

FORMULA FOR SUCCESS IN THE CHEMICAL INDUSTRY

Analyzing energy at the extremes **P4**

Strategies for success: Seven habits of effective petrochemical producers **P8**

Russian petrochemicals: A bump in the road **P10**

Europe POM price recovery less certain as China slows **P12**

Advantages and risks in investing in Iran's petrochemical industry **P13**

Tight oil & fracking growth drive polyacrylamide **P14**



VISION

If you think 2015 was interesting, just wait for 2016

By Michael Smith **P3**

FEATURE

Formula for success in the chemical industry: Analyzing energy at the extremes

By Dave Witte and Mark Eramo **P4**

INSIGHTS

Strategies for success: Seven habits of effective petrochemical producers

By Roger Green **P8**

Russian petrochemicals: A bump in the road

By Sean Stevenson **P10**

Europe POM price recovery less certain as China slows

By Ryan Monis **P12**

Advantages and risks in investing in Iran's petrochemical industry

By Michael Smith **P13**

Tight oil & fracking growth drive polyacrylamide

By Rob Taylor and Adam Bland **P14**



Michael Smith

Vice President EMEA,
IHS Chemical

VISION

If you think 2015 was interesting, just wait for 2016

2015 has proven to be a genuine rollercoaster ride for the global petchem industry. While the first half of the year was characterized by global inventory tightness, re-stocking on the back of recovering crude oil prices and very healthy margins in some regions and sectors, the second half of the year is beginning to look like somewhat of a nightmare. In the second half of August 2015, global stock markets declined rapidly, while WTI fell below \$40 per barrel and Brent was heading in the same direction. Towards the end of the month, some recovery of both crude oil and the stock markets became apparent.

Nevertheless, markets remain nervous and volatile. Companies all along the value chain are shifting their gears into cash flow management and inventory control mode. No one wants to be stuck with overvalued inventories in a falling market; particularly when underlying demand is also weakening.

All is not gloom and doom, however, but we would only be fooling ourselves, if we were to believe that 2016 is going to be a banner year. Global GDP growth has been stuck in a tight range of 2.5–2.8% for the last four years, and there is good reason to expect that 2016 will provide us with more of the same. While more advanced economies such the United States and West Europe are expected to continue to recovery slowly, several emerging markets are facing increasing economic headwinds, which are being exacerbated by plunging commodity prices. China's economy continues to decelerate and the best we can hope for is an annual GDP growth rate for the coming years somewhere between 6-7%.

In spite of the meager economic outlook, opportunities will present themselves aplenty in 2016 for those companies quick and nimble enough to take advantage of them. The lifting of Iranian sanctions is one of these. Several of the articles in this publication should inspire and motivate readers not to wait for supposedly better times, but to think beyond conventional wisdom and be proactive. The entire team at IHS Chemical looks forward to assisting you in identifying and grasping opportunities in 2016 and beyond. From subscriptions to bespoke consulting services, we will provide you with the tools you need to be successful.

Visit: www.ihs.com/ChemicalConsulting for more information on our capabilities.

Formula for success in the chemical industry: Analyzing energy at the extremes

By understanding the impact of low crude oil prices, the resulting effect on demand and changing competitive market dynamics, chemical companies can make sound capital investment decisions.

The biggest headlines about reduced oil prices focus on consumers' relief from pain at the pumps. But the impact of lower-priced oil is much larger and far more complex. The decline in crude oil prices at the end of 2014—compared to the 2010 to early 2014 period—has introduced a new set of dynamics for global economic growth and is impacting the operating plans for companies in virtually all industry sectors.

In global energy markets, lower crude oil pricing in 2015 placed the United States—not Saudi Arabia—in the key role of regulating global crude oil supply in response to market pricing. No doubt, consumers in some countries are benefiting from lower energy prices, leaving them with more discretionary income. For example, US consumer spending growth accelerated in 2014 from 2.5% in the second quarter to 4.4% in the fourth quarter as oil and gasoline prices were plunging. Policy makers from importing-oil countries are investigating options to exploit the benefits. However, not all countries are experiencing the benefits of lower crude oil prices. Oil-producing nations such as Saudi Arabia and other OPEC nations are exploring how low crude oil pricing will impact spending on domestic programs and budgets that are reliant on higher-priced crude exports.

Lower crude oil prices are also shaping the planning and operations of chemical companies. Each year the industry invests billions of dollars in new and sustaining capital to keep pace with demand growth (see figure). Business leaders decide where to invest in new capacity and how to operate and maintain existing assets based in part on energy market dynamics, as well as trends in the manufacturing and consumption of durable and non-durable goods, and overall market profitability. In light of lower oil prices, executives are now debating

the viability of investment decisions that were considered must-do projects just 12 months ago. For example, one US-based, non-integrated ethylene consuming company recently put the brakes on a new ethane-based steam cracker project that last year promised an exceptional return on investment.

The two foundational risks for chemical manufacturers are market supply and demand imbalances, and energy-driven changes in production costs. The development of significant imbalances between available capacity and demand growth can and often does create boom-and-bust cycles in the chemical industry, directly affecting overall profitability. Companies able to align new capacity with global demand growth are less likely to face over-supply or undersupply conditions. In a perfect world, organizations would invest in low-cost capacity with direct access to strong demand growth markets when the global market begins to transition from a period of over-supply to tighter market conditions.

Absent a crystal ball, however, chemicals executives must now make decisions that will impact the future of their companies for decades. To minimize the risks of changing economic trends and energy costs and to maximize profitability over time, chemical companies must develop robust strategic plans that can flexibly adjust to energy market volatility. By understanding the complex and changing dynamics within the petrochemical value chain, firms can more reliably make these adjustments and ensure they produce the right chemical products at the right locations for the right markets. Only then can these companies create business and investment strategies that drive success in periods of extreme cyclicality.

Investing in turbulent times

Chemical companies dedicate a substantial portion of their annual budgets to constructing new assets and maintaining or modernizing existing assets to meet market needs, and con-

forming to strict regulatory and operational standards so they can compete effectively. Boardroom investment decisions are driven by strategic plans that seek to leverage advantage in three primary areas: energy and feedstock costs, proximity to demand growth, and technology.

Energy and feedstock costs: The differential between oil- and gas-based feedstock prices in the highly competitive markets of the Americas, Asia, Europe, and the Middle East divides cost-advantaged from cost-disadvantaged chemicals producers. Whether the analysis focuses on elementary feedstock choices (such as naphtha, ethane, or propane), power costs, or alternative values for use in crude oil refinery products and heating markets, successful producers must exploit opportunities to create competitive advantage. Cost-advantaged producers can capitalize on these conditions through investments in new multibillion-dollar production facilities. Because as much as 75% of the cost of producing petrochemicals is related to hydrocarbon values, companies with a cost disadvantage may choose to invest in lower-cost raw materials (such as a conversion to ethane cracking in the US market) or attempt to relieve competitive cost pressures through product differentiation.

Proximity to demand growth: Demand can drive or stifle the need for new investment. Today, assets that derive margin from a wide gas-to-oil differential – such as those in North America and the Middle East—are experiencing margin declines. Large, capital-intensive projects already underway will likely continue in these cost-advantaged regions. In energy environments where the supply-curve is lower and flatter, proximity to demand growth can provide a strong competitive advantage, in which companies leverage freight and logistics costs as a barrier to protect or grow market share.

Technology advantage: In commodity chemical markets, competition is driven by cost, service, and reliability. Non-commodity chemicals derive competitive advantage from their product attributes or the functions they serve. Regardless of the competitive differentiator, technology serves as a clear, important variable. For example, the use of on-purpose propylene technology (PDH, propane-dehydrogenation) in North America today allows propylene producers to take advantage of excess propane supply in the region to provide low-cost propyl-



ERAMO: *The two risks for chemical manufacturers are supply/demand imbalances, and energy driven changes in productions costs.*



WITTE: *Constructing operating plans that create optionality is key to survival in today's highly volatile world.*

ene versus naphtha co-product propylene from a steam cracker. Producers with sustainable technological advantage typically enjoy better performance in terms of volume, profits, and lower margin volatility over the chemical cycle.

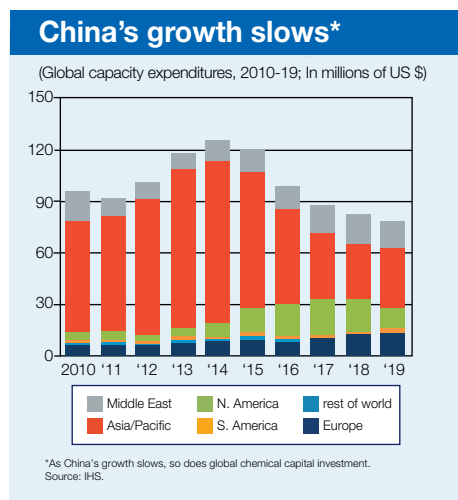
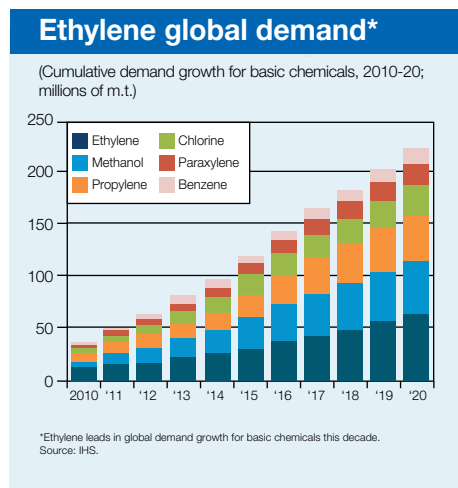
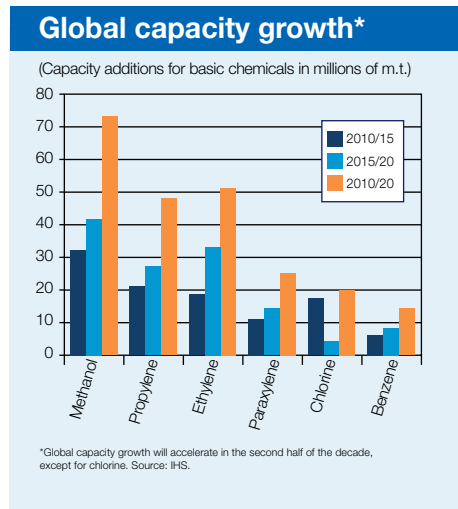
Even for the most competitive and strategically placed assets, investment decisions take place against a backdrop of market and political uncertainty. The chemical industry continues to be buffeted by unpredictable and often volatile regulatory, economic, and energy dynamics. For example, 2014 kicked off with continued momentum in North American shale feedstock volumes and record industry profits for gas-based assets and Chinese coal-based technologies. Downstream industries such as converters that produce many finished or semi-finished consumer goods struggled to absorb relentless price increases, squeezed between the chemical producers on one hand, and consumer products and retail industries on the other. A fourth-quarter decision from OPEC to let market forces set oil pricing, in the face of both weak petroleum demand and rapidly rising shale supply, resulted in a dramatic reversal in crude oil and chemical pricing by year's end.

Global economic recovery continues to be uneven. Economic activity in China, Europe, and Brazil, among others, remains sluggish. As a result, chemicals demand is still tepid, and the drop in oil prices has not yet encouraged manufacturers to keep or build inventory. A significant result of lower crude oil prices has been a lower and flatter supply curve. When combined with a stronger US dollar, this flattened supply curve changed the competitive landscape and redistribution of profits, both geographically and throughout the value chain. As a result, downstream markets became more profitable in 2015.

Understanding shifting energy dynamics

Energy is the primary cost factor in the manufacture of chemicals, with crude oil and natural gas the key determinants of production costs. Changes in relative costs of these key energy sources (and the resulting impact on derived feedstocks) play a significant role in the competitiveness of various regions and the willingness of chemicals manufacturers to invest.

For example, from 2010 through the end of 2014, significant price differences between North American natural gas-based raw materials and those derived from crude oil transformed that area into a low-cost region for chemical production. This shift has led to rapid stock equity appreciation in line with growing



profits. Accordingly, a large number of domestic and international chemical companies are advancing plans to build or expand facilities in North America.

Change in energy markets creates nearly instant responses in chemical prices. Falling

energy prices often translate into a buyer expectation of “lower prices tomorrow.” This anticipation creates a collective pause in demand, generating inventory and price reductions as well as market-share battles. Rising energy prices tend to create an opposite expectation of “higher prices tomorrow.” What follows are higher inventories, a demand surge, and rising prices. Both movements can dramatically affect overall supply and demand balances, increasing profitability volatility.

The impact of lower-priced crude oil varies. Consider how a \$50-per-barrel downturn in oil prices affects global consumers. Petroleum imports are distributed to approximately 90% of the world's population. Unsurprisingly, Asia-Pacific and Europe are the largest petroleum importers, while Central Asia and the Middle East are the world's net suppliers. Shale and oil sands have dramatically increased the self-sufficiency of North America, but the region still benefits from the drop in crude oil pricing.

At approximately 80 million barrels a day in global demand, a \$50 reduction in the price of oil creates a significant transfer of wealth—trillions of dollars move from oil-exporting countries to oil-importing countries. In addition, there is a transfer of value between oil producers and downstream beneficiaries such as industry, governments, and consumers. The chemical industry is one of the key beneficiaries of that value transfer. Nearly 10% of the global production of energy is consumed into chemicals—mostly as naphtha, which accounts for approximately 500 million metric tons. Another 400 million tons of coal, oil, gas, and gas liquids are consumed, some of which derive a portion of their value from crude oil via various market relationships. In addition, any stimulus to GDP created by a drop in crude oil prices results in an overall benefit to the chemical industry through an increase in overall demand for durable and non-durable goods.

Correlating low crude oil pricing with investments

A significant change in the price of crude oil impacts not only short- and medium-term demand but also the relative cost structure and cash margins for many chemical value chains. Marginal-cost producers—those that supply the last high-cost increment of production that satisfies the final ton of demand, and whose cost structure sets the lowest possible limit of pricing—often consume oil-

FEATURE

derived hydrocarbons as a primary feedstock. Lower-cost producers that use feedstock based on gas, coal, or gas-liquids – such as ethane or liquid petroleum gas (LPG) – are able to capture the difference in feedstock costs as margin. In an environment of falling crude oil prices, low-cost chemical producers experience a reduction in cash margins as selling prices based on crude oil decline more than their own alternative feedstocks.

The flattening of the cost curve—resulting from lower crude oil pricing—causes the cost structures of higher-cost producers to drop faster than the alternative gas- and coal-based technologies. This dramatically reduces the competitive advantage previously enjoyed when oil was near \$100 per barrel. For gas-based producers looking to

high-cost markets as a source of demand, this shift is significant. For low-cost producers who access the market via exports, freight and logistics costs will play a more significant role in competitiveness, modifying regional trade flows.

Lower crude oil prices are encouraging some chemical companies to delay and further assess investments that were dependent upon a significant oil-to-gas (or oil-to-coal) differential. Producers are re-evaluating their investment returns and testing the robustness of their competitiveness assumptions. Offsetting some of the lower oil-gas differentials, however, is an expectation of lower capital expenditure (capex) escalation. For example, IHS is seeing signs that layoffs and reduced

capex budgets originating in the upstream shale-related US energy industries are relieving previously tight conditions for skilled labor as well as demand for engineering resources.

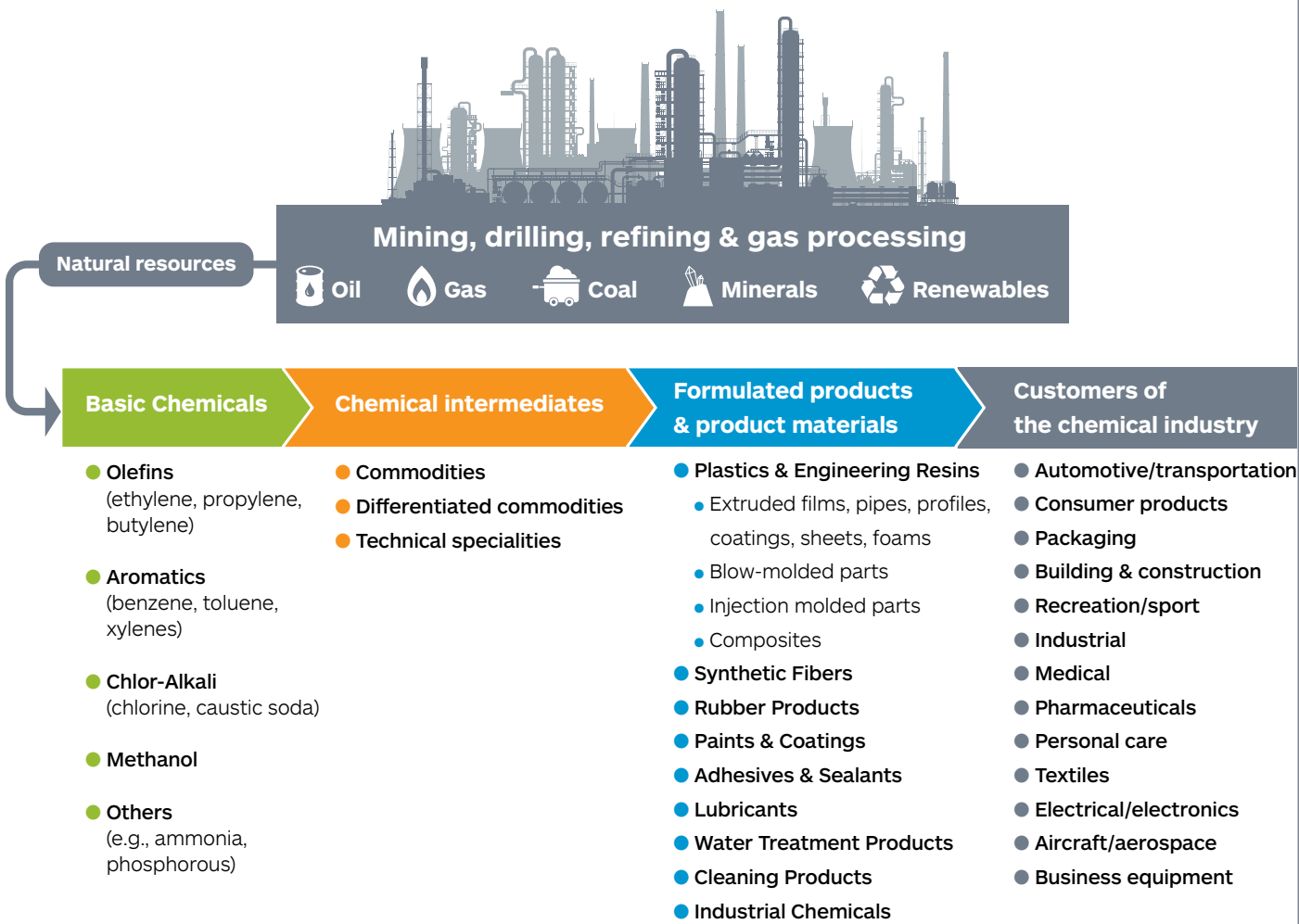
Energy stimulates the upcycle

Given the current oversupply of crude oil, IHS Energy is forecasting crude oil prices to remain well below \$100 per barrel (Brent basis) for the next two to three years. During this time, global energy and chemicals markets will respond to the current crude oil oversupply, and market participants will keenly observe how OPEC will adapt to this new energy market dynamic.

While the near-term outlook remains subdued for chemicals demand and

The chemical industry value chain

The chemical industry enables our modern living standards through the conversion of basic energy into consumer products. The underlying factors that lead to success for companies in the chemical value chain are low-cost feedstocks, high levels of operational efficiency, continuous innovation of products and processes, and robust growth in the end markets the industry serves.



margins, low oil prices are expected to positively impact the industry over time – sowing the seeds for better economic conditions, lower petrochemical prices, and improved global petrochemical demand. Since crude oil acts as the primary driver for feedstocks and serves as the marginal production cost and price-setter for many chemicals, plastics, and fibers, a decline in crude oil prices typically leads to lower product prices. Macroeconomic demand-related effects can expand wealth transfer to the greater global population. In addition, the lower prices of petrochemicals relative to other competing materials – such as glass, paper, and metals – accelerate substitution demand. Reduced plastics prices will also cut demand for recyclable material compared with virgin resins, providing further demand stimulus.

The outlook clearly varies by region and value chain, with some specialty sectors benefiting from the lower pricing likely to see a reversal and others simply so oversupplied that additional demand will not matter. For example, the decline in crude

oil prices in the second half of 2014 moderated the advantageous competitive conditions in North America. However, some advantage remains and will continue to provide an incentive for planned investments in the region.

IHS also anticipates that a pause in new project approvals—combined with higher GDP and stimulated demand created by lower energy prices—could result in very tight supply and demand conditions in the next five years. Over time, this could lead to a significant upcycle in certain markets, such as the ethylene value chain. Although there will likely be yet unannounced builds, IHS expects investment to slow appreciably from 2017 to 2020 to the lowest levels since the start of the last decade. Underlying trends in capital access, such as the ability for projects to be financed in emerging markets like China, will contribute to the slowdown in capital investment. The slowing in capital programs related to shale may reduce capex inflation concerns experienced in some markets.

For investors, the primary economics of the

chemical industry are still attractive in the current market, even if they are not as rewarding as they were over the last three years. Experienced producers recognize that market conditions can and do change. The investment horizon is long and must withstand variability in underlying drivers. Optionality and asset flexibility, superior performance in both operations and construction, and sustainable competitive advantage ultimately provide value to both customers and investors while creating long-term success.

Ideal investment conditions are rare in the chemical industry. Strategic planning lends companies the flexibility and nimbleness they need to make short-term operating plan adjustments that accommodate this volatility. Companies that take action quickly will be able to take the greatest advantage of current market conditions. And wise decisions made in 2015 will result in both productive and profitable facilities coming online three to five years from now.

Mark Eramo is vice president, Chemical Industry Insights, IHS; Dave Witte is senior vice president, IHS Chemical.

IHS CHEMICAL

Crude Oil Turmoil and the Global Impact on Petrochemicals: Navigating an uncertain course back to “normal”

How will the path of crude oil prices in the return to “normal” affect major petrochemical markets?

Addresses Three Oil Price Recovery Cases:

- “V”-shape, a return to early-2014 prices in the short term
- “U”-shape, a few years of low prices before recovery
- “L”-shape, a long-term low price scenario for 5+ years

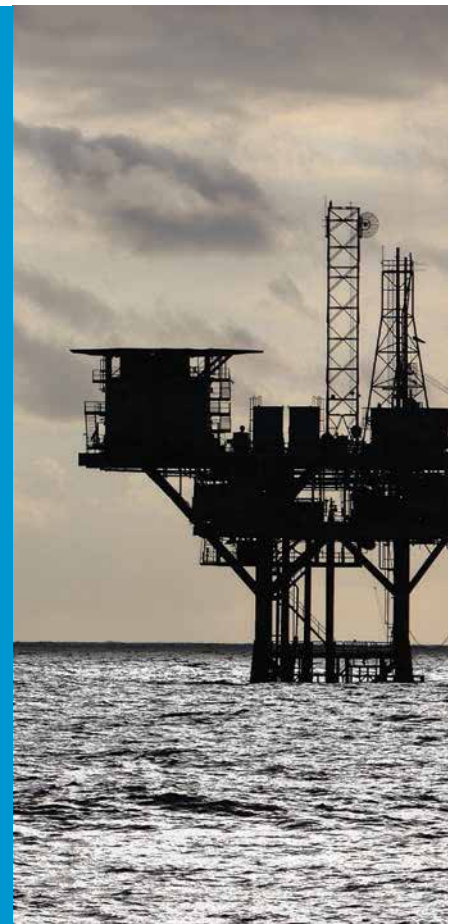
Analyzes the impact on petrochemical markets:

- Regional production economics
- Supply, demand, and global trade
- Capital investment decisions
- Signposts and turning points for each case

To receive a detailed study prospectus, please email ChemicalSpecialReports@ihs.com



8672-0415TS



The seven habits of highly effective petrochemical producers

European petrochemical makers are no strangers to a challenging environment. Limited competitive feedstock, a rising tide of imports and a highly regulated market all weigh on performance. Whilst most producers would choose an easier life, Europe remains home to seven of the top fifteen companies in IHS Chemical Week's 'Billion Dollar Club' of chemical companies.

Accustomed to economic headwinds, 2015 has given a welcome fillip to the industry in Europe, stemming from a decline in crude oil price which has flowed into reduced pricing of petrochemical feedstocks and wider energy costs.

European players have had a short term boost in 2015 due to a combination of:

- Economic recovery and demand improvement
- Margin improvement from low oil impact on feedstock and energy costs
- Reduced working capital as raw material and finished good prices reduce
- Re-stocking after the drawdown of inventories during the oil price fall
- Euro weakness which has a negative impact on imports and boosts competitiveness of exports

Now is the time for European producers to capitalize upon the opportunities before them and we look, with apologies to Stephen Covey, at the seven habits of highly effective European petrochemical companies.

1. The right cost positioning

Whilst Europe is not (yet at least) blessed with abundant low cost hydrocarbon supply, access to readily traded feedstocks is easy and the excellent port infrastructure allows imports of a wide range of feedstocks to suit almost all needs.

We see a number of producers seek lower cost feedstock through importing LPG or ethane to feed steam crackers, generating new supply-chain and value chain opportunities. This approach is best suited to coastal locations and flexible cracker assets, as evidenced by a number of recent announcements:

- Ineos signed a long-term contract for US ethane for its crackers in UK and Norway and has commissioned a fleet of ships
- Sabic announced its intention to import ethane at Wilton, UK, and is modifying the cracker to enable greater feedstock flexibility

- Borealis is planning to import ethane for its Stenungsund, Sweden plant
- Versalis is to enhance the flexibility of its Dunkirk, France, steam cracker to take US ethane

A lighter cracker feedslate yields a lighter product slate resulting in tightening markets for heavier co-products in the C4+ range. Consequently those producers who are less able to change their feedstock have an opportunity to increase value addition from heavier fractions. Indeed, we see a scramble to secure C5 and heavier aromatic fractions to feed important resins markets. IHS Chemical has studied the supply and sourcing of C5 and C9 feedstocks by modelling every EMEA cracker to determine the volumes of co-products produced by each over the next ten years taking account of increasingly lighter feedslates. Our analysis highlights supply bottlenecks and identifies potentially lucrative new sources of resin formers throughout the region. The coming years will likely see important shifts in valuation ranges for the key resin former streams.

2. Portfolio balance (divest to reinvest)

Successful operation in a cyclical and volatile environment necessitates a well-constructed product portfolio that is not overly reliant upon a single value chain. We shall certainly witness periods of high energy costs and periods of low (or even negative) growth in markets and therefore a business needs to be able to operate through each of these conditions and emerge unscathed.

Companies should not fear cyclical markets for the opportunity of super-profits at the peak can more than offset the challenges of bottom-of-cycle economics, provided the business is correctly positioned and managed - declaring force majeure at the cyclical peak can leave a company licking its wounds for many years.

A classic example of portfolio balance is achieved by integrated oil companies such as Total, which can balance a petrochemical business that benefits from lower oil prices with the upstream E&P business where the converse

applies. Other opportunities lie in balancing the more resilient margin of specialties with the higher-volume opportunities of commodities.

IHS Chemical has seen its successful clients being quick to rebalance portfolios, using divestment to allow reinvestment. Divesting non-core assets allows focus on core businesses and growth regions, and can create additional sources of value.

3. Focus on value

European companies have a great deal of value embedded within them as a result of deep experience and expertise. Releasing this value to the benefit of the enterprise and shareholders is vital to continued success. Many European companies sit upon a mountain of intellectual property, and many require help in recognizing and monetizing the value intrinsic in their technologies, and product development capabilities.

A focus on differentiated products aligns well with the sophisticated European market and also provides some respite from industry cycles.

We see a number of companies looking to the value of their technology profile and asking if licensing is a route to extracting greater value. It is interesting for

example to see BP licensing its PTA technology. We also see companies in developing regions seeking to access technology through acquisition of companies in Europe.

Linking into the portfolio theme, above, companies are also starting to critically examine carve-out of non-core or orphan parts of their business as a route to releasing short term value to the core enterprise and also reinvigorating otherwise neglected segments in the hands of new owners.

4. Align with the customer markets

Probably the most important factor after competitiveness is effectively accessing customer markets. The most common challenge posed to IHS' chemical consulting group is to determine optimized marketing plans for new, expanded or reconfigured petrochemical facilities.

Supply chains are extending and accessing high growth or emerging markets remain a constant challenge as the world evolves. We see China becoming more self-sufficient in some products, yet remaining the global sink in others, whilst African opportunities are piquing the interest of majors in every region with a rising middle class and urbanization driving



GREEN: An improving outlook will bring new opportunities for success in Europe.

demand centers. Accessing long-range markets can be achieved through judicious choice of partnerships, and the more sophisticated the end market, the more important the selection of the correct marketing partner.

From a European perspective it is important to align with customers, we see our most sophisticated clients closely aligning their businesses with end-use industry structures, whether that might be aerospace and defense or automotive industries. We are all in business to serve customers, aligning to their needs rather than our own is vital. Organizing along the lines of chemistry is no longer appropriate for anything other than the most commodity-oriented of businesses.

5. Exploit technological change

At the highest level, reinvestment in production technology to reduce costs and to improve product quality remains a fundamental tenet of the industry. New technologies continue to emerge and there are opportunities for disruptive technologies to change the structure of several value chains.

However it's not just a question of the technology that we apply to our own manufacture, the pace of technological change in end use industries is accelerating. The last five years have seen an unprecedented shift in automotive drive trains and uptake of advanced composites into what were previously considered relatively mundane applications.

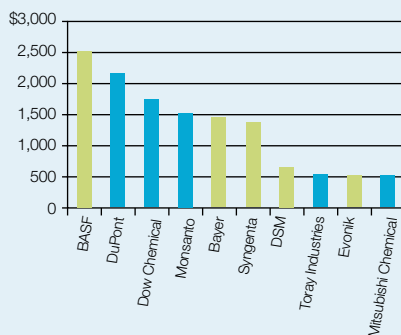
Identifying future opportunities for current products and modifying the production portfolio to meet the changing needs of customer industries are critical to the successful direction of chemical businesses.

Increasingly businesses are asking questions about the development of key end-user indus-

tries and "horizon scanning" is an increasingly important part of the long term planning cycle for majors. We are frequently asked to provide analysis of new and disruptive technologies both in the direct chemical industry and in adjacent fields that may prove threats or indeed opportunities for chemical producers.

2013 total chemical R&D

(In millions of dollars)



Source: IHS Chemical Week.

6. Pursue operational excellence

We refer to production plants as our assets and they are indeed just that. It is vital that we maximize the return from this capital-intensive hardware, both by running plants hard, but also protecting the investment through adequate and focused reinvestment in sustaining capital. One of the most common questions IHS is asked during technical due diligence support is "are the assets adequately invested and what will its longevity be".

The recent spate of force majeure declarations in the ethylene and derivatives chain demonstrates a creeping culture of underinvestment and turned potential winners into

losers as margins spiked. There is nothing more dispiriting than to see record product margins when your plant is idled, indeed often because your plant is idled.

Operational excellence is dependent upon a complex chain of business decisions including supply and offtake contracts, inventory management and logistics arrangements.

7. Innovate

Standing still is not an option! Developing new products and more efficient processes is critical to keep ahead of the cost and margin curves. The top R&D spenders serve the most sophisticated customer markets; Europe, the US and Japan. As illustrated in the figure below, R&D leaders BASF and DuPont each spent over \$2 billion in 2013, equating to 3% and 6% of revenue respectively. This is a level of commitment that lays the foundations for future success, but inevitably it is the first area to come under budgetary stress when financial results are disappointing.

IHS observes that the priorities of the R&D leaders typically focuses on the new product pipeline, on product performance, process development and innovative customer solutions.

Stringent European regulations add to the costs of staying in business, and there is pressure on the whole industry to enhance sustainability. There is a need for the industry to do more with less, and to replace traditional feedstocks with sustainable alternatives, whether that comes from municipal waste or bio-sourced materials

The outlook

A benign oil price environment opens a window of opportunity for European producers to capitalize on a period of positive economic growth in the region. There is a small respite in financial pressure and whilst there is no red on the P&L, this presents the ideal opportunity to plan for the future investments. In particular, the uncertain oil price outlook is delaying investment decisions at a time when demand is supported by strong economic fundamentals, in terms of GDP growth and low interest rates. The industry is heading to a period of strong margins buoyed by above average growth and below average re-investment. Those who invest counter-cyclically will, once again, be the winners.

—ROGER GREEN

Roger heads IHS Chemical's consulting business in Europe and Africa. Roger and his team spend the majority of their time working with clients on investment-related projects, market studies, project financing, technology assessments and mergers and acquisitions.

2013 ranking	Company (headquarters)	2013 chemical sales in millions \$	Chemical revenues % overall sales
1	BASF (Germany) a	\$81,490	78%
2	Sinopec (China) b	68,898	16
3	Sabic (Saudi Arabia) d	60,681	90
4	ExxonMobil (US) b	59,273	10
5	Dow Chemical (US)	57,080	100
6	Royal Dutch Shell (Netherlands; UK) a, b	55,673	--
7	LyondellBasell (Netherlands) c	37,778	76
8	DuPont (US)	35,734	100
9	Ineos (Switzerland)	28,279	100
10	Bayer (Germany) d	27,375	67
11	Formosa Plastics Group (Taiwan)	25,236	27
12	Sumitomo Chemical (Japan) d, q	24,290	20
13	Mitsubishi Chemical (Japan) d, q	23,215	77
14	Linde (Germany)	22,927	100
15	Total (France) b	22,293	9

Notes: a) Excludes oil and gas b) Includes intersegment sales c) Excludes refining d) Excludes pharma, health care, and/or other nonchemical businesses q) Fiscal year ended 31 March 2014

Russian petrochemicals: A bump in the road

Russia is home to one of the world's largest reserves of gas. At the end of 2014, only the huge fields of the Middle East, Venezuela, and Canada exceeded Russia's proven oil reserves, according to BP's Statistical Review of World Energy. Russia combines this large quantity of natural gas and oil, abundant reserves of cheap coal, access to other important minerals, an economy that has grown rapidly over recent years, an educated workforce, a robust industrial and manufacturing heritage, and a large and increasingly sophisticated domestic consumer base. With these, the country would appear to have all of the ingredients for a successful commodity and specialty petrochemical industry.

Russia has, however, struggled to fully realize its potential in the face of a number of headwinds. Nonetheless, the industry continues to develop significantly, with a number of major projects expected to emerge over the next five years.

Strong in some value chains

The petrochemical industry in Russia is smaller than in other major developing industrialized countries with a petrochemical industry, such as Saudi Arabia, China, and India.

Russia has always been a major producer and exporter of gas-based commodity chemicals; methanol, ammonia, and urea have played a large role in Russia's chemical exports since the 1960s. The country is also a significant player in synthetic rubber—an industry that developed because of the Soviet Union being largely cut off from access to supplies of natural rubber during the Cold War. The industry has, however, developed less than other commodity value chains, such as polymer resins and performance and specialty chemicals.

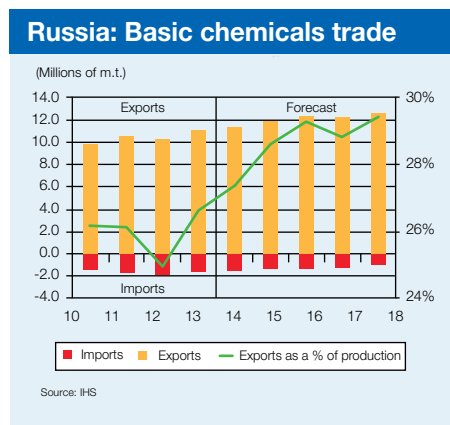
A long way to go

Because of the distances involved, a major challenge for a number of producers in Russia is accessing export markets. For example, the large industrial city of Omsk, in western Siberia, is home to substantial refinery and petrochemical assets and enjoys low-cost feedstock. However, moving products globally from this remote location is a challenge. The nearest ice-free deepsea

ports, such as Novorossiysk, Russia, on the Black Sea or St. Petersburg, Russia, on the Baltic, are over 3,000 kilometers away. Overland routes are no more palatable. From Omsk, the industrialized regions of eastern China and Western Europe are each around 5,000 kilometers by rail. Frequently, higher logistics costs offset any competitive advantage afforded by the low-cost feedstock. This is one reason Russian producers have traditionally concentrated on domestic markets, where their advantage is greater and the high logistics costs serve as a barrier to entry to competing importers.

High capital costs

The remoteness of some assets and feedstock sources brings other challenges, such as the costs of building a large asset in a remote location. Mobilizing manpower to these locations and moving large, heavy, and expensive components, such as rotating equipment, pre-assembled process units, and pressure vessels, so far inland is difficult and expensive. The



harsh climate in most of the country means construction productivity is low; it is simply not possible to erect chemical plant in a blizzard at -40°C . Recent IHS studies suggest that the total installed cost of a chemical plant in inland Russia can be 30–70% more expensive than that for an identical plant built on the US Gulf Coast or in the Middle East.

Outward outlook

The outlook of Russia's petrochemical industry mirrors the country's recent, more



STEVENSON: Russian petrochemical industry developments continue, despite the domestic slowdown.

outward-facing attitude. The recognition of the need for better market reach combined with improved feedstock infrastructure, such as oil and gas pipelines, has encouraged developing petrochemical projects with better access to global markets. The Baltic Gas Chemicals Company has announced it plans to develop a large, export-oriented methanol plant at Ust Luga, near St. Petersburg on the Baltic, giving access to the large import markets of central and Western Europe. Eurochem similarly has signed a large engineering, procurement, and construction (EPC) contract with Maire Tecnimont for an ammonia-urea unit in nearby Kingisepp. IHS is aware of other companies interested in developing here. The Rosneft VNHK petrochemicals and refining complex at Nakhodka, near Vladivostok, is one of a number of projects being developed in Russia's Far East that combine advantaged feedstocks with seaborne access to the largest petrochemical consumer of them all, China. Even inland, improved infrastructure for gas distribution and separation is enabling Sibur to consider an ethane/propane-fed polymers complex in Russia's remote Amur region, which will presumably be much better positioned to supply Chinese polymer converters.

Domestic producers are also investing in expanding production facilities that are increasingly targeting export markets. For instance, the ongoing Zapsibneftkhim project, which will augment polymer and other olefin derivative capacity at Sibur's Tobolsk site, will be the first large-scale cracker to be added in Russia for 30 years.

Overseas, Russian producers are leveraging their marketing and technology know-how in synthetic rubbers. Sibur has announced

joint ventures with Sinopec in Shanghai and Reliance in Jamnagar, India, to build nitrile rubber and butyl rubber production facilities, respectively. Russian rubber producers have shown interest in the acquiring Lanxess's rubbers business unit, which the company has been seeking to divest.

Geopolitical and economic headwinds

Recent global events have significantly affected industry and the wider Russian economy. US and EU sanctions are making Western enterprises, such as EPC contractors, more wary of doing business with Russian industry. Sanctions have effectively shut Russian companies out of finance on European and US money markets, increasing the companies' reliance on domestic lenders, such as Sberbank, and Russian and international sovereign wealth funds. This situation is pushing up financing costs and resulting in very high hurdle rates for investment. The dramatic fall in the value of the Russian ruble due to the fall in oil price—from 35 rubles to the dollar in July last year to

70 rubles to the dollar in August—has proved to be a double-edge sword. It has made procuring equipment priced in dollars or euros effectively twice as expensive for a Russian purchaser but has also increased the revenues for ruble-based Russian producers selling chemicals into export markets priced in euros and dollars. Petrochemicals companies, such as Nizhnekamskneftekhim, have reported sizeable rises in ruble-denominated first-half earnings as a result.

The high ruble exchange rate has substantially increased costs for a country that relies on imports for many of its non-energy needs, with inflation currently running at an official 15.6%. Russia's economy has slowed markedly as a result, with IHS forecasting the economy to contract by 4.6% in 2015 and be broadly flat in 2016, ending several years of robust growth. This slowdown is likely to further affect the Russian domestic markets in the short-to-medium term for chemicals and drive producers to seek new markets overseas, although IHS expects GDP growth to recover from 2017 onward.

Continued development

Already a major player in some key global chemicals markets, Russia seems to be embracing the continued development of its huge oil and gas reserves into advantaged petrochemical products. The country is also increasingly focusing on both international markets and cooperation with non-Russian companies to develop its reach and breadth. These initiatives are helping Russia to mitigate some of the continued structural issues related to location and capital costs. The current economic and geopolitical situations are slowing progress, but IHS views these as merely bumps in the road of the ongoing development of the Russian petrochemical industry.

—SEAN STEVENSON

Sean Stevenson is a director of IHS Chemical Consulting based in London. He has 27 years of experience in the petrochemicals industry, including plant operations management, commercial and business development roles and consulting. He has managed numerous consulting engagements in Russia and the Commonwealth of Independent States and monitors industry developments in this region closely.

IHS CHEMICAL

Partner with IHS Chemical Consulting for strategic and tactical thinking tailored to your needs

Tailored, single-client solutions

- Business Strategy & Planning
- Market Research & Forecasting
- Feasibility Studies
- Benchmarking
- Competitive Analysis
- Technology Evaluation
- Strategic Due Diligence
- Renewables
- Socio-Economic Impact
- Training & Education

We leverage an unmatched combination of information, insight and expertise to help you make the leap from data to results.

Americas +1 877 658 6355 | EMEA +44 1344 328155
Asia and Pacific +65 6226 5363 | Global +44 1344 328155



Europe POM price recovery less certain as China slows

Polyacetal (POM) is a versatile, medium-performance engineering polymer with a number of niche applications where its performance characteristics make it cost effective in many industries serving automotive, appliances, electrical, and electronic manufacturers. Two types of POM are generally made: homopolymer and copolymer. POM homopolymers typically exhibit excellent mechanical properties but are less stable than POM copolymers. POM copolymers, on the other hand, are very stable but mechanically poorer.

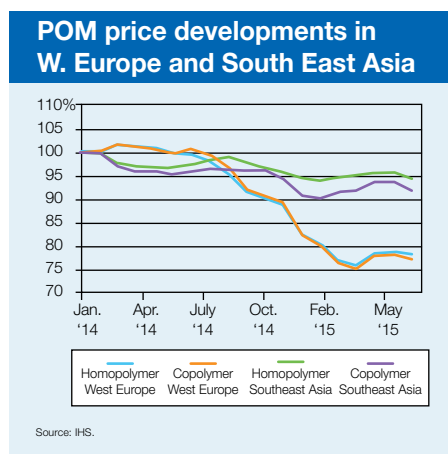
The barriers to entry for POM producers lie not in the production of the polymer but in accessing the markets. Major buyers are original equipment manufacturers (OEMs) in the automotive, electrical, and electronics and appliances industries. These OEMs insist on reliable specifications and product certifications. These can be a challenge for new producers.

Global POM demand reached approximately 1.2 million m.t. in 2014, with a global installed capacity of approximately 1.7 million m.t. in the same year after capacities in China and Malaysia built up. Operating rates globally have been relatively low. China is a major producer and an important exporter to European markets. In China, POM is also consumed in a wide variety of end uses with significant exports of finished products containing the polymer. Importantly, most Chinese players can only produce lower-specification material and have not generally had product certified by major OEMs. High-specification material in developed markets has therefore not faced significant competition from Chinese imports.

Over the past few weeks, China has signaled that it needs to stimulate its economy. Most notably, the country devalued its currency over three days from 11 August. It also cut the main interest rate for the third time in a year on 25 August. These actions indicate weaker competitiveness with other markets, notably Europe and the United States. Furthermore, weak demand growth in China's domestic market cannot counterbalance the effects of lost competitiveness. China needs to export, and the policy to devalue its currency can only be a stimulant to exports. The move is clearly to

strengthen exports and make Chinese goods more competitive.

In Europe, POM demand has been lackluster, with prices softening throughout the year. With China's demand slowing, the European POM market will not likely support a general price increase anytime soon even though some European producers have recently increased prices for specialized POM. Europe's supply is dominated by a few companies that produce branded, high-specification POM—often as part of a wide portfolio of products with different characteristics with varying prices. European prices of both homopolymer and copolymer had been softening faster than the prices in Northeast Asia, as shown in the chart below. Europe's prices were more than 20% below those in January 2014, whereas in China, the reduction was around 5%.



As well as the aforementioned weak demand in Europe, the euro/dollar exchange rate pressures and the continued impact of Asian/Chinese POM exports into the European market have also exacerbated these price changes.

POM economics are driven mainly by its feedstocks, which, in the case of POM copolymer, are ethylene oxide and methanol. The market and pricing dynamics of these are showing the impact of shale gas in the United States and coal-to-chemicals developments in China. However, the market well recognizes that tiered pricing exists based on brand, volumes, certification, and source.

Celanese, one of the major European produc-



MONIS: POM prices in Europe will remain under pressure in light of Chinese market developments.

ers of POM has announced an increase in its prices of specialty products in June, seemingly signalling that the price drops will no longer be accepted by producers in Europe. This price increase has not materialised in the market yet, but it remains to be seen if negotiations for Q3 prices will show a reversal in price trend.

Speaking to customers in Europe, Giovanni Coiro, principal analyst, engineering resins at IHS, expects that third-quarter prices will roll over from the second quarter, with fourth-quarter prices slightly increasing. The recovery in prices expected toward the end of 2015 will now likely happen in 2016.

A slower Chinese economy could hamper any recovery in Europe. Prices will remain under pressure. Already, Chinese and other Asian producers are pushing POM onto the markets in Europe, where lower-specification POM producers now face competition from these Asian exports. With the demand in China now potentially lower, imports into Europe from China will increase. This will likely hurt prices in the short-to-medium term.

In summary, recent news coming out of China signals that both domestic demand and exports are under pressure. Chinese POM prices have been stronger than European prices in recent months, with Europe experiencing pressure from declining demand and prices. It is expected that as more Chinese POM finds its way on the European market, prices will remain pressured despite European producers' efforts to maintain them.

Ryan Monis has worked for IHS since January 2013, working on single-client projects. Before this, Ryan had been responsible for the sulfur and sulfuric acid market reports at CRU.

Advantages and risks in investing in Iran's petrochemical industry

A rekindling of direct foreign investment in Iran's huge petrochemical sector -- if and when sanctions are lifted -- could reap large rewards for nimble investors with the significant intestinal fortitude necessary to assume relatively high levels of economic and political risks.

Iran's many risks include an extremely high degree of political risk, legal uncertainty, and bothersome levels of administrative and bureaucratic obstacles. Yet despite these risks, Iran has a number of important advantages to potential petrochemical investors, including low-cost feedstocks and access to major markets. Iran has the world's fourth-largest supply of proven oil reserves and the second-largest supply of conventional natural gas reserves, much of which is rich in ethane. This is significant given that chemical feedstock availability in other countries such as Saudi Arabia, Kuwait and Oman, has become more limited.

If you are a global petrochemical producer looking at Iran for its investment and growth opportunity, and you can briefly forget about the major business and political risks involved, Iran presents an attractive opportunity. Major chemical players are chomping at the bit to explore the potential that Iran offers, but they will not be doing so haphazardly. These companies are used to operating in risky environments and managing significant risk—it's the nature of the business, but the reward has to significantly outweigh the risk.

The Iranian petrochemical industry, while quite diverse, is primarily focused on exploiting the country's vast resources of ethane-rich natural gas. On the one hand, the country converts methane from natural gas to methanol and urea. But Iran also cracks ethane and other natural gas liquids to produce ethylene, which is then polymerized to PE or processed to MEG.

Aside from the lure of oil reserves and abundant ethane feedstocks, the price of ethane gas in Iran is kept low by government mandate. In general, ethylene production costs in Iran, based on ethane, are comparable to those in Saudi Arabia or North America; i.e. the lowest in the world. Both ethylene and polyethylene are key products for Iranian

export, and lifting of sanctions would enable the Iranians to expand production and export an additional 1 MMT of ethylene/polyethylene within 12 months to two years.

Trading companies will be eager to access these volumes of Iranian ethylene and PE, but the impact on global operating rates is not expected to be dramatic—less than 1 percent lower than currently projected. Nevertheless, additional Iranian ethylene in the form of polyethylene could hit the market just when global operating rates are at a low point in the years 2017-2018, which would exert some downward pressure on prices.

Another key export commodity for Iran is methanol. Iran is a major methanol producer and exporter, with 5 MMT of capacity, and methanol producers in Iran also enjoy very advantageous production costs. Lifting of

on the flow of capital and goods, as well as limited access to necessary technology, parts and materials, Iran missed this goal by a long shot.

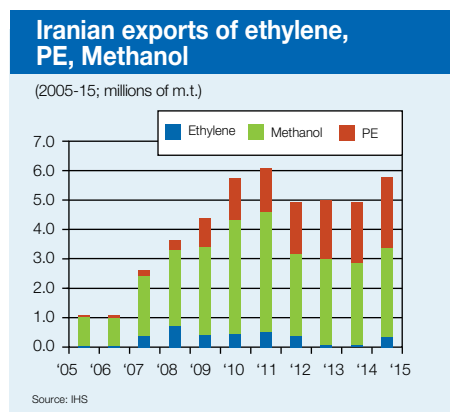
Before the sanctions were implemented, Iran was a major supplier of petrochemicals to Europe; primarily ethylene, PE and methanol. However, total petrochemical export volumes from Iran did not suffer significantly as a direct result of the sanctions. Under the sanctions, these products were simply redirected to Asian, African and some South American countries, principally China and India. Business with Europe virtually disappeared.

The much larger impact resulted from the inability of Iran to maintain and invest sufficiently in its oil/gas and petrochemical feedstock and export infrastructure, which has led to chronically low capacity utilization rates, not the least due to periodic shortages in ethane feedstock. Development of the Iranian energy sector has been impeded by international sanctions that have stifled the influx of essential foreign investment and technology.

Progress in the country's steam-cracker investments has been slow since the start-up of the Kavyan 1 unit in late 2012, and feedstock is in short supply. Progress on the Kavyan 2 unit has been delayed by the sanctions limiting gas shipping. Sanctions have also restricted developments of the gas processing necessary to extract ethane for feedstock. Even the existing crackers at Bandar Assaluyeh are short of feedstock, so adding further steam-cracker capacity will be of little use until natural gas and feedstock availability increases.

Lifting of sanctions on the industry and on Iranian finances will re-ignite foreign investment and allow Iran's petrochemical industry to get back on a fast track to growth. The re-integration of Iran into the global business community will revitalize the country's petrochemical business in a major way. Iran will take steps toward resuming its important role in supplying global markets with much needed petrochemical products.

Michael Smith is Vice President EMEA, IHS Chemical



sanctions would accelerate Iran's methanol production plans and drive progress on many proposed projects. While Iran has proposed projects totaling more than 20 MMT of new methanol capacity, a more realistic figure of approximately 10 MMT could be added by 2025.

Impact of sanctions on Iran's petrochemical industry

In the early 2000s, Iran embarked on an ambitious petrochemical expansion plan based on the country's huge abundance of natural gas. The original plan was to expand petrochemical production capacity from 9 MMT in 2001, to 100 MMT annually by 2015. However, as a result of tightening restrictions

Tight oil & fracking growth drive polyacrylamide

Polyacrylamides are used in a very diverse array of end-use sectors from water treatment and paper production to enhanced oil recovery and drilling fluids. The highly concentrated market is tightly controlled by a handful of global players offering tailor-made solutions to customers across a variety of industries. Whilst some of the downstream industries will see stable and GDP-led growth, others will be particularly strong once crude oil prices rise and the demand for tight oil and gas becomes far more important once again to the global economy

Overview

Polyacrylamides are high-molecular-weight polymers that find applications in numerous industries, such as papermaking, wastewater treatment, mineral processing and the oil industry. They are principally used as a flocculant to remove suspended particles and impurities, although they are also widely used as viscosifying agents for flood water in enhanced oil recovery (EOR) processes.

Anionic polyacrylamides are typically copolymers of acrylamide and acrylic acid and find applications in the separation of cationic species found in mineral processing and drilling muds. Cross-linked, or structured anionic, polyacrylamides are also used in papermaking processes as a synthetic alternative to micro-particle species such as silica and bentonite.

Cationic polyacrylamides are typically copolymers of acrylamide and a cationic quaternary salt, and find applications in the separation of anionic species found in wastewater treatment, sewage-sludge dewatering and papermaking processes. The most commonly used cationic quaternary salt is dimethylaminoethyl acrylate, quaternised with methyl chloride (DMAEA.MeCl quat), although other variants are also available depending on the application conditions.

High-molecular-weight flocculants should not be confused with coagulants, which are lower-molecular-weight and high-charge density products such as polyDADMACs (Diallyldimethyl ammonium chloride) and polyamines. Coagulants act to neutralize the charge on colloidal material such that they coalesce into discrete particles which are often subsequently treated with flocculants to aid separation.

The high-cost elements of the polyacrylamide production process are typically the cost of the raw materials acrylamide and quaternary monomer for cationic polyacrylamide. It is therefore essential for producers to be back integrated into at least one but ideally both of these feedstocks to remain cost competitive. The purchase of cationic monomer for polyacrylamide production not only puts manufacturers at a cost disadvantage but also restricts the quality and range of products since



TAYLOR: Back integration is the key to success in the polyacrylamide business.



BLAND: Increased regulations in the water sector usually comes with higher use of polyacrylamide.

the cationic monomer must be supplied with inhibitors to prevent polymerization in transit. Acrylic acid is generally purchased for manufacture of anionic polyacrylamide production. All major global producers of polyacrylamide are back integrated into acrylamide.

Polyacrylamides are supplied either as solids or liquids; however, both products need to be dissolved in solution prior to application to ensure correct concentration. Solid products benefit from lower transportation costs and longer shelf life, typically two years, but require effective solution makedown equipment which can be expensive and bulky. Space is not always available for equipment in many applications or the application levels are cost prohibitive. Liquids benefit from ease of application, but carry higher transportation costs since they are typically supplied as 40% active material. Shelf life, typically 6-12 months, and separation of product may also be a concern with liquid products.

Barriers to entry high

While there are a number of producers who dominate global production and supply of polyacrylamide products and systems, SNF

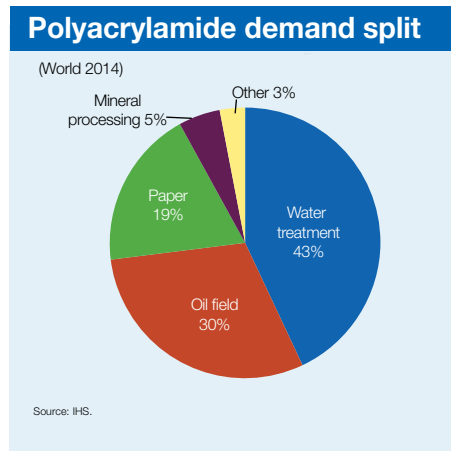
Anionic, cationic and nonionic PAM applications

Anionic	Cationic	Nonionic
Mining - Cyanide leaching, gold	Waste water - sludge dewatering	Mining - Separation of minerals from gangue in acid leaching-copper, uranium
Mining - Extraction: alumina	Paper - wet-end additives	Mining - Flotation: iron ore, gold
Oilfield - Drilling fluid ingredient: Conventional, Hydraulic Fracturing and Enhanced Oil Recovery (EOR) flood systems		
Oilfield - Drag reducer: Conventional, Hydraulic Fracturing and Enhanced Oil Recovery (EOR) flood systems		
Oilfield - Flocculant: Conventional, Hydraulic Fracturing and Enhanced Oil Recovery (EOR) flood systems		
Oilfield - Shale inhibitor: Conventional, Hydraulic Fracturing and Enhanced Oil Recovery (EOR) flood systems		

Floerger is the only truly global producer with significant capacity for all major product forms in all regions. SNF accounts for almost half of all global capacity. Other major producers include BASF, Ecolab's Nalco unit and Kemira, who all operate units in several locations globally. Many producers sell a process and technical service package and not just the material. Polyacrylamide is just one part of a "basket" of products in processes where it is used and many buyers will use a "one-stop shop" where they can buy all of the materials for the end-use process. SNF is the major supplier of polyacrylamides to third parties who offer a basket of products but do not themselves produce the entire product range.

Oil and gas recovery drives growth

Polyacrylamide is used in a number of diverse sectors and industries but dominated by two: water treatment and oilfield chemicals. The water treatment sector accounted for over 43% of global demand in 2014 with polyacrylamide used as a flocculant in municipal water and sewage treatment as well as industrial water treatment processes. The water treatment sec-



tor is forecast to see the strongest growth in the developing economies of Asia, Africa and South America, whilst it will see more modest growth in Europe and North America. Regulations in the water sector are one of the key drivers, typically with increased regulations comes higher use of polyacrylamide.

The oilfield chemicals sector is the second-largest demand sector where it is used in drilling muds and EOR as a thickening agent/suspension agent, wastewater treatment from drilling operations and to increase extraction rates from older wells. In 2014, the oilfield sector accounted for 30% of global demand, with future demand expected to be driven by hydraulic fracturing particularly in the United States, oil sands in Canada, and EOR in China. However, the relatively recent drop in crude oil price will slow growth into this sector in the short term. Once crude prices begin to rise, investment is expected to begin to pick up once more, driving polyacrylamide demand higher.

As growth into these dynamic derivative areas picks up, new supply sources will be required and IHS is well placed to advise on where new supply should be built and how the market dynamics will develop.

Rob Taylor has nine years' experience working in the petrochemicals industry. He works with IHS Chemical Consulting on a variety of custom-made projects across the business. Adam Bland is associate director, specialty chemicals at IHS Chemical Consulting. Adam has more than 20 years of commercial experience in the water and paper industry.

Found these articles valuable?

Don't miss out on future issues.

Subscribe to the complimentary
IHS Chemical Insight &
Consulting Bulletin today.

www.ihs.com/chem-bulletin

9364-TB-0615





**Industry information
and expertise...**

**from coal
to chlorine**

Every decision matters.

That's why leaders rely on IHS to help them make the best choices.

As the premier provider of global market, industry and technical expertise, we understand the rigor that goes into decisions of great importance, guiding them with thinking that matches the scope of their needs.

IHS... when decisions matter

