A Borouge newsletter for the pipe industry

BorPipe

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Providing a new water supply to a second community in Nepal

GPPA provide plastics engineering course in Cairo

Wim Roels and Lynette Leong opening the "Troubled Waters" exhibition

Borouge PP and PE materials produce great tanks!

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SHAPING the FUTURE with PLASTICS

Editor's Note

Firstly I would like to welcome Wim Roels as the new CEO of the Borouge Marketing Company, who took over from William Yau at the beginning of July. I would like to thank William for his support and in particular for his interest in the "Water for the World" initiative and the BorPipe newsletter and wish him good fortune in his new role within Borealis. Wim Roels is well known to many of us as he has worked in a number of positions within Borealis since he joined them in 1989 and I am sure that he will be talking to many of you over the coming months.

One of Wim Roels' first duties on Monday 4th July was to cut the tape on the "Troubled Waters" photographic exhibition which was staged in the entrance to the Borouge Pte headquarters building during Singapore Water Week. This exhibition by the well known Belgian photographer Dieter Telemans, highlights the global water crisis and gives an insight into its causes and consequences. After Singapore Water Week the exhibition was shown at a number of other sites around Singapore and later in the year will be shown to the Borouge office staff in Shanghai.

In early July the 4th Singapore International Water Week took place and 1500 delegates from all over the world attended the different conference sessions to discuss water scarcity and the potential impact of climate change. In a number of dedicated Business Forums the specific needs of the different regions around the world were debated by a panel of senior politicians and experts in water and wastewater management.

Later in August over 2,500 politicians, business leaders, representatives from international organisations, scientists, mayors and water professionals gathered in Stockholm, Sweden for the annual World Water Week, which this year focused on " Water in an Urbanised World." In one full day session nine African Ministers were present to listen to a number of speakers address these issues and present some solutions in sub-Saharan Africa. An important contribution was made by Sam Parker CEO of Water and Sanitation for the Urban Poor (WSUP) who showed their success in bringing water and sanitation to the poor in three African cities and called upon representatives from local service providers in these cities to attest to their success.

Industrial projects continue to feature in BorPipe and in this issue you will see Borouge and Borealis PE and PP materials being used for a large diameter sea outfall for a power station in Europe and for tanks and tank linings for the Indian chemical industry. Polyolefin corrosion protection systems for a number of large oil and gas pipelines are also covered including the offshore lines within the massive Gorgon Gas Field project in Australia.

Also in this edition we feature two articles from experts in their own specific fields. In the first Dave Whittle, the Development Director of Swagelining Limited, talks about the great potential for Swagelining ™ technology outside of the standard utility business and what they are doing in his company to exploit these opportunities. In the second Steve Beech who is chairman of a number of ISO and CEN committees and working groups brings you up to date with the latest changes to the plastic pipe specifications.

David Walton
Marketing Manager
Business Unit Pipe

Contents

Borouge PP and PE materials produce great tanks!

Some of the tanks produced from Borouge materials using the latest spiral winding technology at Jet Fibre Pumps & Equipments Pvt. Ltd

Jet Fibre Pumps and Equipments Pvt. Ltd. was established in 1993 in Ahmedabad, Gujarat, India as a manufacturer of PE and PP industrial systems including a wide range of storage units and tanks. Since that time they have become experts at producing tanks from 300mm to 3600mm diameter with a capacity of up to 60,000 litres, using the latest spiral winding technology. Recently Jet Fibre Pumps have carried out a number of trials using the latest Borouge PP-B and PE100 materials and gained improvements in both quality and production efficiency.

In the first trial they made a seamless transition from Borealis BorECO™ BA212E PP HM to the same grade of material produced in Abu Dhabi by Borouge. They see many advantages in using this higher stiffness material in both processing efficiency and cost structure.

They also switched from a competitor's PE80 material to BorSafe™ HE3490-IM PE100 material for the production of spiral wound PE tanks. Using the Borouge material they were able to produce a high quality tank with a very smooth surface at a 10% higher output compared to even the PE80 material.

Commenting on the trials, Mr Amrut Patel of Jet Fibre Pumps and Equipments Pvt. Ltd. stated that: ***"Clearly the Borouge materials bring many benefits to us and our customers in improvements in mechanical properties and processing."***

Borouge strengthens its leadership in India's tea and coffee plantations

The Zurrantee tea plantation near Darjeeling, India

200mm rising main pipeline erected with mechanical clamping

The green and undulating tea and coffee plantations of India are extremely picturesque and are visited each year by many tourists. They are also very important to the country's economy but in recent years the task of producing high quality produce has become more difficult due to the increasingly erratic weather conditions. In these circumstances the quality and effectiveness of the irrigation system becomes extremely important to the profitability of the plantation.

Plantation owners tend to favour the use of semi-permanent sprinkler irrigation systems using a mixture of buried or fixed mains and portable sub-mains and laterals. In recent years polyethylene pipes have been used for both elements of the system combined with polyethylene injection moulded quick release couplings for the portable sub-mains and laterals. This enables the irrigation systems to be moved from one area to another depending upon the needs of the plants.

The Zurrantee Tea Estate in the Dooars foothills close to Darjeeling is typical of the many tea plantations in this area which is a very popular tourist destination. Recently they decided to install a semi permanent irrigation system covering 159 hectares of the estate which was supplied by Hallmark Aguaequipments Pvt. Ltd. The system was designed completely in PE100 materials by leading consultant Mr. RN Chatterjee. The water is drawn from the Neora River using a pump capable of delivering 400 gallons per minute at a 95 metre head and carried through a network of mains, sub-main and lateral lines to the sprinkler heads which irrigate the crop.

All the pipes and fittings in the project were manufactured from Borouge BorSafe HE3490-LS and BorSafe HE3490-IM PE 100 grades respectively. The 200mm diameter main pipeline was installed in a fairly narrow strip through fairly tough terrain and is subjected to constant water hammer due to the elevation changes. The dual feeder mains were installed one on top of the other using specially designed mechanical supporting clamps fixed into the steeply sloping terrain because

of the working space constraints. Jointing of these mains was by butt welding and special care was taken to ensure that the welds were of the highest quality as the pipes would be subjected to considerable axial forces. The portable irrigation sub-mains and laterals were 160 and 110mm diameter PE100 pipes 6 metre long fitted with quick release couplings to connect to each other or to one of the many other components in the system. In total 30 sprinkler heads were supplied and the overall length of the pipework was over 5.4km.

The system operates on a rotational basis to cover each part of the 159 hectares every 17 days during the dry periods during the year. Using the system in this way the yield has increased to 60 tons which is considerably more than in previous years. In addition they are able to obtain two additional pickings of tea which considerably increases income as leaf produced during the normally lean periods fetches considerably higher prices.

Utilising Borouge compounded PE100 material ensures the highest quality for the pipes and fittings which in turn ensures the highest possible durability for the system operating in relatively tough above ground conditions. Using the higher performance of PE100 enabled the designer to minimise the cost of the system whilst meeting all the pressure and flow requirements of the system and optimising pumping costs.

Borouge board members pay tribute to Jain's initiatives in agriculture

Members of the Borouge Pte Board and their hosts during their visit to Jain Irrigation in India

Early in June 2011 Borouge Pte held its Board Meeting in Mumbai, India. During their visit the board members expressed keen interest to visit Jain Irrigation, which has become a global company in manufacturing plastics pipe systems and a major innovator in the micro irrigation market.

The Borouge board members met with Jain Managing Director Mr. Anil Jain and paid tribute to the initiatives the company had taken to improve water efficiency in agriculture. With a turnover of US$820 million and a global workforce of over 7000 employees Jain Irrigation has a presence in 120 countries. In addition to their manufacturing plants Jain have demonstration farms in several locations in India and overseas where they can test their latest irrigation developments and demonstrate the benefits to local farmers. In addition to plastic piping manufacture Jain has diversified into a number of other businesses including the manufacture of plastic sheets, tissue culture products, processed fruit and vegetables and solar heaters and lanterns.

Borouge and before that Borealis, have had a very long standing and successful relationship with Jain Irrigation and the board members further reinforced our commitment to our key customers and our determination to continue to innovate and develop new plastic materials.

An update on the International and European Specifications

Steve Beech,
Chairman of CEN TC155/WG 12

At the recent PE100+ Association Advisory Board meeting in Cambridge the editor caught up with Steve Beech who for many years has been involved in the development of International and European Standards. Taking this opportunity the Editor asked him what was happening at the ISO and CEN committees and were there any hot issues coming up for discussion soon.

Steve I know that you are currently involved in a number of standards committees, can you tell us how you came to be involved and which ones you are currently working in?

When I joined the Pipe Technical Service and Development team at BP Chemicals in 1985 I worked for Bill Allwood who was at that time responsible for most of the standards work in ISO/TC 138. I was gradually phased into this role as I obviously possessed the right qualities – some might say boring and pedantic!

At that time we were developing the first UK specification for polyethylene drinking water systems (WIS 4-32-03), which was introduced in 1985 and significantly helped with the development of the UK PE water pipe market. The first ISO committee I joined was the Rapid Crack Propagation Committee of SC4 chaired by Philippe Vanspeybroeck back in 1986. This involvement grew and now I am a member of all the principle ISO/TC 138 Sub-Committees and chair some of the Working Groups involving polyethylene pipe systems and test methods. The development of the CEN European standards started around 1989 and my main involvement was with TC 155/WG12 for PE water systems. I became chairman of this group in 2008 and my remit now covers PE pressure pipe systems for gas, water and sewerage.

The main PE pipe standards at ISO for gas and water pipes are ISO4437 and ISO4427 – can you give us an update on these specifications?

All ISO standards are reviewed every three years and revised if this is deemed necessary. In the most recent review of ISO 4437 for PE gas pipes in 2010, it was decided to revise the standard and at the same time incorporate the PE fittings standard ISO 8085 to produce a system standard in four parts. This work will start later this year in ISO/TC 138/SC4/WG3 and I am the chairman of this group. As the ISO 4427 PE water system standard is already produced as a systems standard no revision was deemed necessary in the review of this standard.

It is important to recognize the contribution that these standards have played in the successful development of the PE pressure pipe markets all around the world. I think that water and gas engineers have a great deal of confidence in these specifications and very few problems have been reported where these standards have been applied. The only major failures that I am aware of are where poor quality non conforming or non-compounded materials have been used, which is why the standards strictly specify that only approved PE compounds shall be used for the production of pressure pipes.

And what is the situation for the equivalent CEN standards to these?

The equivalent European standards are EN 1555 for PE gas systems and EN 12201 for PE water, which were first published as system standards in 2003.

In 2008 the standards were reviewed and it was decided to revise the documents to take into account the higher requirements already introduced into the ISO standards. The task was given to the dormant TC 155/WG 12 committee and I was asked to be the chairman of the group. The work on EN 1555 gas has been completed and Parts 1 to 5 have been published. In CEN guidance on test schedules is provided in Part 7 'Assessment of conformity' and I expect publication of this final part early next year. The revision of EN 12201 has followed and Parts 1/2/3/5 are currently being finalised for publication in September. Part 4 covering valves will be subject to formal vote before proceeding to publication and work on the Part 7 will follow after agreement of the equivalent gas document.

I know that Hot and Cold water pipes specifications cover a wide range of plastic materials but what is the current situation for PP-R and PEX pipes?

The EN ISO system standards for Hot & Cold water do indeed cover a wide range of plastic materials and were first published in 2003. EN ISO 15875 for PE-X Hot & Cold Water systems has been confirmed in a subsequent review. The EN ISO 15874 for PP Hot & Cold systems is currently being revised to incorporate the new PP-RCT materials which provide a step improvement in performance allowing the material to be used in all classes of plumbing and heating applications. This revised standard has been agreed and is expected to be published early in 2012.

I believe that the Industrial piping specification ISO15894 is also under discussion – can you give us an update?

EN ISO 15894 covers polyolefin materials for industrial application and has been long overdue for revision as the current document does not reflect the true performance of modern PE pipe materials. This revision has now started under my chairmanship and the higher performance requirements of ISO 4427 and ISO 4437 have been incorporated. The stress rupture calculations have also been substantially revised to reflect current day performance of PE 100 and PE 80 materials. At the same time an annex for PE-X materials is being added, which was a clear omission in the past as many industrial applications operate at high temperatures. The first working draft has just been completed and will shortly be subjected to a vote after which it will then take a minimum of 2 years before final publication.

I know that for the above product standards there a lot of supporting standards and test methods that have to be developed – can you give us a run down on some of the important ones?

There have been updates of several test method standards over the last few years:-

- ISO 11357-6 covering the OIT method has been adopted by ISO/TC 138 and TC 155, as it provides a better interpretation of the test results.
- ISO 13479 describing the notched pipe test was revised in 2009 with no significant alterations made to the procedure. However, the life of the cutter was extended and changes made to the way the notch is measured after testing.
- ISO 9080 which describes the long term pressure test and the analysis of the data is under revision and will in future provide improved knee detection.
- The ISO 12162 classification document was revised in 2009 and introduces a way of dealing with applications requiring different lifetimes and temperature basis in addition to normal MRS classification. Both this and the revised version of ISO 9080 document now provide clear guidance that achieving a classification level does not confirm that a material is 'fit for purpose' as it must also meet the requirements regarding resistance to slow crack growth and RCP defined in the product standard.

Are there any real hot issues that need to be resolved and what can we do to help?

The introduction of high stress crack resistant PE100 materials has led to the demand for a new test method to measure slow crack growth, as the lifetime of these materials in the notched pipe test exceeds one year in duration. ISO/TC 138/SC5/WG 20 Slow Crack Growth is studying alternative tests that can reduce the testing time including the 'Cracked Round Bar' and the 'Strain Hardening" test.

ISO 21307 Butt Fusion Procedures was first published in 2009 and although it provided a step forward it included three different fusion procedures which can cause confusion in the industry. I have been working with a number of experts on a project to evaluate the three procedures and recommend harmonisation, which has been funded by the PE 100+ Association. The results suggest that it is feasible to use one procedure up to 20 mm or 30 mm wall thickness and then use an alternative procedure for thicker wall pipe to provide greater ductility in the welds. However this proposal has yet to be agreed by everyone.

As to the future, I think that whilst standards for plastic pipes and fittings have undoubtedly made a major contribution to the success and reliability of plastics systems they are complicated, especially when compared with those for competing materials and some thought needs to be given to how we can simplify them in future revisions. To do this will require input, understanding and acceptance from all sides of the industry. For example, perhaps end users could accept a lower level of testing for product manufactured from materials listed by the PE 100+ Association which offer the highest levels of performance and are subjected to regular rounds of testing.

World Water Week focus on "Water in an Urbanising World"

Nine African Ministers attended the panel session at the end of a full day focus on Africa

At the opening session of the 2011 World Water Week in Stockholm in August, global leaders called for increased investments in disaster-resilient infrastructure and smarter water management to avoid droughts, floods and pollution from further threatening the food, energy, and water security in a rapidly urbanising world. In total over 2,500 politicians, business leaders, representatives from international organisations, scientists, mayors and water professionals gathered in Stockholm, Sweden for the annual World Water Week, which this year focused on " Water in an Urbanising World."

The number of people living in cities is expected to rise to 80 per cent of the world's population by 2050. Most of this growth is happening in areas at risk of both water shortages and disastrous floods. In his address Anders Berntell, Executive Director of the Stockholm International Water Institute (SIWI) stated: ***"More than 800 million people live in slums, where water related diseases, such as diarrhoea, malaria and cholera have devastating effects on the livelihood of families and the economies of their countries." Further he warned that: "We run the risk of losing the battle on water and sanitation in many cities around the world, and that is a fight we cannot afford to lose."***

Also speaking at the opening session, the 2011 Stockholm Water Prize Laureate, Professor Stephen Carpenter of the University of Wisconsin-Madison highlighted that producing food for more people and bigger cities will strain available freshwater resources. He said: ***"We need an agriculture that can feed 9 billion people while maintaining the water supplies and other ecosystem services that people need. The connections between food and water security have never been more important."***

Nowhere is the problem of water and sanitation worse than in sub-Saharan Africa and a full day was set aside to discuss the continent's problems under the convenorship of the African Ministers Council on Water (AMCOW) and several NGO and funding organisations. In Africa over 350 million people are without clean water and 600 million have no access to sanitation and most of these people are poor and live in communities around the large cities. Where utilities do not extend their services to these urban low income areas the people have to rely on poor quality and overpriced water from informal service providers.

A number of speakers addressed these issues and presented some solutions including Sam Parker CEO of Water and Sanitation for the Urban Poor (WSUP). During his presentation Sam called upon three representatives from local service providers to attest to the success of their work together in bringing water and sanitation to the urban poor. At the end of the formal sessions the Global Water Partnership (GWP) and AMCOW launched a joint programme to support water and climate change adaptation in Africa. The aim is to reduce the risks that climate change brings, especially the increasing risks of droughts and floods and to develop water resources in a way that builds resilience to disasters while developing strong economies.

The Stockholm Industry Water Award was presented to Nestlé for

its leadership and performance to improve water management in its internal operations and throughout its supply chain. The Award Committee recognised Nestlé's work to improve the water management of its suppliers, which includes over 25 million people who are involved in its entire value chain. After being presented with the award Peter Brabeck-Letmathe, Chairman of Nestlé SA, said: ***"I am most grateful for this recognition. We have identified water as the biggest challenge for future food security, and beyond that, for economic growth. This is probably the most prestigious award in this area for a company – and it will be a strong encouragement for us to continue with our efforts."***

Nestlé is the largest food and nutrition company in the world, employing around 280,000 people in over 100 countries. Over the past decade, Nestlé has reduced the total water withdrawals by over 30 percent, more than doubled the water efficiency of their internal operations and made significant reductions in the quantity of wastewater discharged into the environment.

World Water Week is an annual event in Stockholm, Sweden which is organised by the Stockholm International Water Institute (SIWI) to provide a platform and a meeting place for all those interested in water and sanitation issues. The theme of the 2012 Stockholm Water Week will be "Water and Global Food Security."

PE100+ presentation at EA Water Conference in Mumbai

A PE100+ Association planning meeting in progress in Mumbai

As part of the continued efforts to promote high quality PE pipe materials in India, Chanchal Dasgupta of Borouge made a presentation on behalf of the PE100+ Association to the EA Water seminar on "State of the Water Sector" Conference in Mumbai in June. The two day conference, which was organised by EverythingAboutWater, who are India's leading knowledge provider to the water and wastewater sector, brought together all the stakeholders with the objective of sharing knowledge to encourage a more healthy, robust and value-adding water sector.

Chanchal described the benefits of using high quality PE100 pipes for water distribution and in particular the importance of using pre-compounded raw materials as specified in the International specification ISO4427. He described how the PE100+ Association members regularly submitted pipe samples for testing to ensure that their listed compounds meet the association's rigorous performance requirements. This gives the water industry around the world the security that pipes produced from PE100+ Association listed materials will provide a long and trouble free service life.

Following the successful seminar in Delhi in September 2010, PE100+ Association members agreed to follow up with a series of presentations at water conferences around India. The earlier seminar in Delhi was attended by the Indian Government Minister of State for Water Resources Shri Vincent H. Pala who talked about the future challenges in India to maintain water and food security and the importance of using high quality PE pipe materials to develop a reliable and durable infrastructure so that the current losses of treated water through leakage in the network can be arrested.

EA Water are planning to hold three more conferences similar to the Mumbai event in Chennai, Delhi and Kolkata, where other PE100+ Association members will be presenting similar papers.

Retesting PE100 pipes oil flow lines after 15 years operation in Oman

Some of the PE100 pipelines after 15 years operation in the Sim Sim oil field in Oman

In the 1990's Petroleum Development Oman (PDO) became concerned about the potential environmental impact of a major oil spillage in their oil fields and developed a no leak policy which demanded a radical change in their pipeline materials. After two years of leak recording, it became apparent that within the Nimr Area, two satellite fields, Warad and Sim Sim, accounted for 45% of all leaks. It was therefore decided that all the existing carbon steel pipework in the Sim Sim oil field would be replaced with non corroding PE flowlines and headers. The PE selected was BorSafe HE3490 pre-compounded PE100 material and the pipes were produced by the local manufacturer, Amiantit Oman

The crucial issue in the design of the Sim Sim pipelines was the operating conditions which were 50°C and 10 bar pressure whilst transporting the very corrosive water/crude oil (80:20) mixture. The design service life for the pipelines was set at a minimum of 15 years, which was well in excess of the 2 year life expectancy of the existing steel pipes.

Overall 19km of 6 inch and 12 inch SDR 6 PE100 pipes were installed in the Sim Sim oil field. In the first project standard black pipes were supplied and since the black bulb temperature in the Oman desert could reach more than 80°C, the surface laid pipe was protected with a small shelter. For later projects Amiantit Oman supplied pipes with a 1mm thick white PE outside layer which eliminated the need for a shelter on top of the surface laid pipes. Initial tests after a year of operation showed the pipe was performing well and was not showing any signs of deterioration.

Now after 15 years of operation samples were again taken from the pipes and a series of tests carried out.

Constructing water supply systems to additional villages in Pakistan

Villagers installing the PE pipe in the trench down the steep mountain side during the first project

Following the successful project in 2010 to construct water supply schemes in the Neelum Valley, Pakistan, Borouge has agreed to sponsor the HEED Association to construct three additional water supply schemes for communities in Jagran Valley whose existing schemes were also severely damaged during the monsoon floods of 2010.

The Jagran Valley is situated 74km from the regional capital Muzaffarabad and is one of the most beautiful areas within the region. One of the main attractions is the Jagran Lake which is fed from water from the surrounding snowcapped mountains, but in the floods of July 2010 this turned into a massive expanse of water destroying the crops upon which the local farming communities relied. Their existing water supply systems were also destroyed in the deluge and like many other communities the residents of the villages of Butgran, Riyyan Seeri and Nuttan Pattian now have to manually transport their water down the steep slopes from the springs high up in the mountains. The HEED project will be to design and construct new water supply systems for the 260 families and the local primary school and its 200 students in these three villages.

Tensile test samples were taken at three places through the wall of the pipe and the tensile strength exceeded 25MPa and the strain to failure for each sample was above the 350% required by the specification (actual values were 380-427%). In addition the oxygen induction time (OIT) was measured at five points through the wall thickness of the pipe and the lowest level was 43 minutes compared to the specification minimum of 20 minutes.

Reporting on the results Anette Nilsson of Borouge's Innovation Centre said: ***"Clearly the pipe has been heavily used and there are indications that oil has penetrated at least partly through the wall, but there was no major degradation of the material due to the water/ oil mixture or due to the sun on the outside of the pipe and the results indicate that the pipe could continue to operate for many years yet".***

The current operators of the Sim Sim field, MedcoEnergi, were also amazed that these PE100 oil flow lines were still operating satisfactorily after so many years exposed to the severe conditions of the desert in Oman.

A crucial part of the HEED process is to encourage each community to form a Water Committee that is well represented by all groups within the community. A mutually agreed Memorandum of Understanding (MoU) will then be prepared which will provide details of the proposed water supply scheme from inception through to operation and maintenance phases. As stated by Mubashir Niaz, the President of the HEED Association: ***"It is particularly important to encourage the participation of women and children in the process as this improves community ownership for the project and ensures that a sustainable solution is achieved".***

GPPA provide plastics engineering course in Cairo

Rob Lawrence and Mona Abu El Khair of GPPA surrounded by the EnPPI Engineers

In July the GPPA conducted a three day training course in Cairo for a group of engineers from the Engineering for the Petroleum and Process Industries (ENPPI). This organisation was established in 1978 in Egypt to provide a fully integrated engineering, procurement, construction supervision and project management service to the petroleum, petrochemicals, power and other related industries. With the increasing use of non-metallic materials in their pipe systems their management turned to the GPPA to provide a structured introductory course on the design and engineering of plastics pipe systems.

The course took the 22 delegates from some very basic material science through to some of the more complicated design considerations. The GPPA was supported by Engineer Nagwa of the Plastics Technology Centre in Alexandria who presented a module covering plastic pipe testing and quality control and Andy Wedgner and Chanchal Dasgupta of Borouge who covered much of the material on PE applications as well as the more technical field of steel pipe coating.

At the end of the three days the trainees were subjected to a tough end of term examination but Rob Lawrence was happy to report that there were no failures and indeed a small number of candidates gained distinctions in recognition of their exceptionally high grades. The ENPPI Training Centre have subsequently requested the GPPA to propose further more advanced training modules in order to make their engineers fully confident in the design of plastic systems.

Andy Wedgner discussing the detail of electro-fusion joints with some of the delegates

Chanchal Dasgupta explaining the finer points of irrigation engineering and steel pipe coating

Beijing's water recycling programme starts to have an impact

Manoeuvring the 1200mm diameter pipes into position for the LiangMaiQiao water recycling project

Delegates from the Beijing Water Recycling Co. at the Technical Seminar

Beijing faces a severe water shortage due to the expanding urbanization and growing population which creates an increasing demand for water. The ground water level in Beijing has dropped 20 metres over the last 30 years and the government is now buying water from Hebei Province. One part of the solution is to make greater use of recycled water.

Beijing Drainage Group's Vice General Manager, Zhang Jianxin, says that the use of recycled water has already had a significant impact on water usage. Currently recycled water from the city's sewage treatment plants provides nearly 19% of the city's total water requirement, which is mainly used for power plant cooling (56%), agricultural irrigation (25%) and replenishing water courses (16%). Investment funds are already in place for a further 14 sewage treatment plants for the city which will expand its treatment capacity by a further 3.8 million cubic meters per day. This means the plants could produce recycled water that meets over 20% of the city's total water consumption by 2015.

One company at the heart of this programme is the Beijing Water Recycling Co which is responsible for the construction of many of the large pipelines around the city. The company was established in 2004 by the Beijing Drainage Group which is a state owned enterprise with the key target for the collection, recycling and reuse of sewage and wastewater in the central part of the city of Beijing. One of their recent projects was the 1200x70mm PE100 pipeline recently installed along the banks of the Liang Ma River as part of the "LiangMaiQiao" water recycling scheme. The total length of this pipeline was 7.5 km and a significant portion was produced by Borouge customer Chinaust using BorSafe HE3490-LS PE100 material.

Now that a number of their projects had involved PE pipe the engineers were eager to learn more about the material and its basic properties and were pleased to accept the offer of a Technical Seminar from Borouge. At the meeting there was a lot of discussion about material quality and the importance of using pre-compounded PE100 material in order to produce pipes that meet all the requirements of the ISO specifications. Key properties of PE100 pressure pipes such as low sag, slow crack growth, rapid crack propagation and MRS were presented. One point of concern for the engineers on the installation of large diameter PE pipes was the soil loading as in places they would have to be buried 6-7 metres deep in order to avoid existing infrastructure. Information was presented by the team which showed that with a 70mm wall the pipe was able to withstand the soil loading at this depth even if the pipe was empty.

After the meeting the engineers made it clear that in future they would only purchase PE100 pipes made from qualified pre-compounded materials that meet the full requirements of the ISO specifications. This should ensure that the newly installed recycled water network in Beijing will function for many years to come and help to solve the acute water shortage in the city.

PIPA and Borouge support the recovery of Christchurch

The city of Christchurch in the South Island of New Zealand suffered the loss of 181 lives and sustained serious damage to its buildings and infrastructure from a series of earthquakes. In fact as this edition of BorPipe goes to press it will be exactly one year since the first earthquake struck on 4th September 2010. Since that time there have been over 8,000 recorded tremors including a major earthquake measuring 6.3 on the Richter scale in February this year which caused the deaths and destruction.

Both local and national government are continuing to work hard to repair the damage but the cost is significant to New Zealand's relatively small economy. The latest estimates by the Treasury indicate that at least 800 km of pipelines will need to be repaired at a cost of NZ$2 billion (US$1.7 billion) and that the total cost of repairing and rebuilding all the damage created by this series of earthquakes is equivalent to 8% of New Zealand's GDP.

In the February earthquake much of the water distribution system was destroyed by the seismic displacement and the subsequent liquefaction of the soil and many of the suburbs of the city had to be supplied with water by tankers before piped supplies could be reconnected. Clearly the pipe system, comprising a mixture of asbestos cement, cast iron and PVC pipes, was vulnerable to the earth movement as these spigot and socket systems have very little resistance to axial stress. By contrast the local gas distribution system, which is constructed of welded PE pipes, suffered no failures, which confirms the results seen in earthquakes in Japan and the USA.

To quickly repair and provide a short term replacement for the broken water and sewage networks many polyethylene pipes and electrofusion fittings are being used. For many of the installers working for Christchurch City Council this is the first time they have used them so to try and help them understand the simple "do's and don'ts" of installing PE systems Alan Shore of Borouge and Mark Heathcote from the Plastics Industry Pipe Association of Australia (PIPA) arranged a PE pipe seminar in Christchurch. The Canterbury branch of the New Zealand Contractors Federation organised and hosted the event which attracted delegates from the installers, pipe manufacturers and engineers from both the StrongerChristchurchAlliance and the City Council.

Alan Shore of Borouge and Mark Heathcote of PIPA answer the questions from the local engineers in Christchurch

Throughout the seminar Alan and Mark were able to draw parallels with the successful approach taken by PIPA members in Australia in the new and extremely large Coal Seam Gas projects. Here too there were many workers who were not used to working with PE systems but through the adherence to simple procedures and testing regimes a very positive outcome was achieved.

The question and answer session was extremely lively and actually lasted longer than the formal presentations as many had questions regarding the training and accreditation systems for installing PE systems. The additional knowledge they received together with the excellent performance of the local PE gas distribution system certainly gave everyone a lot of confidence in the future of PE systems in the earthquake prone regions of New Zealand. It also demonstrated to them that the local PE raw material suppliers, pipe manufacturers and equipment suppliers were on hand should they require any additional support in the future.

Bauku rises to meet the challenges of the Wilhelmshaven project

The pipe lengths raised into the vertical position prior to filling the profile with liquid concrete

Extrusion welding the inside of the spigot – socket joints

When German pipe producer Bauku agreed to supply the 3.4 metre diameter pipes for the new 3km sea outfall for the Wilhelmshaven Power Station they knew they would face some interesting challenges, particularly in the installation phases of the project. In this article Bauku's General Manager Marcus Hawerkamp describes the construction of the large diameter spiral wound pipes and the installation procedures developed to minimise the stresses on the pipes during the installation in the busy harbour.

It is more than five years since Bauku changed from PE to PP for the construction of large diameter spiral wound pipes due to the higher stiffness of the material. This enables the desired pipe stiffness to be produced at a lower weight per metre which provides a more competitive offer to the concrete or steel alternatives. The 3.4 metre diameter sea outfall pipeline for the Wilhelmshaven Power Station was no exception and was produced using BorECO BA212E from Borealis. The pipe sections were each 5.5 metres in length and were joined using an integrated spigot – socket system.

To create the necessary negative buoyancy for the installed pipeline it was decided to fill the hollow helical profile with concrete rather than use external concrete blocks. This is a far more cost efficient method although it makes the pipes heavier to handle during transport and assembly as it increased the weight of each pipe from 1.5 tons to 3.5 tons. Filling was achieved by raising the pipe lengths into the vertical position and pumping liquid concrete into the hollow profile.

Once the filling with concrete was complete, the pipes were laid down in the horizontal position and were connected into longer pipe strings. Each pipe joint was welded from the inside and outside using the extrusion welding technique according to DVS 2207-4. The welds provide the construction stability necessary to resist the tensile and bending forces exerted on the pipe joints during installation and at the same time ensure a leak tight connection with a long service lifetime. Tests confirmed that each joint was able to withstand a tensile force of up to 40 tons without failure or long term damage to the joint or the pipes themselves.

Originally it was believed that long pipeline sections of up to 180 metres could be installed in one operation but it was soon clear that there was insufficient space on land and at sea in the busy industrial harbour. Other installation systems were considered and evaluated taking into account the limited space on the quayside and the amount of harbour traffic and finally together with the specialist construction company Möbius, Bunte and Züblin it was decided to use two cranes each with a lifting beam to place 50 metre lengths of pipe on to the transportation barge. After several pipe lengths are on the barge it can carry them to the laying platform where they are lowered to the sea bed using other cranes.

Many test runs were carried out to validate the installation system. Initially the 50 metre lengths of pipeline were lifted from the quay to the transportation barge and back several times. In other trials pipe lengths were lowered into the water of the harbour with and without the floatation tanks in order to understand their buoyancy characteristics in the water. When these extensive tests were complete the installation could be undertaken.

Borcoat HE3450-H approved by Petrojet in Egypt

A view of the 30 inch steel pipe coated and tested at the Petrojet factory at Port Said, Egypt

Petrojet, the major steel pipe manufacturing and coating company in Egypt, is also providing a full range of pipeline services to the Oil and Gas industry in the Middle East. They have two pipe coating plants one at Suez and the other at Port Said in Egypt.

As part of the ongoing approval programme for the new high performance top coat Borcoat HE3450-H from Borouge, a number of tests were conducted at their Port Said plant.

Five lengths of 30 inch diameter LSAW steel pipe were coated with a 3-layer PE coating with a minimum thickness of 3.5mm. The process was carried out at standard conditions and produced a coating with a very good visual appearance. The operators noted that the coating extruder had a higher specific output with a lower motor load than standard and the coating was more even in thickness over the weld and body of the pipe.

The peel strength of the coating was measured at temperatures ranging from 40 to 90°C and the results significantly exceeded the requirements of the standard. The impact strength of the coating was measured using a 1.5 kg dart which was dropped from 1 metre height onto the pipe surface at 40°C. This impact was repeated ten times followed by Holiday testing at 25 KV, which showed that the the coating was still functioning. In addition MFR, tensile elongation and shore D hardness tests were carried out in the laboratory and all the test results were well above the requirements.

The Petrojet team was very happy with the test results and issued an approval report on the completion of the trial. They also agreed to place commercial orders for Borcoat HE3450-H so they could evaluate the full processing benefits of the grade.

Borouge partners attend 2011 WEDC Conference

The HEED stand at the WEDC Conference at Loughborough University

On 6th - 8th July the 35th International Water Engineering for Developing Countries (WEDC) Conference took place at Loughborough University in the UK. First held in 1973 the conference provides a platform for water and sanitation practitioners from all over the world to share their experiences of working in poor communities. The previous 34 conferences have been attended by over 8500 participants from 80 different countries and the series has developed over 1700 papers providing a unique resource for the sector.

This year two of our "Water for the World" partners attended the event and presented the results of work performed in different parts of the world which have been supported by Borouge and Borealis. Mubashir Niaz, the President of the Pakistan NGO HEED reports: ***"On our small stand we proudly displayed our Neelum Valley Water Supply project poster that can be seen in the background of the attached photograph. I also managed to talk to many of the people who visited our stand and explain about our great work in the Neelum Valley. Also in the photograph are two visitors from Tanzania Dr Salha Kassim and Mr Hamad, who is Tanzania's Minister of Infrastructure and who was very interested to discuss HEED's ambitions in Africa".***

Water and Sanitation for the Urban Poor (WSUP) Project Director, Tim Hayward, was also at the conference and organized a small side event to describe some of their experience and learning from their projects in Maputo, Nairobi and Kumasi. As Tim explains: ***"Our event received a lot of attention from the 60 or so delegates who were largely from European, African and Asian NGOs and in the discussion afterwards it was clear that many were interested in WSUP's approach of working with the local service providers to improve water and sanitation services for the poor communities in and around large cities".***

Continuous development of the Swagelining™ technology

"Swagelining™" is a close fit PE lining technique which was originally developed over 20 years ago by British Gas and United Utilities in the UK to renovate some of their gas and water distribution pipelines. Swagelining Limited, based in Glasgow in the UK, considers the best is yet to come for polymer lining technology. The company has made its mission to take the technology to a new level of capability and enable polymer lining to solve a wider range of problems in all pipeline sectors from water to hydrocarbons; onshore and subsea.

In this article the Editor talks to Business Development Director, Dave Whittle and asks him about the company, the latest technological developments and some of the most recent success stories.

Swagelining's Business Development Director Dave Whittle

I know that you have a British Gas background but can you tell us a little more about yourself and the development of the company?

Throughout my 30 plus years in the industry, I have been employed in various engineering capacities in the UK and internationally and have developed an extensive knowledge of the construction, maintenance and rehabilitation of large pipeline networks. My experience of Swagelining™ originated in British Gas and since then I have had direct involvement as client, service provider and technical advisor on various lining projects.

I joined Swagelining Limited when the company was formed in 2009 as their Business Development Director. The company was set up to energise polymer lining technology using Swagelining™ as the foundation of the service delivery. Quite simply, we all believe that polymer lining technology has more to offer the pipeline business but we felt the basic technology was stranded in a time warp around the 1980's. We are determined to bring the technology into the 21st century, which is a view shared by many of our clients and we are now looking at applications for polymer lining that no one would have dreamed of a few years ago. It could certainly be considered as mature technology but it has huge potential to do more - that's our mission.

Can you outline the fundamentals of the Swagelining™ process for us and what makes the process unique compared to alternative pipe lining technologies?

We believe that Swagelining™ offers simplicity, capability and flexibility all in one technology. Fully concentric PE pipe reduction within an elastic state means we can install really long lengths and still manage a varying internal diameter. We believe it to be the only process capable of installing fully structural liners in larger diameters and finally, it's the only technology that really delivers a compressive fit. Also as the liner is not deformed in any way during insertion, it does not need to be pressurised to make it revert. Originating in probably the most extensive physical PE reduction trials ever undertaken in the industry, the physics of the process are perfect for polymer lining of new and existing pipelines. These properties also make it really suited to a wide range of polymers for higher performance service requirements. The Swagelining™ system uses a polymer pipe which has an outside diameter slightly larger than the inside diameter of the pipe to be lined. After sections of liner pipe are butt-fused together to form a continuous pipe string slightly longer than the host, the pipe is then pulled through a die to temporarily reduce its diameter. This allows the liner string to be easily pulled through the original pipeline.

After this has been pulled completely through the host pipe, the pulling force is removed which allows the liner to return naturally toward its original diameter until it presses tightly against the inside wall of the host pipe forming a compressive fit. The tight fitting liner results in a flow capacity close to that of the original pipeline and single pulls of over 1,500m can be engineered, even at large diameters, to minimise costly excavations and connections.

The Swagelining of an old 39 inch cast iron water main with a 1016mm PE100 pipe in the UK

As you are no doubt aware in many countries the PE pipe standards are not as strictly applied as they are in Europe, which means that the pipe quality can be lacking – can you tell us how this impacts your process?

It's all about quality, we therefore go to great trouble to ensure that the correct grade of raw material is specified and extruded to exact tolerances. It is important to recognise the environment in which the materials will see service both during installation and during operation and to specify and procure accordingly. As we look at projects globally, we are always assessing the local capabilities but there can be no compromise on the standard of the raw material or the pipe. In our process, we are putting the pipe under considerable stress so high quality pipe is mandatory.

The Swagelining™ process was developed in the gas and water utility sectors, can you tell us what improvements you have introduced and maybe some recent success stories?

The first thing we did was look at the constraints to the growth of the technology. When our analysis was complete it became very clear that we needed to focus on the development of the "Integrated Lining System" offering design and engineering solutions covering a range of different applications. This includes selecting materials to match the service environment and developing very high pressure weldable connectors and pressure balancing technology to avoid vacuum collapse in hydrocarbon service. We have new products being tested for inclusion in the 'Integrated Lining System' that are designed to further extend the capability of the technology as we seek to increase the level of applications in all sectors of the pipeline industry.

To illustrate the increasing scope of Swagelining™ technology I would like to outline a couple of recent water projects:

The first was the relining of a 600m DN concrete locking bar water main in Australia which required a fully structural solution. An SDR 11 PE 100 pipe was selected and engineered pull lengths of over 600m were designed, to take account of the busy urban environment, minimise disruption and retain capacity, whilst delivering the 'stand alone' system requested by the client.

Swagelining™ was also selected by a major UK water utility to line a section of existing 39 inch diameter trunk main, over 100 years old, as a comparative trial prior to embarking on a major programme to rehabilitate some 80km over the next few years. As the existing pipelines were structurally sound, a semi structural liner was designed. This 1016mm SDR 51 PE 100 liner was installed in lengths restricted to a maximum of 750m due to site layout, although it was calculated that pulls of over 1000m could have been achieved in this case.

I understand that Swagelining™ has also been successfully applied in the Oil and Gas sector – can you tell us about your experience with lining offshore steel pipelines?

Swagelining™ first saw service in the oil and gas sector in 1995, providing a polymer lining solution to prevent internal corrosion in subsea high pressure water injection lines in the North Sea. To complement the lining system, a high pressure connector system was developed to secure and seal the liner called WeldLink®. Today this technology is still being used for installation by reel ship, j-lay vessel and in pipe bundles. PE liners have been

Installation of a PE100 liner into a riser for subsea service in West Africa

installed in reeled pipelines up to 16" diameter and the WeldLink® connector has recently been tested to 405 bar operating pressure for a riser project installed in 2000m water depth off the coast of West Africa. To date there has been no known failures of the system, even operating in these harshest of environments.

We know that PE is particularly resistant to abrasion – have you any examples from the mining sector that you would like to share with us?

The service environment produced by transporting mining slurry is unique in the pipeline industry. Slurries are naturally abrasive and will wear down the wall of steel pipes to a point where pipeline integrity becomes at risk. Polymer lining of pipelines for mining slurry transport has proven to offer a longer term solution as the polymer absorbs the impacts of the particle collisions, reducing their energy and abrasive capabilities.

Working with pipeline engineers and constructors worldwide, we support the design process for the pipeline system layout. Tight fitting liners are normally preferred in slurry pipelines as they resist internal movement when surges occur. The compressive fit delivered by Swagelining™ ensures the liner will remain tight for its full service life – even after extensive wear – and is still capable of resisting vacuum collapse.

Swagelining™ is currently being used on a number of projects for mining applications in South Africa. A recent copper mine project in Zambia saw Swagelining™ selected for installation of PE100 liners up to 610mm. As the route of the pipeline ran through community areas the Environmental Agency required a system which was quick to install and provided 'double containment'. Engineered pull lengths of over 700m allowed flanged connections to be kept to a minimum, with lifetime integrity maximised and project cost savings achieved.

Have you any plans for future technical or market developments that you would like to tell us about?

Although PE lining is well established in the Water Injection field as an "off the shelf" solution, there are always new challenges to overcome. Higher temperatures and longer life requirements steer us to consider other polymers for these more demanding environments. Currently we are working with a major oil company to assess the feasibility of installing a polymer liner into a deep water steel catenary riser system – an industry first!

In the Oil and Gas industry Swagelining™ has already been used to line pipes for the transportation of crude oil but it is now being considered for products such as multi-phase, operating at high temperatures where corrosion resistant alloys may previously have been the only option. By informed material selection, the introduction of our proprietary venting technology and the appropriate connection system all form part of our 'Integrated Lining System' to deliver a complete solution. With up to 40% cost saving over corrosion resistant alloys we believe wider use of polymer liners in hydrocarbon service is inevitable. It's just a matter of time before someone is going to realise that polymer liners can provide an option to the cost premium and the extended lead times for corrosion resistant alloys. Technically, we are just about there for 100°C operation and should be up to 130°C shortly. We are also working on a solution for 240°C for extreme environments.

We aspire to work closely with clients to understand their pipelines, operating environment, construction plans and their service design requirements. The more we know about their needs, the more we are convinced about the capability of polymer lining technology to grow and make an increased contribution in all of the pipeline sectors globally.

If you want to know more about Swagelining Limited then visit their website **www.swagelining.com** or contact them at **enquiries@swagelining.com**

Cindy Wang of Borouge returns to Sichuan Province three years on

One of the new shopping areas built in the earthquake area of Sichuan Province

The 160mm PE100 pipe still bringing water from the reservoir to the temporary village of Shengli

In May 2008 the province of Sichuan in the mountains of Southern China was devastated by a major earthquake which killed 87,000 people and made millions homeless. In response to the situation that many of the victims endured NGO Lin Aid, Singapore Water Association and Borouge organised a new water supply system for one of the temporary villages.

The new 160mm diameter PE100 pipe produced by Sichuan Chinaust from BorSafe HE3490-LS material brought the water from a reservoir to a new mobile water treatment plant in the village of Shengli, enabling people to drink the water without boiling it first. At that time this was a major step forward for the villagers who had endured so much and they duly celebrated the occasion as shown in BorPipe issue 12.

Three years later Cindy Wang from the Borouge Beijing Office travelled back to Sichuan Province to see the current situation. The contrast was unimaginable, as Cindy commented; ***"The cities in Sichuan and the neighbouring states of Shaanxi and Gansu seemed to have risen, phoenix-like from the rubble. The media report that In Sichuan alone, nearly 3,000 schools, 1,000 hospitals and more than 5 million homes have been built or renovated. Now every family has been provided with a home and a job, and everyone is protected by social welfare".***

According to official figures from the National Development and Reform Commission (NDRC), by the end of April 2011, over 90% of the overall reconstruction budget had been spent which equates to US$136 billion. As Cindy remarked; ***"This incredible achievement is the result of huge efforts by many people and organisations including many NGO's. Also during the reconstruction every earthquake area received support and financial sponsorship from another Chinese province or city. For example, the county of Beichuan in Sichuan province were sponsored by Shandong province, which is a very beautiful and modern rural area in Eastern China."***

Visiting the site of the "Water for the World" project Cindy heard from Mr. Xi Chengyou, leader of Shengli village that the buried PE pipeline was still functioning well and some people who are still using the temporary accommodation rely on it in their daily life. The mobile water treatment plant was however no longer in use but carefully stored away in case it is needed in the future. He said that of course some projects are still going on, such as the development of suitable residential housing for some of the old people who are still suffering psychological problems following the earthquake. This project was being supported by a number of organisations including "Social Workers Across Borders" who are a Hong Kong based NGO.

Returning to Beijing Cindy remarked; ***"Clearly, following such a major earthquake the "Water for the World" project with Lien Aid and the Singapore Water Association made a great deal of difference to many people's lives and a major contribution in getting village life back to normal."***

For more details of the original project at Shengli village, visit **www.waterfortheworld.net**

Providing a new water supply to a second community in the mountains of Nepal

The inauguration ceremony was presided over by Sujata Koirala Chairperson of the SKMT

Great excitement amongst the children at the new water stand pipe at their school

In Nepal millions of people still walk on average 6 km each day to fetch water to meet their basic needs and 10,500 children below the age of five die each year from water related illnesses. According to Water Aid Nepal 14 million people have no access to sanitation and 7.1 million are deprived of safe drinking water. A number of NGO's are working in the country to try and improve the situation and one of these is the Sushma Koirala Memorial Trust (SKMT).

One of the recent projects undertaken by the SKMT was the Hattikhor Water Supply and Sanitation Project which was supported by Borouge, their customer Hisi Polyethylene Pipe Industry and the entire local community. This project was to construct a new water supply system for the residents of Shivamandir VDC of Nawalparasi and upgrade the sanitation facilities at the local school.

The population of the district recorded at the 2008 census was 2275 but the new scheme was designed to meet the projected 2025 population of 3336 residents with a demand of 45 litres per person per day. When the existing water supply system ceased to function the local people resorted to using wells and springs. But these sources tend to dry up during summer months and people were left to walk many miles to distant springs and streams to fetch their drinking water. Some of the people have even resorted to using water from irrigation canals which is not safe for human consumption.

At the beginning of the project SKMT organised meetings with the community Water Users Committee to explain the proposed work and describe the main features of the design and gain their commitment to carry out some of the construction work. The initial task was to build a 75 cubic metre concrete water storage reservoir which was done to a large extent by the local people themselves supervised by engineers appointed by the SKMT. From this reservoir PE100 pipework distributed the water to the individual tap stands and to a smaller storage tank at the school to supply the drinking water and toilet facilities. It was also part of the project to upgrade the existing school toilet facilities and to construct a new girls' toilet block.

The community also did a major part of the excavation and reinstatement of the pipe trench although local experts were hired for laying and jointing of the pipes. The pipes were produced by local pipe producer Hisi Polyethylene Pipe Industry from BorSafe HE3490-LS material from Borouge – both material and pipe production were heavily subsidised to keep the project costs manageable for the SKMT. The public

tap stands were also constructed by the Water Users Committee who also set up a scheme to collect a monthly payment for the maintenance of the system.

The inauguration ceremony took place in mid June and was presided over by Sujata Koirala, the Chairperson of the SKMT, whose inspiration and considerable personal support was the driving force behind this project and the earlier one in Thathalli village. The ceremony took place in front of representatives of the entire community together with invited guests including Pushp Raj Singhvi, Vice-President and Managing Director of Borouge India. He later explained: ***"It was a day of great celebration for the local people as the project made a real difference to their daily lives. I was proud to be able to represent Borouge at the ceremony and to contribute to yet another important "Water for the World" project in our region".***

In the official report Hari Prasad Dhungana the Executive Director of SKMT thanked Pushp Raj Singhvi and Sharad Sharma the Chairman of HISI Polyethylene Pipe Industry for their valuable support and personal involvement in the project. SKMT Board Member, Rakesh Hamal, gave his personal thanks to all the contributors to the project as well and added: ***"I would also like to single out one of the SKMT team, Karishma Shrestha, for special thanks because she has been very much involved in all the water projects conducted by the trust and has put tremendous effort and dedication into these projects to make them successful".***

Borcoat HE3450-H improves coating performance for large diameter water pipes

Some of the large diameter coated steel pipes being transported to site

Ratnamani Metals and Tubes based at Bhimasar, Kutch in the state of Gujarat, India are a company specializing in the manufacture and supply of custom made steel pipes for a variety of applications. Recently they provided 3-layer PE coated steel pipes for two very large diameter water transportation projects and for the first time they used the new Borcoat HE3450-H top coat.

The first was for a project in Italy which required 5.4 km of 64 inch (1625mm) diameter coated pipe. The second was much closer to home, being the Navada – Botad pipeline in Gujarat State for the Gujarat Water Infrastructure company. This project required some 20.5 km of 3-LPE coated pipe 67 inches (1700mm) in diameter.
The higher output and improved processability of Borcoat HE3450-H certainly helped them to coat these large diameter pipes at a reasonably high line speed of up to 1 meter per minute. It also helped them overcome cracking problems of the coating on top of the welds which they were facing with their regular coating grade.

It is worth noting that Borcoat 3-LPE coating systems have also been chosen for many other large diameter pipeline projects, including the Ras Azur Project of SWCC, Saudi Arabia which comprised 970 km of 48 and 72 inch diameter pipelines. With the increasing scarcity of water, more and more large diameter cross country water pipeline projects are expected in the future and 3-LPE coating systems are being increasingly adopted to reduce corrosion and provide a longer service life and lower whole life cost for the pipeline.

PE100+ Advisory Board Meeting in Cambridge, UK

The delegates at the PE100 Advisory Committee Meeting in Cambridge, UK

Around 45 delegates attended the annual PE100+ Association Advisory meeting in Cambridge in the UK, where the organisation present their work from the previous 12 months and discuss their activities for the coming year with a group of representatives of the plastic pipe value chain. Many of the delegates had toured Cambridge the day before which houses one of the world's oldest universities and leading academic centres. The University itself dates back to the 13th Century and many of the original buildings are still used by students today, which makes it an important tourist destination and the ideal place to discuss education and training in the plastic pipe industry.

The President of the Association, Ulrich Schulte reviewed the work of the Association in 2010, which included major promotional seminars in Moscow, Russia and Delhi in India together with many activities in China including the publication of the PE100+ Book in Chinese. The Association are also heavily involved in the next Plastic Pipes Conference in Barcelona through the PPCA which finances this series of international conferences and many members also sit on the Organising Committee.

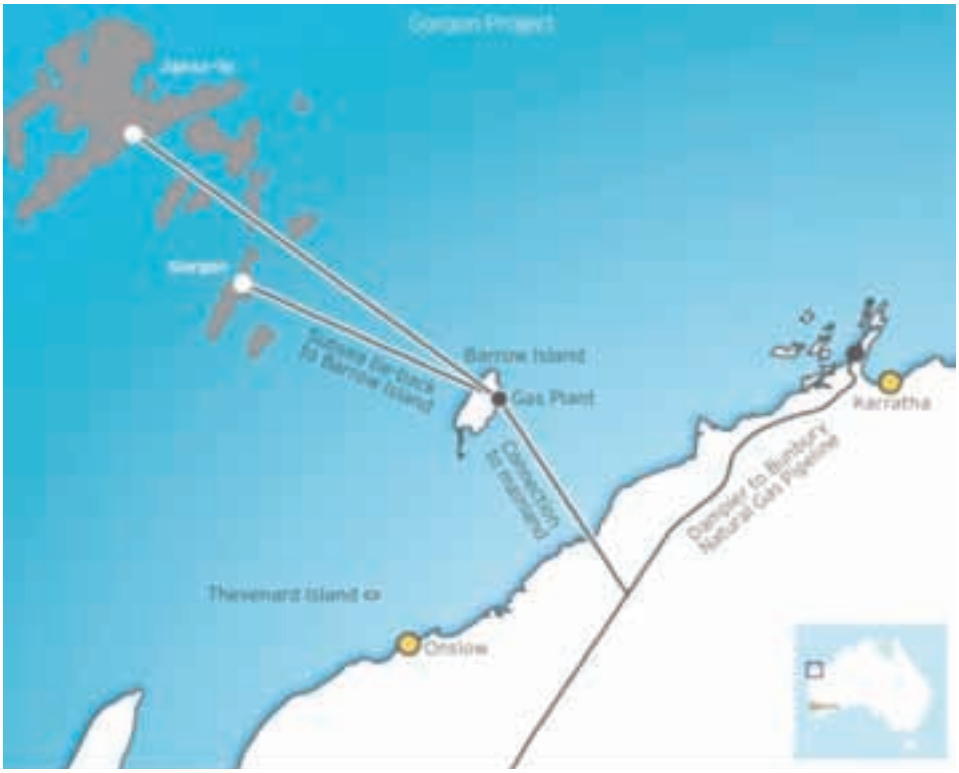
The plan for 2011 includes a major seminar in Morocco together with further events in Russia, China and South East Asia. The Association is also planning to sponsor a Life Cycle Analysis (LCA) investigation into larger diameter water mains comparing PE100 with ductile iron pipes. This will use the same model as the exercise sponsored by TEPPFA for smaller diameter water mains (110mm) which is summarised on their website **www.teppfa.com**. Further progress was also reported on the large diameter butt fusion study and the report is expected to be ready within the next three months. Additional topics of interest to the plastic pipes industry for possible future study by the PE100+ Association were identified in a brainstorming exercise for Advisory Board members later in the day.

The brainstorming followed a number of presentations from external speakers including Rob Lawrence of the GPPA who discussed some of the special educational challenges in the Middle East. Despite a large number of successful case stories in the region, engineers still tended to over-design in terms of pressure and temperature which sometimes made plastic systems uncompetitive. He also pointed out the importance of the Operation and Maintenance Departments who could veto plastic systems if they were unsure of how to maintain and repair the systems. Therefore much of the early activity of the GPPA has focussed on education on these aspects for the Middle East water and wastewater engineers.

Mike Shepherd discussed training and education in the UK water industry and identified some of the tools that had been developed to help engineers. However more was still required particularly relating to on-site supervision and quality procedures for the welding and installation of PE systems. The design of city gas projects was presented by Steve Roberts of GL Noble Denton who stated that many of the projects were led by the gas transmission companies whose engineers were not familiar with plastics and therefore education and training was a key to success.

The meeting was closed by the President of the PE100+ Association who thanked everyone for their participation and contribution to the meeting.

Borcoat materials protecting the offshore gas transportation pipes for the Gorgon Gas Field



Location of the Gorgon Gas Field off the coast of Western Australia

The Gorgon Gas field, 130 kilometres off the coast of Western Australia is the largest single resource project in Australia's history and will require around AU$43 billion (US$46 billion) of investment to achieve its full potential. This will include the construction of a Liquefied Natural Gas (LNG) plant on Barrow Island from which LNG will be exported to Japan, China and SE Asia and a separate domestic gas supply for Western Australia. Overall the project which will be operated by a consortium led by Chevron is expected to boost Australia's Gross Domestic Product (GDP) by some AU$64 billion (US$67 billion) and at the peak of construction it will employ around 10,000 people.

Connecting the well to the LNG plant and the other onshore facilities will require a considerable quantity of high pressure steel piping. These sub-sea pipelines are particularly vulnerable to corrosion and will therefore require a durable coating able to withstand the high pressures deep below the surface of the ocean. The coating system used for these sub-sea pipelines has to resist a higher compression load and have a higher creep resistance than standard coatings and the designers of the Gorgon Field have specified a three layer polypropylene (3LPP) coating for the pipelines. This includes a PP anti-corrosion coating for the external surface, an external PP rough coat followed by a concrete weight coating.

The coating company assigned for the Gorgon Project was WASCO Coatings in Kuantan, Malaysia. WASCO operate in 14 locations around the world, including Malaysia, Singapore, Indonesia, Australia, China, India, the U.A.E., Nigeria and the U.S.A. The WASCO Kuantan site is capable of coating pipes from 4 inch to 60 inch in diameter and lengths up to 24m. Overall 850 km of 6 inch to 34 inch diameter offshore pipeline is to be coated using a 3LPP Borcoat coating system comprising an epoxy primer, Borcoat BB127E grafted powder adhesive and Borcoat BB108E-1199, followed by a rough coat of BB108E-1199 powder. The coating contract started in mid 2010 and will continue until early 2012.

Following pipe coating, rigorous testing was carried out on the coated pipes. Peel tests were carried out at temperatures of 25°C and 100°C. For the 8 inch diameter pipe with a 12 mm wall thickness the measured peel force was 265 – 294N/cm compared to a specified minimum of 200N/cm at 25°C. At 100°C, peel strength obtained was 167-177N/cm, compared to a specified minimum of 80N/cm.

The Borcoat 3LPP coating system will provide protection from corrosion and external damage across a broad temperature range from -10°C up to +115°C and withstand deep sea pressures. Using the Borcoat PP coating systems for the Gorgon Project pipelines will ensure that the pipelines will have a long trouble free lifetime transporting the gas efficiently to the different parts of the field. The product range is backed by over 20 years of success in some of the world's most critical offshore projects providing corrosion protection in some of the toughest environments.

Borouge stage "Troubled Waters" Exhibition during Singapore Water Week

Borouge Pte CEO Wim Roels and Lynette Leong, CEO of CapitaCommercial Trust opening the exhibition

Ms Ha from NGO Lien Aid presenting some of their work to the Borouge office staff

The "Troubled Waters" photographic exhibition was staged in the entrance to the Borouge Pte Headquarters building in Singapore during Singapore Water Week. It was organised by the local Borouge Communications team in cooperation with the building owners, CapitaCommercial Trust. The exhibition, by the well known Belgian photographer Dieter Telemans, highlights the global water crisis and gives an insight into its causes and consequences. During the rest of July the exhibition was then moved to other CapitaCommercial Trust properties in Singapore including Capital Tower, Six Battery Road and Wilkie Edge.

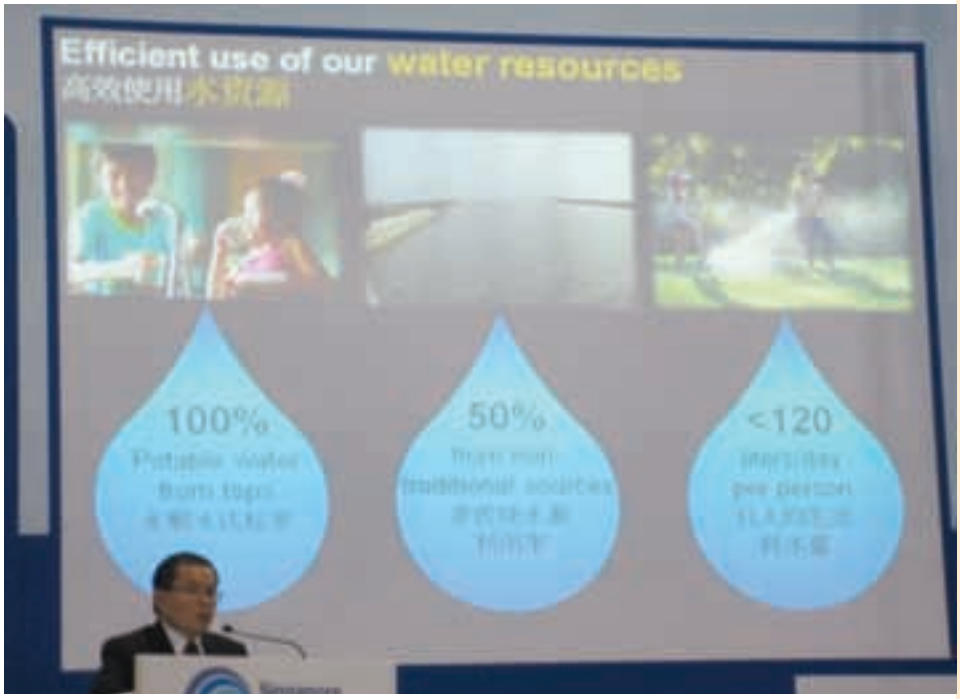
During the week of the exhibition the Borouge "Water for the World" team also presented a number of the water projects that have been carried out in South East Asia to the office employees. In a number of the projects Borouge has partnered the NGO Lien Aid, who are also based in Singapore and Ms Ha was also present to represent the organisation.

In 2008 Borouge worked with the Singapore Water Association and Lien Aid to provide clean drinking water to some of the earthquake victims in the Sichuan Province of China. Following this Borouge has also supported Lien Aid in two hospital projects in Vietnam. In the first, which was the National Children's Hospital in Hanoi, the patients only had access to poor quality water and there were few drinking and hand washing facilities. Many of the patients were therefore forced to purchase bottled water for drinking and washing. But now thanks to the work of Lien Aid supported by Borouge the situation is much improved and the children can now enjoy clean drinking water from one of the 28 new facilities around the hospital, greatly improving their chances of a successful recovery. The second project is at the Thach Ha District Hospital in the Ha Tinh Province of Vietnam and involves the installation of both water supply and waste water treatment systems and this project is still under construction.

Also exhibited inside the office pantry area was the growing display of children's drawings visualising the value of water which were collected from Abu Dhabi and Singapore staff. Overall the Borouge staff in Singapore greatly appreciated this opportunity to update themselves on the progress of the Water for the World programme and plans are now being formulated to stage the "Troubled Waters" exhibition in the Borouge Shanghai office during the autumn.

Increased investments in water and wastewater systems highlighted at Singapore International Water Week

In July over 1500 delegates from all over the world attended the 4th Singapore International Water Week. The delegates accept that water scarcity is one of the most important issues facing them now and in the future and it will require significant investment by many countries to achieve any improvements. In a number of dedicated Business Forums the specific needs of the different regions were debated by a panel of experts.



Delegates at the China Plastic Pipes Association Annual Conference

In China the government recognise that despite considerable investment in the last five years they still have much to do as over 50% of the water supply plants in the major cities still supply substandard water. Also many of the water supply pipes are old and worn out resulting in leakage rates in excess of 15%. Also in China the sewage treatment system lags behind the water supply facilities and in nearly 50 cities there are no sewage treatment facilities. The newly developed Sino-Singapore Tianjin Eco-City was presented as a model of what can be achieved in water and wastewater management using the latest systems and technology.

This situation has led the Chinese government to set what they call three controlling "red lines" in water resources management covering total water consumption, the efficiency of water use and the amount of pollution discharged into rivers and other potential water sources. This will mean that in the next planning period from 2011 to 2015 a further 2358 water treatment plants will be built and US$20 billion will be allocated to the renovation of 73,000 kilometres of old water supply pipes and the installation of a similar length of new pipelines. In addition they plan to spend a further US$37 billion to significantly extend the sewerage network by 150,000 kilometres.

India will also have to make major investments in their municipal water supply systems and wastewater treatment plants for its growing cities and the underserved rural population. With a total population that is expected to overtake China as the world's most populous country, it is essential to accelerate improvements in water management systems and increase the involvement of private industry in the sector.

At Singapore Water Week Dr. Mihir Dhah, a member of the Indian governments Water Resources Planning Commission, explained that in future there would be more emphasis on the management of ground water, which currently supplies two thirds of India's water needs. This would start with accurate aquifer mapping followed by the setting up of Aquifer Management Associations which would be responsible for managing this resource in a sustainable way and persuading local farmers to use modern irrigation systems to reduce extraction rates. Schemes would also need to be developed to recharge the depleted aquifers with water from recycling or rainwater harvesting systems like those being pioneered in the State of Karnataka in the South West of India. In order to reduce consumption in large cities it was proposed that buildings above a certain size would be required to install a water recycling system.

All these new systems are going to require many kilometres of PE and PP pipes and many moulded and fabricated fittings which bodes well for the future of the plastic pipe industry in these countries.

Tifoplast inaugurate their new 1.2 metre extruder

The Borouge team helping to load the material into the extruder during the factory visit

The Borouge team at the Tifoplast seminar

Vietnam has achieved remarkable economic growth and reductions in poverty over the last decade and this strong economic growth has been accompanied by increasingly rapid urbanisation and significant increases in wages and quality of life. Unfortunately the development of basic water services has not kept pace with economic growth, leaving around one third of the population without adequate water supplies and two thirds of the population without sanitation.

Recently the Vietnamese government has taken a number of initiatives to stimulate the water market which has led to a significant increase in demand for PE pipes. As one of the main PE pipe suppliers, Tifoplast have decided to increase their capacity to meet this growing demand and has invested in a new Cincinatti-Battenfeld extruder capable of producing pipe up

Industrial Plastic Pipe Seminar with Hallmark Aqua Kolkata

Prashant Nikhade of Borouge enthusiastically presenting his paper to the conference

In July Borouge customer, Hallmark Aqua Kolkata, organized a seminar for the local industry at the town of Barbil in the Kendujhar district of the state of Orissa in the eastern part of India. Since the region around Barbil has the fifth largest deposit of iron and manganese ores in the world the use of plastics pipes in mining was a subject that generated great interest. Indeed mining in this area is a major source of revenue generation for both the central and the state governments.

More than 70 delegates attended the seminar including representatives from OMDC (Orissa Manganese Development Corporation), OMML (Orissa Manganese & Minerals Ltd.), SAIL (Steel Authority of India), Triveni Earth Movers Pvt. Ltd., Essel Mining & Industries Pvt. Ltd. (Aditya Birla Group), Sarda Mines. Pvt. Ltd. (Jindal Steel & Power Ltd.), Rungta Mines Ltd. and IDCOL Kalinga Iron Works Ltd.

Prashant Nikhade of Borouge presented a paper entitled "HDPE Pressure Pipes – Getting Stronger and Versatile" in which he described the benefits of using PE100 pipes in a number of mining related applications including water and slurry transportation, dust suppression and portable quickly assembled pipelines for mine de-watering. He demonstrated the advantages of using PE pipes for such applications

to 1,200mm in diameter. To celebrate this investment they invited more than 300 guests from all over Vietnam to an inauguration event in Hai Phong in the north of the country. As the major material supplier to Tifoplast they invited Borouge and their local agent Han Huy Trading to the event and also asked Borouge to present a paper at the accompanying seminar.

The event started with a welcome dinner on the evening of 4th August followed the next day by a tour of the factory and a technical seminar. At the seminar Borouge Marketing Manager Robin Bresser presented a paper outlining the important advantages of using polyethylene pipe compared to alternative materials. He also introduced the latest member of the Borouge family – high stress crack resistant PE100 materials and outlined the added value they can provide in difficult installation conditions. He described a number of recent projects from around the Borouge region where these materials have been used for trenchless installation techniques to provide additional security for the system owners.

using case stories from the Middle East, Australia and other parts of the world. His presentation was followed by a number of case stories from India presented by Indranil Chakraborty from the Hallmark Aqua team. The data he presented from the Sukhinda Chromite Mine water supply project in the tough, hilly terrain in Tisco, Orissa, including power consumption calculations, installation times and many more details really impressed the engineers.

After the seminar Indranil Chakraborty and John Menezas from Hallmark Aqua expressed their thanks to Borouge and said that they were very pleased with the response from the audience and the willingness of the engineers to consider replacing their old systems with PE pipes for the techno-commercial reasons presented.

BorECO PP sheets lining large industrial concrete tanks

A “bird’s eye view” of one of the large process tanks lined with BorECO PP sheets

Many parts in an industrial processing plant such as tanks and vessels need to be protected from corrosion or abrasion in order to provide an acceptable service life and the ideal solution is to use sheets made from corrosion resistant PP material.

Typical examples are the two concrete tanks used in the process of producing stainless steel by JSL Stainless Ltd. at their Jajpur plant on the east coast of India. In operation these tanks are used to wash the in-process ore material in a strong acid solution which would otherwise severely corrode the surface of the concrete structure. Earlier protection systems using glass fibre sheets were unsuccessful and therefore JSL turned to PP sheets.

The 20mm sheets were produced by Sangir Plastics from Borouge BorECO BA 415E material at their plant in Pardi in the western part of India. As described in the last issue of BorPipe Sangir Plastics found that the BorECO material produced excellent quality sheets at a 5-7% cost saving compared to their standard PP material. These sheets were cut and welded in situ to line the concrete structure. A rectangular mesh of reinforcing strips was then welded to the PP sheets on the inside of the tank to stiffen the liner against thermal expansion. Once the acid wash outlet section was completed the tank was ready for operation for many years to come.

Overall this project used over 5,500m² of PP sheeting which was produced from 12 tons of BorECO BA145E material. It is just one of many examples where PP sheets can be used in industrial plants or large municipal sewers to protect concrete or metal structures from corrosion and abrasion.

WSUP empowers local communities to manage their water and sanitation services

Julieta Muinga by the water distribution point she manages

For years, Julieta Muinga had struggled to make enough money to bring up her five children in the Chamanculo district of Maputo, Mozambique, where the average daily household income is less than US$1 per day. When the Tchemulane Programme, supported by Water and Sanitation for the Urban Poor (WSUP) reached her neighbourhood, things were about to change for good.

As a single mother, raising her children had always been difficult and to earn money she travelled long distances to work as a maid but she barely earned enough money to cover her travel costs. She often had to leave her children alone during the day and lived with the constant fear that her children would not be safe. Her neighbours and in particular the local community leader, monitored this situation closely and noted that, despite Julieta's struggle, she always showed great responsibility for what she did and managed her home with pride. Although she was rarely joyful, she nevertheless had the air of a "woman fighter" - a quality that the local community respected. In this article Nacima Figia, one of WSUP's team in Mozambique describes the impact that the programme had on Julieta's life.

The Tchemulane programme is a WSUP supported initiative, developed in partnership with the Maputo municipality and the local NGO Optar to establish essential community services in poor areas of the city. Activities in the Chamanculo district involved delivering improved water and sanitation services. When the community heard the good news that their services were going to be improved they gathered to discuss what they would need to do to manage these services in a sustainable way. To everyone it was clear that someone would be required to operate the water distribution point and the community chose Julieta.

Julieta was thrilled and asked herself, "Why me? Why have I been chosen?" The local leader, sensing her anxiety, explained, "You were chosen because of how you strived to survive and support your family. We are creating an

Borouge supports ADB to promote trenchless technology in India

Andy Wedgner of Borouge explains the benefits of high quality PE materials in trenchless techniques

As we know from the many successful case studies trenchless technology using PE pipes can provide very efficient and cost effective solutions for renovating old leaking pipelines and installing new systems in congested areas. To support the use of trenchless technology in its many projects throughout India the Asian Development Bank (ADB) recently organized a training session in Delhi for engineering staff from water infrastructure companies of various state governments of India in cooperation with the Indian Society for Trenchless Technology.

The two day programme was split into nine different sessions covering all aspects including the technical procedures, contact conditions and specification and the economics of using trenchless techniques compared to conventional installation methods. In one of the sessions Andy Wedgner of Borouge described in detail the key properties of PE materials and the importance of pipe quality when carrying out pipe lining and insertion, pipe bursting and directional drilling procedures. He explained how Borealis and Borouge have developed High Stress Crack Resistant (HSCR) materials that are especially designed for these

opportunity for us all to work together to minimize our suffering." Julieta happily accepted the task of managing the water sales and the residents collected the equivalent of US$16 which would enable her to purchase water and start reselling it to the community.

Julieta is much happier now because the income that is generated from the business helps to improve her family nutrition; she now has time to rest and devote time to her children. She now has money to buy better food and clothing. When her family and friends visit her, she is proud to be able to provide a decent meal. Her life has improved dramatically. "Managing this business has given me hope and also provides essential services to the whole community. I am learning about business skills and am dedicated to assisting my community. I no longer doubt my ability to build a better future."

Water and Sanitation for the Urban Poor (WSUP) is a partnership between the private sector, civil society and academia focussed on addressing the increasing global problem of inadequate access to water and sanitation for the urban poor and the attainment of the Millennium Development Goal targets, particularly those relating to water and sanitation. Borouge and Borealis became members of WSUP in 2007 as part of their "Water for the World" initiative.

trenchless techniques where external damage is likely to arise due to stones in the soil or sharp fragments of the host pipe. Even under these severe conditions the slow crack growth properties of the material will ensure that no scratches or scores on the new pipe will develop into cracks that could cause a failure during its operational life.

A total of 28 engineering staff members responsible for implementing ADB projects across the whole of India attended the complete course. In addition to the presentations they also received copies of a number of newly released publications and CD's for their reference. Following this comprehensive training the engineers now understand the importance of employing high quality PE pipes and trenchless technology in their future projects.

Coal Seam Gas in Australia – an update on the industry

One of the coal seam gas wells in a remote region of Eastern Australia

Butt welding the twin gas and water pipelines prior to installation

Over the past twelve years, coal seam gas (CSG) output in Australia has increased well over one hundred fold and CSG now accounts for over 10 per cent of gas consumed in Australia and 30 per cent of the consumption in the eastern states of the country. Many further coal reserves have been discovered in the eastern states, which could raise Australia from the fourth to the second largest exporter of Liquefied Natural Gas (LNG) by 2015. Four major gas companies are planning to sink over 30,000 wells and invest over US$32 billion over the next few years to develop this business.

The development of these CSG fields will require a great deal of pipework over the next few years – pipes to collect the gas, to transport it to processing sites and to transport it many kilometres to east coast ports for liquefaction and export. The lower pressure part of the systems will be in PE100 and already much of this network is being installed across rural Queensland. In parallel with the gas pipelines will be water pipes as water is recovered as part of the gas extraction process. After separation the water will be treated so that it can be used for industrial cooling and for replenishing depleted water courses. These twin pipe systems will be 315 to 500mm in diameter and will be installed using mechanical ploughs which provide a fast and low cost means of installation in these rural areas.

Major high pressure steel transmission pipelines up to 1000mm diameter are also being planned by the major gas companies to transport the gas to liquefaction plants that they are planning to construct at east coast ports. Corrosion protection will be a major issue with these pipelines providing opportunities for 3-LPE coating systems.

Conference Call for Papers

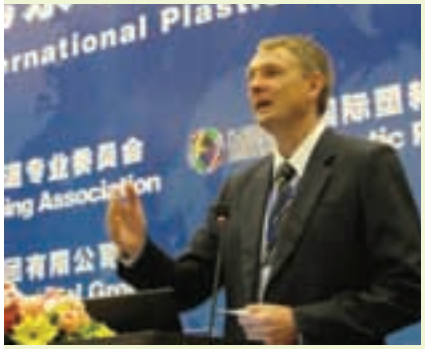
An official call for papers has been announced for Plastic Pipes XVI, the next International Plastic Pipe Conference. This global conference and exhibition will take place in **Barcelona, 24-26 September 2012.** Authors have until 15 November 2011 to submit their paper in abstract submission form. Final deadline for completed work will be 16 May 2012.

Innovation has always been a motor for growth within the plastic pipe industry. During the last thirty years, presentation of conference papers has thus served as a major platform for many new and interesting pipe materials, systems, applications and technical developments.

PLASTIC PIPES CONFERENCE ASSOCIATION

CPPA
China Plastics Piping Association

International Plastic Pipe Conference to be held in Beijing in November organized by the China Plastics Piping Association



Robin Bresser of Borouge speaking at the 2009 Plastic Pipe Exchange Conference

In order to promote the development of the plastic pipe industry in China, the China Plastics Piping Association (CPPA) and the Plastic Pipe Conference Association (PPCA) are co-organizing the 2011 International Plastic Pipe Exchange Conference which will be held in Beijing on November 27th to 29th, 2011. At this spin-off conference, some selected speakers from Plastic Pipes XV in Vancouver, Canada have been invited to present their papers together with a number of eminent local speakers.

The conference builds on the success of the 2009 International Plastic Pipe Exchange Conference, which was visualized like a "golden bridge" between the West and East. Like this earlier conference it will provide a good platform for technical communication and help enhance the progress of the plastic pipe industry in China.

The CPPA invites plastic pipe manufactures; raw material and additive suppliers, processing equipment manufacturers, system designers and end users, testing institutes and certification bodies, the media and all other interested parties to join them at this event and contribute to the sustainable development of the plastic pipes industry in China.

NB: The Plastic Pipe Conference Association (PPCA) organizes the international series of Plastic Pipes Conferences and comprises of the Plastic Pipe Institute, PVC 4 Pipes, PE100+ Association and the European Plastic Pipes and Fitting Association (TEPPFA).

KEY AREAS

Typically, papers are expected to deal with key areas such as market issues, pipeline solutions, applications and developments. Nonetheless, organizers are also keen to receive interesting papers that are not directly related to these categories. It is important to note all papers must be presented in the English language and in pdf format.

Market trends occupy a principal focus as well as interesting experiences worldwide. From market issues above ground, attention shifts to below ground and to the solutions and experience that are acquired. Major landmark projects incorporating PE100 pipe systems for example, are of particular interest given the current scope and scale of their use throughout the world. The ingenious underworld of trenchless technology holds equal fascination.

Plastic pipe applications are developed on a continuous basis and novel uses are therefore encouraged for review. The same applies to new plastic pipe materials and structured wall and multi-layered systems. Innovative product design and testing tools for pipelines are also clear indications of how technology within the industry is shaping the future.

Plastic Pipes XVI is organized by the Plastics Pipe Institute, PVC4Pipes, PE100 +, TEPPFA and national and regional trade associations. Location for the conference and exhibition will be the Hotel Arts close to the old centre of Barcelona. Further information for the submission of papers can be found on the conference website at: **www.ppxvi.org**

Details of conference registration, exhibitors and accommodation can be obtained from:
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Calendar of Pipe Events

Date	Event	More information
6 September	SAPPMA Conference, Midrand, South Africa	www.sappma.co.za
8-9 September	18th India Oil & Gas Review Summit, Mumbai	www.biztradeshows.com
29 Sept – 1 Oct	Water Philippines 2011, Manila	www.waterphilippinesexpo.com
3-5 October	Power & Water Middle East, Abu Dhabi	www.adnec.ae
3-6 October	No-Dig Down Under 2011, Brisbane, Australia	www.nodigdownunder.com.au
10-11 October	Trenchless Middle East, Dubai	www.trenchlessmiddleeast.com
13-15 October	2011 Water-Expo, Beijing	www.waterexpo.cn
22-25 October	APIA Annual Convention, Sydney, Australia	www.apia.net.au/events
9-11 November	Water N.Z. Conference, Rotorua, N.Z.	www.waternz.org.nz
10-12 November	Viet Water, Ho Chi Minh City, Vietnam	www.bvents.com
20-23 November	2nd Arab Water Forum, Cairo, Egypt	www.arabwatercouncil.org
21-24 November	2nd IWA Development Congress & Ex, Kuala Lumpur, Malaysia	www.iwa2011KL.org
27-29 November	Plastic Pipes Spin-Off Conference, Beijing	
04-08 December	20th World Petroleum Congress, Doha	www.20wpc.com
13-15 March	WETEX, Dubai	www.wetex.ae
27-29 March	Asia Water, Kuala Lumpur, Malaysia	www.asiawater.merebo.com
6-8 June	AquaTech China, Shanghai	www.aquatechtrade.com
28-30 June	2nd Int. Tube and Pipe Ind. Expo 2012, Beijing, China	

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