

UNIQUE CONTENT AND INSIGHTFUL OPINIONS ON THE SHIFTING MOVEMENTS WITHIN THE MARKET BY THE INDUSTRY'S MOST INFORMED AND INFLUENTIAL SOURCES

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IT'S ALL CHANGE AND CHALLENGE AHEAD AS INDIA AND CHINA DRIVE THE WORLD DEMAND FOR BITUMEN

India and China are going to dominate world bitumen demand in the coming decade. Both countries have ambitious road-building programmes that will create plenty of challenges and changes in bitumen technology and the market's supply chain. *Kristina Smith* reports.

In October 2017, Indian prime minister Narendra Modi announced that his government is planning to build 83,677km of new highways in the next five years and invest at least \$108bn in the nation's road infrastructure.

There is a certain amount of rhetoric involved in this statement ... a significant proportion of this budget has already been announced and there are serious doubts that this rate of construction can be achieved. However, it does demonstrate the scale of India's ambition.

China's vision is no less bold. Its 'One Belt, One Road' initiative stretches far beyond its national borders with plans to build a plethora of infrastructure stretching from China through Central Asia and the Middle East to Europe.

Asia-Pacific is already the largest market for bitumen and analysts expect growth in demand in this region will be responsible for an overall

rise in global bitumen demand, dominated by India and China. Estimates of how much world bitumen demand will grow vary from 2.5% to 4.6% compound annual growth rate (CAGR).

The market for additives is set to rise too, as developed and developing markets look to build roads that can withstand the rigours of climate and traffic loading for longer lengths of time. According to Transparency Market Research, the global market for bitumen additives, worth US\$3.3bn in 2016, could rise

to S\$4.7bn by 2025, equivalent to 3.8% CAGR by volume. The Asia-Pacific region is the biggest consumer of asphalt additives with a 32% market share, followed by North America.

In India, private sector involvement is likely to drive innovation. The government's recently announced toll-operate-transfer (ToT) model is reported to be attracting significant overseas investment due to its relatively low-risk profile. With return-on-investment at stake, investors will be pushing for technologies that can minimise maintenance requirements and maximise toll revenues.

For China, the drive for new technology

Pörner has supplied its Biturox technology to 11 plants in India, including this one – the 10th – for IOCL (Indian Oil Company Limited) at Barauni. When its 11th plant comes on line, Pörner says its technology has the capacity to produce 80% of India's bitumen





ABOVE: This is one of four sections of Mumbai's expressway which has been surfaced with Kraton Polymer's HiMA (highly-modified asphalt)

will come from several sources. Chinese contractors, already active in overseas markets, will adopt ideas from overseas. Other changes may be led by a government which is showing its growing commitment to reducing carbon emissions. Recycling, currently in its relative infancy, will increase as will energy-saving lower temperature mixes.

INDIA'S MATURING MARKET

India has one of the largest road networks in the world, second only to the US, although much of its network consists of roads that are low-grade and too narrow for their traffic volumes. Modern road construction is still in its relative infancy there says Murali Krishnan, a professor in the department of engineering at the Indian Institute of Technology Madras, in Chennai.

The National Highways Development Programme is overseen by the National Highways Authority of India (NHAI) which was only set up in 1996. A significant amount of the programme has yet to be delivered and was wrapped up into October's impressive announcement.

"Industry watchers and academics perceived that NHAI would be similar to the Federal Highway Administration in the US," says Murali. However, rather than going away and creating a new system like the US's performance-based Superpave, the NHAI steered clear of technical development and left it to the parent ministry, explains Murali:

"Economic reasons overtook the whole highway building scenario - most of the highways were delivered in build-operate-transfer (BOT) mode. They made some piecemeal changes here and there on bituminous pavement design and then

transferred the ownership related to the durability of the pavement to the organisations doing the construction."

In performance terms, the result of the BOT model has been incredibly varied. "After ten years in service, some roads prematurely failed, and some have behaved very well," says Murali.

There is a theory that highways delivered under public-private-partnership (PPP) models tend to deliver longer-lasting roads. However, in India, this theory does not appear to hold true.

The reason for this is that the government inserted a clause which said that the roads must be re-surfaced a number of years into the concession period, says Murali. This meant that there was no point in paying for a higher-performance material such as polymer modified bitumen (PMB) because it would be ripped up anyway before the end of its potential life.

As a result, the use of PMB on NHAI projects has been limited. Poor demand for PMB generally is reflected in Shell Bitumen's decision to withdraw from India, although its global bitumen research and development centre is still located in Bangalore, within the larger Shell Technology Centre Bangalore.

Meanwhile Kraton Polymers, which specialises in SBS polymers, is focusing on promoting its HiMA (highly modified asphalt) technology in India. "In India there is a significant gap between where we want our infrastructure to be and where it currently is," says Govind Khetan who heads up Kraton's Indian business. "We are working very closely with the entire value chain including PMB formulators, road contractors, designers and the end users about the state-of-the-art technology, like HiMA, which is available globally."

Last year saw four trial sections of HiMA installed on the Mumbai expressway and on other busy roads. "We expect that these sections will act as technology demonstrators for specification formulations in India in the

"That means the pavement temperatures are 70 to 75 degrees. A highway constructed in December will melt in June"

Professor Murali

future," says Khetan. "Kraton has suggested a HiMA-based specification to the government to be included in all future activity in the country." This year should see the first use of HiMA in commercial road projects, Khetan adds.

If ever a country needed modified bitumen, it must be India. Professor Murali explains the variation in climate and the challenges this brings for those designing and maintaining roads. In the north of the country in the Himalayas near the Indo-China border, temperatures fall to minus 20 or minus 30 degrees due to the high altitude.

"At 20,000 feet and above you are at sub-zero temperatures for nine or ten months of the year which means you are looking at cold mix, something with emulsion," says Murali. "We don't even have the facilities for mixing it. That's going to be very tricky."

Head to the area between Rajasthan and West Bengal and the weather brings different challenges, temperature that range from minus 20°C to plus 45°C in the summer. "That means the pavement temperatures are 70 to 75 degrees," says Murali. "A highway constructed in December will melt in June."

Roads on the south coast face very different, yet equally demanding, weather conditions: non-stop rain that begins in June and continues relentlessly for three months.

Add to these extremes of climate the extremes of traffic loading, and the challenge for India's highway designers becomes almost insurmountable. "The nightmare is overloading," says Murali. "Indian trucks carry 30 to 40% or even more than they are designed for. There are no penalties, except perhaps in toll plazas where they might catch overloading."

"Highways designed for ten years have failed after two or three years. There are so many overloaded trucks that you have used up the life," he says.

Perhaps the ToT model offers new hope. Murali and his colleagues are busy carrying out research projects into technologies that can →

→ help extend the life of road surfaces. He talks of a 100-km long section of road which will contain 15km test sections for technologies including polymer modified asphalt and glass reinforcing grids.

“Changes are happening but it’s going to take some time,” says Murali. “It will be at least another 10 years before we see a lot of innovation on the road.”

CHINA’S GROWTH CONTINUES

The scale and speed at which China is creating new infrastructure are difficult to comprehend. Between 2008 and 2017 the total length of road in China increased from 3.7m km to 4.7m km, according to market researchers Ibis World. In that time, its length of highway more than doubled from 60,300 km to 131,000km.

Its ‘Belt and Road’ initiative should ensure that road building continues, even though the rate of growth of construction output has slowed. Launched in 2013 as ‘One Belt, One Road’, the programme is split into two parts: the Silk Road Economic Belt which is an overland corridor and the 21st century Maritime Silk Road, which is a sea route

between southern China, East Africa and on to the Mediterranean.

As a foreign policy initiative, aimed at boosting trade and economic growth across Asia, ‘Belt and Road’ will involve a huge amount of infrastructure. Ports, roads, rail, power generation and industrial facilities are all part of the plan. Some reports suggest that as much as \$900m of ‘Belt and Road’ projects are already underway.

The use of PMB is already well-established in China, with local suppliers including Xi’an Guolin Industry and Guochuang Hi-tech. Shell, which opened its third regional R&D centre in Bangalore at the end of 2016, marketing their heavy-duty PMB Cariphalte in China, as well as standard bitumen and bitumen emulsion.

Shell’s involvement in China stretches back some way. It supplied products for roads around the Beijing Olympic Park and the China Pavilion for the 2010 World Expo in Shanghai. It was involved in the 302km-long Guangdong Guangle Expressway and in the 70km Lanzhou’s airport expressway, part of Belt and Road, which connects Lanzhou

Zhongchuan Airport to the city centre and which opened in 2015.

More recently, Shell reported its involvement in the main bridge deck for the Hong Kong-Zhuhai-Macau Bridge, part of a new 55km link from Zhuhai in China’s Guangdong Province to Hong Kong and Macau.

China took its first steps towards a carbon trading scheme at the end of last year, introducing emissions quotas for companies in the power sector. Analysts have taken this as a sign that the country wants to move towards a more sustainable approach to development and business.

Recycling and the use of reclaimed asphalt pavement (RAP) are likely to increase as road authorities look for both cost-effective and sustainable solutions. Ammann customer Tianjin TianHeJianLing Road & Bridge Engineering Technology, is working with the ministry of transport to carry out tests and collect data on the RAP it is producing with Ammann’s ABA UniBatch and UniGlobe asphalt plants.

“Tianjin City is one of the first places in

Double Barrel XHR

from ASTEC



Patented Double Barrel XHR



LEFT: India has one of the largest road networks in the world and much of its network consists of roads that are low-grade and too narrow for their traffic volumes

China to use RAP technology,” says Zhen Jianling, CEO of Tianjin TianHeJianLing Road & Bridge Engineering Technology. “During the expansion of a new road construction project, we seized the chance to use large quantities of RAP.”

Road builder CSCEC Road & Bridge also uses Ammann’s UniGlobe plants to produce mixes containing RAP. “In recent years, as more and more public-private partnerships are coming out, we also are paying more attention to recycling technology,” said Zhou Shixin, chairman of a CSCEC Road & Bridge branch in Shijiazhuang City.

Ammann has upgraded CSCEC Road

& Bridge’s four UniGlobe plants by adding parallel drums to its plants which heat the RAP before it goes into the mixer. The drums heat the RAP gently, avoiding damaging it by over-heating.

Unlike markets in Europe, North America and many other parts of the world, China is good at adopting and adapting technology from overseas. “There’s a better culture for accepting technology from outside and applying it locally rather than reinventing the wheel” says Carl Robertus, technical and research director at Nynas. “They have a way of doing things that could potentially produce new ways of doing things there.”

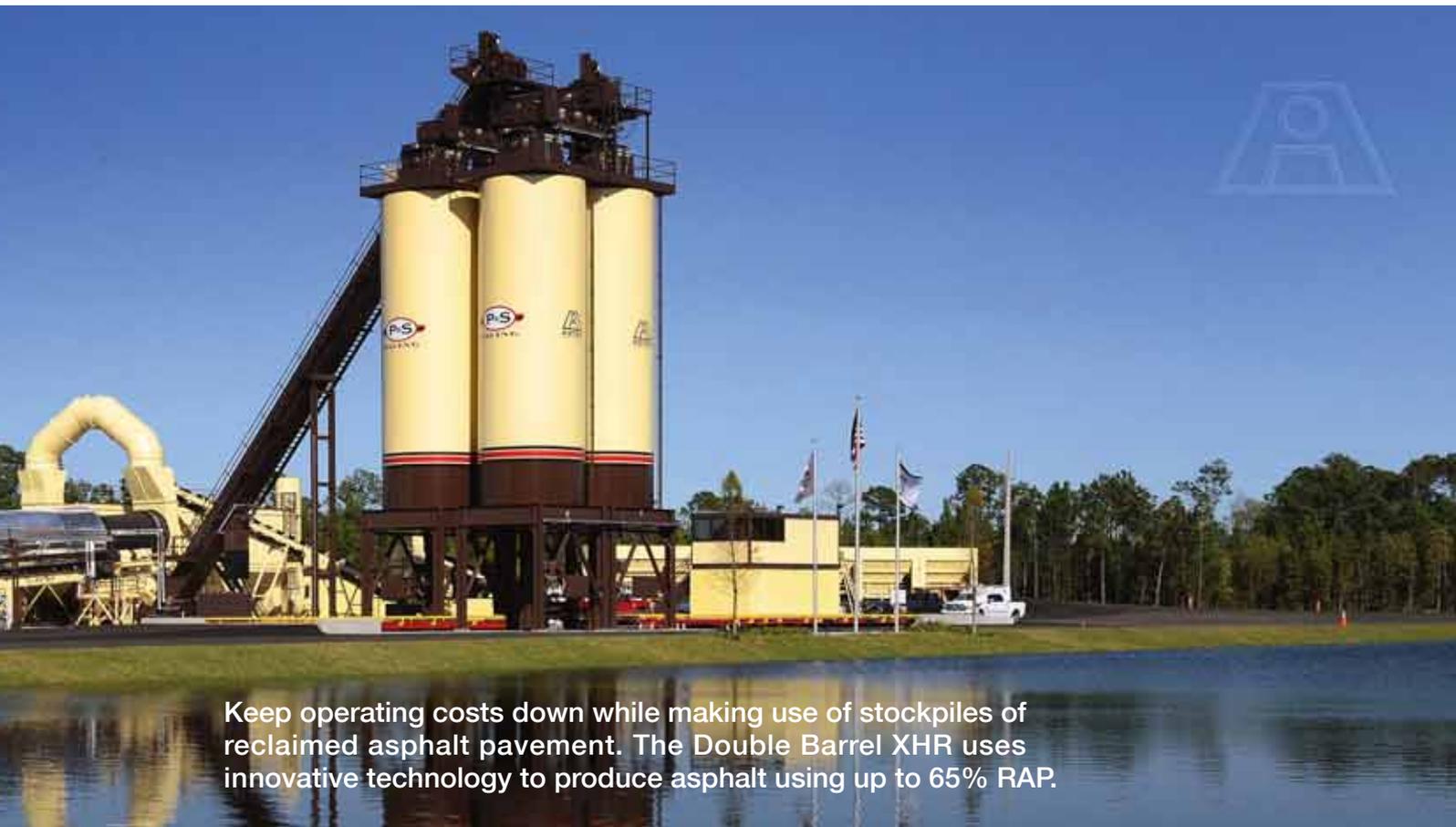
NEW ERA FOR BITUMEN?

Both India and China supply a large proportion of the bitumen they use for roads at home. As their energy demands have grown, so have the sizes of their refineries.

“We see there is a huge increase in refining capacity in China and India and I would expect that, along with the increase in capacity, we will see an increase in bitumen production capacity that could meet the increase in demand for bitumen,” says Robertus.

“They are building different types of refineries, monster refineries, focused on producing fuels and energy materials rather than bitumen. But of course, if there’s a bitumen market, as long as the economics are right, the refineries will produce bitumen.”

Andreas Pörner, managing director of bitumen plant and technology specialist Pörner (Austria), highlights two major changes →



Keep operating costs down while making use of stockpiles of reclaimed asphalt pavement. The Double Barrel XHR uses innovative technology to produce asphalt using up to 65% RAP.

→ that will impact on bitumen production and quality: changes in refinery technology and new environmental regulations.

“Most of the modern mega-refineries built in the Gulf region, India and China, are provided with deep cracking or coking units to process the crude residues for higher yields of white product - they simply do not produce any bitumen,” he says.

The new environmental regulations come from the International Maritime Organisation (IMO) which says that by 2020, ships cannot be powered by bunker fuels anymore which – unlike the petrol and diesel we use for cars and the kerosene used for planes – contains up to 3.5% sulphur.

“Now many refiners are confronted with the IMO requirement to provide 0.5% sulphur, by either deep hydrotreatment or by use of sweet crudes combined with blending, or to process the sour residues in another way such as coking or gasification,” explains Pörner. “Many new ships are fired by natural gas which also reduces the demand for bunker oil in the longer term. Good prices for unrefined bunker oils will soon be history.”

Since it is too late for refineries which have not started a conversion process to change now, Pörner predicts that some will start producing bitumen or increase their bitumen production. “Refineries with lower processing depth will presumably concentrate more on bitumen and produce more top-quality binders,” he says.

BELOW: Shell Bitumen has been involved in a number of high-profile projects in China, the latest of which is the main bridge deck for the Hong Kong-Zhuhai-Macau Bridge



“Of course, this world is too big to generalise - with so many cultural, economic and political differences influencing local conditions and sectional markets - but we can expect there will be more and better bitumen available for good prices.”

Pörner, is well-placed to comment on global trends, having supplied its Biturox plant and technologies in many locations around the world, with its plants producing 13m tonnes of bitumen or over 10 percent of world output, according to the group. Since 2000

it has delivered over 35 Biturox projects to refineries in Europe, Africa and Asia, with plants constructed in Russia, Oman, Azerbaijan and India in the last 12 months or so.

Pörner describes Biturox technology as “an oxidation process by which compositions of refinery raw materials are upgraded to high-value bitumens, with an increased pen (penetration) index.” The quality of the bitumen can be tightly controlled, says Pörner, in contrast with the vacuum distillation process which sees the chemical separation of oil’s components with the quality of bitumen dictated by the crude.

“Biturox air rectification changes the chemical structure of the material – making the refinery quite independent in its crude selection,” says Pörner.

The challenge with some modern bitumens is that they meet the specifications – as defined by traditional tests – but don’t have the same properties as bitumens historically do. The challenge for researchers and industries is to

come up with new tests that more accurately measure performance. These are being developed but are a long time from being usable, says Murali.

“You cannot complain that bitumen is not as good as it used to be when you don’t have the tests to tell the refineries what you need,” says Murali. “Most of the bitumens, at some point in the future, are going to be modified. We have to treat it at our end. We cannot expect the refineries to treat them for us. It’s not economical for them.”

Over the past 20 years, Pörner’s Biturox technology has become widely used in India. The first plant was installed at IOCL’s (Indian Oil Company Limited’s) Chennai refinery in 1994, the latest, 11th licence was granted to MRPL-Mangalore Refinery and Petrochemicals Limited in summer 2017.

India produces much of its own bitumen from 12 refineries. The remainder generally comes from Singapore and Malaysia. According to Pörner, around 80% of India’s bitumen production, or 3.9 m tonnes, could be produced by Biturox plants soon.

China’s refinery sector is set for consolidation over the next few years, encouraged by government policy. Small, privately owned ‘teapot refineries’ are being bought up by bigger players.

“Both China and India have to cover their demand by additional imports of considerable volumes,” says Pörner. “China has already increased its own bitumen output by processing imported crude oils. Most Chinese origin crudes were found to be too waxy to produce good bitumen, such as that needed for highways. Traditionally, Singapore, a city state with three big refineries, Malaysia and Korea are big bitumen exporters to China. Iran and Venezuela export several million tonnes to the world markets.”

Pörner points out that demand in other regions will also rise. “There are several other countries with ambitious road construction programmes such as Turkey, Kazakhstan and South Africa that will have to import greater volumes of bitumen,” he says. Meanwhile, analysts predict that demand from Russia and Brazil will be relatively weak.

Despite Asia-Pacific’s growing appetite for bitumen, the rest of the world won’t be left short, says Nynas’ Robertus. He points out that Europe’s bitumen demand still hasn’t reached the level it was at before the global financial crisis of 2007-2008.

Around 80% of India's bitumen production, or 3.9m tonnes, could be produced by Biturox plants soon





→ “Since the economic downturn, bitumen demand in Europe has dropped significantly, around 30% less was consumed last year compared to 2008,” he says. “In some areas of Europe, the decline has been higher, up to 60%, while other regions have seen growth or stability.”

That fall in demand has created the changes in bitumen supply which have seen many European refineries closing altogether and others upgrading to produce higher quality feeds instead of bitumen. But Robertus predicts that European supply will easily meet European demand over the next five years – although there are certain seasonal variations – with excess production exported to northern Europe.

“Will there be route of bitumen exports from Europe to Asia? That is really a long way. Although I see bitumen travelling further today within Europe, I don’t think there have been any bitumen exchanges over such long distances,” he says. “Sometimes there are occasional exchanges across the Atlantic, but that is rare because there is still excess capacity in Europe.”

Nynas operates only in Europe and has overhauled its bitumen supply model recently by adding its Harburg refinery in Germany, which it acquired from Shell, then extensively updated. Last year was its first full year of production, with the plant supplying bitumen to Germany, Switzerland, Austria, France and Nordic countries.

As with the road-building countries around the world, Europe, with more of a focus on road rehabilitation and maintenance will see a growing demand for PMB, says Robertus; “If you look at the traffic loads and how they are expected to grow, we have to find ways of strengthening the material. PMB has been around for 40 years but its use continues to grow.”

Robertus also predicts the rise of warm mix-type technologies that allow mixes to be produced and laid at lower temperatures. Nynas’ focus for the European market is very much aligned with sustainable development, he says, offering solutions that allow temperature reductions and hence energy savings, re-use of materials and technologies such as PMB that give a longer pavement life.

POLITICAL UNCERTAINTY

It is undeniable that India, China and other countries in Asia-Pacific offer huge opportunities for those involved in the production and supply of bitumen and bitumen technologies. However, political and economic issues can mean that progress and growth are not always smooth.

At the end of the last year Argus Bitumen, which provides data and analysis about the bitumen market, highlighted a slowing in demand for bitumen in the Asia-Pacific region due to political challenges and cuts in infrastructure spending, particularly in Indonesia and Vietnam.

“China’s bitumen consumption had been expected to hold fairly steady but government environmental inspections pushed up domestic inventories and slowed road construction activity,” Argus Bitumen reported. “China’s bitumen imports fell by 11.6% from a year earlier to 3.84m tonnes in January-to-September 2017 as a result, even given a relatively low base in September 2016 because of the impact of the G20 summit in Hangzhou at the time.”

In India, politics also took their toll, said Argus: “Delhi’s abrupt demonetisation policy in November 2016, combined with the major goods and services tax (GST) reform in July 2017, combined to send bitumen consumption lower by 4% in April-to-September.”

Companies eyeing India and China must be prepared to play the long game. Italian additive specialist Iterchimica has been active in India for the last seven or eight years. “Certainly new markets are always difficult but our products are now approved by the Indian Roads Congress which means that they can be used on government projects,” says Iterchimica director Alessandro Giannattasio. “We went through a very long process of approval and testing.”

For Iterchimica and many other companies, China is a different proposition. “China is a much more difficult market,”

ABOVE LEFT: Europe’s bitumen demand still hasn’t reached the level it was at before the global financial crisis of 2007-2008, despite higher-quality feeds becoming more popular
ABOVE: Tyres are already used in asphalt in China, India, Portugal, Spain, the US and some Eastern European countries

says Giannattasio. “We are working with some Chinese contractors who are working on projects overseas, but for us the Chinese market is too complicated.”

Tenacity and patience may pay off. In ten or twenty years’ time, India and China could well be leading the world on bitumen technology and pavement design.

“The point is that China and India are building tens of thousands of kilometres of roads which leads enormous practical experience and allows investment into a lot of research, in proper standardisation, well-thought-out strategies and tailored construction methods,” says Pörner. “Both countries have very different economic areas, climatic zones and weather conditions which increases even further their practical experience.”

“Furthermore, Chinese contractors in particular – based on economic aid provided by their government – are extremely active in all third-world countries and therefore are gaining even more experience from overseas projects, as well as exporting their own know-how.” □