BORPIPE

A Borouge magazine for the infrastructure industry

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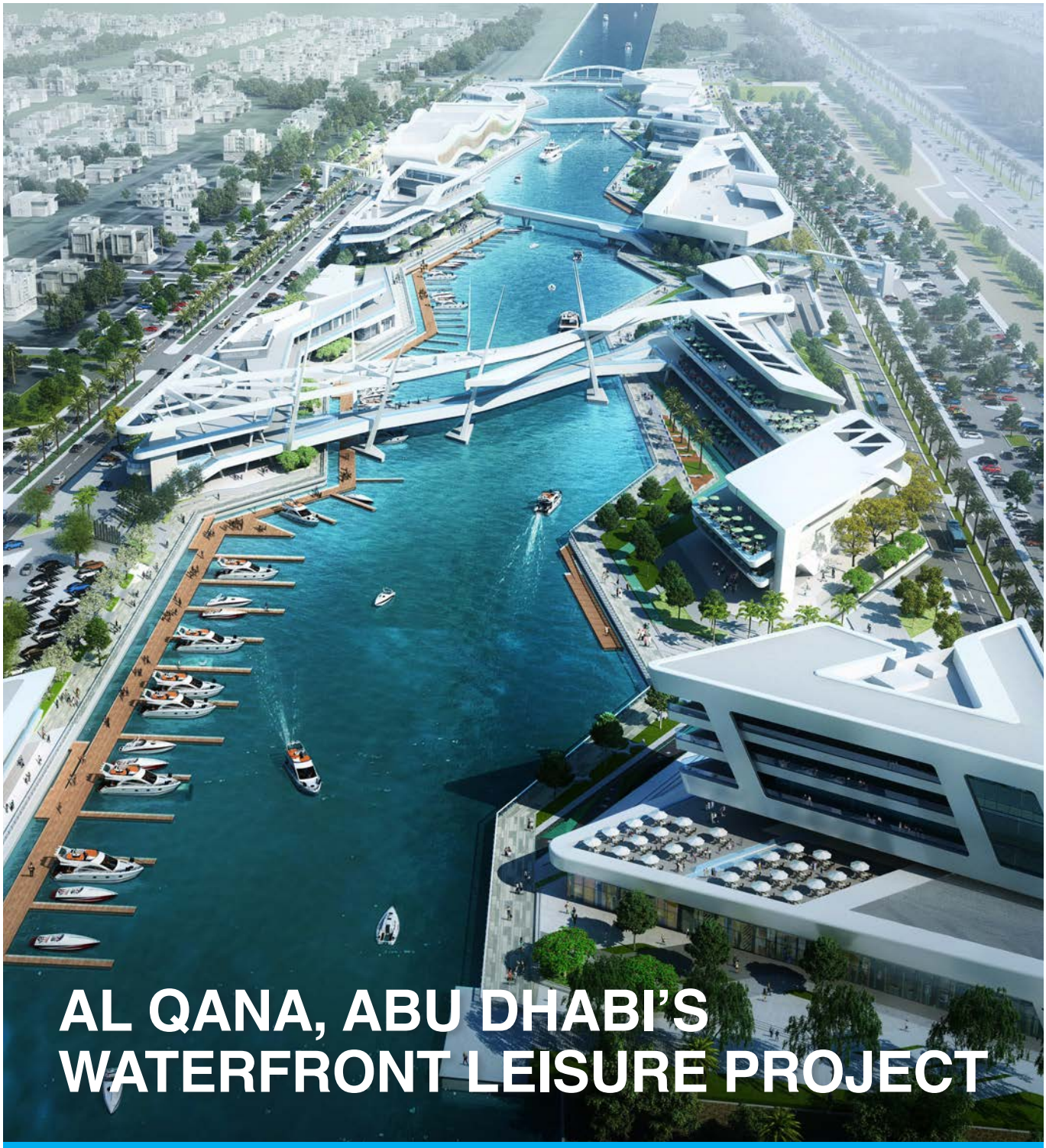

AL QANA, ABU DHABI'S WATERFRONT LEISURE PROJECT

Polyolefin lining of steel pipeline systems

Investigative techniques for the identification of materials used in PE pipes

Success stories of Borstar® RA140E with K-Wasser, Lesso and RAKtherm

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INSPIRING TOMORROW

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A note from the editor

Greetings from our second edition of the year! We are now late into 2020 with no tangible signs that the pandemic is being brought firmly under control in many parts of the world. While many are still trying to cope with the effects of this unprecedented event, there are promising signs that utility projects designed to upgrade the current municipal water, gas and sewage networks in Asia Pacific, Middle East and Africa are restarting. These basic necessities are even more important in today's world where clean water and efficient sanitation is critical to protect local communities. Plastic pipe systems are unquestionably the appropriate solution for providing these services.

Our cover features a unique project in Abu Dhabi that will utilise the benefits of polyolefin systems for a wide range of its service utilities. The designers studied many options but eventually decided to use polyolefin piping systems for reliability, cost effectiveness, speed of installation and leak-free operation. PE100 systems were used for its water supply systems, pre-insulated chilled-water pipes and irrigation mains. Gas mains supplying the project were designed in PE100 as this is again the proven, cost effective and safe choice for municipal gas networks around the world. Indoor plumbing systems utilised PP-R pipes for its welded leak-free joints and the high temperature kitchen drainage systems uses PE100 piping system. Lastly, polyethylene drip irrigation pipes will ensure that the lush surroundings are maintained while using water in the most efficient manner.

As a continuation of our efforts to assist the industry maintain the highest quality and further reduce instances of substandard pipes, we provide an insight into a typical step-by-step technique to identify materials used to manufacture PE pipes. This is usually performed on pipe samples provided to us – usually as a quality surveillance verification step or when it is suspected that non-virgin/recycled PE material is used during pipe manufacture. The article concludes with some examples of actual pipe samples that were tested and the conclusions reached.

With the growing need for many asset owners to rehabilitate or extend the useful operational life of their ageing steel pipelines, we showcase the growing use of polyolefin lining as a very cost effective method to rehabilitate aged/leaking steel pipelines across various industries.

In the indoor plumbing segment, we share the latest success stories by several customers who have benefited from Borstar® RA140E material. Finally we showcase a Water for the World project from Mozambique that highlights how a PE100 system is often the best choice to provide reliable water supply.

We hope you enjoy reading this issue!

Your editor,

KH Lou

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TOP STORIES

Al Qana, Abu Dhabi's waterfront leisure project which is on track for completion by end 2020

by Sultan Al Kendi

Artist impression of Block D – Cinema. (Courtesy of Al Qana)

Al Qana is Abu Dhabi's latest and most unique waterfront destination bringing a new modern outlook on social dining and entertainment in the capital. The development is one of the most anticipated tourist landmarks in Abu Dhabi featuring seven anchor destinations spanning over 2.4km of scenic and picturesque waterfront walkways.

Al Qana offers residents and visitors a collection of attractions with state-of-the art facilities from waterside eateries, the largest standalone cinema in Abu Dhabi, the Middle East's largest aquarium, first-of-its-kind lifestyle hub including wellness facilities, UAE's first virtual reality (VR) park, a specially dedicated kids' zone and landscaped community areas especially focusing on open-air spaces with lavish landscape and water features designed for families. It is perfectly suited for the post-pandemic demand for a healthier lifestyle.

Fouad Mashal, CEO of Al Barakah International Investment, developer of Al Qana said: "We are proud to be creating something world-class for many generations of people in Abu Dhabi. When we set out to design and build Al Qana, the

Fouad Mashal, CEO of Al Barakah International Investment.

team did not just think about what people need right now, but what our families, friends and businesses will need for the next 30 years and beyond." Mashal added: "The popularity of the project has been overwhelmingly well-supported by key partners such as the Abu Dhabi Municipality, as we plan to add tremendous social and entertainment value for our citizens and residents, as well as attracting millions of visitors to the capital."

The project was initiated six years ago to offer residents of Abu Dhabi a family-friendly destination close to home and will be more relevant to the post COVID 19 situation for people who seek safe outdoor spaces and healthier lifestyle choices. Al Qana is the first-ever Build-Operate-Transfer (BOT) model implemented by the Abu Dhabi Municipality (ADM) and is jointly developed by Al Barakah International Investment. International Construction Contracting Company (ICCC) is the lead contractor in charge of the development of the project. When completed by the end of this year the total cost will be almost USD 300 million.

Artist impression of Block N – VIP dining. (Courtesy of Al Qana)

Right from the start, the project designers were extremely keen to merge the unique architectural features with a sustainable environmental footprint. They studied various alternatives for the water, gas, chilled-water, plumbing, drainage and irrigation systems so as to balance environmental impact with capital and operational costs. Because this landmark project would be the first tourist development in Abu Dhabi developed under a public-private-partnership, the founders took a very long term view. Solutions deployed would need to be viable and reliable for the entire project duration.

It is therefore extremely encouraging that the project owners ultimately decided that a polyolefin-based piping system would best meet their needs. As the UAE boasts several world-class suppliers of high quality polyolefin piping systems it was therefore also a very practical choice. NAFFCO supplied the SDR 9 & 11 PE100 water distribution pipelines, PE100 pre-insulated chilled-water pipes and irrigation mains as it offered superior whole life cost (weldability, flexibility and monolithic system) when compared to other rigid piping systems. Hepworth UAE supplied the 63-250mm OD PE100 gas pipe systems conforming to the ADNOC gas distribution standard of utilising only pipes made of pre-compounded orange PE100 material. The gas pipes were joined with a combination of butt-fusion and electrofusion couplers supplied by GF Piping Systems and inspected by Bureau Veritas and DNV GL.

The hot and cold water plumbing system supplied by Eppinco was designed in PP-R material because of its superior properties at elevated temperatures. It is also a fully fusion welded system, thereby reducing the risk of leakage. In the kitchen areas HDPE drainage systems were chosen because of the material's superior elevated temperature and environmental stress cracking resistance. These pipes were supplied by Cosmoplast. The polyethylene drip-irrigation system used to maintain the landscaping and lush features surrounding the project were also supplied by Cosmoplast.

Residents of Abu Dhabi will therefore be eagerly awaiting the official opening of this project and it will serve as another destination of choice for individuals and families and raise the profile of the area surrounding the Sheikh Zayed Grand Mosque and the nearby Memorial Park.

UTILITES

BorSafe™ PE100 helps Shenzhen Gas expand their network

by Jinghui Li

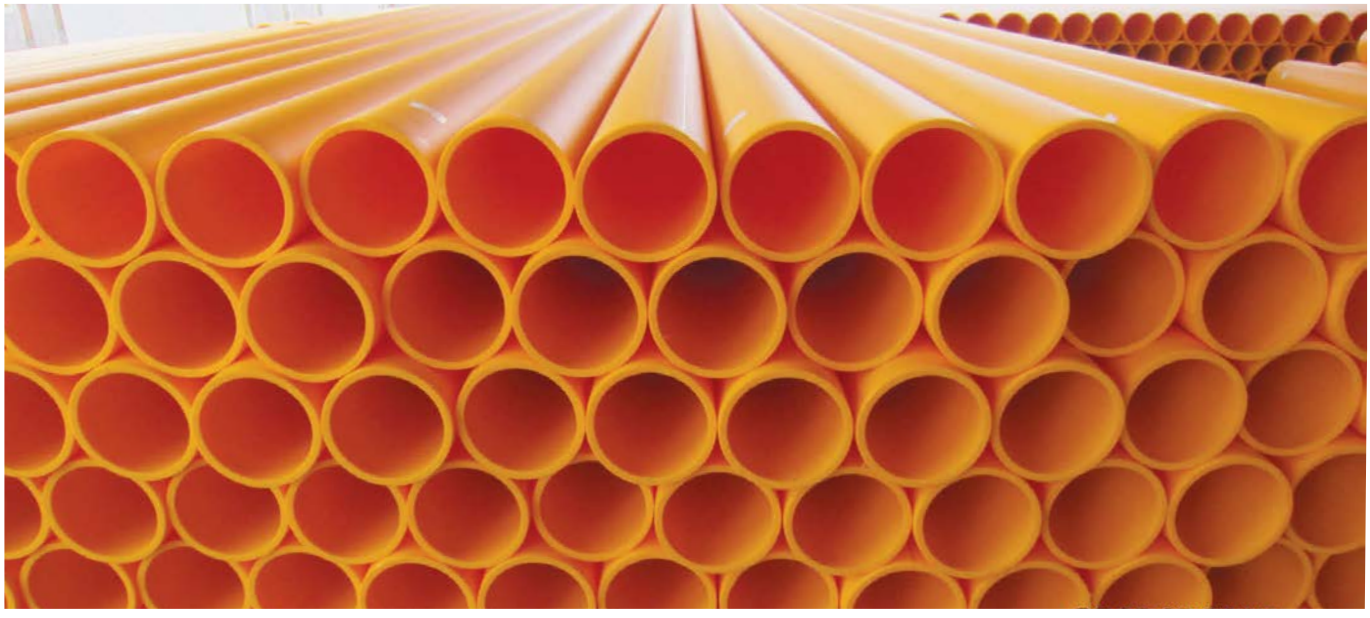
Shenzhen is the largest city on mainland China that borders Hong Kong. It is a city of more than 16 million inhabitants and is often known as China's Silicon Valley. The Shenzhen Gas Corporation Limited (SZGC) distributes piped gas, liquefied petroleum gas and also bottled gas to the city. SZGC is also involved in the investment and construction of gas pipelines and its business is mainly focused in the Guangdong province. It was founded in 1982 and was listed at the Shanghai Stock Exchange at the end of 2009. With USD 3.39 billion in assets, SZGC has operations in 11 provinces with 45 chartered pipe networks to serve a total of 18 million people. It owns pipeline networks in excess of 18,000km. (Source: szgas.com.cn)

Shenzhen has witnessed a rapid growth in the city's municipal gas network in line with other urban centres in China. Polyethylene (PE) has played a key role in supporting this growth. The material advantages of flexibility, corrosion resistance, and toughness are particularly beneficial in the coastal area where Shenzhen is located. SZGC prefers orange PE100 for the municipal gas networks for the following reasons:

- The vibrant colour significantly improves its visibility while being excavated for repairs/network expansion
- Potential defects on the pipe surface can be easily detected
- It is made of the latest generation of high stress crack resistant material (PE100RC)
- It has more than 30 years of safe and successful track record with gas utilities worldwide
- An orange compound absorbs less moisture than a black PE100 compound in the humid climate of southern China, which reduces instances of bubbles that can sometimes form during butt fusion if the resin is not sufficiently dried before pipe production
- Excellent resistance to Rapid Crack Propagation (RCP), which is especially important for gas pipes

Modern orange PE100 materials such as the BorSafe™ HE3492-LS-H also provides other advantages when used in tropical climates with high Ultra Violet (UV) radiation levels as it is more highly UV stabilised compared to other similar materials. It has passed UV exposure tests of 7GJ/m^2 versus the usual expected standard of 3.5GJ/m^2. This can provide extra safety during transportation and installation in case the orange PE100 pipes need to be stored outside for more than 1 year depending on the intensity of the UV radiation.

Pipe converters benefit from using the BorSafe™ HE3492-LS-H because it has been specially formulated to be extruded with significantly less plate-out and also exhibits good low-sag performance. These processing benefits coupled with the overall advantages of the pipe as mentioned above ensure that gas utilities have safe and reliable networks to supply the energy needs of cities for the present and future.



Gas pipes produced from BorSafe™ HE3492-LS-H orange PE100.

Polyolefin lining of steel pipeline systems

by M. Murali (Aegion Corporation/USTS) & KH Lou

CORROSION AND IMPORTANCE OF INTERNAL LINING

Corrosion is a major concern for utilities, oil & gas and other industries relying on critical pipelines. Numerous technologies have evolved over the last few decades to specifically address the concern of internal pipeline corrosion, some of which include chemical inhibition, coatings, exotic alloys, and internal lining. The technology of internal lining with thermoplastic pipe liners has proven to be one of the most cost effective solutions for protecting pipelines from corrosion and abrasion.

Data from the table below shows that the combination of carbon steel (CS) with PE liners were the most cost-effective solution to prevent internal corrosion steel pipes for this national oil company (NOC). The results below are even more relevant today as the entire oil & gas industry grapples with the heightened cost sensitive operating environment due to the challenges of low energy prices and subdued global demand. PE liners, where practical, can serve as an important corrosion mitigation tool for oil & gas, utilities and even other industrial operators. The following article aims to show how this can be the most cost effective and sustainable solution for the operator/pipeline owners.

	Unit	Quantity	Unit Price	CS		CS+ HDPE		CS + Chemical Injection	
				USD	%	USD	%	USD	%
Capital Expenditure (Capex)									
CS pipeline	M	3,000	120	720,000	90.00%	360,000	61.33%	360,000	29.75%
HDPE liner	M	3,000	75	–	–	225,000	38.33%	–	–
Chemical injection skid per flowline	Nos	1	450,000	–	–	–	–	450,000	37.19%
Pig valves per flowline	Nos	2	50,000	–	–	–	–	100,000	8.26%
Total Capex				720,000	90.00%	585,000	99.66%	910,000	75.21%
Operational Expenditure (Opex)									
Cost per leak repair	Nos	5	6,000	30,000	3.75%	–	–	–	–
Hydrotest	Nos	2	25,000	50,000	6.25%	–	–	100,000	8.26%
Monitoring and maintenance of chemical injection system	years	20	5,000	–	–	–	–	200,000	16.53%
Monitoring of HDPE system	years	20	10,000	–	–	2,000	0.34%	–	–
Total Opex	years	1	2,000	80,000	10.00%	2,000	0.34%	300,000	24.79%
Total Cost (Capex + Opex)				880,000	100.00%	587,000	100.00%	1,210,000	100.00%

Source: Innovative field trial results of flangeless grooved HDPE liner application in a super gigantic field for oil flow line internal corrosion management, Dr Abby Kalio,Mr Marwan Hamad Salem et al – SPE-192894 ADIPEC 2018

Typical comparison of the life cycle cost between commonly used corrosion control methods by a regional national oil company (NOC) in the Middle East.

The roller reduction box temporarily reduces the liner diameter before insertion into the host pipe.

Safetyliner™ with external grooves were produced with HE3490-LS-H for recent projects in the Middle East.

AVAILABLE TECHNOLOGY

Polyolefin lining of steel pipeline systems is an established corrosion and rehabilitation method worldwide. Specialist contractors such as United Pipeline Systems (now part of Aegion Corporation) have been active in this market globally for more than three decades. United is the global leader in providing thermoplastic lining systems for internal pipeline protection and has constructed and internally lined more than 40,000km of pipelines since 1985. With locations in the USA, Canada, Chile, Brazil, and the Middle East, United can respond quickly with specialised personnel, equipment and materials to complete turnkey projects anywhere in the world.

THE TITE LINER® SYSTEM FOR WATER AND HYDROCARBON SERVICES

United Pipeline Systems developed the Tite Liner® system, a technology that enables a thermoplastic liner to fit tightly inside a host pipe. The Tite Liner® system temporarily reduces the thermoplastic liner's diameter for insertion. Following installation, the liner then expands to act as a continuous barrier between the host pipe and the corrosive or abrasive material. There are no pressure limitations or limit on the maximum host pipe diameter for the Tite Liner® system. The liner pulling length depends on various factors such as pipeline conditions, terrain etc. United has pulled up to 2,400m in one go. Bends with 40D radius can be pulled through. For shorter lengths, 20D radius bends can also be pulled.

SAFETYLINER™ SYSTEM FOR HYDROCARBON SERVICE WITH GASES

United developed the Safetyliner™ system for use in gaseous applications. Safetyliner™ offers all the same thermoplastic lining protection of the Tite Liner® system but differs in that a series of small grooves exist on the outside of the liner in order to provide an exit path for any gas molecules that may permeate the liner. The unobstructed grooves also provide the ability to immediately detect any possible leaks. The advanced design of the Safetyliner™ has proven especially effective in applications such as CO_2, sour gas, 3-phase oil and tailings pipelines.

The Passive Reinjection System is the simple way in which the permeated gases are re-injected into the flow stream. It connects the annulus to the flow stream through one, or several, one-way check valves. It does not eliminate pressure in the annulus the way continuous venting does, but it does ensure that the annular pressure never exceeds the pipeline pressure.

United's LinerGuard™ System (active re-injection) enables both the continuous low annular pressure and zero release of annular gas to the environment. LinerGuard™ enables a closed loop system whereby permeated gases are reintroduced back into the flow stream. This results in a ventless and collapse proof liner system.

LINER MATERIALS

The selection of an appropriate liner material is a critical part of the lining process. Not all thermoplastic polymer materials are suitable for use as liners in oilfield pipelines because of the variety of fluids and operating conditions such as pressure and temperature. Not all materials can be installed as a tight-fitting liner. Several thermoplastic polymers have been used as liners in oilfield service in different environments. The designed service life of Tite Liner® is based on the individual customer's requirement, however the typical duration is 20 years.

Tite Liner® HDPE

Polyethylene (PE) is the most commonly applied liner material. In the past, many operators restricted the use of first generation PE liners to 50°C (122°F) in hydrocarbon service and 60°C (140°F) in water service. PE materials have undergone significant improvements over the past 20 years. Development of third generation bimodal resins further enhanced the application envelope of PE liners. Current products such as the BorSafe™ HE3490-LS & HE3490-LS-H can be designed for operating temperatures of up to 80°C (176°F) in water service. In hydrocarbon and multiphase service, the recommended maximum operating temperature depends on the fluid composition but should not exceed 65°C (149°F).

Tite Liner® RT system

United Pipeline's Tite Liner® RT system is based on Polyethylene Raised Temperature (PE-RT) material specifically designed for the severe conditions present in oil & gas and industrial environments. The Tite Liner® RT system utilises multimodal polyethylene resin technology that enhances its high temperature performance.

The Tite Liner® RT system offers a temperature rating of up to 90°C and is intended for use in pipeline and piping systems where extreme conditions such as high temperatures, pH imbalanced water (saline solutions), aggressive chemicals, hydrocarbons, or highly oxidative conditions exist. Suitable applications include oil & gas field pipelines, gas distribution pipelines and other industrial/mining applications.

JOINTING METHODS

Flange system

The Tite Liner® system's flange fittings have been used since 1985 to provide a tight seal and restrained joints for pressures up to and over 5,000psi. Each raised face steel flange is machined to match the inside diameter of the steel pipe and inspected to verify that the raised face dimension is correct. A radius that matches the radius of the polyethylene flange-fittings is manufactured by United Pipeline Systems to exact dimensions to ensure superior performance of the completed flange connection.

Flange jointing system.

Flangeless system

The United Pipeline corrosion resistant alloy (CRA) welded connection allows for the connection of two thermoplastic lined sections of steel pipe without the use of flanges. The connection creates an end seal on the thermoplastic liner which is tested to over 9,000psi and materials are either thermoplastic or CRA. This flangeless system complies with ASME B31.3, ASME B31.4 and ASME B31.8.

OTHER FEATURES

Monitoring systems

The Tite Liner® system is a non-bonded, pipe within a pipe system that allows continuous monitoring of the completed pipe lining system. Thread-o-lets are welded onto the steel pipe at each end of a lined section of pipeline and a small hole is drilled in the center of the thread-o-let through the steel pipe wall only. A riser pipe then connects the thread-o-let to a valve. A common practice is to routinely open this valve to ensure that the system is intact and the absence of fluid flowing through the valve is proof that the liner pipe continues to provide a protective barrier.

LinerWatch™

Real-time condition assessment can be beneficial for pipeline owners and operators, alerting them to any imminent and potential issues before failure occurs. The LinerWatch™ system uses a remote solar-powered device that monitors the integrity of thermoplastic lined pipe systems. By measuring pressure in the annular space, the system monitors the integrity of the liner and host pipe in real-time and sends information directly to the web-based LIVELINE™ – a real-time monitoring app for displaying streaming data from sensors. The system gives owners and operators an early detection system for internal liner breach, external pipeline damage and other failures that could lead to damage to the system or the environment.

Rotational lining of a steel tee.

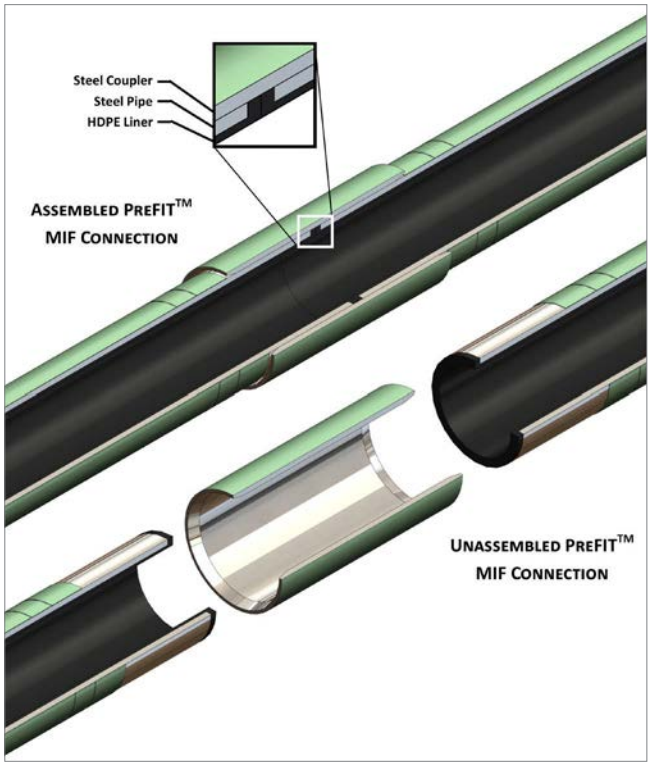
FITTINGS

Rotational lining (or rotolining) allows the bonding of a uniform, seamless polymer layer to the interior of virtually any metallic structure, regardless of shape and complexity. In the rotolining process, granular resin is placed inside the structure to be lined and all openings are covered. The structure is heated while simultaneously being rotated about two axes. The resin melts and flows evenly over the entire inner surface of the structure, bonding to the metal substrate. Once cooled, the result is a monolithic corrosion and chemical resistant lining that conforms to complex shapes and is virtually free of stresses.

Wall thicknesses can range from 3mm to 11mm, but typically range from 6mm to 10mm, depending on the size and service of the part. Standard raised face weld neck flanges or United's proprietary Flangeless Connectors may be integrated into the lined fitting allowing for installation in either a mechanical or fully welded system. Structures such as manifolds, well heads, tees, bends and reducers can be protected in this way. High performance thermoplastics such as HDPE, ETFE and PFA can be used.

PreFIT™ Tite Liner® system

The PreFIT™ Tite Liner® system is a new product offering of pre-lined pipes with a range of supporting end connectors. This system utilises thermoplastic lining inside a steel pipe, effectively combining the strength of steel with the corrosion, chemical and abrasion resistance of thermoplastic. The PreFIT™ Tite Liner® pipes are factory lined in a controlled environment and are ready to be deployed in the field for immediate use on a project basis or stocked for use as needed. End connections are available as flanged, coupler, or mechanical interference fit (MIF).



PreFIT™ Tite Liner® system.

CASE STORY

A Middle East NOC with more than 1,000km of pipeline assets was constantly suffering from internal pipeline corrosion problems. In this particular case, internal corrosion in the high pressure water injection flow lines resulted in leaks that subsequently reduced the productivity of oil production. After discussions and careful evaluation of available options, the operator decided to rehabilitate their internally corroded steel pipes with HDPE liners. The Tite Liner® system made from BorSafe™ HE3490-LS-H was used to rehabilitate a 6 inch steel pipeline.

BorSafe™ HE3490-LS-H, a high stress crack resistant PE100 with superior slow crack growth properties was selected to provide additional safety for the liner of such a critical application in case of any surface damage to the liner during insertion. Performance monitoring vents were installed at the flanges for pressure monitoring and bleed off. The entire lining operation was completed in record time including the installation of spools meant to be retrieved after the stipulated testing. The injection pipeline was brought back to normal operation and the extra smooth surface and excellent flow properties of the HDPE liner enabled the pipeline to reach the normal operating conditions even though there was a reduction in internal diameter of the pipeline due to liner thickness.

After 5 years of continuous operation, the spools were removed and tests were conducted to compare their properties with that of an unused liner. Notably, it was observed that the properties of the liner on the retrieved spools were within the stipulated limits, which confirmed that it had not been negatively affected while in continuous operation.

RAKtherm delivers PP-R plumbing solutions to 35 countries worldwide with the support of Borstar® RA140E

by Ioannis Inepekoglou

Mr Ali Hashim, chairman of RAKtherm.

OVERVIEW

In the following interview, we feature Mr Ali Hashim, chairman of RAKtherm, one of the most well-known suppliers of plumbing solutions in the wider Middle East region. RAKtherm or more formally known as Gulf Plastic and Converting Industries is part of the Hashim Industry group established since 1963 in the Kingdom of Saudi Arabia to serve the region's construction industries. RAKtherm is the flagship division of the group and a pioneer in the supply of plumbing solutions such as PP-R, PE-X for drinking water and also piping for waste and drainage systems. RAKtherm is a leader in the regional piping industry with over 50 years' experience in manufacturing in Saudi Arabia and Egypt and the company is uniquely positioned to capitalise on the booming construction industry in the region with more than 40 stockists worldwide across the G.C.C., North and South Africa, South and East Asia, and Europe. In the plumbing segment, it focuses on the pressurised hot and cold water application as well as under floor heating in residential, commercial, and industrial buildings. RAKtherm offers the widest range of PP-R that is complimented by PE-X piping systems, multilayer oxygen barrier pipes and aluminium composite pipes. They also supply uPVC piping systems and are the first supplier of multilayer uPVC in the region.

What is the current state of the hot & cold (H&C) plumbing market in MEA?

Historically, copper and steel pipes have been the preferred materials for most plumbing and heating installations, but since the introduction of plastic pipes 20 years ago, these have gained significant market share. Experience in construction technology is a fundamental requirement to design and subsequently supply a versatile and comprehensive plumbing system. Utilising the highly developed European standards of manufacturing and the highest quality raw materials such as PP-R and PP-RCT has enabled us to be certified by globally recognised bodies such as DVGW, SKZ, HY, CSTB, and CARSO. These independent certification bodies conduct continuous random inspections on RAKtherm's entire product portfolio, thus giving our customers confidence in our products' quality and reliability. The regional H&C plumbing industry is expected to maintain its market position in the Middle East, Africa and the EU. We also see a growing demand from Southeast Asia, India and more recently, South America. The PP-R pipe for H&C water segment and uPVC for drainage systems are thus expected to account for a larger share of the worldwide plastic pipe market.

How did RAKtherm decide to enter the H&C market?

RAKtherm, through the wider Hashim Industry, was involved very early on in the construction industry. With the booming construction and real estate sector in the last two decades, we saw an opportunity to pioneer the use of innovative and more sustainable plastic piping solutions for the H&C market and we also invested heavily in the latest technologies in drainage solutions with uPVC in order to support this vision. The plumbing market was especially attractive as it offered a very big opportunity to innovate from the traditional metallic materials. Our significant investment early on in this segment gave us the opportunity to shape the plumbing industry and allowed us even more opportunity to expand our plumbing solutions' range to serve the market.

What is your strategy to maintain your leadership position?

RAKtherm represents the ultimate piping solution! Our brand speaks of the quality innovation of our product. Over the years, we have resolutely ensured the quality of our products and our growing list of satisfied customers and referrals attest to this fact. Because of this, we continue to achieve and maintain excellent performance not only in the Middle East but also in the global market as we have 40 stockists worldwide. We are committed to providing highly engineered piping solutions with superior product performance and guaranteed operational efficiency. Our continuous innovation which has allowed us to move ahead of our competitors is key to our success. In the piping segment, we leverage on the superior properties and all round support that comes with the Borstar® RA140E to ensure that our products are consistently of the highest quality.

Water Front Abu Dhabi.

Dubai's Blue Water Island mega project will feature the world's largest observation wheel (Eye of Dubai).

Can you give us an example of a recent project and how it was implemented successfully?

We recently completed several very prestigious projects in the UAE such as The Water Front Abu Dhabi, Blue Water Dubai, Hameni Residential Towers Jumeirah, Artesia Akoya Dubai, Sheikh Zayed Residential projects and the very famous Cleveland Clinic Abu Dhabi. In all these projects, the developers, some through their contractors/architects had been in touch with us very early on during the planning stage to discuss the design, supply, installation, testing and even future maintenance as they have a very long history of working with us. By being involved early on, we avoid potential design and installation issues especially if the client is running on a very tight deadline or insufficient considerations are given to the proper integration of the different building systems. As our clients are either government agencies or well-known private companies like DAMAC, Meraas or Mubadala, their main priority will always be the timely completion of these projects and also the reliability of the plumbing system. Our sales, projects, technical and customer service teams are constantly available to ensure that our clients' requirements are fulfilled and we provide full system guarantees as required by the tenders.

Why did RAKtherm select Borstar® RA140E for their PP-R production?

Borstar® RA140E is a 3rd generation PP-R with an excellent balance of mechanical properties and processability. The collaboration with Borouge played a significant role in the success of PP-R plumbing pipes in the UAE and the GCC region. We started our PP-R production with Borouge as our partner as we demanded only the highest quality materials and the Borstar® range of PP-R materials was already well known in the plumbing market. Partnering with Borouge early on when the market was still in its infancy allowed us to build up our customer base across the competitive regional markets and also ultimately widen our reach to over 40 countries across the GCC, North and South Africa, Southeast Asia and Europe.

What is the future of PP-R H&C plumbing systems in the MEA region?

As the construction industry becomes more complex and technically demanding, we foresee that PP-R will continue to play a key role because of its reliability, efficiency and very long service life that can extend to more than 50 years. PP-R is approved for the production of pipes according to DIN 8077/8078 which conforms to the most stringent standard. Its key advantage remains the ease of installation and leak free fusion jointing method.

Are there any new areas of development in the H&C segment that is currently being looked at?

Yes, we are looking forward to PP-RCT as the next obvious evolution of the PP-R plumbing system.

How can a supplier like Borouge help grow the H&C pipe market more effectively?

We continue to appreciate Borouge's support and contribution in joint promotional activities such as workshops and seminars with different members of the plumbing value chain, PP-R material innovation and product development trainings and targeted awareness and education sessions with project owners and consultants. Apart from all these, the regular and reliable supply of PP-R materials will be extremely helpful to support the growth of the market.

UTILITIES

GF Piping Systems provides safe gas connections to 40,000 Indonesian households via the Jargas project

by Catherine Winata

Completed pipes before being delivered. (Courtesy of GF Piping Systems)

GF Piping Systems recently delivered over 1,000km of polyethylene piping systems for the Indonesian Jargas project as of August 2020. This represents about one third of the total new PE gas distribution piping installed in the country under this project. The Jargas project is a key project by the Indonesian government under the National Medium Term Development Plan 2020-2024. Jargas, short for Jaringan Gas (National Gas Network) in the Indonesian language, is a national project coordinated by the Indonesian Ministry of Energy and Natural Resources (ESDM) which aims to provide a natural gas distribution network to 4 million households across the country. It aims to provide large parts of the population with access to energy in a safe, environmentally friendly and cost effective way since Indonesia boasts the second largest natural gas reserves in Asia Pacific (Source: US EIA, 2018).

Indonesia is targeting a more than threefold increase in households being connected to its natural gas network (from 74,496 to 266,070 new connections) from 2019 to 2020. There are more than 560,000 households connected to the national city gas project as of 2019 and the ambitious plan by the ESDM is to add another 4.1 million households to this expanded network by 2025 (Source: ESDM 2019).

GF Piping Systems supplied PE pipes in sizes of 20, 63, 125, 180mm diameters and fittings via two engineering, procurement and construction (EPC) companies, KSO Noorel – Waskita and KSO Pratiwi – Dhamma. The pipes were made from BorSafe™ ME3441 medium density polyethylene (MDPE) material which has been used for more than 30 years by gas utilities across the world and thus have a long and proven track record in safety and reliability. The use of the BorSafe™ ME3441 medium density polyethylene resin results in pipes with very good flexibility, which is especially useful for pipes used for sub-mains and house connections. Gas utilities and their customers can be confident that pipes supplied by GF Piping Systems using such materials already exceed requirements set for PE gas pipes according to internationally recognised standards such as the ISO4437. GF Piping Systems, supported by Borouge, continues to recommend that the gas utilities only use PE compounds for critical applications such as municipal gas and where possible, tighten surveillance and quality control procedures. This will ensure that PE pipes supplied to meet the rapid expansion of the national city gas project is not impacted negatively by substandard pipes.

ADNOC In-Country Value (ICV) programme continues to grow and benefit the UAE

by Mohamed Jaber and Hasan Al Hosani

As a key contributor to the UAE economy, the Abu Dhabi National Oil Company (ADNOC) Group is tasked to ensure that the nation's sizeable oil & gas reserves are not just monetised through its sales overseas but are also utilised as a powerful catalyst to drive transformational change in the domestic private sector to support the next phase of the growth and diversification of the economy. It is with this aim in mind that ADNOC launched an In-Country Value (ICV) initiative for its suppliers in November 2017. In 2019 and 2020, several other government and semi-government entities joined this programme for their own suppliers as well. The ICV programme generated USD 7 billion[1] for the domestic economy in 2019, marking a total of USD 12 billion[1] generated for the UAE economy since its inception. Up until the end of 2019, it has generated more than 1,500 private sector[2] jobs in the local economy for Emiratis.

The ICV is a certification programme for all vendors and suppliers providing products and services to ADNOC and participating government entities. Each vendor will be awarded a score based on the ICV certification programme and is updated/renewed annually. It prioritises vendors/suppliers fulfilling the following criteria:

(i) Goods manufactured in the UAE
(ii) Provide development opportunities for local UAE talents in the private sector
(iii) Localisation of critical supply chain capabilities

ADNOC's ICV strategy is also an extension of its growth strategy to create a more profitable upstream and more valuable downstream.

Two recent steel pipe coating projects completed and delivered by the National Petroleum Construction Company (NPCC) for ADNOC Offshore are examples of projects that contribute to the ICV programme. The two projects are:

(1) Upper Zakum Facilities: 3LPE coating of 13km of 42 inch diameter steel pipeline that required 118MT of the Borcoat™ PE coating system
(2) Bu Haseer Full Field Development: 3LPE coating of 19km of 10 inch diameter steel pipeline that required 56MT of the Borcoat™ PE coating system

NPCC is an extremely well known player in the energy sector in the Middle East and wider South Asian region. Its continued growth is a testament to the support it has received from ADNOC and the UAE. It commissioned its first FBE/PE/PP pipe coating plant in 1994 followed by the move to its current Mussafah fabrication yard the following year. In 2001 it secured its first major engineering, procurement & construction (EPC) contract from Shell. Through a series of acquisitions and an injection of a new local shareholder, by 2017, it was ranked 5th by Oil & Gas Middle East. By 2018 it had more than 1,400 engineers across its 4 international engineering centres and as of last year, completed the Umm Lulu Super Complex, which ranks among the largest offshore oil platform in the world at 32,000MT and is almost as tall as London's Big Ben.

Source

[1] https://www.thenational.ae/business/energy/adnoc-extends-in-country-value-programme-to-target-more-smes-1.937282

[2] https://www.gulftoday.ae/en/business/2020/02/25/adnocs-in-country-value-programme-pumps-dhs44b-back-into-uae-economy

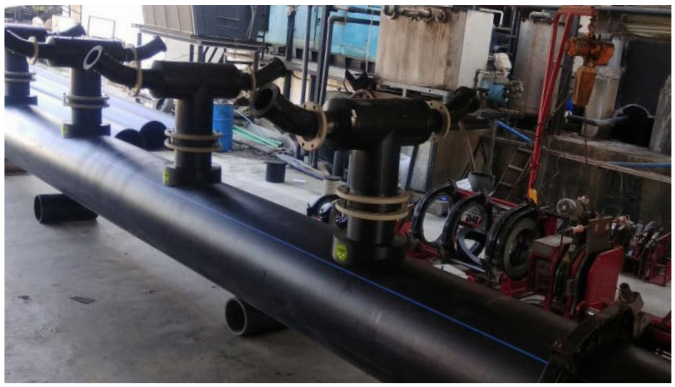
10 inch coated pipes for the Bu Haseer Full Field Development. (Courtesy of NPCC)

Coating of the Upper Zakum 42 inch pipeline being completed. (Courtesy of NPCC)

INDUSTRIAL

Sangir Plastics' "custom made" marine outfall diffusers using pipe and fittings produced from BorSafe™ PE100

by Sushil Mandhana (Sangir Plastics Pvt Ltd) and Srinivas Goud, Prashant Nikhade



Brine diffuser.

Sangir Plastics, based at Pardi in the State of Gujarat in Western India, produces a wide range of plastic pipes, fittings and sheets for both industrial and utility applications. Being at the heart of India's chemical industry, they are very familiar with the value of PE and PP materials in containing and transporting corrosive chemicals and have developed, with Borouge's support, a number of innovative solutions to challenging engineering problems.

They recently completed the fabrication of 'custom made' PE100 diffusers to replace stainless steel using the 900mm OD HDPE pipe manufactured for the Vizag Tuni Project from BorSafe™ HE3490-LS. Made from PE100, they have weight and corrosion resistance advantages over stainless steel while operating as a brine discharge outlet. PE100 is also more cost effective than stainless steel, which will still corrode after a period of time when exposed to such a corrosive environment. The diffusers maintain the correct dilution of the effluent with the main body of water thereby protecting the environment for as long as the outfall is in operation.

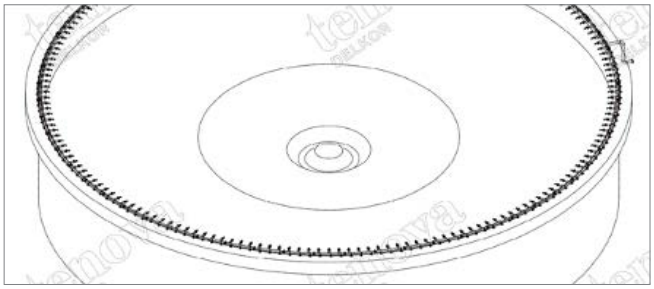
The overall length of the diffuser was 36m with branching of 315mm diameter which were all joined by electrofusion. The entire diffuser was made from BorSafe™ HE3490-LS PE100. Steel-insert flanges with thermoplastic covering were also used. The entire diffuser was tested at 8bar hydrostatic pressure, which is of the same rating as the pipe itself.

CIRCULAR DIFFUSER FOR FROTH SPRAY ASSEMBLY

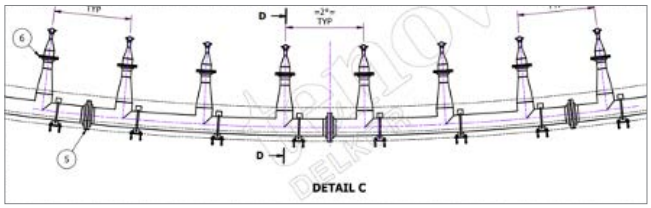
The team at Sangir also completed a unique export project that called for the fabrication of a circular diffuser with a froth spray assembly (see schematic and picture on the right). It was made out of 315mm PE100 sections again manufactured from BorSafe™ HE3490-LS. This design consists of 315mm diameter headers and 180 equally spaced nozzles of 180mm diameter.

When fully assembled, the circular diffuser measured 15.8m in diameter comprising of equal sections each of 2.9m length. To fix the nozzles, 180 electro-fusion saddles were used. Steel-inserted HDPE coated flanges were used in the assembly. Each of the 2.9m long segments were hydro-tested to 10bar. Due to the tight fabrication tolerances for this critical export order, electrofusion saddles were used as they ensured the main header pipes were not physically distorted or its strength compromised.

“The timely and successful delivery of this product to yet another customer again demonstrated the workmanship and quality that has always been our focus. It also demonstrates our capability to innovate tailor-made solutions backed by a high performance material such as the BorSafe™ HE3490-LS”, remarked Sushil Mandhana, Managing Director at Sangir Plastics Pvt Ltd.

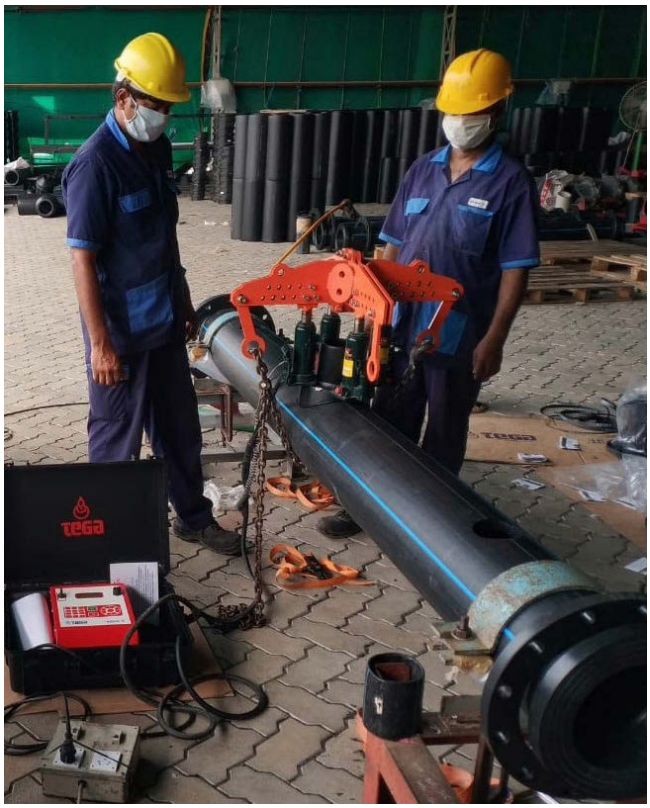


Schematic of nozzle arrangement for the circular diffuser for the froth spray assembly.



Schematic of pipe with nozzle details for the froth spray assembly.

Sections of the 2.9m long header pipes for the froth spray assembly.



Ensuring perfect ferrule mounting on pipe for forth spray assembly.

Investigative techniques for the identification of materials used in PE pipes

by Dr Nisha Antony (Borouge Innovation Centre)

INTRODUCTION

Polyethylene (PE) pipe materials in use today are highly engineered polymers designed to meet the challenging requirements for long-term applications. While the pipe value chain has benefited from the continuous evolution and improvements in PE pressure pipe materials, the issue of pipe failure due to the use of resin of substandard quality, caused by the intentional or unintentional mixing of 'similar' or different resins into the pipe material is still a problem faced in certain regions/market segments. It is therefore of utmost importance for the asset owners to have a surveillance mechanism to routinely check that pipes being supplied to them have not been made with materials blended in a manner that can deteriorate its physical properties and affect the long term performance of the pipe.

Borouge has established its competence in both polyethylene and polypropylene pipe material identification and has also offered the service of validating the 'fingerprint' of the material used to manufacture pipes and fittings. This service is offered to the entire pipe value chain and the following article gives an overview of the analytical techniques and methodologies applied to identify the material used when a pipe sample is received. An analysis flow-down criteria to differentiate the Borstar® virgin resin from other manufacturers' resins or unknown materials is also explained and examples from investigations of failed pipes received from end users are also discussed as case studies. We conclude with the repercussions of raw material mixing and contamination on pipe quality and performance.

PURPOSE OF RAW MATERIAL IDENTIFICATION

Material identification protocols are employed to understand the components present in the pipe, so as to derive correlations to properties and performance. Also referred to as Deformulation, Fingerprinting or Reverse Engineering – depending on the breadth and depth of scope – material identification protocols involve chemical, thermal, compositional, structural and morphological analyses to derive a complete design print of the polymer. Information thus generated from different techniques are put together in a systematic and coherent manner, and the material composition is carefully deduced. Forensic polymer science is the study of failure and root cause analysis of polymer products, in which material identification plays a central part.

Material identification protocols can be applied on pipe resin (pellets), freshly produced pipes, a pipe product that has been in use for any lengths of time, or a failed pipe. There are a wide variety of reasons for pipe raw material properties to vary from specification, i.e. from resin production to pipe manufacturing, and later on in the application environment as well. The whole scenario can be presented as a cause and effect diagram, as shown in Figure 1.

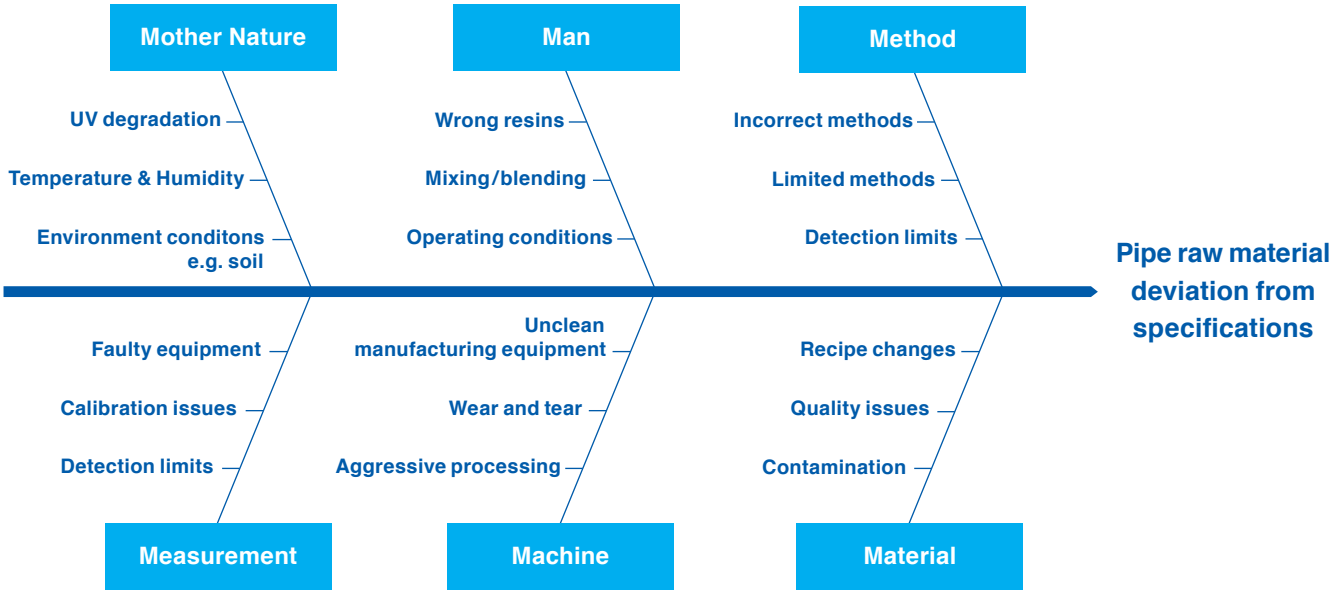


Figure 1: Cause and effect diagram for deviation of pipe raw material specifications due to multiple factors.

It is therefore of utmost importance to check the pipe material before and after the pipe is manufactured. The purpose of material identification for pipe products can also be summarised below:

(1) Verify that the pipe material is similar to what was declared
(2) Verify if the material has been blended or mixed, intentionally or unintentionally. If found to be blended, it is of interest to know:
   a. What has been mixed, and to what degree, using the base resin as reference
   b. Has recycled material been added? If yes, assessment of the content and composition of recycled material is an advantage
(3) Understand whether the material has been contaminated in any form. Most common sources of contamination are:
   a. Manufacturing equipment (resin or pipe): Residues from an improperly purged equipment, and unavoidable wear and tear are usual causes
   b. Packing, transport or any re-packing steps, especially for the resin
(4) In fresh and used pipes, material identification protocols help in the quantitative evaluation of additives, particularly antioxidants, and their condition. This allows an understanding of whether the active antioxidants present will sufficiently protect the pipe for the duration of its remaining life

The benefits of material identification are summarised in Figure 2.

MATERIAL IDENTIFICATION FLOW DOWN

Each resin producer uses slightly different components in the production of its materials. Differences in molecular architecture, type and content of additives and co-monomer, morphological characteristics with signatures of the base polymer and dispersed components are a few examples. Modern PE100 materials can have complex polymer structures, and contain dozens of formulation components. An analysis flow down followed at Borouge is given in Figure 3, classifying the overall pipe material characterisation approach in three different levels with progressively increasing levels of complexity. In each level, tests are conducted and matched against reference values. This analysis approach is highly sample and/or problem dependent, and may not require all of the techniques in each of the level shown below. On the other hand, additional techniques may be required for special cases. Based on case by case observations, the analysis techniques to be used are based upon the discretion of the expert analyst.

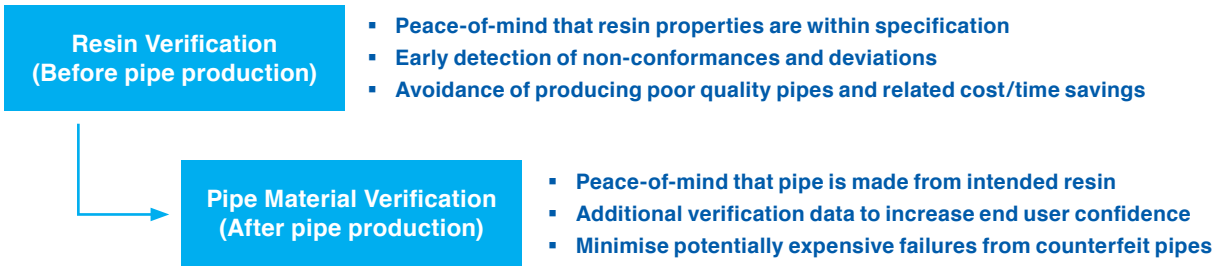


Figure 2: Benefits of material identification process.

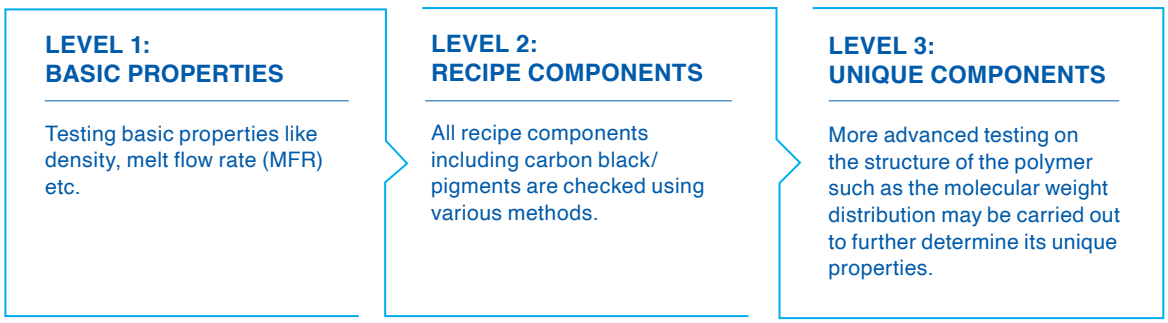


Figure 3: Analysis flow down for pipe material identification.

CASE STUDIES

Three case studies on failed pipes received from end users are detailed below. These examples are for illustrative and educative purposes only, and are not intended to represent any standard products produced by pipe manufacturers.

(1) Failed Pipe – Use of wrong material

Figure 4 shows two failed pipes received from an end user where the supplier claimed to be produced with HDPE PE100 pipe grades. These failed pipes have turned highly brittle and appear to be severely degraded. The sample failed basic level 1 tests which clearly shows it is very likely not made from standard pipe materials.

When it became clear that the failed pipes were not made from pipe grade HDPE or MDPE, level 2 tests were then carried out. These indicate that the material consists mainly of linear low density polyethylene (LLDPE). Commonly added fillers such as calcium carbonate ($CaCO_3$), titanium dioxide (TiO_2) and talc can also be detected by tests in this level.

(2) Failed Pipe – Use of mixed material

Instances of PE pipes made by mixing with cheaper or recycled material appear to be increasing in some regions, likely a result of resin cost reduction initiatives. Blending inferior quality resin into pipe materials has to be done with extreme caution. This is because blending can introduce morphological inhomogeneities into the resin, which in turn can lead to premature pipe failures. Photos of such a pipe sample received from an end user, which failed during service and is suspected of material mixing, is shown in Figure 7. The inner surface of the pipe is very rough. The observed failure is a brittle failure, in a random direction, and appears to be a rapid failure. Although the failure propagation from inner to outer side of the pipe is evident, there is no slow crack growth pattern, failure initiation points or micro-cracks on the inner surface, and therefore the failure is not primarily consequent of oxidative degradation of pipe material. Further, the failure does not lie along any of the processing defects seen on the inner surface.

Figure 4: Photographs of failed pipes received for material identification. [Note: For illustrative purposes only]

Detailed investigation of the product shows partial compliance to level 1 tests. As in the previous case, level 2 tests were carried out with seven different tests chosen for resin component verification, however, the sample failed all tests. The reasons for non-compliance of even the basic recipe components for a black HDPE PE100 pipe resin is immediately evident from light microscopy analysis. Internal morphology of the pipe material shows the presence of different types of particulates (amber/ brown/yellowish/black) in large numbers, as well as natural smears and natural domains (Figure 8). In polarised light microscopy mode, many of these natural domains show well-defined spherulitic structures, with characteristic appearance of that of polypropylene photopolymer. From level 2 tests, these spherulitic domains can be confirmed to be polypropylene homopolymer, and its origin is unknown.

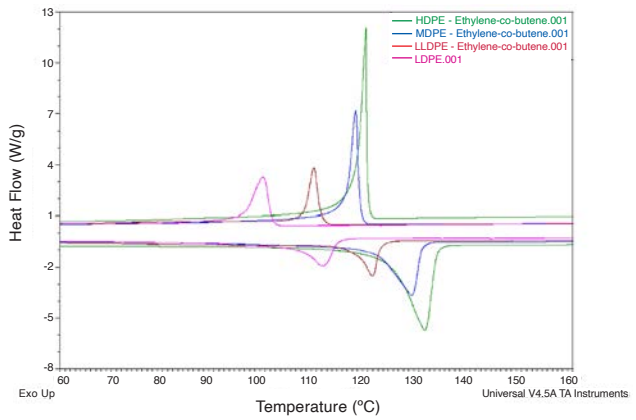


Figure 5: A comparison of the DSC thermographs showing melting and crystallisation profiles of different types of polyethylene.

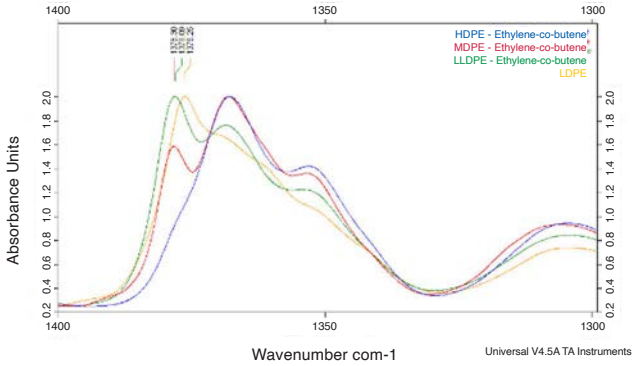


Figure 6: A comparison of the FTIR spectra showing co-monomer absorption region for different types of polyethylene.

When tests at level 1 were unable to sufficiently help the investigators fully conclude the type of materials used in making a pipe, combining it with results from tests in level 2 will usually be sufficient as shown in this example.

(3) Non-conforming pipe material – mild contamination

It is straightforward to conclude from analytical data of pipes produced with very different materials than the intended resins, or when there is large extent of blending with other polymers. It becomes more challenging, when resins are blended or contaminated with small quantities of similar materials. One such example of a borderline case of a pipe sample is explained in this section. All tests from level 1 passed requirements for this sample. At level 2, most tests passed but there were some exceptions noted in its composition.

To understand the reasons behind these slight deviations, dynamic rheology and advanced elemental analysis were carried out with tests from level 3. Results from level 3 gave a clearer confirmation that the basic polymer is the same as reference. Figures 9 & 10 shows some of the analysis done on the pipe sample in this example.

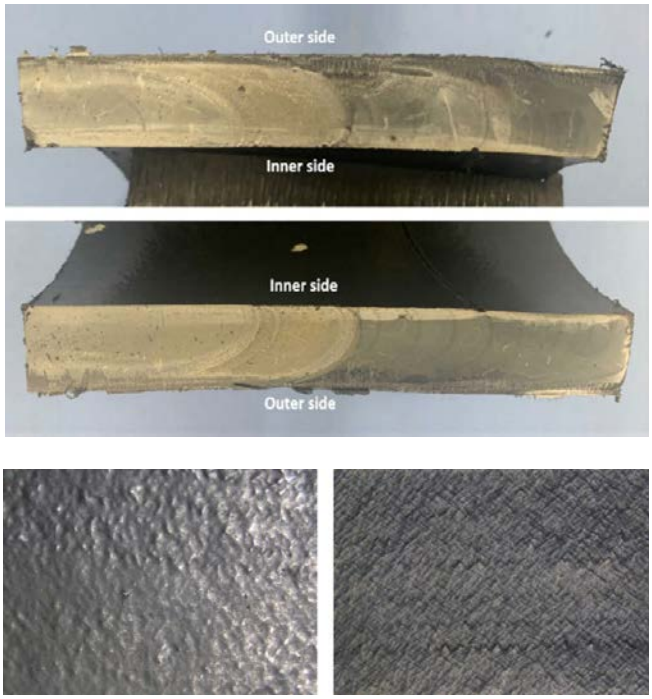


Figure 7: (Top) Photograph of a failed pipe sample suspected of material mixing. (Bottom) Rough inner surface of the pipe consequent of rheological instabilities and processing defects. [Note: For illustrative purposes only]

Figure 8: Light microscopy images showing internal morphology of the failed pipe in Figure 7. Different types of coloured particles and characteristic spherulitic domains of polypropylene are seen.

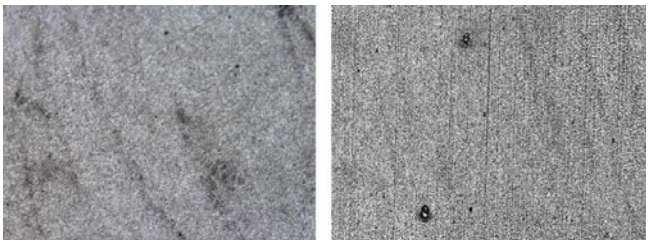


Figure 9: Light microscopy images of sections taken from a pipe sample with slight contamination from unknown sources.

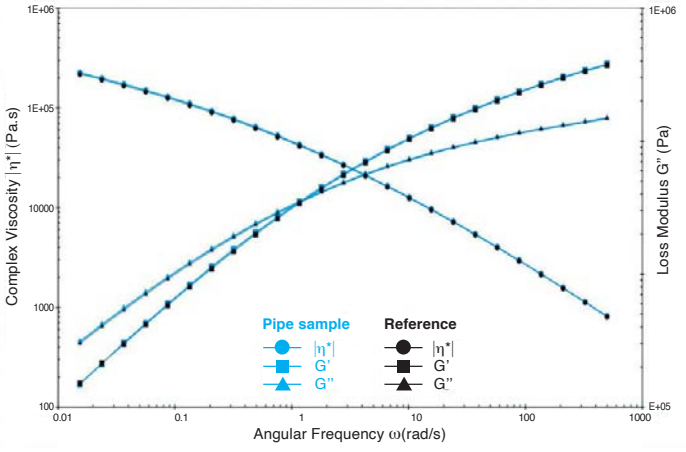


Figure 10: Frequency sweep curve of material from a pipe sample (blue curves) with reference (black curves), where a perfect overlap is observed.

CONSEQUENCES OF RAW MATERIAL MIXING AND CONTAMINATION

The consequences of raw material mixing and contamination can range from inferior and/or inconsistent mechanical properties, surface and/or bulk defects, and eventual product failure. The few examples of pipe samples received from end users highlight some of the implications.

Poor/inhomogeneous mechanical properties

Pipes made of mixed or contaminated material often exhibit large variation in impact and tensile properties within different regions of the sample. Such an example is shown in Figure 11(a) for a pipe material having a different composition from virgin material.

A large scatter of elongation can be seen for test specimen taken from different regions of the pipe. Such failures just after yield point, without a decrease in yield strength is often attributed to material inhomogeneity caused by contamination, voids due to poor interfaces (e.g. inorganic particles) or mixing of two incompatible materials. Figure 11(b) shows comparative data for a reference pipe with a typical stress-strain curve of a virgin PE material, i.e. yielding, natural drawing and strain hardening is observed.

Surface Defects

Figure 12 shows micrographs of surface defects found on pipes received from end users, all of which were produced with material with quality issues. Readily observable coloured particles, hard particles and inclusions, blisters and pores, and surface roughness caused by processing difficulties can be seen.

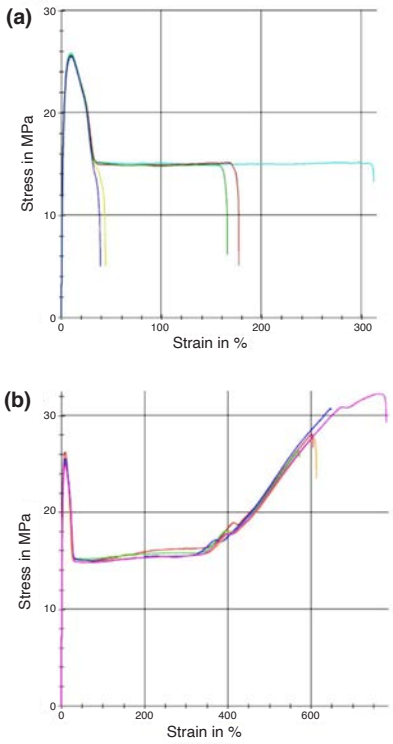


Figure 11: Stress-strain curve for (a) pipe made with mixed or contaminated material showing large scatter in tensile property (b) comparative data for a reference pipe made with virgin PE material. [Note: Data for illustrative purposes only]

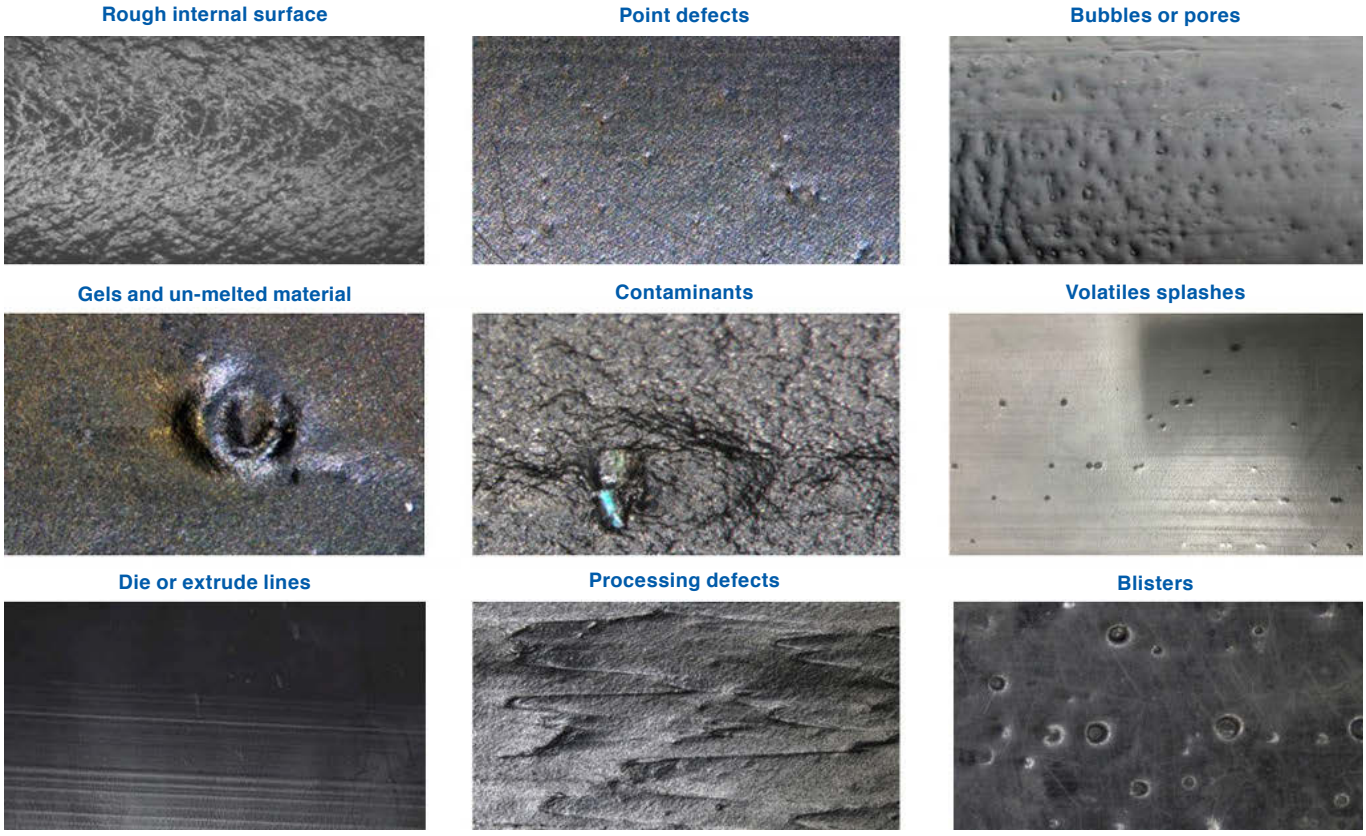


Figure 12: Selected micrographs showing surface defects on pipes produced with mixed or contaminated material. [Note: For illustrative purposes only]

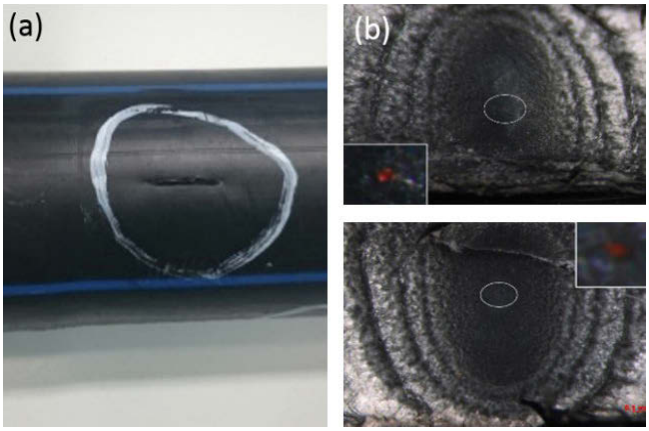


Figure 13: (a) Slit type brittle failure seen on the pipe surface. (b) Micrographs of the two sides of failed area, after opening up the crack. Slow crack initiation from a red-coloured inclusion can be seen. [Note: For illustrative purposes only]

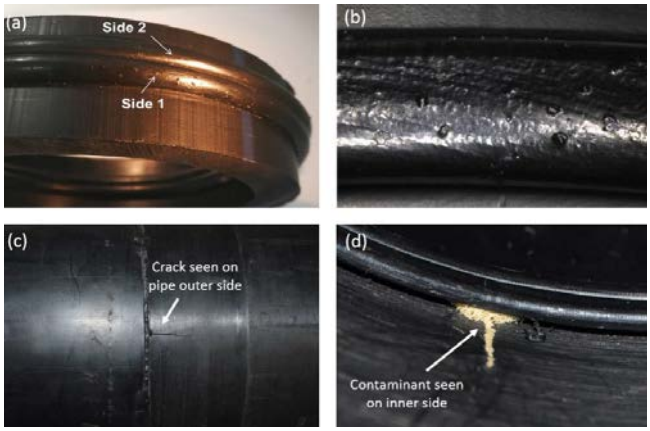


Figure 14: (a) and (b) shows photographs at two different magnifications for a very rough weld bead, caused by material inhomogeneity. (c) shows photograph of a cracked weld region as seen on the outer side of pipe. (d) shows part of a foreign contaminant in the crack and sandwiched into the weld bead, as seen on in the inner side of pipe. [Note: For illustrative purposes only]

Failure Initiations

Brittle, slit-type failures in pipes caused by defects, contaminants or inclusions that act as stress concentration points are well reported in literature. These stress concentration points turn into initiation regions for slow crack growth, leading to its ultimate failure. Slow crack growth can occur in pipe as well as fusion joints. An example of a red-coloured inclusion in the pipe material leading to slow crack initiation and propagation is shown in Figure 13.

Weld Failures

The presence of contaminants can severely degrade the integrity of butt fusion welding. Foreign particle inclusions and large-scale morphological inhomogeneity have been known to be causes of failures in butt fusion joints. Figure 14 shows two examples of inferior weld joints caused by inhomogeneous materials and contaminants present in the weld area.

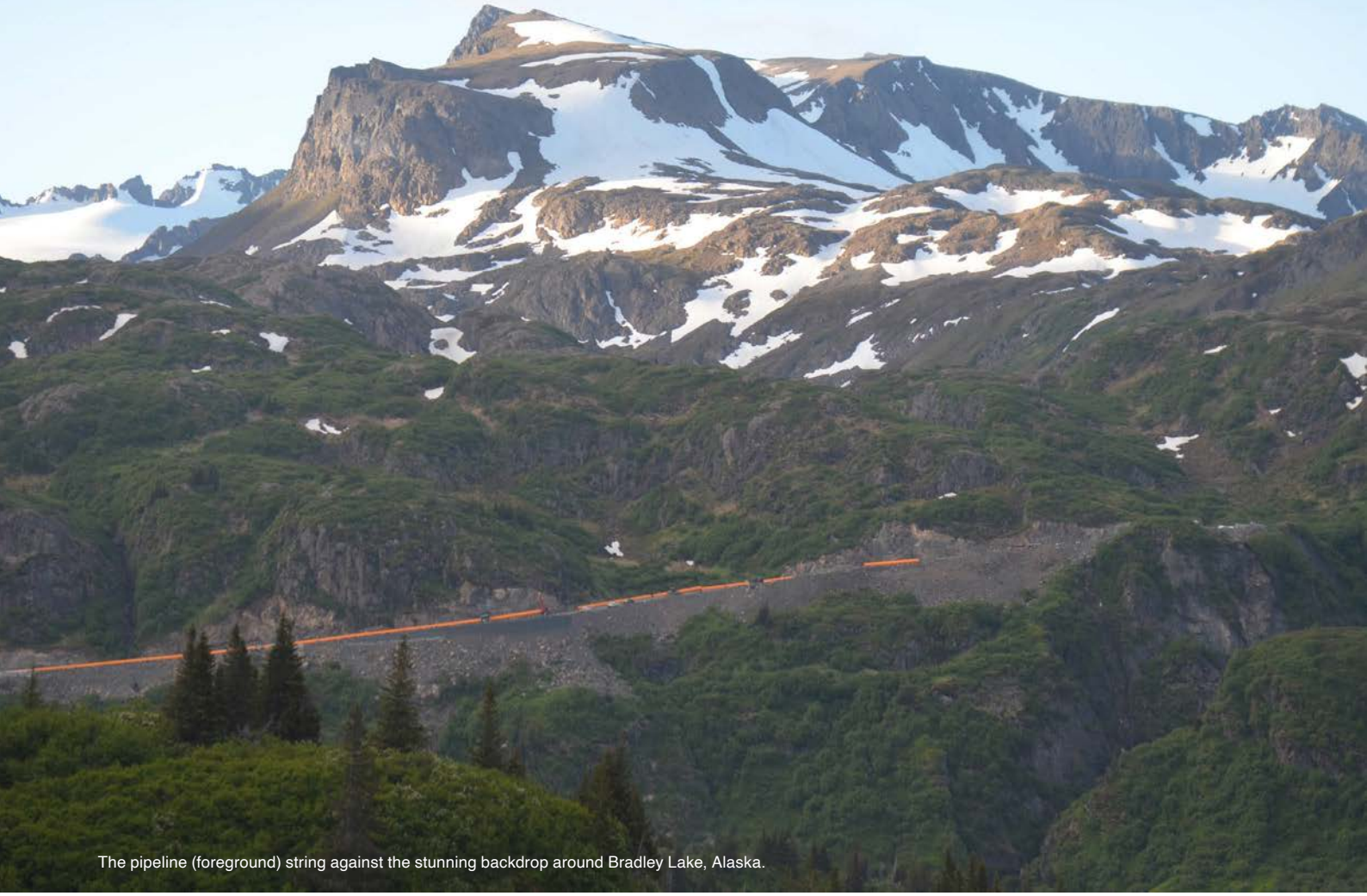
CONCLUSION

Polyolefin pipes are usually designed to operate for 50 years. However, their integrity and lifetime can be compromised even when a small extent of blending or contamination is present. This article attempts to explain how a pipe or resin sample may be characterised using a detailed step-by-step technique. A systematic flow-down to cross-check the authenticity of material used to manufacture the pipe comprises of three steps: (1) testing of basic properties, (2) partial or full identification of major resin components and (3) verification of unique structural or compositional components in the resin. Only if the pipe material achieves the established or required target value for each test based on international standards and/or internal methods, may subsequent steps be carried out. We used several case studies to demonstrate how the systematic flow down is employed in a typical analysis and allows customers and end users to understand the benefits of Borouge's gated flow-down methodology for them. From the case studies shown, it is recommended that the key testing points for pipe products are (1) resin analysis before pipe extrusion and (2) verification of key properties after pipe production/installation. Detailed data generated from material identification protocols can support decision making and position the pipes for the right applications. Adherence to such protocols can prevent any non-conforming pipes from being installed in the field.

INDUSTRIAL

PE100 supplied by UPI successfully installed for the Bradley Lake hydro expansion project

by KH Lou



The pipeline (foreground) string against the stunning backdrop around Bradley Lake, Alaska.

In the November 2019 edition of BorPipe 46, we featured a first-of-its-kind SDR21 1,600mm diameter orange PE100 made from the BorSafe™ HE3492-LS-H high stress crack resistant material by Union Pipe Industries in Abu Dhabi that was to be shipped all the way to North America for a hydroelectric project. Orange coloured PE100 is usually used in sizes below 1,000mm diameter for municipal gas distribution and never in such large diameters.

The team comprising of McElroy, ISCO Industries, Orion Construction Inc. and GMC Contracting recently completed the installation of the pipes on site in Alaska. Welding the pipe strings in the hilly terrain was achieved by the equally impressive Talon 2000, McElroy's largest machine designed specifically for fusing the large diameter thermoplastic pipes. The Talon 2000 is a self-propelled vehicle with the unique ability to safely lift pipes from the ground, position it to be fused and move from joint to joint

Polyethylene is more flexible compared to other materials even in such sizes (1,600mm OD) and can snake around the tight corners as it follows the contours of the terrain, making it a very practical choice.

The Talon 2000 in action as it effortlessly moves down the pipeline string while welding each joint.

The contractor made an excellent choice of selecting PE100 with higher resistance to crack propagation because site conditions may sometimes cause potential pipeline damage.

down the pipeline. It features a quick-action trimer and an electric-powered indexer to accurately and safely position the heater and trimer into the fusion machine. This challenging project, carried out in the breathtaking scenery on Bradley Lake, provided an excellent opportunity to demonstrate the value that the Talon 2000 brings to installation teams on the field.

The 2.7km pipeline will divert glacial runoff from Battle Creek to the Bradley Lake Dam and is part of the USD 46 million Bradley Lake hydropower expansion that began in 2018. It will increase the hydro facility's production by 10% and is scheduled to be completed by August 2020.

CONSTRUCTION

China Lesso confirms Borstar® RA140E's higher extrusion throughput and reduced energy consumption

by Henry Zhou & Mark Yu

Production floor. (Courtesy of Lesso)

PP-R mixed with grey colour masterbatch.

The China Lesso Group is a conglomerate supplying home furnishing and building materials in China. It had revenues in excess of USD 3.8 billion in 2019 from its product portfolio of piping, sanitary ware, kitchen ware, doors & windows, water purifiers, fire-fighting equipment, valves, home furnishing and other building materials. They own subsidiaries locally and overseas in the US, Canada, Indonesia, India, Uganda and Malaysia. It has more than 30 years of experience in the production, research and development of pipe products and supplies polyethylene pipes, uPVC, PP-R plumbing pipes and aluminium-plastic composite pipes among others. With a total production capacity in excess of 2.5 milion tonnes of all types of pipes per annum, the Lesso Group is one of the largest suppliers of plastic pipes in China and the world.

Setting	Unit	Reference A	RA140E	Reference B
Screw speed	1/min	107.14	105.63	81.97
Motor load	%	59.03	58.07	58.29
Melt pressure	MPa	18.24	17.68	17.58
Melt temperature	°C	209.8	210.2	209.8
Haul off speed	m/min	17.53	17.53	13.85
Weight per metre	kg/m	0.148	0.15	0.149
Throughput	kg/h	155.65	157.9	123.83
Current	A	98.53	96.95	97.41
Cooling water temperature	°C	30	30	30
Barrel temperature	°C	195-200	195-200	195-200
Tooling temperature	°C	195-205	195-205	195-205

Table 1: Parameters of the extrusion line for the three PP-R grades.

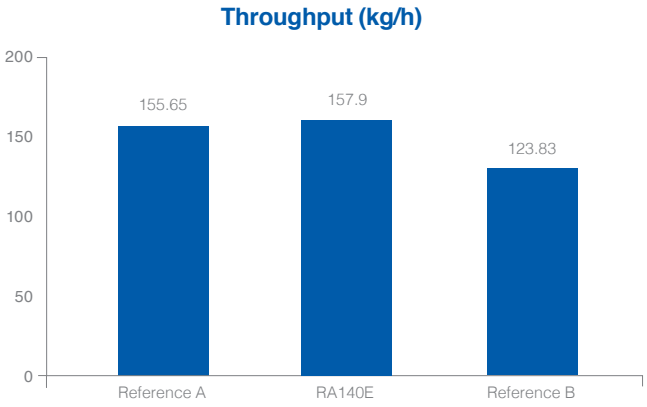
The Lesso Group and Borouge have a very long and successful partnership and they recently decided to validate the performance of the Borstar® RA140E PP-R material in their Guangzhou plant. Two other PP-R materials that are commonly used at the same plant were selected to be evaluated on the same extrusion line. The line had a screw diameter of 65mm and L/D ratio of 38. Identical 2% grey colour master batch was mixed with each PP-R material before extrusion.

Pipes of 20mm diameter were produced from all PP-R materials (designated: Reference A, Reference B and RA140E). The production line was allowed to stabilise for several hours and was adjusted to fit the different optimised parameters for each material. Table 1 summarises the key extrusion line parameters for the three different PP-R materials.

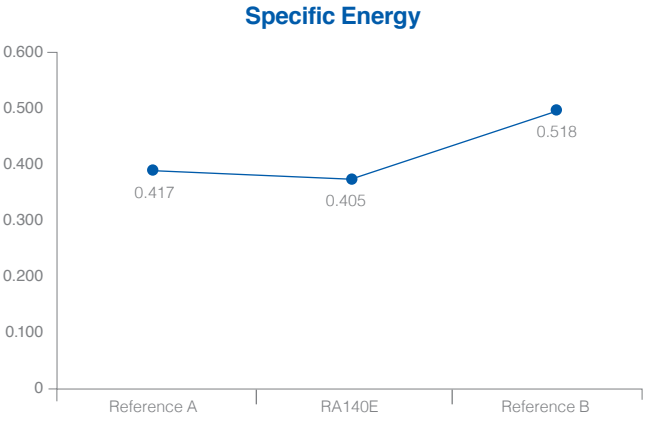
It is shown in Table 1 that RA140E has a 1.4% higher throughput compared to Reference A and 21.6% higher compared to Reference B.

Since the extrusion line does not record the specific energy directly the specific energy is calculated based on the formula below:
Specific energy = (total power x motor load) / throughput.

Through this exercise on this particular machine, we demonstrated that the specific energy to extrude RA140E is 2.9% lower than reference A and 21.8% lower than reference B. This validation exercise was carried out partly in response to the Lesso Group's initiative to continuously reduce the environmental footprint of its large production operation and also to demonstrate to its customers that environmental and resource protection is an important criteria for the entire group. The unique properties of Borstar® RA140E thus allowed the customer to improve productivity while reducing its energy consumption.



Throughput of the different PP-R materials on the extrusion line.



Specific energy comparison.

Parameter	Unit	Reference A	RA140E	Reference B
Specific energy	KWh/kg	0.417	0.405	0.518

Table 2: Specific energy calculated for each material in the trial.

CONSTRUCTION

K-Wasser starts up PP-R pipe production with Borstar® RA140E

by Amos Tay

PPR pipes & fittings made from Borstar® RA140E.

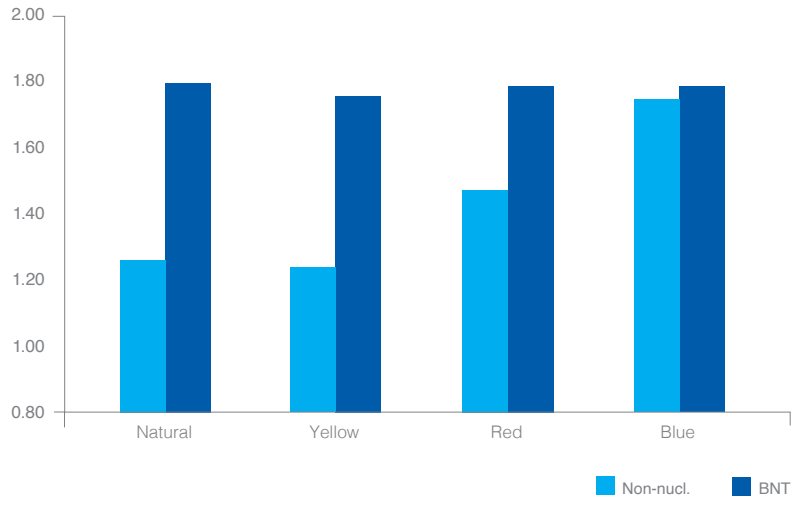
K-Wasser Technology Company Limited (KWT), located in Rayong, Thailand, is a major distributor of polypropylene random (PP-R) hot & cold water plumbing systems. A sister company of K-Wasser Germany, KWT focuses on the design, development, production and sales of PP-R building water supply and drainage products, and has established a successful and reliable track record with its customer base across the world. Until recently, all its products were sourced from its German parent company. The K-Wasser Germany and its group of approximately 30 associate companies boasts an annual turnover exceeding 1 billion Euros. In 2018, KWT decided to expand its business into PP-R pipe manufacturing, establishing a 5,000 square metre manufacturing plant.

Due to unforeseen circumstances resulting in administrative delays in KWT's plant registration, the start-up of the new plant had to be pushed back by four months later than originally scheduled. KWT was therefore extremely keen to shorten the usual production start-up cycle time, so as to catch up on its overall production timeline. A new PP-R pipe production plant may take up to three months to stabilise production, especially in a new location with less experienced production workers.

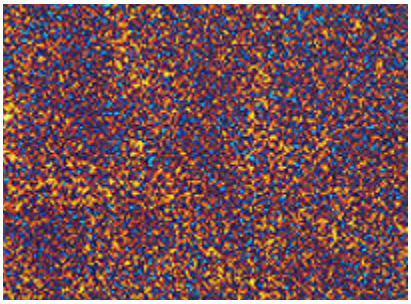
KWT contacted Borouge to support them with the start-up as their parent company, K-Wasser Germany, had very positive experience with the Borstar® range of PP-R pipe materials. With onsite technical support from Borouge, KWT's plant took less than a month to achieve successful PP-R pipe production utilising Borstar® RA140E.

Potential technical issues were also avoided as KWT decided to only use compatible master batches that were optimised with RA140E to achieve smooth and cost efficient production. Taking into consideration logistic and delivery lead times, KWT selected the AMPIPE-R master batch that was already tested with the RA140E base PP-R material and was coincidentally manufactured in Rayong as well. This combination proved optimal and KWT was able to:

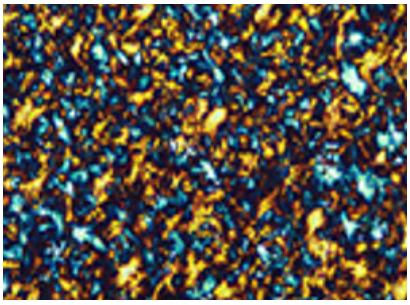
(i) Achieve excellent processability and pipe impact properties
(ii) Run a high extrusion output with greater energy savings
(iii) Access multiple material stocking options with shipment times of less than 1 week
(iv) Obtain quick response time for colour matching and colour correction with short lead time for commercial delivery of colour master batch
(v) Minimise material scrap rates



Alpha nucleation leads to finer crystalline structure and shrinkage independent of pigment.



Alpha nucleated PP-R.



Non-nucleated PP-R.

The Borstar® RA140E alpha-nucleated PP-R has an improved stiffness to toughness ratio. The innovative Borealis Nucleation Technology (BNT) gives the product superior shrinkage properties independent of colours as well as better pigment dispersion. In addition to this, the higher crystallisation temperature means that the cycle time for the production of injection moulded fittings can be reduced by up to 20%.

Ampacet, whose production facility is also conveniently located in Rayong, provided KWT with specially formulated PP-R master batch that provides flexibility in the colouration of the pipes made with RA140E. Because these master batches are tailored to be used specifically with RA140E, they provided KWT with an option of starting up production quickly and efficiently with very little rejects thus ensuring a final product that would meet all the stringent end user and regulatory certifications.

Mr Wang Yu, Production Manager at KWT, said, “Our contractors gave us feedback that our PP-R pipes made using RA140E enables them to more easily perform fusion jointing and speeds up their installation. In addition to this, we achieved time savings of 3 seconds per cycle when injecting fittings using the RA140E compared to when using another PP-R material, due to the faster crystallisation of the material.”

KWT was thus able to start-up their production quickly and efficiently with very little rejects thus ensuring a final product that would meet all the stringent end user and regulatory certifications. All KWT PP-R pipe products are currently fully NSF and WRAS certified.

KWT is extremely confident that the current partnership with Borouge and Ampacet will be very helpful in allowing the company to further expand its production capacity and target new markets in the fast growing region. KWT is focused on its three key pillars – quality, productivity and meeting the highest regulatory compliance. As Mr Peng, Managing Director of KWT noted, “Leveraging on KWT’s German production track record and brand recognition in the market with innovative materials such as the Borstar® RA140E and additives from Ampacet produces a winning combination that will bring them to the next stage of growth.”

W4W

Delivering a safe and sustainable water supply to more than 50,000 residents in Maputo

The pipeline being installed. (Courtesy of WSUP)

Mozambique is one of the world's poorest countries, with half the urban population living below the national poverty line and only one quarter having access to piped water. At the same time, increasing urbanisation is placing ever-growing demands on water services. There is therefore a critical demand for a sustainable, good quality water supply for residents.

In the Greater Maputo region, which includes the country's two largest cities – Maputo and Matola – there are 16 small scale operators (SSOs) who run local water supply systems on behalf of FIPAG, the national water infrastructure owner. This model – where a utility company subcontracts supply services to SSOs – is common in countries such as Mozambique, as the SSOs are better able to meet the needs of large numbers of low-income consumers than a major organisation such as FIPAG. The SSOs' services are therefore critical for the low income residents to receive water. However, the SSOs had raised concerns that both the quality and quantity of the water they distributed had declined. Borealis and Borouge, through Water for the World, saw an opportunity to fund a project that would significantly improve the local water system and the residents' lives.

Water & Sanitation for the Urban Poor (WSUP) initiated the project and implemented it on the ground, as part of its wider programme in Mozambique. In addition to Borealis, FIPAG and the SSOs, other key stakeholders include Borealis pipe customer POLITEJO, which manufactured the HDPE pipes used to upgrade the network, employing Borealis' PE100 material. Several consultants, contractors and works supervisors also supported the planning and implementation of the work.

Having assessed the potential works needed in each of the 16 SSOs, 12 were selected as priorities for the project. The works carried out included constructing tertiary water supply networks using HDPE PE100 water pipes, repairing existing water tanks and training the SSOs' staff to manage, operate and maintain pipeline systems. The project also supported FIPAG, so it could more effectively monitor the water quality the SSOs' delivered, and increase the SSOs' capacity to provide a good quality water supply to their customers. The works were completed in November 2019, with provisional handover to FIPAG. The final handover was signed in May 2020, following a six-month provisional guarantee period.

The project has substantially improved the water supply for local residents. Particular benefits include better water quality, reduced water losses and, in a number of the local areas, a doubling of hours of service each day. Customers without water had their supply reinstated and the overall social pressure on the system was reduced. In total, the project has benefited nearly 51,700 local residents. In addition, more than 150 experts received technical training provided by Borouge technical experts over the course of the project, on topics ranging from the design and installation of PE100 pipes to managing water quality and reducing water losses.

The project also ensured that the local water supply infrastructure is more resilient and requires less maintenance, due to the added value provided by the HDPE PE100 pipes. Although these pipes are initially more expensive than traditional materials, they offer substantial long-term advantages. HDPE pipes come in significantly longer lengths of over 50 or 100 metres, against six metres for the alternative materials. This means fewer junctions, easier installation, less leakage and lower maintenance. Joints between pipes are permanently fused, further reducing the likelihood of leaks. HDPE pipes are also becoming popular for household connections and smaller tertiary networks, with mechanical joint fittings being widely available in the local market, reducing the need for international orders.

Residents benefiting from the water supply project. (Courtesy of WSUP)

Robin Bresser, Borealis' Head of Marketing Pipe, says: "We are delighted to have been able to support this project. Using high-quality HDPE pipes made from our BorSafe™ PE100 material means that this upgraded system will last longer and need less maintenance than a system using rigid materials. This will help to ensure a sustainable water supply for local residents for years to come."

Carla Costa, Mozambique Country Programme Manager at WSUP: "This vital project enables improved access to water for low-income residents in Mozambique's major cities. The upgraded system, providing a more reliable supply of better-quality water, will make a material difference to local people's quality of life."

Source

https://www.waterfortheworld.net/projects/delivering-a-safe-and-sustainable-water-supply-to-more-than-50-000-residents-in-maputo

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