume, the mass in density is in proportion to the volume.

Photo 8: Device for density determination

C. Product tests

The following test are product tests, the samples will not be damaged and can be used afterwards if they pass the tests. If a product (pipe/fitting/manhole) will not pass the tests the product should be marked „QC failed" and should be stored separately. These tests have to be done after each pipe produced and a target-performance comparison should be carried out.

7. Moisture Test

To avoid bubbles and blisters in the pipe wall it is important to know the moisture content of the raw material.

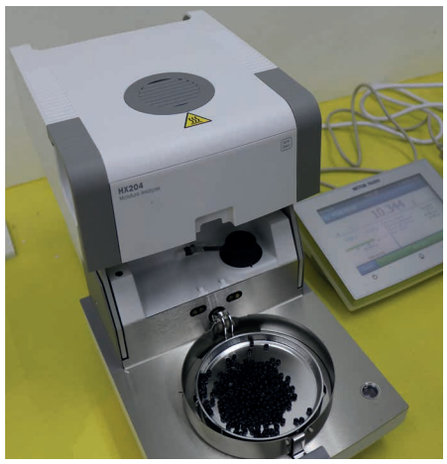


Photo 9: Device for moisture analyzing

The maximum moisture inside the material should be 3%, to have a secure and safe production of pipes.

Photo 10: A staff member measuring out the pipe profile

8. Surface finish - inner and outer surface

All pipes and fittings shall have a smooth or profiled outside surface. The inner surface should always be smooth, due to the necessary hydraulic value. Minor sinks and fluctuations in the pipe wall are permissible, provided that the minimum wall thickness is maintained throughout.

9. Product dimensions

The dimensions of pipes and fittings shall be measured using suitable measuring devices. The measurements should be carried out according to EN ISO 3126. And the measurements have to be done 24hr after the production of the pipe. The results of pipe length, inside diameter, length of socket, length of spigot, height of the profile and the weight of the pipe/ fitting/manhole should be noted down for each pipe.

10. Colour of the pipe

The individual extrusion layers of pipes and fittings shall be throughout uniformly coloured.

11. Checking of the correct marking

According to several standards, different minimum markings should be seen on the pipe.

12. Checking of the QC-Report of the used raw material

Here a final check is carried out, to prove that a proper raw-material check was done, before using this raw material.

Test of jointing: In case a „not-welded" joint system is used, the joint has to be tested against „root penetration". All welded joints (like the Krah integrated electro-fusion") are „resistant against root penetration".

The results of the internal control testing shall be recorded, and, as far as possible, statistically evaluated. Records shall be kept for at least five years, and submitted to the inspection body on request. If the pipe / fitting passed all test a quality certificate according to DIN EN 10204 can be made. Three different classification of quality certificates are available: 2.1, 2.2 and 3.1 (a sample pipe should be produced, to carry out the „damaging" test according to A).

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Krah Pipes GmbH & Co. KG

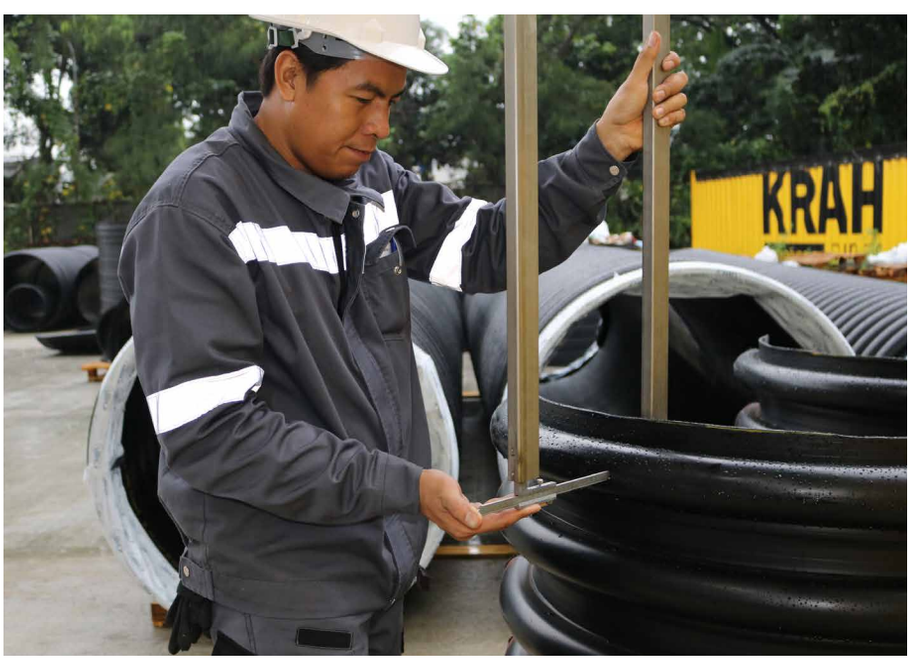

Photo 11: A staff member measuring out the pipe profile

Krah at Plastic Pipes 2017

SPE India's International Conference

CEO Alexander Krah at the last Plastic Pipes

SOCIETY OF PLASTICS ENGINEERS INDIA, (SPE India), are pleased to announce Plastic Pipes 2017 International Conference to be held on 23rd and 24th November, 2017 at Hotel Leela, Mumbai and Krah Pipes will be there (again).

SPE India:

Society of Plastic Engineers India is a global leader in arranging Seminars and Technical Conferences and has always being successfully managing Seminars, Technical Conferences and have always managed to create a platform for Techno-Commercial discussions within the Plastics Industry. Being a recognized body, there is no doubt that participants will go back with a lot of information and knowledge after the event.

Current Scenario:

Worldwide the demand for plastic pipes is projected to grow > 5% per annum through 2019 to about 20 million KM from the current size of about 14 million KM. Construction applications make up the largest share of plastic pipes demand. Although construction spending is reportedly decelerating in China, the world's largest plastic pipe market, plastic pipe demand in the country is still projected to rise by about 9% annually. Due to the ongoing efforts to expand the access to potable water and sanitation systems, the growth in plastic pipe demand is also expected to be robust in many developing countries. Technological advancements and improvements in polymer resins have caused an increase in share of plastic pipes in sectors including telecom, energy and industry. As far as India is concerned, plastic pipes is a well-established product since the first installation of PVC pipes in 1960s. The sector has grown substantially in last 5 decades and has reached the size of ~ 2.5 MMT. Their acceptance is increasing due to the long term performance, ease of installation and the awareness towards the 'life cycle cost' concept. Nationwide infrastructure development, rapidly increasing urbanization, Government's focus on irrigation and the 'make in India' drive are some of the major factors facilitating the growth of plastic pipe industry in the country Alexander Krah will present the newest developments in large plastic pipe systems.

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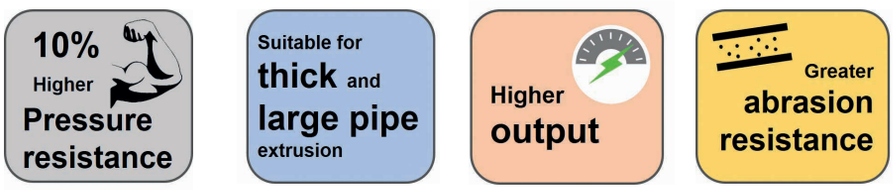
Alexander Krah
Krah Pipes GmbH & Co. KG

EL-Lene H112PC

Superior Strength Polyethylene Black Compound for Pressure Pipes by SCG



Since ancient Roman aqueducts, water management has been continuously developed to become pipeline system and plastic appeared as the rising star material. With benefits of lightweight and flexibility, plastic was first used for pipes in the early 1950s, with continuous development of higher strength all along since then. Starting with PE63, the first generation of HDPE pipe material, followed by PE80 with an improvement of pressure resistance, the plastic pipe industry is now in the era of PE100, the third generation of HDPE pipe that was significantly developed in its key properties. In the present, PE100 is used to convey various types of flowing substances including water, gas (fluids), and slurries.

In 2014, SCG Chemical Co, Ltd. has successfully developed EL-Lene H112PC, an innovation with higher pressure with an MRS of 11.2 MPa. Our own developed polymerization process and special catalyst were selected to produce this advanced material, resulting in PE112 with no knee that perform beyond current conventional PE100.

Benefits of EL-Lene H112PC

1. 10% higher Strength

From regression curve, EL-Lene H112PC shows LPL value of 11.3 MPa at 20°C which is more than 11.2 MPa. Moreover, no knee point was shown on the regression curve in every temperature testing. This material thus has minimum requirement strength, MRS rating 11.2 MPa @ 50 years, and is classified as PE112.

2. Better use for large thick pipe extrusion

EL-Lene H112PC can be produced in a wide range of pipe diameters with same processing parameters as conventional PE100. It is highly recommended for very thick wall and large diameter pipes.

With special design of high molecular structure portion, EL-Lene H112PC can resist sagging behavior better than conventional PE100. It is also easier to run with less die gap compensation setting and result

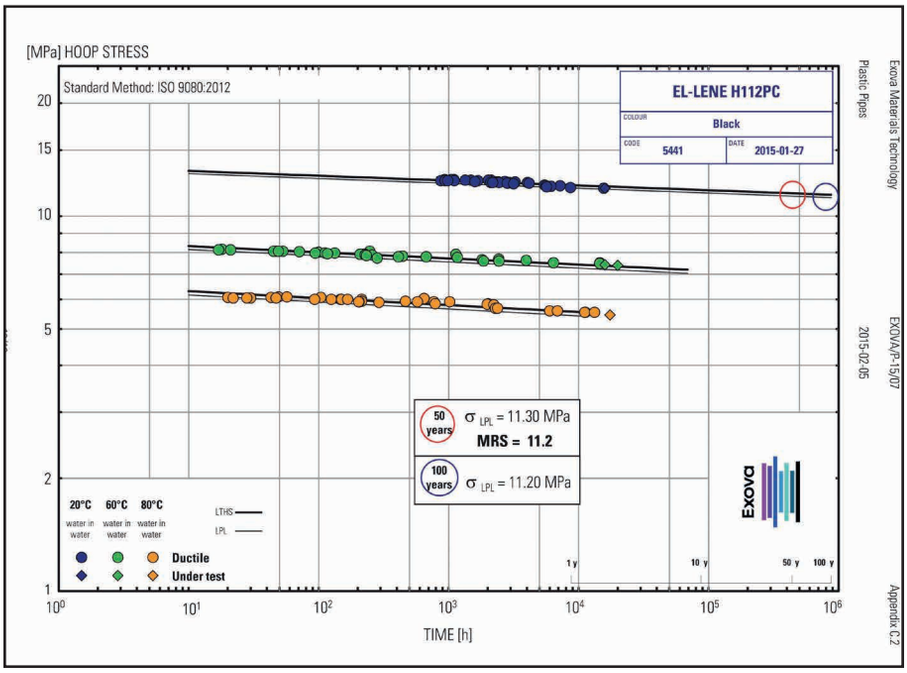


Figure A: Test result of long term hoop stress of EL-Lene H112PC material

equal wall thickness (no sagging).

3. Efficient processing and productivity

EL-Lene H112PC and EL-Lene H1000PC show close viscosity at extrusion shear rate, so they can use same processing parameters (Figure C). In a single screw extruder, melting occurs primarily as a result of viscous dissipation (or shearing) of polymer. EL-Lene H112PC can drive from screw to front of the die more than the case of PE100, resulting in higher output / throughput up to 10% in 315 and 800 mm OD. (Figure D).

4. 60% superior abrasion resistance

In mining, PE pipe have been used for tailing and water management pipeline in both open pit and underground mining, which have different requirements. Tailing pipelines are used to transfer the sediment slurry; abrasion resistance property is the key benefit of PE Pipe. From real field test in mine, EL-Lene H112PC shows 60% better abrasion resistance than convention PE100.

With 10% higher pressure withstanding from PE100, EL-Lene H112PC can provide additional safety factor and prolong shelf life, which can save project cost along the value chain, whether you are project owners, installers, or converters.

Furthermore, 60% improvement of abrasion resistance from conventional PE100 can help mine owners or EPCs to extend maintenance cycle which directly affect to lower maintenance cost.

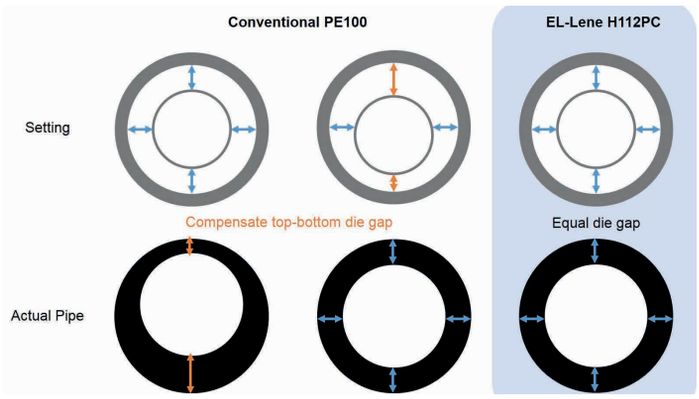


Figure B: Sagging resistance performance for large and thick wall pipe production

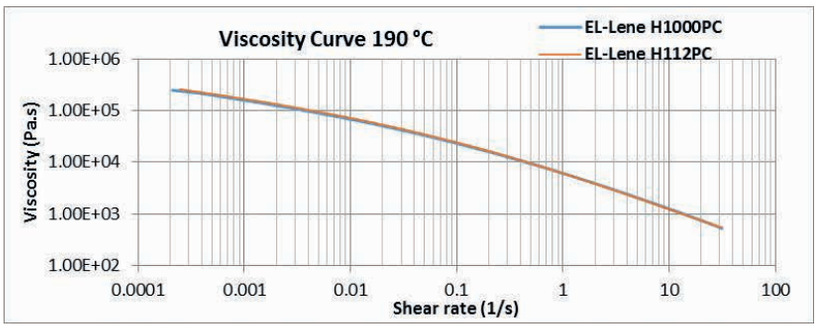


Figure C: Viscosity at extrusion shear rate of EL-Lene H112PC and EL-Lene H1000PC

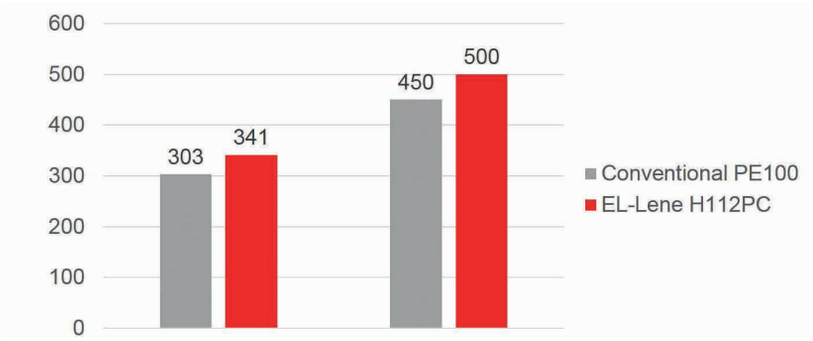


Figure D: 10% higher throughput of EL-Lene H112PC compared to conventional PE100 on Pipe extrusion

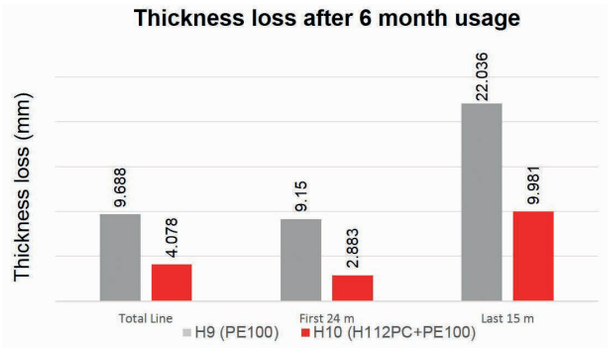


Figure E: Abrasion resistance comparison between EL-Lene H112PC and conventional PE100

General properties of EL-Lene H112PC

GRADE	H112PC	TEST METHOD
Color	Black	-
Classification	MRS 11.2 (PE112)	ISO 12162 and ISO 9080
MFR @ 5 kg.	0.20 g/10min	ISO 1133
Density Compound	0.960 g/cm^3	ISO 1183-1
Tensile Strength at Yield (MPa)	24 MPa	ISO 527-2
Resistance to Slow Crack Growth	3,750 hours	ISO 13479
Resistance to Rapid Crack Propagation (RCP) Resistance	Pc,s4 > 10 bar	ISO 13477

Link Product Pipe System:
https://www.scgchemicals.com/en/products-services/market/building-infrastructure/pipe-system
Website: www.scgchemicals.com
Email: pipe_compound@scg.co.th

Author:
Pipe Business, SCG Performance Chemicals Co., Ltd.
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Bending and curving
of profiled Krah pipes

Photo 1: Short-term bending conditions, the welding was done outside and now the pipe is moved into the trench DN/ID 1200 mm

Photo 2: Long-term conditions, of a bended Krah Pipe DN/ID 1300 mm

The high flexibility is already very known for Krah-Pipes, and a basic reference for the bending is given by R=50 x DN/ID for long term and even R=25 x DN/ID for short term.

So technically these two cases have to be diveded, in long and short term examination. The long term is to reduce fittings (bends) and the short term aspect is during the installation e.G. using the S-sinking method in water applicaitons, relining. What is an easy way to make a detailed calculation, to be sure that the pipe will not fail? How to calculate the minimum bending radius for a Krah Pipe with profiled wall structure, in helical style?

$$R_{min} = \alpha \times DN\ [mm]$$

R_{min} = minimum bend radius [mm]
α = bend ratio [-]
DN/ID = Nominal pipe diameter, here inside pipe diameter [mm]

The minimum bend radius is defined as the smallest radius to which the pipe may be safely curved.

A maximum of total strain elongation should not exceed:
ε=2,5 [%] (long term, 20°C) and
ε=5,0 [%] (short term, 20°C).

Strain of the outer fiber

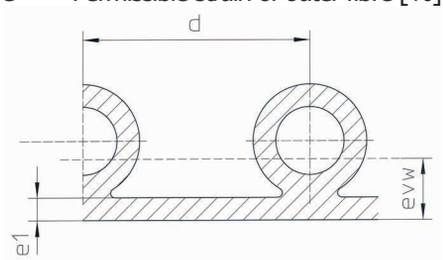
R_D = Minimum radius against strain of the outer fiber [mm]

$$R_D = \frac{r_a}{\varepsilon}\ [mm]$$

r_a = Outer radius

$$r_a = \frac{\text{Nominal pipe diameter}}{2} + e_1\ [mm]$$

e_1 = Solid waterway wall thickness [mm]
ε = Permissible strain of outer fibre [%]



Sketch 1: Cross section of a Krah pipe

Photo 3: Deployment of a Krah Pipe DN/ID 2400 mm

Local Buckling

R_K= Minimum bending radius due to buckling [mm]

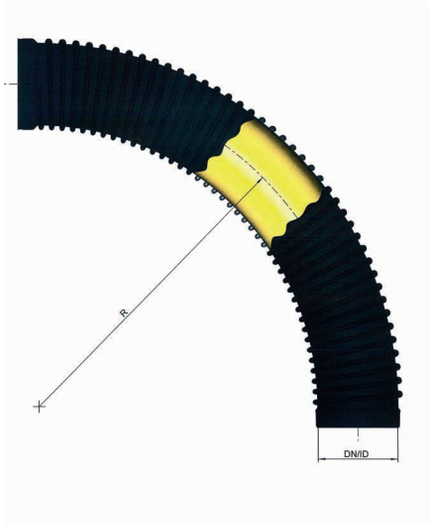
$$R_K = \frac{r_m^2}{0{,}28 * e_{vw} * SFF} [mm]$$

r_m = Medium pipe radius

$$r_m = \frac{\text{Pipe diameter} + e_{vw}}{2}$$

SFF= Spiral-factor [-]

e_{vw}= Equivalent wall-thickness



Sketch 2: Principle of a Krah pipe bending

Spiral-factor: The spiral-factor (SFF) is a factor of the equivalent solid wall reduction for Krah Pipes. This factor considers the helical profile around the pipe, together with the usage of the equivalent wall thickness. The factors are:

	Profile distance (d)	
SFF	min.	max.
0,85	85 mm	100 mm
0,80	>100mm	180 mm
0,75	>180 mm	250 mm

Table 1

The spiral factor for other profile distances are available on request.

Result:

R_{min}=max(R_D,R_K)

The minimum bending radius is the maximum of R_D and R_K. This mathematical approach can be used for corrugated pipes with ribs.

Sample Calculation:

Longterm at 20°C :

$$R_D = \frac{606 \times 100}{2{,}5} = 24{,}24 \text{ m}$$

=> α = 20,2

Short-term at 20°C :

$$R_D = \frac{606 \times 100}{5} = 12{,}12 \text{ m}$$

=> α = 10,1

$$R_K = \frac{623}{0{,}28 \times 46 \times 0{,}80} = 37{,}6 \text{ m}$$

=> α = 31,4

R_{min}= max (R_D,R_K)= 37,6 m

=> α = 27,64

The minimum bending radius for this pipe is 37,6 m for long and short-time at 20°C.

This calculation will be implemented in our next Mickey software.

Photo 4: Test for evaluating the spiral factor

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Water hammer
and how PE pipes react

For designing a pressure pipeline all pressure load phases must be considered and in reference to the loading time be evaluated. Besides the test-pressure, the maximum operation pressure (MOP) and also the water hammer effect have to be considered and implemented in the static design! This procedure is valid for all pressure pipe materials and systems, but flexible pipe materials provide some advantages.

What is a water hammer?

A water hammer is a pressure surge or wave caused when a fluid in motion is forced to stop or change direction suddenly. A water hammer commonly occurs when a valve closes suddenly at the end of a pipeline system, and a pressure wave propagates in the pipe. This pressure wave can cause major problems, from noise and vibration to pipe collapse. But it is possible to reduce the effects of the water hammer pulses with bypasses, expansion tanks, surge tanks, blowoff valves and other features. Rough calculations can be made e.g. by using the Zhukovsky equation, also known as Joukowsky equation.

How do Polyethylene pipes react?

Polyethylene is a flexible material and provides a kind of damping effect to short-term peak loads like they happen due to water hammer. The effect of water hammer is reduced by this flexible behaviour.

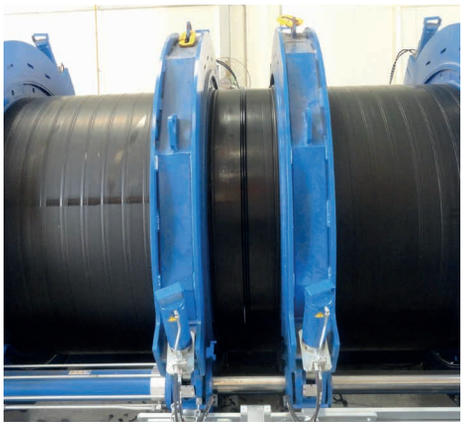


Photo 1: Krah pressure pipe, spiral wound acc. to DIN 16961. Source: UGPM, Sultanate Oman

The more flexible a pipe, the lower the loads by water hammer!

In contrast: The stiffer the pipe-material, the higher the pressure peak by water hammer!

$$c = \frac{1}{\sqrt{1 + \frac{E_F \cdot d_i \cdot (1-\mu^2)}{E_P \cdot e}}} \cdot \sqrt{\frac{E_F}{\rho}}$$

$$\Delta p_{jouk} = \rho \cdot c \cdot \Delta v$$

Caption:
- c = pressure wave velocity [m/s]
- μ = Poisson's Ratio [-]
- d_i = Inner diameter [mm]
- e = Wall thickness [mm]
- E_P = Flexural Modulus Pipe Material under surge load [Pa]
- E_F = Compression Modulus Fluid [Pa] (Water = 2,1 x 10^9 MPa)
- ρ = Density of Fluid [kg/m³]
- p_{jouk} = theoretical pressure difference [bar]
- Δv = velocity difference of flow [m/s]

The above mentioned results based on the Joukowsky equation and valid for the time period where the velocity of the flow is changing, for a time lower than the reflection time Tr of the wave and for typical friction-situations of water-supply-systems.

$$T_r = \frac{2 \cdot l}{c}$$

So far the time for the change of flow is bigger than the reflection time, the peak is concentrated to the point of actuator and will decrease until the end of the line. For thermoplastic pipes (e.g. Krah pipes) the creep behaviour of the material has to be considered. The short term strength, what is decisive for water hammer load capacity, is much higher than the long term design strength. That is another big advantage of thermoplastic pipes!

In general, such equations like the Joukowsky equation are fine for rough calculation, but for design and detailed planning of course a complex calculation with computer-simulations are recommended and indispensable.

Another important point is, that also an abruptly shut down of a pump can be responsible for surges and by this also underpressure can occur after the pump. Flywheels and the increase

				comparison of different pipes / masterials [1]			
				PE 100	PE-GF	Steel	GRP
Input	Inner Diameter	di	[mm]	1400	1400	1400	1400
	Maximum Operating Pressure	p	[bar]	10	10	10	10
	Velocity of flow	vo	[m/s]	1,5	1,5	1,5	1,5
	Poisson Ratio	μ	[-]	0,42	0,42	0,3	0,58
	Wall-thickness [2]	e_{min}	[mm]	93,3	58,3	12,5	20
	Medium Diameter	dm	[mm]	1493,3	1458,3	1412,5	1420
	Compression Modulus Fluid	EF	[N/mm²]	2100	2100	2100	2100
	Density Fluid	ρ	[kg/m³]	1000	1000	1000	1000
	E-Modulus [3]	EP	[N/mm²]	1100	2300	210000	12500
Results	wave propagation velocity	c	[m/s]	292,26	332,039	1019,81	488,39
	theor. pressure difference by water hammer	**p_{jouk}**	**[bar]**	**4,38**	**4,98**	**15,3**	**7,33**

[1] table is considering values from literature and practical use
[2] under consideration of typical safety and reduction factors
[3] short-term values

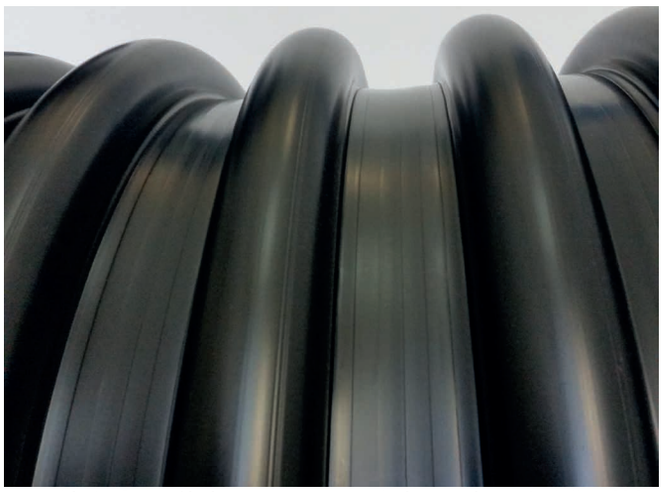
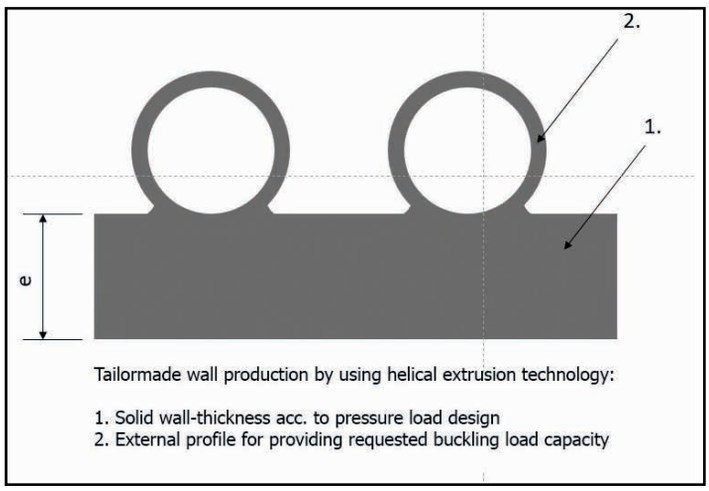


Photo 2: Profiled pressure pipe, spiral wound acc. to DIN 16961, produced on a Krah machine at UGPM, Sultanate Oman



of centrifugal mass can be used successfully as safety device against water hammer. But in each case it is recommended to investigate the short term vacuum stability of the pipes. For thermoplastic pipes a very efficient way to increase the stiffness and vacuum stability is to add an additional profile to the solid wall. On this way the moment of inertia of the structured wall increases significantly and the vacuum stability as well. By using the helical extrusion technology (Krah production procedure) the design can be made tailormade and guarantees the possibility of perfect inner pressure capacity (solid wall) and buckling load capacity!

Authors:
Mohammed Al Hashani
UGPM Co. LLC, Sultanate Oman

Dipl.-Ing. Stephan Füllgrabe
Plaspitec GmbH, Germany

FAQ

A new section of our newsletter "ImProfil" will from now on be the "Frequently asked questions", shortly FAQ. In every issue we will answer some of the most asked questions we get from potential customers and interested parties about the Krah Technology. Also, please feel free to send us some new ideas for our FAQ at **improfil@krah.net**.

Which lifetime do Krah pipes promise?

Krah pipes are produced with high quality Polyethylene with live service times of more than 100 years, this meets the client's requirements perfectly.

Can Krah pipes resist inner pressure?

Yes, due to the tailormade design any Krah pipe provides a certain solid waterway wall-thickness for the requested inside pressure.

How long can Krah pipes be stored?

The outside storage period depends from environmental conditions. At site we recommend 1 year max. storage time. At a factory under perfect conditions there is no limited storage time. Also check out our brochure "Storage and handling of Krah pipes".

What is the stiffness of Krah pipes?

Any needed stiffnesses and stiffness class can be produced. Stiffnesses from SN2-SN16 acc. to ISO9969 are possible and also ring stiffnesses of SR2-SR164 acc. to DIN 16961. The wall structure is designed acc. to local requirements.

What is the dimension range?

Krah pipes can be produced in all inside diameters from DN/ID 400 until DN/ID 5000 mm, in steps of 100 mm. Other non-metric sizes are available on request.

What about the bending angle?

Krah pipes can be bend in a radius of 50x pipe diameter. Due to the flexibility of Krah pipes, often additional fittings (bends, elbows) can be avoided.

What is the delivery length of Krah pipes?

Usually Krah pipes are produced and delivered in a length of 6m, but in accordance to site conditions also any shorter length can be manufactured. Furthermore prefabricated pipe lengths of 18 m can be shipped to construction site to shorten the already short installation time.

How important is the eSDR in the Krah pipe production?

eSDR means "equivalent SDR (Standard Dimension Ratio)" and allows a simple comparison to axial extruded pipes with same stiffness. Often you find in tender text a SDR class mentioned, even if no pressure pipe is requested – only because of the related stiffness. A Krah pipe with e.g. eSDR11 provides exactly the same stiffness as an axial extruded pipe with SDR 11 – but with a much lower price!

How is the earthquake stability of Krah pipes?

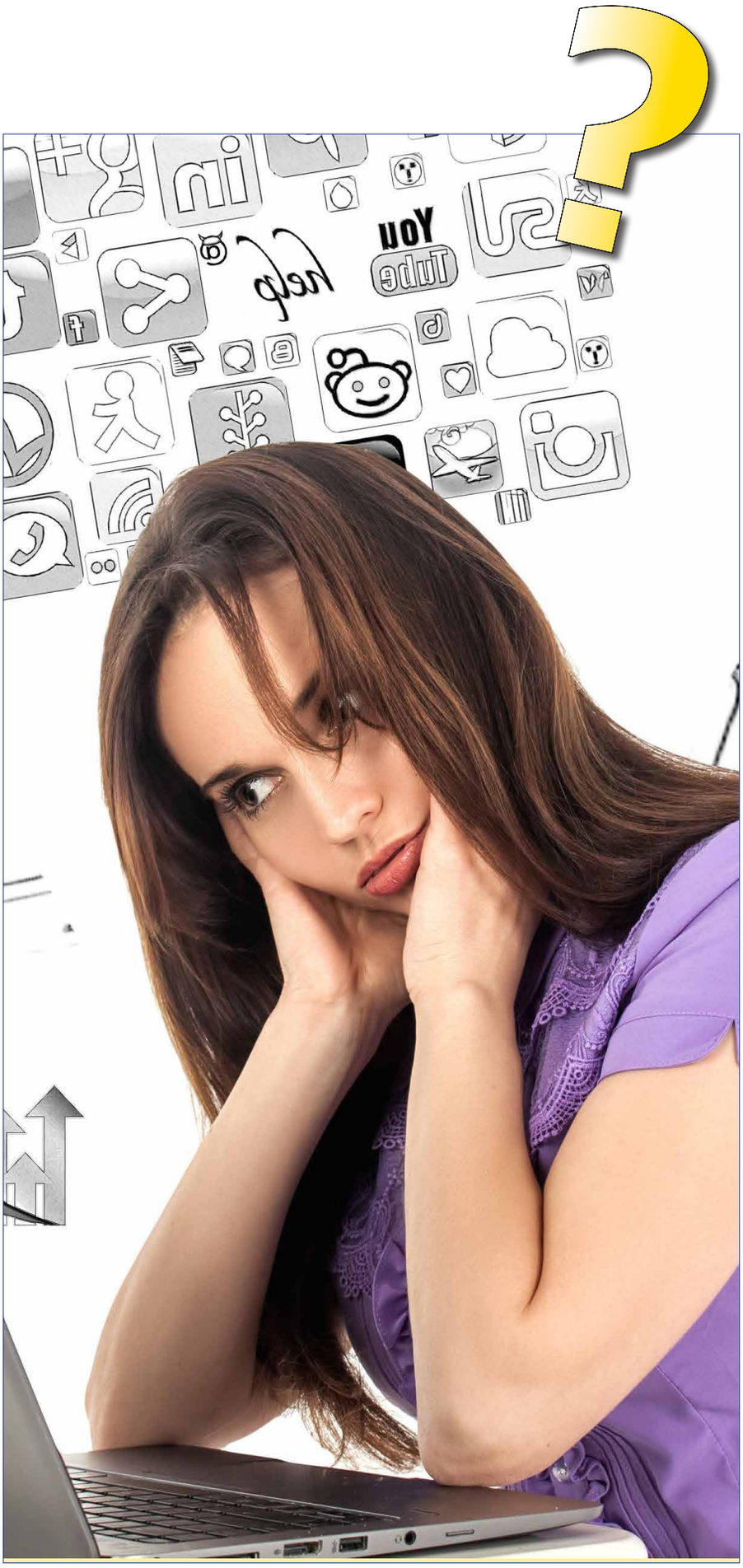
Krah pipes jointed by E-fusion (or any other welding system) are flexibly designed and homogenously jointed. That provides the best possible safety against soil movements and earthquakes.

How do I connect Krah pipes? What do I need for it?

Usually Krah pipes get jointed by integrated E-Fusion, the socket is already homogenously formed at the pipe end, the other pipe end is equipped with a solid wall spigot. But also jointing by butt-fusion, extrusion welding or simply by rubber gasket is possible. Your local Krah factory can provide you with all solutions.

How about chemical resistance?

Polyethylene and Polypropylene are very resistant against many chemicals at certain temperatures. A brochure is for download available " Chemical resistance of Krah pipes"



Short news

„Big & Beautiful" calendar for 2018

Following the tradition of the past years we will publish a new calender by the end of 2017. The pictures will be taken in October this year, with new models and pipe applications. If you know someone who would look good between large pipes please let us know and he/she will eventually feature this year's issue for 2018!

Postal subscription to ImProfil

From now on you will be able to submit to a postal subscription for the "ImProfil" - Newsletter on the **www.krah.net** homepage - of course for free. Should you also have any matters you would like us reporting about or have any suggestions for our newsletter we would be happy about a short feedback from you - just send us a quick mail under **improfil@krah.net** and we will implement your suggestion in the next issue. We will publish the next edition of ImProfil in December.

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www.krah-pipes.de

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