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THE NEWSPAPER FOR THE
CHEMICAL AND
LIFE SCIENCE MARKETS

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Borealis plans to acquire full ownership of Speciality Polymers Antwerp to grow its polyolefin business.

Mexichem buys German PVC producer Vestolit from US-based private equity investor Strategic Value Partners for \$292 million.

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People:

Anne Noonan will resign as senior vice president, industrial engineered products, at Chemtura to pursue another opportunity.

Gordon Sangster joined Codexis as Senior Vice President & Chief Financial Officer.

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Building a Future-Proof Business

AkzoNobel puts Sustainability at the Center of Every Strategic Decision to Increase Shareholder Value

What have sustainability and social responsibility to do with the financial performance of a materials company and the value it creates for its shareholders? A conversation with Ton Büchner, CEO of AkzoNobel, provides astonishing answers to this question. Büchner — a Dutch national and an engineer by training, with an MBA degree and global management experience — took the helm at AkzoNobel in 2012. Michael Reubold spoke with him about the role sustainability plays in the corporate strategy.

CHEManager International: Mr. Büchner, AkzoNobel has a proven track record in the area of sustainability. What role does sustainability play in your corporate strategy?

T. Büchner: Our corporate strategy is focused on organic growth and



“The energy disadvantage in Europe is real.”

Ton Büchner, CEO and Chairman of the Board of Management and the Executive Committee, AkzoNobel

operational excellence, and it has sustainability built in at the heart of everything we do. We believe that business is sustainability and sustainability is business. You can't disconnect these two. We

drive sustainability in all aspects of both our operations and our support functions. And by doing so for an extended period of time it has brought us to the number one position in the Dow Jones Sustain-

ability Index for our industry for the second consecutive year. We drive sustainability under a very clear strategy that is implemented inside the individual business strategies.

So, sustainability also impacts your business strategy and performance?

T. Büchner: Yes, it is about building sustainability into the business strategies. It has both an impact on the way we procure things and an impact on the way we invest, with the focus on using fewer things to create more value. And that can be in terms of energy efficiency and raw material efficiency. A second part that is important to us is on the front-end innovation side. We spend a significant amount of our innovation budget on developing new products that have a sustainability advantage for our customers. So, it really does have an impact.

Are you able to measure that impact?

T. Büchner: What we have tried to do is to commit to a set of targets that we want to deliver by 2020, for instance that 20% of our revenue should come from products that really deliver raw material and energy savings to our customers.

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Lanxess CEO Starts Realignment

CEO Matthias Zachert, who took over from Axel Heitmann as CEO of German specialty chemicals producer Lanxess on April 1, is wasting no time in realigning operations and portfolio to eliminate weaknesses that led the company to post a net loss for 2013.

In presenting figures for this year's second quarter, Zachert also revealed preliminary details of the "Let's Lanxess Again" strategy outlined in brief in May and simultaneously announced the resignation of Werner Breuers, who had management board responsibility for the sagging Performance Polymers segment as well as Advanced Intermediates.

Although Zachert said Breuers had asked to leave the company when his contract expires at the end of May next year, he said he continues to act in an advisory capacity for the remainder of his contract. The CEO personally will take over responsibility for the two segments until a successor is named, within the next 12 months.

Lanxess' three-phase corporate realignment scheme will begin re-



Matthias Zachert, CEO, Lanxess

shaping the company's appearance with effect from January 1, 2015. Along with streamlining administrative functions it foresees regrouping several rubber businesses to take account of what Zachert said are overlapping customer and regional structures, both in established and emerging markets.

In future, the butyl rubber and performance butadiene business units will be part of a newly minted Tire & Specialty Rubbers unit, to be headed by Jorge Nogueira. The high performance elastomers and Keltan elastomers business units will become part of a new High Performance Elastomers unit headed by Jan Paul de Vries.

While Zachert has not ruled out a sale of the specialty chemicals product line of the rubber chemicals business — for which the company officially is seeking "strategic op-

tions" — until further notice these activities will be operating in union with the functional chemicals business unit and Rhein Chemie into a new Rhein Chemie Additives (ADD) business unit to be headed by Anno Borkowsky, current chief executive of the Mannheim, Germany-based subsidiary.

As part of the drive to create a leaner organizational structure, Lanxess is reducing the number of business units from 14 to 10 and combining group functions. At the same time, an operational excellence initiative will be at work examining all production facilities with respect to market requirements and synergy potential, while a marketing and sales excellence initiative evaluates the effectiveness and efficiency of the company's international distribution network.

Some of the 1,400 measures contained in the realignment scheme are aimed at cost cutting and may go hand in hand with job losses. Zachert said he had agreed with employee representatives not to discuss details. However, the CEO noted as he did earlier that any headcount reduction would largely take place in rubber operations outside the company's home market.

Roche to Buy InterMune

Roche has agreed to buy US biotech company InterMune for \$8.3 billion in cash, marking the latest multibillion-dollar deal in a consolidating pharmaceutical sector.

The Swiss drugmaker said it would pay \$74 a share through a tender offer for InterMune, representing a premium of 38% to the closing price on August 22. Although it is paying a big price for InterMune, the deal is seen inside Roche as a "bolt-on" acquisition, given the company's own market value of around \$250 billion. Under the terms of the agreement, Roche will commence a tender offer to acquire all outstanding shares in the US firm no later than Aug. 29.

The acquisition, which has been recommended by the boards of both companies, is the largest by Roche since 2009, when it bought out the remaining stake it did not already own in US biotech group Genentech for around \$47 billion.

Roche CEO Severin Schwan said the deal would allow the company to broaden and strengthen its respiratory portfolio, adding that he believed there was a good strategic and cultural fit between Roche and the California-based biotech firm.



Severin Schwan, CEO, Roche

"For us at Roche, this transaction is a good example of a value-creating bolt-on acquisition; we focus on targeted acquisitions that really complement our portfolio, rather than trying to diversify or going into mega mergers," Schwan told reporters on a conference call.

Adding InterMune to its portfolio will give Roche a promising new drug, pirfenidone, for treating a progressive and ultimately fatal scarring condition of the lungs, idiopathic pulmonary fibrosis (IPF).

The drug already has been approved in Europe and Canada, and is undergoing US regulatory review.

Industry analysts expect the drug, which is given as a pill, to have sales of \$1.04 billion in 2019, according to consensus forecasts compiled by Thomson Reuters Pharma.

The deal is a further step by Roche to diversify away from its reliance on cancer drugs, where it is the world leader, by expanding into other disease areas, such as respiratory medicine.

Roche already markets Pulmozyme for cystic fibrosis and Xolair for severe asthma in the US and has other experimental respiratory products in clinical development.

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Germany Gives Green Light for DEA Takeover by Russians

Germany's economics ministry has given the go-ahead for energy group RWE to sell its oil and gas unit DEA to a group of investors led by Russian tycoon Mikhail Fridman.

A clause in Germany's foreign trade law, would have allowed the ministry to stop the deal, announced earlier this year, if there were concrete signs it threatened "public safety and order," but the clause has never been invoked.

In a statement, the ministry said it did not expect the deal to negatively impact Germany's energy supply. When it was first announced the €5.1 billion sale was criticized by senior German politicians in March, as relations between Russia and the West deteriorated over Ukraine. The sale will hand Frid-

man, Russia's second-richest man, and other co-investors stakes in about 190 oil and gas licenses or concessions in Europe, the Middle East and North Africa. Germany currently receives more than a third of its gas and oil from Russia. More than 6,000 German companies are active in the country and business associations and trade bodies have warned that an escalation in tensions over Ukraine would result in catastrophic losses for firms. RWE also must obtain approval from other countries in which Dea has activities, including the UK, Norway, Denmark and Egypt. Germany's approval was regarded as the biggest challenge, however.

The European Commission signalled its approval in July. (dw) ■

Emerald Performance Materials, headquartered in Cuyahoga Falls, Ohio, USA, has completed the sale of the company to an affiliate of private equity firm American Securities. Emerald, formed in 2006 from the divestiture of six specialty chemical businesses from Lubrizol, has been an affiliated portfolio company of Sun Capital Partners since 2006. Terms of the private transaction were not disclosed.

Emerald's portfolio includes benzoic acid and derivatives such as fragrance ingredients and plasticizers, specialty resins, reactive liquid polymers and modifiers, antioxidants, accelerators, colorants, foam control products and other additives. The products are used in a wide range of end markets, including flavors and fragrances, food and beverage, personal and household care, composites, structural adhesives, coatings and plastics.

"We are extremely proud of our accomplishments during our tenure as a Sun Capital Partners portfolio company — doubling the company's

revenue and achieving a three-fold improvement in EBITDA," said Candace M. (Candy) Wagner, president and CFO of Emerald Performance Materials. "We have many exciting opportunities ahead of us and look forward to this next phase as an affiliate of American Securities," she added.

Significant investments in new plant equipment have enabled the mid-sized specialty chemicals company to expand capacity at its Rotterdam, Netherlands, and Kalama, Washington (US) sites in order to meet increased customer demand for benzoic acid and downstream specialty products such as non-phthalate plasticizers and fragrance ingredients. In addition, the company added assets at its Charlotte facility for expanded production of foam control and specialty silicone materials, increased capacity of its reactive modifiers at Maple Shade, New Jersey, and expanded R&D and pilot plant capabilities at Kalama, Cincinnati, Charlotte, Moorestown and Akron. (dw) ■

Clariant Builds New Masterbatches Plant in Australia

Swiss specialty chemicals producer Clariant has announced plans to build a new masterbatches plant in greater Sydney, Australia. The Muttenz-based company said the new plant will mainly supply the Australian market with a full range of color and additive masterbatches to meet the growing local needs. Commis-

sioning of the new facility is planned for fourth quarter of this year.

The new Australian plant will support Clariant's masterbatches business in Asia-Pacific and help it increase its customer service focus in the region," said Mathias Lütgen-dorf, member of the company's executive committee. (dw) ■

Mitsui to Acquire DuPont Agrochemical Fungicide Assets

Japan's Mitsui has agreed to acquire global business operations for DuPont's copper fungicide Kocide.

Mitsui's US subsidiary will establish a local company to buy the business trademarks for Kocide, as well as product registrations, registration data, manufacturing know-how and certain third-party contracts, along with the US group's copper fungicide production facility in Houston, Texas.

Under the terms of the deal, DuPont will continue to sell Kocide in the Asia-Pacific region for up to

five years. Mitsui will supply and distribute Kocide and copper fungicide mixtures to DuPont for the purpose.

Copper fungicides are a key fungal and bacterial disease management tool for farmers, in particular for organically-grown fruits and vegetables such as grapes and citrus fruits.

The main active ingredient of Kocide is cupric hydroxide, widely used as a protectant fungicide for disease control in stand-alone and mixture applications with other fungicides. (dw) ■

Catalent Prices New York IPO

US-based Catalent, which claims to be the leading global provider of advanced delivery technologies and development solutions for drugs, biologics and consumer health products, is pricing its initial public offering of 42,500,000 shares of its common stock at \$20.50 per share.

The shares began trading on the New York Stock Exchange on July 31, and the offering is expected to close on August 5, 2014. The com-

pany has granted the underwriters a 30-day option to purchase up to an additional 6,375,000 shares at the initial public offering price.

Catalent, which has its corporate headquarters in New Jersey, said it expects to receive net proceeds of around \$822.7 million after deducting underwriting discounts and estimated offering expenses. It intends to use the proceeds to pay down debt. (dw) ■

IPO in Sight for Former DuPont Automotive Coatings

US paints and coatings maker Axalta Coating Systems, the former automotive coatings business of DuPont, is planning an initial public offering (ipo), according to a filing with the regulatory authority US Securities and Exchange Commission.

The company, currently owned to 95% by private equity investor Carlyle Group, has not yet revealed the timing of the stock launch or details of pricing and the number of shares to be floated. However, the news agency Reuters said banks hired by Carlyle to handle the transaction are expecting to raise up to \$1.6 billion.

Citigroup, Goldman Sachs, Deutsche Bank, and J.P. Morgan are listed as book runners, along with BofA Merrill Lynch, Barclays, Credit Suisse and Morgan Stanley.

Axalta said it intends to use any net proceeds from the offering, plus cash on hand, to pay down debt.

Based in Philadelphia, the former DuPont business makes liquid and powder coatings for the automotive and general transportation industries. It operates 35 manufacturing centers and does business in more than 130 countries. (dw) ■

BASF Invests €1 Million in SmartKem

BASF Venture Capital, Octopus Investments and Entrepreneurs Fund have together invested €3 million in Welsh technology company SmartKem, with each contributing €1 million.

SmartKem is a leader in research and development of high perfor-

mance organic semiconductor inks used in printed thin film transistors (TFTs), which drive unbreakable and fully flexible electronics, including flexible OLED displays. (dw) ■

Borealis to Acquire All of Speciality Polymers Antwerp

Borealis has completed the acquisition of all DuPont Holding Netherlands shares of Speciality Polymers Antwerp. The polymer producer based at Zwijndrecht, Belgium was founded in 2000 as a 50:50 joint venture of Borealis and DuPont and has recently been a 67:33 joint venture of DuPont Netherlands with Borealis' Belgium-based subsidiaries Borealis Polymer and Borealis Kallio.



Mark Garrett, CEO Borealis

"The acquisition of the full ownership of Speciality Polymers Antwerp is in line with our strategy to grow our polyolefin business in specific market areas," said Borealis CEO Mark Garrett. "Acrylate copolymers are an important building block for our value-added products sold into our core energy and infra-

structure market." Under the new arrangement, DuPont will continue to serve the market with ethylene vinyl acetate (EVA) and acrylate copolymers and Borealis will supply DuPont with ethylene vinyl acetate (EVA) and acrylate copolymers from the Speciality Polymers Antwerp facility. (dw)

Solvay to Sell US Eco Services Business to CCMP Capital

Solvay has signed a binding agreement to sell its US-based Eco Services sulfuric acid virgin production and regeneration business to affiliates of CCMP Capital Advisors, a private equity investor. Completion of the transaction is expected in the fourth quarter of this year.



Jean-Pierre Clamadieu, CEO, Solvay

The company is changing hands for \$890 million (€660 million), which according to Solvay represents just over eight times adjusted EBITDA for the 12 months ending June 30.

CEO Jean-Pierre Clamadieu said the divestment of Eco Services "is another step in Solvay's transformation aimed at achieving higher growth and greater returns. Eco Services generates stable cash flows, but its business profile differs from Solvay's strategic ambitions."

CCMP Capital, which the Solvay chief said is committed to working with the management team to make the investments necessary to support the long-term growth of Eco Services, specializes in middle

market buyouts and growth equity investments of \$100-500 million.

Reporting financial results for the second quarter of 2014, the Belgian chemical producer said its recurring operating profit (REBITDA) improved by 10% to €485 million, thanks to good volume growth and "sustained strong delivery on excellence measures." Sales increased by 2% year-on-year to €2.6 billion. For the full year, Clamadieu confirmed earlier guidance, forecasting "high single-digit year-on-year REBITDA growth at prevailing exchange rates." (dw)

Ineos Acquires Scotland Shale Gas Exploration License

Ineos has acquired the 51% stake owned by BG Group in a UK shale gas exploration license. The remaining 49% is in the hands of Dart Energy, which is in the process of being taken over by British fracking company IGas Energy. The license covers 127 square miles of Scotland's Midland Valley, which includes the Swiss-based chemical producer's Grangemouth refinery and petrochemical complex as well as the surrounding area, spanning the Firth of Forth and including Grangemouth, Falkirk and much of Stirling.

Calling the buy a "logical next step," Gary Haywood, CEO of Ineos Upstream, said that over the past year the Ineos group company has been putting together a team of experts in the sector, including a number of leading shale exploration and development specialists from the US.

"This expertise gives us the perfect platform to move into onshore exploration," Haywood remarked. No shale gas exploration has yet taken place in the area, but Dart calculates that it could contain 4.4 trillion cubic feet of gas. If 10% were recoverable, some estimates suggest this could provide enough gas to meet Scotland's needs for more than a year.

The Ineos announcement came as anti-fracking activists across the UK gathered for a day of action, in part involving blockades at the offices of energy companies and government agencies. While a survey conducted in June is said to have shown that in the UK altogether as much as 57% of respondents were in favour of shale gas exploration, those in London and Scotland showed the least amount of support, at 52% and 53% respectively. (dw)

Mexichem Buys German PVC Producer Vestolit for \$292 Million

Mexican petrochemical producer Mexichem has reached a "definite agreement" with US-based private equity investor Strategic Value Partners to acquire German PVC producer Vestolit for \$292 million in cash and assumed liabilities.

Following regulatory approval, the asset transfer is expected to be finalized in the fourth quarter of this year, Mexichem said. The German company is Europe's sole manufacturer of high-impact PVC specialties for applications such as weather-resistant windows.

"The acquisition of Vestolit is in keeping with our strategy of becoming a global, vertically in-

tegrated chemical company with a focus on high-end, specialized products," Mexichem CEO Antonio Carrillo said, adding that the PVC producer's current management will be retained. Vestolit CEO Michael Träger said the link-up with its new Mexican owner "is a major step that will strengthen the company's back-integrated production site at Marl, Germany.

SVP acquired the PVC producer, which has annual sales of €500 million, EBITDA of €40 million and capacity to produce 400,000 t/y of PVC, in 2006 from a consortium led by private investor Candover Partners. (dw)

Arkema Inks US Deal for Shale Gas-derived Propylene

Arkema has signed a ten-year agreement with US energy company Enterprise Products Partners for the supply of shale gas-derived propylene to its US operations. Enterprise produces propylene via propane dehydrogenation (PDH). Arkema said that the contract will account for a significant part of the propylene feedstock used by its US acrylics business. Enterprise re-

ceived its permits for the PDH project in May of this year, and already has begun construction. Start-up is planned for first half of 2016. The company is poised to carry out the first massive deliveries of ethane from the Appalachians to the US Gulf Coast. Its regional Aegis pipeline connects individual petrochemical sites in the states of Texas and Louisiana. (dw)

Shell Selling Mature Gas Assets to Focus on Pennsylvania Shale

Shell has revealed plans to sell off some of its portfolio of natural gas holdings to focus on the Marcellus and Utica shale formations in the northern part of Pennsylvania. The energy and chemicals group will sell drilling rights to mature gas producing areas in Wyoming and Louisiana in separate deals for \$2.1 billion as well as sites in two Pennsylvania counties where it operates gas wells.

Earlier, Shell said it was selling 208,000 acres in Pennsylvania and Ohio to Rex Energy for \$120 million. A Shell spokesperson told local media that the moves are part of the group's regular review of its mix of energy production assets. It plans to focus its onshore drilling program on a few of the more prolific formations to boost profitability.

Shell wrote down the value of its shale acreage in the US by \$2.1 billion last year as natural gas prices dropped. In a written statement, Upstream Americas director Marvin Odum said the group is adding "highly attractive" exploration acreage, where it has "impressive" drilling results and divesting more mature dry gas positions.

The Pinedale acreage in Wyoming and the land in Pennsylvania's Potter and Tioga counties is being sold to Houston-based Ultra Petroleum for \$925 million. In exchange, Shell will acquire 100% of a joint venture with Ultra in northern Pennsylvania. In a second deal, Shell's gas assets in northern Louisiana are being sold to Dallas-based Vine Oil & Gas for \$1.2 billion. (dw)

Ashland to Expand HPC Line in Hopewell, Virginia

To meet growing customer demand, Ashland Specialty Ingredients plans to significantly expand production capacity of its hydroxypropylcellulose (HPC) tablet binder and coating ingredient product line in Hopewell, Virginia. The expansion is expected to go on stream in the second half of 2016. The product sold under the Klucel trademark is used in pharmaceutical applications and dietary supplements worldwide.

"Ashland is committed to the overall pharmaceutical market and

has made a number of sizeable investments over the past two years to strengthen our position," said David Neuberger, vice president, Pharmaceutical Specialties, Ashland Specialty Ingredients.

Projects include a pharmaceutical center of excellence opened in Hyderabad, India, earlier this year, the pending expansion of Ashland's technical capabilities in Wilmington, Delaware, and the Polyplasdone crospovidone expansion in Texas City, Texas. (dw)

Kemira and Wilmar Terminate Chinese JV Plans

Finnish chemical producer Kemira and Wilmar International have agreed to terminate their joint venture agreement for the manufacture

of AKD (alkyl ketene dimer) wax in China, citing changes to their commercial objectives. The agreement was announced in November 2013. ■

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Building a Future-Proof Business

Continued Page 1

And we even have given ourselves carbon reduction targets and have introduced a new metric named resource efficiency index, which correlates our carbon footprint with our gross margins and thus indicates how efficiently we generate financial value.

Your ambition when it comes to sustainability could be discounted as a marketing tool. After all, AkzoNobel generates a large portion of its annual revenues with consumer brands.

T. Büchner: Indeed, sustainability is a buzz word and a lot of people are using it for marketing purposes. We really have gone much farther and are using it as an attitude and a way to run the business.

Today, AkzoNobel's business is based on three pillars: Decorative Paints, Performance Coatings and Specialty Chemicals. There were more than three pillars in the past. Is today's setup the optimum in terms of diversification or do you have plans to add further pillars in the future?

T. Büchner: We like all three businesses, and the chance that we will add additional legs to the portfolio is not so high in the short- to mid-term. Our strategy is aimed at delivering leading performance by building on our leading market positions in paints, coatings and specialty chemicals. We are really focusing on operationally improving the present businesses that we have. And with the sale of our Paper Chemicals business announced in July, which follows a strategic review of the business's fit with AkzoNobel's portfolio, we are

following through with our strategy to focus on leading positions.

Sustainability, operational excellence and organic growth, as you say, form a triangle to base investment decisions on. Do all of the investments have to meet these requirements equally?

T. Büchner: What you see in our investments is that there are always measures, of course, on financial return values. We make investments that are very focused on operational excellence, and there are other investments that are focused on growth. All of them have a sustainability component. I can give you one example, which in addition to sustainability, actually serves both operational excellence and organic growth: We invested €140 million in an upgrade of our chlor-alkali facility in Frankfurt. And by doing so we actually reduced our energy footprint and our carbon footprint significantly by improving our efficiency and increasing our use of renewable energy. On top of that, the new facility drives growth because, firstly, capacity has been increased by 50%, thus allowing us to serve more customers; secondly, it is more energy-efficient and is therefore more financially efficient. So that is an example of an investment decision where all three aspects are being served.

Another example is the €80 million investment in our new Imperatriz "Chemical Island" in Brazil, which is now operational. With this project, we strengthen our leading position in bleaching chemicals and we provide sustainable solutions that meet our customers' operational needs.

You recently announced an investment in a new technology center



AkzoNobel started the "Let's Colour" program in 2011 and has since completed dozens of projects around the world to help revitalize neighborhoods.

in China. What is your growth strategy in terms of geographical presence?

T. Büchner: If we specifically look at China, we have been on quite a significant investment program around our Specialty Chemicals business. We have also done a number of acquisitions there. And that all goes in parallel with investments in the Decorative Paints and the Performance Coatings businesses as well. So China has been a target country because the business there has been continuously growing in virtually all its aspects over the last several years. Thus, China is a recipient of quite a significant amount of

new green field investments. And what we are actually doing there is putting in the newest technology, so that we are future-proof when it comes to potential energy-efficiency requirements and when it comes to sustainability requirements that the Chinese government is developing as we speak, now that they realize that something needs to happen in terms of environmental measures that make the country and the cities more livable.

How do you assess the development of the most important regional markets?

T. Büchner: I guess what is important is that the global dynamics in the specialty chemical industry have changed quite significantly because of a variety of factors. And I would highlight maybe three factors that have an impact.

One is the shale gas and shale oil in North America that creates a significant energy advantage for North American industries. All industries that use a lot of energy — and the chemical industry is obviously one of them — have seen an influx of capital investments. But what you also see as an effect in North America is that the price of installing a new facility has already inflated quite significantly since the engineering contractors are quite full.

Another thing is that the Middle East, of course, has continued to develop very actively as well. In

chemical industry right now, China is very fast becoming even bigger as an industry than Europe and the United States combined. And that means that a lot of engineering, a lot of technology, a lot of knowledge, and a lot of growth is taking place in China.

These three developments have certainly created a shift in where people put their investments. And Europe is a bit on the short end

The global dynamics in the specialty chemical industry have changed quite significantly.

of that investment decision cycle at this point in time. And that is in general, it is not specific to AkzoNobel. And some people are rather concerned about the European boundary conditions for success, with the energy advantage going to other regions.

So what is your take on that? As the CEO of a company based in Europe, how do you judge the competitiveness of the European chemical industry in that global context?

T. Büchner: Well, the energy disadvantage in Europe is real. I think that the North American energy advantage will at least continue for the

engineering and chemical background, and a flexible workforce.

What may be success factors for European companies?

T. Büchner: The ability to innovate is an area where we can do something in Europe. Innovation has to continue to be a driver for the business and Europe has always been strong in it. Particularly, innovation on the basis of sustainability can really be a differentiator for Europe, but we all need to put significant efforts in it to make it happen.

Innovation and sustainability are differentiators for AkzoNobel already. In the context of China you spoke about making cities more livable. Is AkzoNobel taking responsibility for this global challenge?

T. Büchner: Yes, for instance in June, we launched our "Human Cities Manifesto", which is really a serious responsibility-taking of AkzoNobel. Half of the world's population today lives in cities and by 2050 this number will probably have increased to 75%. Some of us may not like it, but we are unlikely going to stop it. A lot of people have been talking about the functional aspects of urbanization, that is houses, roads, trains, and so on. These functionality aspects generally forget the livability aspects of cities.

For AkzoNobel about 60% of our revenue is exposed to buildings, infrastructure and transportation, a lot of our products actually end up in

cities. But it seems that people have kind of forgotten to integrate the livability and the enjoyability of cities in the design concepts of urban expansion. And we believe that we as AkzoNobel can play a role there, either with color, with the protection of heritage, with the support that we provide in education or sports initiatives. And with that we can do a lot of things — together with our sustainability approach — that make cities more human as opposed to just functional.

Of course, we are focusing on shareholder value and are doing things to financially improve our business. But sustainability and the responsibility to make cities more human is something that we think we can make a small difference.

During the Soccer World Cup in Brazil TV viewers could often see vividly painted houses in a favela in Rio de Janeiro. Some critics may say that you don't change people's life conditions by just painting their houses.

T. Büchner: Yes, but there is more. Actually, we haven't painted a single house in the favelas in Rio de Janeiro. In that favela in Rio that you see when you stand on Copacabana Beach, we have actually educated a number of local people to become painters and taught them the skills needed to adopt painting as a trade. And these painters have subsequently started businesses. So what we have been trying to do is to stimulate the economy by creating entrepreneurs that actually can work for a living. And that has nothing to do with the Soccer World Cup held in Brazil this summer, because we were doing this favela many years ago. Color has certainly the power to change people's lives.

[Read the complete interview on CHEManager.com/en](#)

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Innovation on the basis of sustainability can be a differentiator for Europe.

the past we used to buy oil from the Middle East. Now, they have subsequently integrated into base chemicals and petrochemicals and their intention is to go further downstream into specialty chemicals. So, in the future we will see added capacity in the specialty chemicals business in a region that also has a significant energy advantage.

And the third aspect that is very important is China. If you look at the

next 20 plus years. So that is one that we are not going to solve quickly if we don't find access to cheaper energy in Europe. Most European government plans at this point in time are actually driving towards more expensive energy. Other issues that are important for the competitiveness of the European chemical industry, of course, are raw material access, the availability of highly qualified people with a technical,

AkzoNobel

Within the 20 years of its existence, following the merger of Akzo and Nobel Industries in 1994, the enterprise with Dutch and Swedish roots has already undergone a fundamental transformation. Through a number of divestments and acquisitions, AkzoNobel has moved from being a diversified conglomerate of businesses like pharmaceuticals, biotech, fine & specialty chemicals, fibers, resins, adhesives or catalysts to becoming a focused paints, coatings and chemicals player. Following the acquisition of ICI, the company restructured in 2008. Early in 2013, a new strategy was launched. Besides pursuing performance goals, the company that reported sales of €14.6 billion in 2013, has been upholding a commitment to sustainability for many years and regards it as a crucial factor to further enhance operational efficiency and stimulate organic growth.

www.akzonobel.com

Focus on Sustainability Makes Perfect Business Sense

Innovation and Sustainability are Key Drivers for Fiber Manufacturer DSM Dyneema

DSM Dyneema is the inventor and manufacturer of an ultra-high-molecular-weight polyethylene (UHMWPE) fiber branded as Dyneema, the world's strongest fiber. Up to 15 times stronger than quality steel and up to 40% stronger than aramid fibers, Dyneema fiber floats on water and is extremely durable and resistant to moisture, UV light and chemicals. Therefore its applications are more or less unlimited.

The fiber is used for a wide and ever-increasing range of applications such as medical sutures, commercial fishing and aquaculture nets, ropes, slings, high-performance fabrics such as cut-resistant gloves and apparel and vehicle and personal ballistic protection.

DSM Dyneema is recognized worldwide as an undisputed and highly successful leader in sustainable innovation.

The business is owned by Royal DSM, a global science-based company active in health, nutrition and materials with 24,500 employees and annual net sales of around €10 billion. DSM believes that its continued success will be driven by its ability to create shared value for all stakeholders, now and in the future. It creates sustainable shared value by innovating in ways that allow its customers to provide better People, Planet and Profit solutions, i.e. solutions to the challenges facing society, the environment and end-users.

These values are reflected in the way DSM Dyneema does business. Gerard de Reuver, CEO of DSM Dyneema, explains: "We cannot call ourselves successful if

that success comes at the expense of others. So when we make a product, and help our customers to develop solutions with it, we strive to make it better than its alternatives. And we ensure that in doing so we work in the interests of people and the planet as well as profit.

Developing Ever-Better Solutions

De Reuver, 12 years with DSM and more than 30 years in life sciences, adds: "DSM Dyneema is a business, so it's vital we make a profit. But we also understand that the entire commercial eco-system needs to be profitable if we are to thrive and be able to continue to invest in developing ever-better solutions. We therefore participate in several open innovation initiatives whose aim it is to accelerate the adoption of more sustainable solutions."

Gerard de Reuver is emotional about sustainability, which he says "is more than the footprint effect on the environment; it is also about the organization and the people. It's about taking ownership for the products we make, and about working with customers to think about innovative product-end-of-life solutions."

Against a background of a growing population, concerns about the environment and resource and energy pressures, sustainable development has become and will remain a global trend for the foreseeable future. "Using two simple molecules, and applying the best production process in the world, we manufacture the very best of products, particularly when compared to nylon and steel. We are providing a better product for our customers, therefore it is our responsibility to think about an end-of-life solution for something we are giving them."

Looking for New Applications

DSM Dyneema embraces its duty to also find new solutions for the material's end of life — maybe by cascading to less demanding applications. De Reuver: "I would like to see us use the materials in a completely new application area. Disaster protection is of particular interest to me. It

is a challenging area to penetrate because the stakeholders are not so easy to influence, but the result would be worth the effort. I'm going to keep pushing."

Although sustainability is not simply a DSM Dyneema issue, Gerard de Reuver feels it is a vital and constant focus — "it is in our genes" — and is prepared to invest in this. "I strongly believe in '3D — Demonstrate you are Dramatically Different' — and we work with our customers to think about unique products that come to life, again."

De Reuver is a self-proclaimed "life science guy", and what gets him excited about his work today is the simplicity of the molecule which gives such huge strength, the opportunity the company still has to use this strength and weight in applications and to see real proof that ideas can come to fruition.

Innovation Remains a Main Driver

"Innovation is an important part of why I'm with this company. If you talk about this product with somebody who knows nothing about the product itself, everybody gets excited; because the beautiful thing is, the product triggers all kinds of new application ideas and people get excited about that. And if they get excited, they have energy and they get positive, and that's what you have in this company."

What frustrates him? "I see it, yet it takes so long before the world really changes itself in using it... sometimes people don't understand the big benefits of what we can do with the molecule, we are doing things which are really innovations."

Innovation remains one of the company's main drivers. His organization constantly looks for new opportunities and is currently developing new initiatives in partnership with customers in a range of industries, including shipping, mooring and glove industry. Improving and building on the company's leadership position, innovation is the only way to create advantages, deliver

becomes easier and success comes to you rather than you are chasing success. If you get your organization into that kind of flow, then nothing can stop you anymore."

Even then, it can take a long time before markets and customers accept that the innovation really works. "When we introduced Dyneema Diamond Technology in cut resistance gloves, it took some

Sustainability is more than the footprint effect on the environment.

win-win solutions and stay on top with changes in legislation, compliance and consumer demands.

De Reuver: "Innovation is often described as driven by societal or industry needs. Yet it is people who make the difference. With technology as the catalyst, DSM Dyneema encourages its people to think big — and be willing to move from existing paths and make new concepts become reality. And they can only do so in an environment that allows them to step out of their comfort zone, make mistakes and learn from them."

Innovation Is a Way to Achieve Differentiation

"It is not enough to allow people the freedom to experiment; you also have to give them the possibility to execute and the means to deliver. You need to create freedom to move. Then at a certain stage, an organization gets into a flow. It

years before customers started to be convinced. When eventually they did — it was a wonderful experience."

Innovation is a way to achieve differentiation. DSM Dyneema wants to see its products come to life. Not me-too products, but unique product/services combinations.

De Reuver concludes: "Our ongoing success with Dyneema is based on our ability to create sustainable win-win partnerships in the various industries and geographies in which we choose to operate. Long-term relationships can deliver excellent results, provided the relationship is based on mutual trust as well as a shared understanding of end-user needs. And business partners are beginning to see the value of this approach."

www.dyneema.com



It is people who make the difference, with technology as the catalyst.

Gerard de Reuver, CEO of DSM Dyneema

Carbogen Amcis to Take Over Bachem High-Containment Facility at Vionnaz, Switzerland

Carbogen Amcis, Swiss-based pharmaceutical process development and API manufacturer, has announced plans to take over operations of a high-containment facility at Vionnaz, Switzerland. The high potency facility opened in December 2005 and was formerly managed by Bachem as an integrated part of that company's Vionnaz site. The unit is said to be cGMP-compliant and inspected by Swissmedic and by the FDA.

"We are facing a significant increase in the demand for high potency services, spurred by the fast-paced growth of the antibody drug conjugates market, said Carbogen Amcis CEO Mark Griffiths. "The expansion in Vionnaz will ensure we can continue to fulfil customer needs and expectations while our company continues to grow and expand." Griffiths stressed that potential customers will



Mark Griffiths, CEO, Carbogen Amcis

benefit from additional high potency capabilities available at the Vionnaz facility such as high potency laboratories, cGMP kilo-scale manufacturing, as well as larger scale lyophilisation.

Vionnaz is dedicated to the development and manufacture of highly potent APIs. The facility is completely independent and features a process development laboratory, a dedicated QC laboratory and two production units fitted with reactors up to 30 l,

as well as a freeze dryer for lyophilisation and chromatography. Operations involving cytotoxic compounds are performed under containment conditions. The building is self-contained and segregated from the outside.

The substantial increase in development capabilities and manufacturing space for highly potent drugs in Vionnaz, along with the recent construction of a clean room dedicated to conjugation projects in Bubendorf, Switzerland, position the company as an outsourcing partner for complex highly potent APIs and ADCs, Griffiths said. In the near future, the company plans to introduce additional capability for highly potent drugs at the Neuland/Hunzenschwil site to meet customer needs in chemical development and niche commercial manufacturing. (dw) ■

Sanofi and MannKind in Insulin Licensing Agreement

Sanofi and US-based MannKind Corporation have signed a worldwide exclusive licensing agreement for development and commercialization of Afrezza human insulin inhalation powder, a new rapid-acting inhaled insulin therapy. The companies plan to launch Afrezza in the US in the first quarter of 2015.

Sanofi will be responsible for global commercial, regulatory and development activities. Under a separate supply agreement, MannKind will manufacture Afrezza at its Danbury, Connecticut, plant. The companies also plan to collaborate to expand manufacturing capacity to meet global demand as necessary.

The terms foresee MannKind receiving an upfront payment of \$150 million and potential milestone payments of up to \$775 million, depending on achievement of certain targets. The two companies will share profits and losses, with Sanofi retaining 65% and MannKind receiving 35%. (dw) ■



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The Power of Combining Strengths

— Integrated Approach to Chemical Distribution Meets Customers' and Suppliers' Requirements —

The role of chemical distribution is often reduced to sourcing, storing, repackaging and supplying chemicals. However, many chemical distributors — such as Brenntag — offer much more to both their principals and their customers. Linking chemical manufacturers and chemical users, the Mülheim, Germany-based group provides business-to-business distribution solutions and value-added services for industrial and specialty chemicals globally. Michael Reubold asked Karsten Beckmann, CEO Brenntag Europe, Middle East and Africa, about the importance of value-added services within the growth strategy of Brenntag.



Karsten Beckmann, CEO,
Brenntag Europe, Middle East and Africa

expectations have become more sophisticated. Therefore, they require a strong partner who is able to manage complexity and enable them to focus on their core business. Both call for an integrated approach to chemical distribution with services that create true value, launch new opportunities, offer competitive advantage and promote growth.

CHEManager International: How has the supplier-distributor-customer relationship changed over the past decade or two?

K. Beckmann: Over the past years and decades, the way in which business is conducted has changed significantly. Today, the world is a kind of global marketplace, providing excellent opportunities for agile and flexible companies. There are distinctive trends that affect the core of each business. Meeting today's requirements of our customers and suppliers, who demand a clear industry focus with dedication, market know-how and technical expertise, is key for Brenntag. We take our partners very seriously and have set up our new commercial organization accordingly in every country in Europe.

How are you viewing the role of Brenntag in this supply chain and how can you become a more integral part?

K. Beckmann: Today's highly competitive and increasingly complex markets require that you listen precisely to the needs of your customers and suppliers. Customers' and suppliers'

The world is a global marketplace providing excellent opportunities for agile and flexible companies.

The new Brenntag organization in Europe has a dedicated customer-facing approach with a coherent and consistent structure across all European markets with each country structured in the three segments Material Science, Life Science and Environmental. On the supplier side, we mirror these three segments with an industry-focused product management, ensuring strong industry expertise.

What kind of value-added services are newly required by your principals and by your customers, particularly in the field of specialty chemicals?

K. Beckmann: Let us take for example food and nutrition. Experts at Brenntag test ingredients and additives and develop formulations at our own in-house application facilities. They can support customers and suppliers with formulation guidance, which can be targeted to achieve cost optimization and use alternative ingredients.

In cosmetics, Brenntag conducts formulation development. Our laboratories support any need like tailor-made formulations and concepts. With regard to Pharma, we are the partner in terms of sourcing of products in the pharmaceutical, veterinary and health-care industries. Our supply chain is reliable, transparent and compliant with industry regulations.

What are the drivers for these increasing requirements on both sides — suppliers and customers?

K. Beckmann: Basically, it requires greater effort to be successful. Global trade and capital flows, increased digital communication, mobility of people and faster traffic and transportation affect all of us. These driv-

ers require that you become more flexible as a chemical distributor. Suppliers and customers request individual solutions matching specific needs; they want easier access to products and services and wish to procure locally, regionally and across Europe. A good distributor must provide direct responsiveness and react quickly to any short-term market challenges.

Which investments and organizational changes have you made to react to customer requirements?

K. Beckmann: At Brenntag in Europe we asked ourselves: "How can we

serve customers even better against the background of the changing market realities?" Today, and after a comprehensive transformation process, we have — as explained before — a dedicated customer-facing approach and consistent organization throughout Europe. We provide a single point of contact, technical sales and sales representatives visiting in person, technical service know-how, support capability, industry and market knowledge, speed of response to quotation requests and to offers, and flexibility regarding order modifications. Also total cost of ownership initiatives have been launched with major key accounts.

Particularly in mature markets like Europe, chemical companies need to focus on innovation in order to stay competitive and profitable. In the past, chemical distribution and innovation were hardly mentioned in the same breath. Is this about to change?

K. Beckmann: On the part of Brenntag, this already changed years ago. Today innovation is one of the key drivers for growth. For example: Suppliers have invited us to support product introductions simultaneously. Here we also provide expertise in developing marketing and business plans. In the past suppliers did this all by themselves, and the product became available for distribution at a later stage. Now we develop applications with our customers whereby we inform our supplier when we see that this can be successful or where slight modifications in the production are needed.

What do you see as the most important differentiating factors for Brenntag in order to stay ahead of your competitors?

K. Beckmann: We bring consistency in a broad spectrum seen from a European coverage toward quality and compliance perspective, technical skills and know-how, embedded in our industry segment organization. It is also important to make the most of economy-of-scale effects in benefit of the supply chain. It doesn't matter where you are located in Europe as a customer and where you want to have your product sold as a supplier: Being serviced by Brenntag with its global network, market intelligence and knowledge means that you are within the reach of these capabilities.

From market intelligence to laboratories and application centers to just-in-time supply — are these services fully rewarded and remunerated by your industry partners?

K. Beckmann: Yes, as otherwise we would not have seen and see the growth we experience. We are continuously in contact with our partners to discuss all issues, and we are working constantly on improving our quality and services. As we do this successfully, we are convinced that our partners will appreciate and remunerate our consistent services also in the future.

The Link between Chemical Manufacturers and Chemical Users

Brenntag, the global market leader in chemical distribution, covers all major markets with its extensive product and service portfolio. Headquartered in Mülheim an der Ruhr, Germany, the company operates a global network with more than 480 locations in over 70 countries. In 2013, Brenntag, which has a global workforce of more than 13,000, generated sales of €9.8 billion.



Krahn Supports Lanxess in CEE

Lanxess' High Performance Elastomers business unit has transferred its distribution business in Poland, the Czech Republic and Slovakia to Krahn Chemie Polska based in Poland. The unit's portfolio includes Baypren polychloroprene rubber, Therban HNBR, the ethylene-vinyl acetate rubbers Levapren and Lev-

amel and the NBR types Perbunan, Krynac and Baymod N, used mainly in automotive, mechanical engineering, construction and oil gas applications as well as in the electrical and cable industries. Lanxess' high-performance elastomers are also used as modifiers for raw materials for plastics and adhesives. (dw)

DenHartogh Enters Romanian Market

Dutch-based chemical distributor DenHartogh is integrating Romanian shipping agency DTS Logistic Services into its network, further expanding its footprint in Europe.

Based in Bucharest, Romania, DTS specializes in international and domestic transportation, as well as integrated logistics. It will repre-

sent the DenHartogh network in the southeast European country.

The distributor, which has offices in a number of European countries, said the Romanian market continues to show healthy growth in its logistics services to the chemical industry. (dw)

M&A in Chemicals & Pharmaceuticals

M&A in Chemicals & Pharmaceuticals

KPMG's Deal Thermometer indicates brisk M&A activity

The first half suggests that 2014 will be a record year for M&A in pharmaceuticals, with the size of deals having increased substantially over prior years.



We are seeing unprecedented levels of M&A deals being announced, with financial sponsors increasingly contributing to the deal frenzy.

Vir Lakshman, KPMG

The value of transactions closed in H1 2014 amounted to USD 86 billion, 70% of the value for the full year 2013. This was driven by pharmaceutical transactions, where activity in the first half of 2014 was almost as high as for the previous full year. The huge volume of pharmaceutical deals announced to date this year suggests that 2014 will be a record year for M&A in pharmaceuticals.

Pharmaceuticals

The US continues to dominate the market with nine of the global top 10 completed deals involving US pharmaceutical companies. With approximately \$310 billion in announced deals, M&A activity in the pharmaceuticals industry has increased significantly in the first half of 2014. The key deal drivers are pipeline replenishments, specialization, financial optimization and portfolio consolidation.

Creative structuring and asset swaps are being deployed to help pharmaceutical players secure deals to grow their core businesses, while exiting non-core activities at the same time. Investor groups are increasingly active in pharmaceuticals, representing 23% of the number of deals completed in Q2 2014. These range from smaller biotech investments to large LBOs such as Carlyle's investment in Johnson & Johnson's Ortho Clinical Diagnostics unit for \$4.2 billion. McKesson Corp., one of the largest US pharmaceutical wholesalers with 2013 sales of \$137 billion completed its acquisition of 75.93% of Celesio for \$6.8 billion.

In April 2014, Novartis, as part of its strategic portfolio review, announced an innovative deal to trade assets. As part of the complex three-way deal, Novartis will swap its vaccine business for GlaxoSmithKline's (GSK) cancer assets positioning it as a leader in treating melanoma cancer. The deal also includes entering into a joint venture with GSK to create one of the largest consumer healthcare businesses. In parallel, Novartis struck a deal to exit the animal health business by selling it to Eli Lilly.

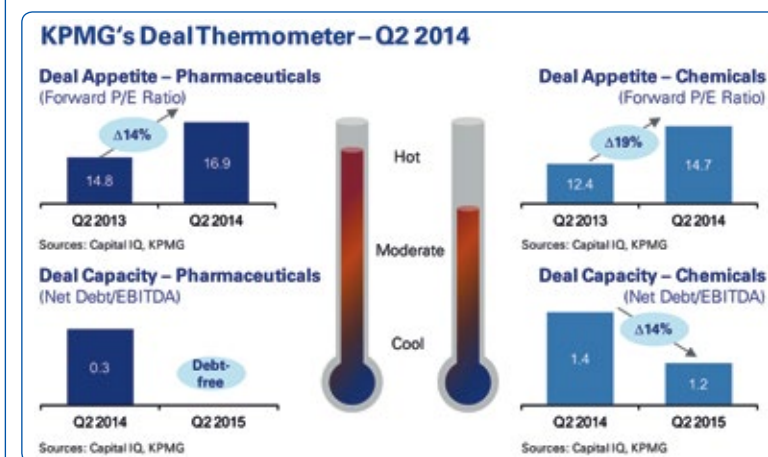
Bayer also contributed to the consolidation in the OTC market — by announcing the \$14.2 billion acquisition of Merck & Co.'s Consumer Care.

Chemicals

Top deals in HY1 2014 were strategic in nature as companies continue to position themselves in an increasingly competitive global marketplace. Portfolio rationalization continued apace as companies exited lower-margin non-core businesses. Specialization and geographical expansion were key deal drivers behind the global top 10 completed deals in HY1 2014.

For instance, by acquiring the leading high-tech materials supplier, AZ Electronic Materials, with an extensive operational footprint in Asia, Merck has strengthened its position as a premium segment solutions provider for the global electronics market.

As part of its acquisition of Clariant's Leather Services Business, Stahl has taken over all the relevant activities including production sites in Germany, Italy and India and laboratories in several countries, expanding market and product coverage. Not unsurprisingly, the US shale gas boom and the resulting decrease in energy prices remains an important factor for US related deal activity.



KPMG's Deal Thermometer indicates a 'Hot' environment in pharmaceuticals and 'Moderate to Hot' environment in chemicals for 2014's second quarter M&A activity. Pharmaceutical and chemical companies have increased their appetite for deals in the last twelve months, reflected by increasing forward P/E Ratios. At the same time, Net Debt/EBITDA multiples are projected to decrease in the year to 30 June 2015, giving them more deal capacity.

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KPMG's Deal Capsule is a regular publication analyzing transactions in Chemicals and Pharmaceuticals. To request copies, please contact Katharina Ashauer, Chemicals and Pharmaceuticals, kashauer@kpmg.com, T +49 201 455-6826.

KPMG AG Wirtschaftsprüfungsgesellschaft is a German leading professional services firm in the chemicals and pharmaceutical sector, providing a full range of audit, tax, transactions and consulting services. KPMG in Germany acquired Stratley AG in 2014, a specialist consultancy, nominated Hidden Champion 2012 — Best Consultancy for the Chemical Industry.



Export of Chemicals to China

Managing an Increase in the Frequency, Number and Thoroughness of Customs Inspections

As a result of recent changes to regulations, the requirements for the import of chemical products into China have become more stringent and more complex. In contrast to the European Union, China has now adopted all the GHS criteria governing the classification of chemicals. For European companies wishing to import chemicals to China, this would mean a re-evaluation of the products. Despite this progress, Chinese chemical laws are still very young in comparison. As such, an overwhelming part of the submission and registration process exists only on paper or in the form of standards. Based on the experiences gathered by the European industry, full compliance can only be achieved with the aid of local consulting experts that facilitate the process. Only those keen enough to undertake the adventure of getting to know a different culture and consequently accepting the idiosyncrasies that may come with cultural differences, have realistic prospects of building long lasting business ties.



Ariane Stoll, Consultant International Projects, UMCO Umwelt Consult



Eric Sun, Regulatory Compliance Consultant, REACH24H Consulting Group

Mindset

The Chinese are known for their friendliness and willingness to help others. Upon first visiting China, one will meet people who are enthusiastic, open minded and more than eager to offer their support. While English is spoken in the business environment without much difficulty, it is essential to comprehend the Chinese language when applying for licenses with Chinese regulatory authorities. Particularly in conflict situations the differences in mentalities become evident. While criticism is often voiced very openly and directly in the countries of the western world, the Chinese prefer to solve conflicts with a great deal of tact. Anyone in possession of said skills will attain a goal-oriented solution more quickly and avoid future conflicts.

Jurisdiction of Regulatory Authorities

Those hoping that a single Chinese regulatory authority is responsible for with hazardous chemicals will be disappointed. A total of 16 government authorities deal with this subject matter. Based on the varying properties and areas of application, a simple chemical product such as a lacquer can fall in the jurisdiction of several authorities.

Required Licenses

Before supplying your branch office in China with chemical pro-

duction must occur, irrespective of the tonnage band. This requires the input of data regarding the ingredients, as well as physical and chemical properties. Under certain circumstances similar products may be registered as product groups.

A thorough inquiry into the specific requirements and the necessary information that must be submitted is therefore a prerequisite for trade with China. Under normal conditions, costly expenditures occur only when products are new to the Chinese market and require registration. In contrast to the European registration process for substances under REACH, substance registration in China does not follow the OSOR principle ('one substance — one registration').

Which Chemical Hazard?

The good news first: China has adopted all of the GHS criteria as they were envisaged in the UN GHS. As such hazard classes and hazard categories like 'Acute Tox. 1' or 'Flam. Liqu. 2' are determined using the same criteria (toxicity and flash point boundary) as in UN GHS.

There is however a snag: The Chinese chemical regulations only accept studies on chemical, physical, toxicological and ecotoxicological properties that have been conducted in a Chinese laboratory. The Chinese specific standards often do not concur with the OECD methods and there is an unnecessary repetition of animal testing. This can lead to differing results and as such to differing classifications of substances.

More fundamental is the fact that in contrast to Europe, China has adopted all GHS categories. As a result properties such as acute toxicity and combustible liquids can have a classification of 'Acute Tox. 5' and 'Flam. Liqu. 4'.

Accordingly, a substance tested by a lab in Europe can be classified as 'Acute Tox. 3', while a toxicological test conducted in China would yield a classification of 'Acute Tox. 4'. The Chinese and European methodology for calculating acute toxicity would be identical if the substance is used in a mixture. However, due to the usage of different initial data (LD50) the resulting classification of the mixture would vary.

Change in Trend at Customs

The media is often abuzz with allegations of bribery and corruption in China. Because of the increased focus, this problem is expected to be minimized if not eliminated altogether. This is being felt by Chinese customs authorities. Where a single customs agent in the past was responsible for a company, now a team of customs agents takes on this responsibility. Previously tolerated deficits are no longer being ignored and the old habits are being abandoned. The consequence for foreign suppliers is that their goods are increasingly being detained for further clarification and as such delivery is delayed. Statistics from recent years show an increased ratio of detentions in custom clearance, which require further clarification and can hamper business activities.

Conclusion

In order to avoid delays, those wishing to venture onto the Chinese market should invest the time in researching the requirements and conditions for exporting to China. For the distribution of chemical products this includes all legal and regulatory aspects dealing with product registration, correct packaging and labeling according to national chemical laws and transportation requirements. Understanding the differences in the Chinese adaptation of the GHS and the European CLP helps avoid customs delays



and ensures that the products are cleared for distribution in China.

Collaboration with a competent Chinese consulting partner is not only essential for finding the appropriate authority and for being able to formulate one's own wishes and

concerns in the correct language and form, but also for dealing with online inquiries, verifications and in meeting one's own quality demands.

One can merit from an exploration of the Chinese culture, for the friendly and forthcoming liaison will

quickly pay off in successful business growth.

Ariane Stoll, UMCO,
Eric Sun, REACH24H

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Fig. 1: Chinese GHS-label, Source: REACH24H Consulting Group China.

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Attractive Areas in China's Chemical Industry

Substantial Technological Knowledge Required, Companies Must Also Consider their Capabilities and Resources

As a consultant specializing in the chemical industry in China, I often get asked for attractive areas in the industry — mostly by companies looking to expand their business. I am usually reluctant to answer them right away. This is not because I am afraid to share my knowledge. Rather, I am concerned that there is no universal answer to this question.



Dr. Kai Pflug, CEO, Management Consulting — Chemicals

In my experience, success in a specific chemical segment depends at least as much on the capabilities and resources of the individual companies as on the general attractiveness of the market (as measured, e.g., by market size, market growth, average profitability, etc.). Or to put it differently, a company highly competitive in an average market segment may be more successful than a laggard in a very attractive segment.

Particularly Chinese companies tend to have difficulties avoiding the areas in which they are less competent, (see Fig. 1, field "Not for us") as they consider only market attractiveness. For example, many Chinese companies have recently moved into coal chemicals, often without any specific competitive strength such as strong technology or own coal resources — a typical case of a potentially attractive market that requires specific internal capabilities and resources for success. As a consequence, one of these companies, the power-generation company Datang International Power, just quit coal chemicals after substantial losses.

However, despite these reservations, it is still a valid question to ask for current attractive chemical segments in China, and I will give a number of examples.

Coatings

It may be surprising that coatings are included in this list as the sector is rather crowded, with an estimated 10,000 companies active in China. However, there are several high-growth niches even within mainstream subsegments of the coatings area.

For example, functional architectural coatings account for less than 10% of all architectural coatings but have much higher growth rates and profitability than the segment average. Main functionalities are solar reflection, insulation and photo catalytic activity (which may give the



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coatings self-cleaning, anti-bacterial and anti-fungal properties).

Industrial corrosion protection is another attractive coatings area as the application of such materials more and more expands from marine uses to general industrial ones.

Electronics Chemicals

The electronics industry uses an extremely broad range of chemicals. Specialty chemicals are part of many formulations in the different processing steps, for example, in the deposition of layers on silicon wafers and in the patterning of these layers. In addition, some basic chemicals such as gases, acids and solvents are used — however, for these chemicals the purity requirements are much higher than for other applications. Overall, the attractiveness of electronics chemicals derives from the growth of the industry in China as well as from the high value created by these chemicals in the processes. The ongoing trend toward larger wafers and smaller structures will also require advances in the chemicals used, which should protect the segment from commoditization.

Filter Materials

Similar to the membrane materials discussed later, high-end polymeric filter materials will profit from rising environmental standards, concerns about air pollution and ongoing economic growth despite the competition from lower-cost glass-fiber material. Electrostatic dust removal is being replaced by the bag-type dust collector, in which polymeric filters are required. As a conse-

quence, market growth is estimated at 10%-15%. Important polymer types include polyphenylene sulfide, polyimide fiber, polysulfone amide, poly-m-phenyleneisophthalamide and polytetrafluoroethylene, which differ in properties such as chemical resistance, temperature resistance and cost.

Fluorochemical Specialties

There are already overcapacities in some areas of fluorochemicals, e.g., fluorosilicones. At the same time, there are still promising subsegments in fluorochemicals. The recent successful initial public offering of Tianhe, a producer with a strong portfolio in fluorotelomers used to make textile surfaces stain resistant, demonstrates this. Fluoropolymers other than the most common ones such as PTFE also have substantial room for growth in China as their share is much lower than in advanced markets.

Membrane Materials

In Western markets, the use of polymeric membrane materials is already well established in areas such as dairy products and other food, the automotive industry (to recover material from electropainting baths), and in medical applications. In wastewater treatment, membranes replace chemical treatment because of their lower material and labor costs as well as a more consistent outcome.

The chemical industry itself also increasingly utilizes membranes in separation processes as these tend to require less severe conditions and much less energy than other methods.

Emerging biotechnological processes, e.g., for the production of biofuels, are also likely to be important applications. Membrane materials used are mostly organic polymers, including polyethersulfones, polyvinylidene fluorides, polyimides and many others.

Nutraceutical Ingredients

Nutraceuticals are foods with health-giving additives and medicinal benefits. They are somewhere on the continuum between pharmaceutical products and foods. While many nutraceuticals have a natural source, the beneficial effect of others is based on synthetically produced ingredients. Nutraceutical ingredients include dietary fibers, antioxidants, prebiotics, minerals,

probiotics, polyphenols and polyunsaturated fats such as the omega-3 fatty acids found in fish oils.

This market is growing much faster than the one for food — the global rate is estimated to be around 6%-7% as an increasing number of diseases are traced back to deficiencies in nutrition. For China, the growth figure is likely to be much higher as the market is in its infancy but benefits from the worries of urban residents about unhealthy food. However, the recent scandals in the Chinese food sector also make a good reputation and experience in branding essential for success in this market.

The recent acquisition of Aland, a Chinese vitamin C producer, by DSM despite the current low margins in the vitamin business illustrates the potential in this segment. As some nutraceuticals already suffer from overcapacity in China, a more differentiated assessment needs to be conducted before engaging in this segment.

Oil Field Chemicals

With a global market size of about \$18 billion in 2014 and annual growth of about 3%-4%, oil field chemicals are already a fairly attractive segment from a global perspective. In addition, as China currently accounts for only about 5% of the global market for these chemicals, domestic growth rates are expected to be much higher as Chinese oil companies expand their

activities both within China and outside. Among the four basic groups of chemicals, enhanced oil recovery chemicals look the most promising if oil prices remain high, but prospects are also good for chemicals for drilling fluids, chemicals for cementing and stimulation, and for oil production chemicals.

Water Treatment

The water-treatment segment will benefit from increased regulation as well as increased awareness of health-related issues among China's growing middle class. While China already has domestic producers of water-treatment chemicals, the more promising opportunities are in the next two steps of the value chain, namely formulation and services. The combination of stricter regulation and the eventual focus of manufacturing and chemical firms on their core companies should lead to a strong demand for companies that offer complete outsourcing of water treatment.

Many More Appealing Segments

These are just some selected examples of attractive segments — there are many others, with examples including subsegments of lubricant additives, high-end carbon and other high-strength fibers, lithium and its compounds, high-end engineering plastics, environmentally friendly flame retardants, as well as specialty adhesives (as indicated

by the recent acquisition of Tonsan by HB Fuller).

Generally, the vast majority of attractive segments are in the area of specialty chemicals. Most commodity chemicals in China suffer from overcapacity and fierce price pressure — and even in those cases where local capacity is lower than demand, local production is often not competitive with imports from countries with lower raw-materials costs. In addition, competition in commodities is often coming from the huge petrochemical state-owned entities (SOEs), such as Sinopec, whose competitive position cannot easily be matched by other companies because of their integrated value chains and their ties to the government.

In addition, many attractive chemical segments are related to the increasing importance of environmental protection in China. This includes filter materials, membrane materials and water treatment.

Most importantly, almost all attractive segments require substantial technological knowledge that is not yet as widely spread or commercially available as that required to produce basic chemicals. In addition, many segments require application knowledge rather than just production know-how. These requirements serve as substantial barriers of entry to these attractive segments, thus amplifying the importance of company capabilities in determining segment attractiveness — which leads back to the beginning of this paper. However, if a company has the general mindset and resources to compete in an attractive segment and lacks only specific technologies, the acquisition of a competitor may be a solution. This can include the acquisition of a non-Chinese chemical company and transfer of the acquired technology for use in the Chinese market.

Tianhe successfully used an alternative. Instead of buying technology, the company hired a few foreign experts with previous careers in leading fluorochemicals producers, and let them develop the technology locally. While slower, such an approach has its own advantages such as the establishment of a deep knowledge base and lower investment.

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Segment	Key Attraction
Coatings, particularly Functional Architectural	Functional architectural coatings are a high-end, high-growth segment within the competitive architectural coatings market
Electronic Chemicals	High growth of customer industry and high value creation of chemicals used
Filter Materials	Rising environmental standards, particularly in industrial applications
Fluorochemical Specialties	Limited competition and high profitability along with rising consumer incomes (e.g., use for surface modification of outdoor clothes)
Membrane Materials	Increasing use of membranes in many industrial applications, sometimes replacing chemicals (e.g., in water treatment)
Nutraceutical Ingredients	Growing health consciousness and growing income of Chinese consumers
Oil Field Chemicals	Huge growth potential due to low base and accelerating activities of Chinese oil companies at home and abroad
Water Treatment	Stricter environmental regulation driving growth particularly for formulations and services



Fig. 1: Internal and external consideration in determining areas for business expansion.

Intensifying Chemical Processes

100 Years Ullmann's: Analyzing Equipment and Methods for Process Improvement

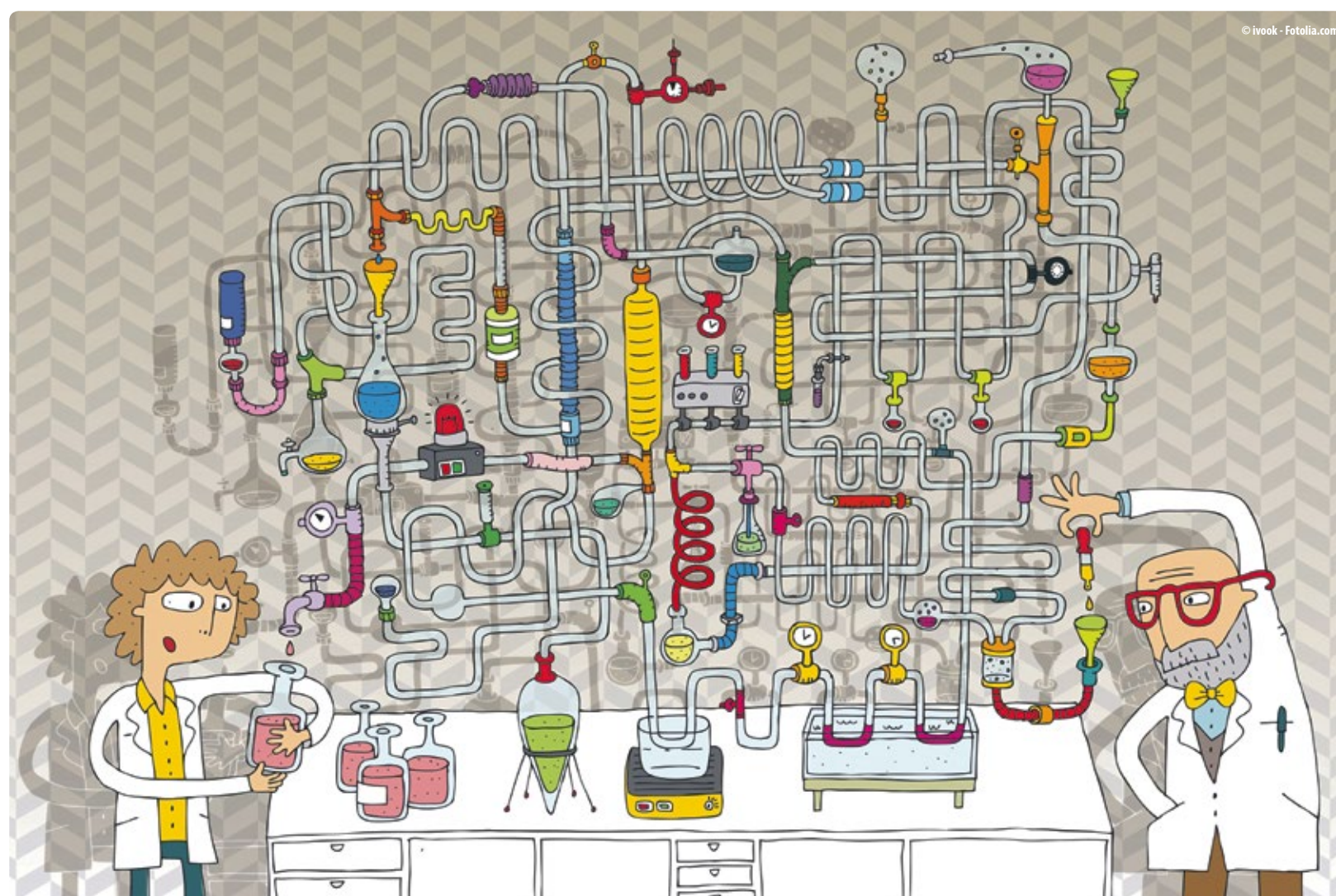
Over the years, the meaning of the term "process intensification" has changed and today, there is still no precise and generally accepted definition. At least there is a general consensus about the fact that process intensification requires a holistic view on the process, considering the process as a whole system. But the term itself is essentially used as a collective term for diverse measures that aim at a "significant" improvement of a process with regard to its efficiency.

The problem with that definition is how one can distinguish process intensification from classical process optimization and to what extent an improvement qualifies as "significant" (or "drastic"). In addition, the measure for the efficiency of a process can still be quite diverse (e.g., energy efficiency vs. time efficiency) which makes things even more difficult.

Often, process intensification is associated with striking but vague catch phrases like "cheaper, smaller, cleaner" or "making more with less". This may be appropriate regarding current discussions in the context of sustainable development. For example, the possibly enhanced corporate image might be one reason for companies to implement process intensification solutions.

A New Concept

However, all these purely descriptive and qualitative attributes do not contribute to specify the term "process intensification" more precisely. In the academic community, the lack of an appropriate and exact definition has led to controversial discussions about whether it is necessary at all to propagate process intensification as a new discipline. Hence, there is a clear need of a distinct definition. In a recent contribution a new approach to process intensification has been proposed, based on a concept which encourages a more fundamental view on the individual process steps by analyzing process routes in the thermodynamic state



space. This allows for the identification of optimal process routes and provides a basis for a systematic and rigorous classification of process intensification options.

In the following, possibilities for process intensification measures will be outlined for which improvements in productivity have been reported in the literature. These improvements can concern, e.g., a reduction of the plant size by reducing the size of single apparatuses or by reducing the number of the latter by integrating two or more unit operations into a multifunctional unit. Other intensification potentials concern, e.g. the specific energy consumption, the amount of reactants used, and of waste products being produced for a specified production height (i.e., the feedstock efficiency). In many cases, the measures to perform the process improvements have been found incidentally or as an empirical result of a series of experimental studies. To summarize, there is currently

neither a theoretical basis nor are there scientific guidelines for process intensification available that can be generalized and thus help to identify process intensification options when analyzing a chemical process as to its efficiency.

Classification Of Components

Process intensification can be achieved by an enhancement of processes which leads to smaller apparatuses and/or by process integration which leads to a reduced number of process steps. Systematic process intensification, however, can only be performed with the help of a suitable methodology that enables us to understand the process under investigation in more detail. For this, one currently still relies to a great extent on experiments.

To get an overview of the options available for process intensification, suitable systematic categories in order to classify the measures have to be introduced. In this regard, Stankiewicz and Moulijn propose to divide the field of process intensification into two areas, namely "process-intensifying equipment" and "process-intensifying methods". This scheme allows a rough classification of the different measures, but still it is only one of several possible classification schemes one could imagine.

From a mechanistic point of view, it is worth considering a differentiation between (drastic) quantitative improvements on the one hand and improvements as a result of qualitative changes on the other hand. Microreaction technology, monolithic reactors, and reactive separations are examples of the first category, since they allow for a significantly improved mass and heat transfer, while in principle the same physicochemical mechanisms still apply as in conventional apparatuses. Of course, in the case of, e.g., microreactors, the significance of the individual mechanisms (e.g., diffusion processes) that contribute to the overall performance can be completely different. The second category comprises, e.g. alternative forms of energy supply for chemical reactions such as microwaves and ultrasound, the use of new reaction media such as ionic liquids, microemulsions, and supercritical phases, or the use of new auxiliary agents such as phase-transfer catalysts. All these measures involve substantial qualitative changes in the process since here new (additional) mechanisms come into play.

Hierarchical Levels

Finally, another possibility for the classification of process intensi-

can be decomposed into a multi-scale structure of four hierarchical levels. The most detailed level is the molecular level, at which phenomena on the scale of individual molecules are regarded. At the next level one considers molecule populations that build up a thermodynamical phase (phase level). In the process, the thermodynamical phase(s) are embedded into apparatuses, or — more abstract — into individual process spaces. This is the process unit level. Usually, the process consists of several such process units. The interconnection between the individual process units and thus the overall process flowsheet can finally be analyzed at the superordinated plant level.

It is obvious that some of the measures for process intensification that are discussed at the individual levels seem to fit to more than just one level. In particular, changes at a certain level have in most cases a strong impact on the levels "above" (e.g., changes at the phase level imply alterations at the process unit level and the plant level respectively). For the classification of process intensification measures into the individual levels it is essential to identify the level at which the main influence on the process is caused.

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This article is an excerpt from the Ullmann's Encyclopedia of Industrial Chemistry (wiley-onlinelibrary.com/ref/ullmanns) which celebrates its 100th anniversary in 2014. More about the topic can be found in the encyclopedia article on Process Intensification, 1. Fundamentals and Molecular Level. More concept articles on general interest topics in industrial chemistry and chemical engineering can be found on the Ullmann's Academy homepage (onlinelibrary.wiley.com/book/10.1002/14356007/homepage/ullmann_s_academy.htm).

Bayer MaterialScience Says CO₂ Research Delivering Further Successes

Bayer MaterialScience's (BMS) research into carbon dioxide as a new raw material for making plastics is delivering further successes. In laboratory tests, the company has succeeded in significantly further reducing the need for petroleum at precursor level through the incorporation of CO₂. Plastics and their components are normally based entirely on oil. The new process also extends the range of plastics that CO₂ can be used to produce. This is the result of the Dream Polymers research project in which BMS is continuing its activities to find new uses for CO₂.

A technology using the greenhouse gas to produce a key compo-

nent for high-quality foam (polyurethane) is already moving toward commercial use. The proportion of petroleum in this chemical is 80%. "We have now succeeded in reducing the petroleum content for making other plastics to just 60%," says Project Manager Dr. Christoph Gürtler.

Carbon dioxide is used twice in the new process. First, the greenhouse gas is incorporated directly into a new kind of precursor (polyoxymethylene polycarbonate polyol), replacing 20% of the petroleum.

Second, it is also used indirectly, producing a chemical that is also incorporated into the precursor for a further 20% saving in petroleum. "As

a result, the proportion of alternative raw materials is already 40%," remarks Gürtler.

In addition to this, the number of plastics that can be produced using carbon dioxide is increasing. "It is now also possible to manufacture thermoplastic polyurethanes, films and casting elastomers in this way," says Gürtler. Such plastics are used in all kinds of applications, including automotive interiors, cable sheathing and sporting goods such as ski boots.

The researchers have already proved in laboratory tests that the manufacturing process works in principle. "Initial application

tests have been positive," confirms Gürtler, but he adds that there is some way to go before the process is commercially viable.

Dream Polymers is being supported by the German Federal Ministry of Education and Research. External institutions in Germany such as the CAT Catalytic Center, the Leibniz Institute for Catalysis and the Fraunhofer Institute for Chemical Technology are also involved.

As part of its Dream Production project, which has already been in progress for some time, BMS aims to use carbon dioxide as a component for flexible polyurethane foam at the Dormagen site from 2016 onward. ■

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Process Industry in the Liberalized Gas Market

Modern Gas Measuring Technology Safeguards Processes and Machines

The liberalization of the natural gas market is bringing significant changes to private and commercial consumers around the world. Besides greater supply security and long-term benefits from increasing competition, a growing instability of the gas properties in the gas grid is causing difficulties for gas suppliers and in specific areas of the process industry. Here, increased use of modern gas measuring technology can help to prevent adverse effects on products, processes, and machines.



Peter Kienke, Director,
Union Instruments

Natural gas and similar gases such as biomethane (enriched biogas, also referred to as bio natural gas) and mine gas are playing an increasingly major role in the energy supply of households, businesses, and industry. This brings economic and ecologic benefits: natural gas and the renewable gases are future-proof, because large reserves are known worldwide and new ones are being opened up, e.g., by fracking. Gases can be easily transported (using pipelines, natural gas distribution systems, LNG tankers, LNG terminals). Moreover, natural gas has the most favorable environmental balance sheet of all fossil fuels. Additionally, existing gas distribution systems form attractive infrastructures via which households, businesses, and industry can be supplied with gas.

For infeed into the gas grid, the limits on the gas properties are defined by the Wobbe index, which serves as a characteristic quantity. In view of the largely uniform infeed up to now, the permissible limits were seldom violated in either direction in gas distribution systems. This stable condition will change in

the future as a consequence of the liberalization of the gas market at the expense of industrial consumers in particular.

Consequential Liberalization of the Gas Market

In light of its economic importance, the natural gas market has become a subject of policy in many countries. The aim of these policies is largely to increase the security of supply of this energy source through liberalization in the direction of more sources of supply in more countries and through measures such as separating the supply and transportation companies, and simultaneously to make use of free competition for a stable price level at the very least.

These positive aspects are accompanied by difficulties, however: The increasing number of sources of supply for gases of different origin, the increase of LNG fractions, and finally the infeed of bio natural gas and possibly hydrogen from PtG (Power-to-Gas) plants will lead to heretofore unknown spatial and temporal fluctuations of the gas properties and thus the combustion value in distribution systems. This can cause difficulties, however, in some sectors of the process industry, such as glass and ceramics production as well as metal and chemical production, whose production processes are highly sensitive to temperature in some cases. Furthermore, a billing uncertainty arises, in principle, for all consumers with regard to their suppliers, since the gas composition within an agreed upon supply volume and thus the energy supplied and to be paid for can fluctuate.

Temperature-Sensitive Processes and Gas Turbines Affected

In the glass, ceramics, and metal industries as well as in parts of the chemical industry, the product quality, but also the efficiency and pollutant emissions, of the individual processes can be negatively affected by fluctuations in the gas properties of the supplied combustion gas. This effect is intensified by the fact that many systems have already been optimized with regard to important parameters and therefore react

with extreme sensitivity to thermal changes. In some processes, even the shape and size of the flame is an important parameter whose variation has a negative impact on product quality. Many companies have recognized this correlation and have come up with a remedy by installing suitable gas measuring technology in their control systems. It must be assumed, however, that other companies are not yet fully aware of this effect on their processes and products. This issue was recently analyzed in detail, including solution approaches, as part of a research project entitled "Analyses of the effects of gas property variations on industrial and commercial applications".

A similar situation is found in the area of electricity and heat generation by gas engines and gas turbines. These are generally already optimized by the manufacturer for operation with a certain gas quality and, thus, react to changes in gas composition with lower efficiency and increased pollutant emissions and occasionally with vibrations, knocks, and even flashbacks, which can shorten the service life and even destroy the equipment.

Remedy Through Gas Measuring Technology

The liberalized gas market thus poses challenges for certain areas of the process industry that must be solved. One option is the further development of gas burners and gas engines in the direction of greater tolerance of fluctuations in combustion gas properties. Another increasingly used solution approach, however, is the integration of suitable gas measuring technology as a field device in the open- and closed-loop control systems of process plants. This enables combustion gas changes to be detected in a timely fashion and measures to be introduced to prevent damage.

For many decades, combustion calorimeters alone defined the gas measuring technology. These devices – for example, the CWD2005 of Union Instruments – enable direct calculation of the Wobbe index without analysis of the gas composition or other calculation steps. The gas to be measured is combusted and the resulting heat of reaction is, by mixing with a heat transfer medium (e.g., air), transferred to this medium. When a gas volumetric meter and an energy converter is added, these devices determine the amount of energy supplied during a particular time segment. A current example of this is the EMS Energy Measuring System. Combustion calorimeters are easy to operate, require only a moderate investment, and function continuously, which makes them particularly well suited for integration in control systems.

Further analysis methods are now also available. These include gas chromatography, a batch analysis method which is more demanding in terms of operation as well as the purchasing and operating costs compared to combustion calorime-



“With innovative technology, we ensure the custody transfer measurement of the energy content of natural gas.”

ters. Another very progressive analysis method uses selective sensors, often in miniature form, to continuously and automatically determine the concentration of certain gas components. This device class includes the gas analyzers from the INCA device series.

Operators of process-related plants thus have the advantage of being able to select from alternative gas measuring technologies, depending on the task and available budget. All of the mentioned procedures have their specific performance profiles and are suitable for integration in control systems of the process industry. As a result, they provide a means for detecting changes of gas properties in a timely manner during plant operation and thus for protecting processes and machines.

Measuring Technology for all Application Areas

With its modularly designed CWD, EMS, and INCA device series, Union

Instruments is one of the leading providers of devices and systems for analysis of natural gas, biogas, and biomethane as well as process gases of the iron and steel industry.

The continuously measuring CWD2005 combustion calorimeter consists of a base unit, which can be equipped for certain application areas through add-ons and/or special approvals – e.g. for custody transfer measurements, for operation in hazardous areas or for use on oil drilling rigs.

The modularly designed INCA gas analyzers are used particularly in the natural gas and biogas markets. The highly integrated sensors use the NDIR method as well as electrochemical or paramagnetic cells for detection of the components CH₄, CO, CO₂, C₂+, H₂S, O₂, and H₂.

The EMS2005 is used for direct determination of an energy quantity transported during a particular time period. It is approved for custody transfer measurements and is used, for example, by municipal utilities for determining the actual

amount of energy obtained and to be paid for. Development and initial installations of this new technology has been and will continue to be accompanied by the board of weights and measures and PTB (German Institute of Physics and Metrology).

The liberalization of the gas market and resulting instability of gas properties in the gas grid puts new demands on consumers. The related fiscal and technological difficulties can be counteracted through use of modern gas measuring technology. Union Instruments provides suitable devices and systems for this purpose.

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The INCA gas analysis system measures the composition of natural gas – here in a biogas plant in Indonesia.

Gas Properties and Wobbe Index

In principle, combustion gases are defined by their chemical composition as well as pressure and temperature. In the case of natural gas, the composition is dependent on the production area and subsequent treatment processes. In the case of biogas, blast furnace gas, and mine gas, it is dependent on the production process. From the chemical composition, indices such as combustion value, heating value, air requirement, and methane index (index for ignition behavior/knock resistance of an engine during combustion of gas mixtures) are derived. For practical reasons, the important characteristic quantity – namely, the gas properties – is not derived directly from the gas composition but is described using suitable characteristic values. In Europe, this is the Wobbe index, which is the ratio of combustion value to the square root of the relative density of the gas. Actually, an upper and lower Wobbe index is also referred to, depending on whether the combustion value or heating value of the gas is used for the calculation. The functional importance of the Wobbe index lies in the interchangeability of gases in combustion devices: Gases with the same Wobbe index can be used interchangeably – with the same nozzle pressure – without adjustments to the respective burner.

Characteristic value	Combustion gases						
	The Netherlands L-gas	Russia H-gas	North Sea H-gas	Denmark H-gas	Nigeria LNG	Egypt LNG	Bio natural gas (biomethane)
Combustion value [kWh/m ³]	10.3	11.2	11.6	12.1	12.2	11.3	10.6
Relative density	0.646	0.574	0.629	0.630	0.624	0.569	0.587
Wobbe index	12.8	14.8	14.7	15.3	15.5	15.0	13.9
Methane index	86	92	79	73	71	92	103

Permissible Wobbe index range for H-gas according to G 260: 13.9 to 15.7

Source: Gasqualitäten im veränderten Energiemarkt, DIV 2014 [Gas qualities in modified energy market]

Lanxess Expands US High-tech Plastics Production

Lanxess is adding a second production line to its US compounding facility for high-tech plastics at Gastonia, North Carolina in the US. The \$15 million expansion will double existing capacity to 40,000 t/y. Production is scheduled to begin in 2016.

The Gastonia facility produces polyamide and polybutylene terephthalate. Output is earmarked for the automotive industry. "The US is the leading market for high-tech plastics, with the automotive industry at the forefront," said Lanxess Corpo-

ration president and CEO Flemming B. Bjoernslev. Automotive industry sales is at their highest level in almost ten years, Bjoernslev noted. Thanks to rising car production and the trend towards more fuel efficient automobiles, US demand for high-tech plastics is expected to increase by roughly 7% per year through 2020, according to Lanxess.

The investment in Gastonia further improves the balance of Lanxess' polyamide value chain by consuming more caprolactam cap-

LyondellBasell to Build New PO/TBA Plant on US Gulf Coast

LyondellBasell will build a world-scale plant for 900 million lbs (408,000 t/y) of propylene oxide (PO) and 2 billion lbs (about 907,000 t/y) of tertiary butyl alcohol (TBA) and its derivatives on the US Gulf Coast, taking advantage of cheap shale gas-derived feedstock. Initial plans see the new facility going on stream in 2019.

The Netherlands-based company said it expects to sell PO in the global marketplace to meet growing demand for polyurethanes. TBA and its derivatives will be sold to meet

the need for high-octane gasoline blending components as well as for use in manufacturing synthetic rubber and lubricant additives.

"While we have not finalized the exact location of the plant, the abundant natural gas liquids associated with shale gas make the US Gulf Coast an advantaged feedstock region," said Pat Quarles, Senior VP of intermediates and derivatives. "This project combines our leading proprietary PO/TBA technology with low cost feedstock," Quarles added. (dw)

SABIC to Upgrade UK Cracker to Process Ethane

SABIC has joined the growing list of petrochemical producers upgrading their facilities to enable processing of ethane-based light feed in the wake of the US shale gas boom.

The Saudi plastics giant said it will complete the modification of the cracker at its UK Teesside site by 2016. Built in 1979, the facility has capacity for more than 850,000 t/y of ethylene and around 400,000 t/y of propylene. Downstream, it feeds a plant for 400,000 t/y of LDPE.

At nearby Port Clarence, work is already in progress on building

a cryogenic tank as part of an import terminal for the ethane. To facilitate the conversion, SABIC has won funding worth more than £9 million from the UK's Regional Growth Fund (RGF).

Steve Elliott, chief executive of the British Chemical Industries Association (CIA) called the investment "highly significant," adding that "it shows great faith in the UK by one of the world's leading businesses."

Sabic employs 600 people directly and 400 contractors at Teesside. (dw)

Managing Under Pressure

Faster, Safer Designs of Processing Plants in One Environment

Safety is of paramount importance within the petroleum and chemical industries. The aims of safety systems in processing plants are to prevent damage to equipment, avoid injury to personnel, and eliminate the risk of endangering the environment and surrounding community. However, with tight commercial pressures to meet deadlines, every step in the design process is critical to ensure safety and accuracy. Therefore, appropriate sizing, manufacture, assembly, installation and maintenance of pressure-relief valves and rupture disks are critical to achieving optimum protection.



Regis Hugonnard-Roche,
Business Consulting Director, AspenTech

When designing a chemical process and its equipment, safety is a top priority. The main concern for engineers is to plan reliable systems that meet standards while considering safety associated with many diverse types of systems (i.e., pressure vessels, columns, flare stacks, etc.). In particular, over-pressurization of equipment or piping is a major safety concern in a plant.

In order to prevent dangerous bursts, explosions and fires, pressure-relief valves and rupture disks are designed and installed to bleed out excess liquid or vapor causing pressure buildup. Process conditions vary considerably at each location in the process plant where there is a pressure-relief device. Completing a design of a pressure-relief device manually can be a time-consuming and labor-intensive exercise. To solve this problem, cutting-edge engineering software contains relief



sizing, which uses process-simulation data to help automate relief-valve and rupture-disk calculations.

Powerful Tools Relieve the Pressure

Engineers are focused on ensuring that all activities carried out at the plant are performed in a safe and controlled environment with particular focus on over-pressure protection, preventing reactor runaway, implementing control schemes and evaluating flare systems. Safety concerns arise from unexpected deviations from predicted behavior, which cannot be explored effectively with traditional steady-state modeling.

Therefore, the engineer always requires a solution that is rigorous, but also easy to use and will not require rebuilding all the existing models. The engineer cannot afford to lose time building models twice and, therefore, needs dynamic software tools to utilize existing steady-state models to evaluate all areas of the plant without wasting funds.

Key priority areas include maximizing safety without over-designing pressure-relief systems, designing control schemes effectively and having reassurance that the tools used meet the industry standard for reliability. Now engineers can perform relief-device design analysis, sizing and documentation from within the

process simulation, reducing the time spent to complete overpressure protection studies. Dynamic simulation modeling enhances the precision, capability and credibility to develop realistic and reliable solutions for the actual plant system.

Today, advances and innovation in software both within individual disciplines and also in the integration across the work flow creates tremendous value for many companies, resulting in capital and energy savings, increased safety and reliability, as well as optimized designs with dramatic improvements in engineering quality and productivity.

Many companies have turned to AspenTech for improved safety through better operational procedures, control-system design and proper relief-valve and rupture-disk sizing. AspenONE Engineering is an integrated lifecycle solution from conceptual design through plant start-up and operations support enabling users to model, build and operate safer, more efficient and more competitive process plants. Aspen Hysys Dynamics and Aspen Plus Dynamics have been successfully used in basic control studies, advanced control studies, operability studies and safety/hazard and operability (HAZOP) studies. Companies are able to meet tighter product specifications through improved

understanding of plant operability issues, ensure faster and safer plant start-ups, and avoid unplanned downtimes resulting in maximum plant availability and productivity.

Expanded relief-valve design and rating in Aspen Plus and Aspen Hysys make the AspenONE solution more comprehensive. New calculations for the fire scenario account for both changes in latent heat in wetted, mixed component vessels over time and changes in relief loads over rising temperatures in unwetted and wetted situations. Rupture disks can now be sized and rated, and multiple-valve configurations can be explored to better design for non-sizing scenarios with smaller relief loads. Adding to prior methods for compliance with API 520 and 521, the software now also provides calculations to comply with the API 2000, 7th edition for the protection of storage tanks.

Reported benefits using dynamic modeling can generate \$15 mil. savings through improved and faster start-up procedures. The avoidance of over-designing relief systems can achieve \$10 mil. in capital cost savings, improved safety through better operational procedures, better control-system design and proper relief-valve sizing, which delivers enormous benefits. Operators can achieve better design decisions

through detailed analysis of the trade-offs between process operability and process integration.

Working Faster for Safer Solutions

The measure of any safety-relief system is determined by the robustness of the design. Pressure-relief valves must be designed to protect against all eventualities and should be installed to react to these conditions within the operation.

Pressure-relief device design and sizing can be a tedious, lengthy process. When time is precious, managing under tight timescales requires efficiency. Relief-device sizing with leading-edge engineering software allows the user to design a pressure-relief device quickly using the process information at the location of the valve. The tools can also serve as an accuracy check to ensure that safety equipment has been properly rated and will perform properly, if needed. It helps designers complete their work faster, so that safety

equipment can be installed and implemented sooner.

Keeping pace with innovation is essential to remain safe, compliant and competitive. Using dynamic modeling software delivers reliable results, saving time while doing more detailed evaluations and allowing engineers to better simulate potentially hazardous situations, improve design effectiveness and prevent catastrophic equipment occurrences. Equipping engineers with powerful tools relieves the pressure to perform safe, accurate engineering models. It ensures that projects meet standards and that their companies will save equipment, costs and, most importantly, lives.

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Bayer and SCAC in Joint Wastewater Reuse Project in Shanghai

Bayer MaterialScience (BMS) is partnering with Shanghai Chlor-Alkali Chemical (SCAC) to reuse salt water from BMS' polycarbonate production at Shanghai.

In the project, the salt water generated in the polycarbonate process will be converted into high quality salt brine, which will then be used by SCAC to produce chlorine and sodium hydroxide.

The partners will jointly execute a technical installation and trial production program to treat and reuse the salt water from the PC process.

Roland Stegmueller, general manager of Bayer Shanghai, said the project will offer environmental benefits by efficiently using natural resources and avoiding unnecessary impact and will also generate commercial advantages for both parties.

Over the past 15 years, Bayer MaterialScience and Shanghai Chlor-Alkali Chemical said they have increasingly strengthened their cooperation around the supply of chlorine and sodium hydroxide, as well as recycling spent hydro-chloric acid. (dw)

Dow Chemical Awards Jubail EPC Contract to Fluor

Dow Chemical has awarded the engineering, procurement and construction (EPC) contract for its planned reverse osmosis (RO) manufacturing facility at Saudi Arabia's Jubail Industrial City to Fluor.

The plant will be part of a mammoth €15 billion complex taking shape at the site of Dow's Middle East partner Sadara and due to come on stream by the end of 2015. Production units are also planned for LDPE, LLDPE and the polyurethane feedstocks MDI, TDI and polyether polyols.

The RO facility will manufacture high-tech elements that purify water for industrial and drinking uses, including a variety of Dow RO products such as its FilmTech brackish water RO elements and seawater RO elements. Output is earmarked for markets in the Middle East and Africa as well as eastern Europe, Southeast Asia, China and India.

"Fluor has demonstrated extensive knowledge and experience within this field," said Dow Saudi Arabia's president, Zuhair Allawi. (dw)

AkzoNobel Breaks Ground on China Decorative Paints Site

AkzoNobel has broken ground on its new decorative paints site at Chengdu, the capital city of China's Sichuan Province.

The new facility is part of an investment of more than €50 million in construction of new production facilities for both powder coatings and decorative paints. The first phase of the project is scheduled to be opened in 2016, with full operation expected by 2017. The new state-of-the-art plant, which will manufacture the full range of AkzoNobel's decora-

tive paint offerings, will create 100 jobs locally.

The Dutch chemical producer employs more than 7,400 people in China, including 500 in R&D. In 2013, it generated revenues of €1.6 billion, the majority coming from local demand.

Within Sichuan province, AkzoNobel currently operates a regional office, a powder coatings production site and a car refinishes training center. A new powder coatings production site is also under construction. (dw)

Merck Breaks Ground on China Pharma Manufacturing Facility

Merck Serono, the biopharmaceutical division of Merck, held the groundbreaking ceremony for its new pharmaceutical manufacturing facility in Nantong, China. The facility, which will be the group's second-largest pharmaceutical manufacturing facility worldwide, will focus on the bulk production and packaging of Glucophage, Concor and Euthyrox, Merck Serono's brands for the treatment of diabetes, cardiovascular diseases and thyroid disorders, respectively. These medicines are referenced in China's essential drug

list, making Merck Serono the first and only multinational company in China to dedicate a large scale green-field investment to the production of drugs on the list.

The new manufacturing plant is located in the Nantong Economical Technological Development Area (NETDA), in the Greater Shanghai region (Yangtze River Delta area) and represents an investment of €80 million. The construction of the site is scheduled to be completed in 2016, with commercial production starting in 2017. (dw)

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Green Is Clean

Organic and Natural Ingredients — A New Era in Home Care and Personal Care, M&A Affects Market Dynamics



With increasing global environmental consciousness, sustainability is gaining focus across business practices. Europe, especially Western Europe, has positioned itself at the center of the green evolution with high levels of consumer awareness and accountability resulting in better acceptance of green products.

Home-care and personal-care markets are highly consumer-driven and thus susceptible to a high level of dynamism with changing end-user preferences. "Go Green" has become an often repeated tagline, and people are bringing home green products and sustainable practices. Thus, organic and natural products are quickly gaining traction in the home-care and personal-care markets.

Overall sustainability in water usage and waste disposal weigh heavily on home-care products. Harmful environmental effects of many ingredients in home-care products such as detergents and dishwashers are continuously publicized, spiking consumer interest. Rising concerns about environmental pollution and depleting carbon resources drive the public to switch to greener lifestyles that help them reduce their environmental footprint.

Similarly, European consumers are becoming conscious about harmful side effects of synthetic cosmetics and increasingly demand natural products. Thus, increasing adoption of greener end products drives demand for innovative ingredients that are naturally sourced and effectively processed to ensure the same performance attributes of existing synthetic alternatives.

What is the Drive?

- Organic and Natural Ingredients Act as a Source of Innovation — End product

manufacturers are always on the lookout for novelty in ingredients for marketing claims as well as for delivering better performance. Innovations in the personal-care ingredients segment are centered on identifying new sources for active ingredients, and this acts as an incentive for ingredient manufacturers to explore natural sources to support their customers in innovation. The home-care ingredients segment largely directs its research to increasing overall sustainability benefit, and overcoming challenges such as improving compatibility for low-temperature cleaning and enhancing product performance. Naturally derived ingredients such as enzymes are increasingly explored for overcoming these industry challenges.

- Increasing End-User Consciousness of Ingredients** — End users of personal-care products are becoming increasingly interested in and aware of the ingredients in personal-care products through the Internet and personal-

and labels (the implementation of the Cosmos standard) is planned to be completed by 2015; until then ingredients will be accepted under different certifying bodies. After 2015, all new ingredients will be automatically certified under the Cosmos standard.

Current Market Scenario

The total Western European organic and natural ingredients market for home and personal care generated revenues of \$ 659.2 million in 2012.

Higher penetration of organic and natural ingredients in the home care segment is the result of high usage of oleo chemicals such as surfactants and fabric enhancers in home-care products. Enzymes have also made great strides as soil-release agents in home-care formulations. The natural-based active ingredients market for personal care is fast-growing, with huge focus on product innovation. Anti-aging and moisturizing ingredients are the

The natural and organic ingredients market is poised for good growth in the home-care and personal-care markets, at a CAGR of 5.0% between 2012 and 2017.

care magazines. Extensive discussions on social media about the toxic effects of many personal-care ingredients such as parabens have made end users highly conscious of their personal-care purchases. Increasing end-user awareness is gradually increasing customer preference for organic and natural products, as they are perceived as safer alternatives to synthetic products.

What are the Challenges?

- Price Pressures from Commoditized Ingredients** — Cost associated with procurement and processing of organic and natural raw materials into specialty ingredients is higher than that for synthetic chemical-based ingredients, a part of which is transferred to customers. Main cost additions include higher raw materials cost (usually a higher concentration is required than synthetic ingredients to provide the desired efficacy) and operational cost due to the extra downstream processing required to ensure purity and efficacy of natural ingredients.

- Formulation Challenges Restrain Adoption of Natural and Organic Personal Care Products** — Because of processing difficulties and restrictions on processing steps to secure Eco labels, natural formulations sometimes tend to be pasty or coarse and therefore might not match up to the look and feel of synthetic formulations.

Regulatory Overview

With increasing consumer interest in organic and natural products, producers need to enable customers to differentiate truly natural products from the array of self-proclaimed natural and organic products, which do not give a clear indication of the natural/organic content of the product. The logos of many certifying bodies such as Ecocert (France), BDIH (Germany), Soil Association (UK), Natrue and Nordic Swan, among which Ecocert is the most well-recognized, provide a unified identity to natural and organic ingredients and finished products in the home-care and personal-care markets.

The wide array of certifications in the market creates confusion among end consumers and slows the pace of market development. With the aim of harmonizing the different labels into a unified standard for personal care, the Cosmos standard was developed and the guidelines published in January 2011. The effort toward unification of standards

segments with high penetration of natural and organic ingredients, mainly because of high market demand and easy availability of oleo chemical-derived refined glycerin as a natural moisturizing ingredient.

Competitive Landscape

Gone are the times when specialty natural extract companies were the sole suppliers of natural-based and organic ingredients for home and personal care. Intense mergers and acquisitions (M&A) activities with oleo chemical and natural extract companies have enabled specialty chemical companies to gain significant penetration into the natural and organic market space. This has resulted in organic growth of the market and also paved the way for healthy competition. The coming years are set to witness more market consolidation and integration of specialty chemical companies and natural extract companies.

Future — Where is the Market Headed?

The natural and organic ingredients market is poised for good growth in the home-care and personal-care markets, at a compound annual growth rate (CAGR) of 5.0% between 2012 and 2017.

In personal care, anti-aging ingredients are the major focus for most ingredient manufacturers to differentiate and innovate. Initially, the anti-aging ingredients market had been focused on masking or preventing the signs of aging, thereby focusing on consumers older than 40. However, because of increasing beauty consciousness, the over-30 age group is also a target for anti-aging products.

In home-care, surfactants and enzymes are expected to experience maximum growth. End markets such as car care, furniture cleaning and air care, although currently niche applications for organic and natural ingredients, are expected to catch up with the green movement and open up new market opportunities. Moreover, increasing success in developing enzymes stable in liquid detergent formulations is expected to drive the market, as liquid detergents are highly preferred in the European market.

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Home Care Ingredients: Percent Revenue Share of Synthetic vs. Organic and Natural Ingredients, Western Europe, 2012



Fig. 1: Current Market Scenario for Home Care Ingredients

Personal Care Active Ingredients: Percent Revenue Share of Synthetic vs. Organic and Natural Ingredients, Western Europe, 2017



Fig. 2: Future Market Scenario for Personal Care Active Ingredients

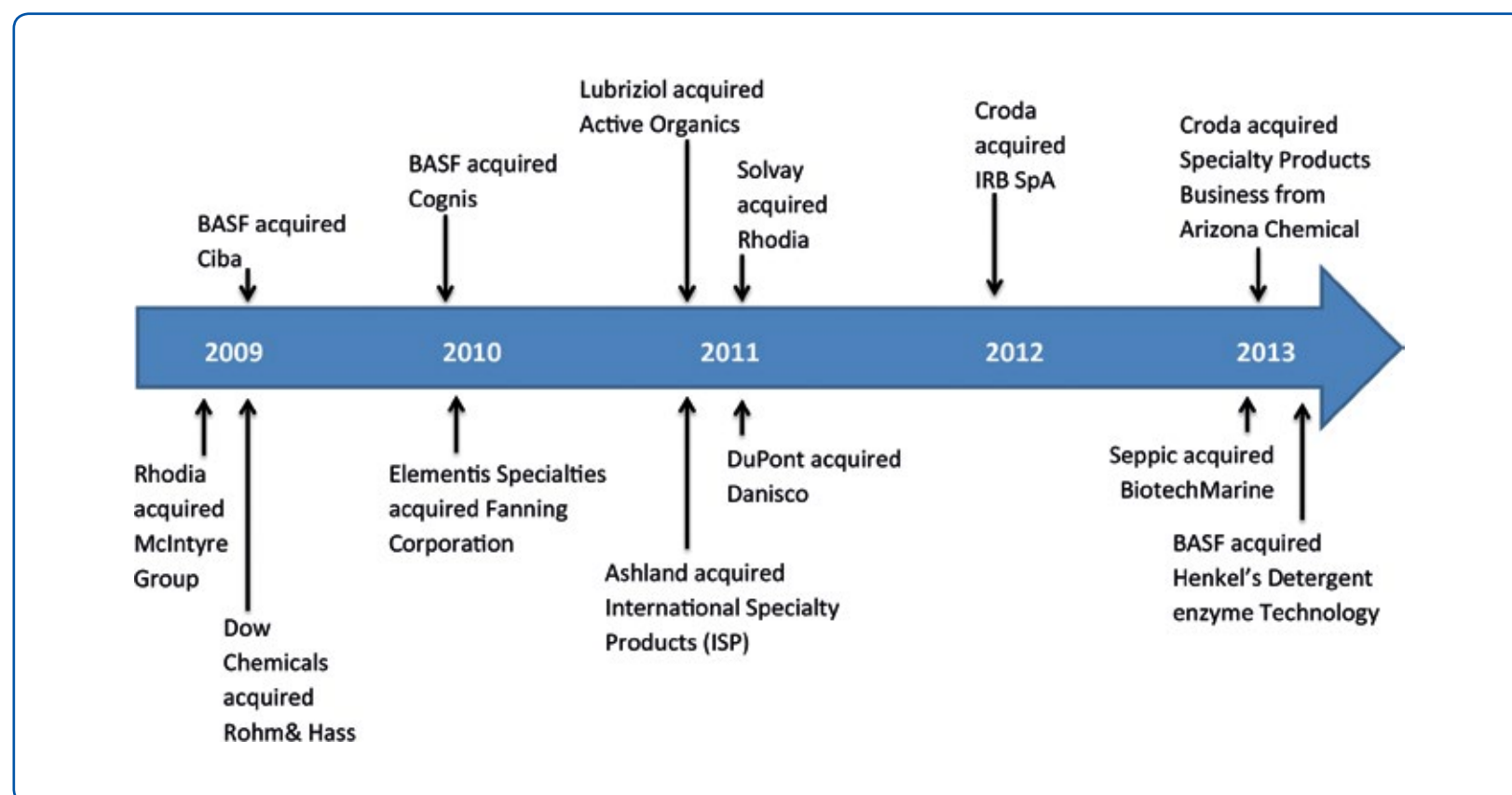


Fig. 3: Competitive Landscape — M&A Impacts Market Dynamics

Creating Value in the New Reality

World Conference on Fabric and Home Care 2014 to Take Place in Montreux, Switzerland

The World Conference on Fabric and Home Care has grown to become the premier international event in the industry. Since 1977, the conference has been held every four years in Montreux, Switzerland. In 2012 it was deemed so essential, an additional conference was held in Singapore and now will be held every two years alternating between Montreux and Singapore.

The conference brings together top-level executives from around the world to discuss global research and perspectives on the technology, products, and business trends of the industry.

This year, the fabric and home care industry returns to the Montreux Music and Convention Center on October 6-9. The city features an expansive history and stunning views of the Swiss Alps and Lake Geneva. In this setting, the World Conference on Fabric and Home Care 2014 will feature some of the most influential leaders sharing their expertise and visions for the future.

Influential Leaders

Attendees can look forward to innovative ideas and presentations



Kasper Rorsted, CEO, Henkel



Michitaka Sawada, CEO, Kao



Itsuo Hama, CEO, Lion



Peder Holk Nielsen, CEO, Novozymes



Kurt Bock, CEO, BASF



H. Fisk Johnson, CEO, SC Johnson

from experts in the fabric and home care industry and beyond. Six CEOs will give their perspectives on challenges facing the industry with keynote presentations from:

- Kasper Rorsted of Henkel
- Michitaka Sawada of Kao
- Itsuo Hama of Lion
- Peder Holk Nielsen of Novozymes
- Kurt Bock of BASF
- H. Fisk Johnson of SC Johnson

Montreux 2014 will also feature 19 executive speakers from Coca-Cola, DuPont, Facebook, Procter & Gamble, Unilever, Walmart, and other international organizations. Sessions will focus on the new reality in the ever-changing industry landscape:

- Sustainability: Realize the balance of economic realities and environmental responsibility.
- Growth: Discover innovations to benefit society.
- Interaction: Harness the energy of the empowered customer and consumer.

New Features

For the first time, Montreux will offer a Technology Showcase. This virtual showcase will highlight the latest research and developments from global industry leaders, government organizations, and academic institutions, though web-based video presentations. Outstanding technical and consumer-led innovation from the industry will be presented with participation from senior technologists and managers. Video presentations are web-based, allowing registered delegates access before, during, and after the conference for viewing at any time.

Also making its debut is the Industry Innovations Incubator, which will feature small companies with cutting-edge ideas and products. Current Innovators include Amyris, Bigheads Network, Cosun Biobased Products, Deino, Institute of Applied Surfactant Research, Revolymer, and Rivertop Renewables.

Azelis Coatings Extends Agreement with Allnex in Germany and Austria

Effective August 1st, 2014, Azelis has extended its co-operation with Allnex, a manufacturer of performance materials for all coating applications. Azelis will now offer the complete range of Allnex liquid resins, additives and crosslinkers across Germany and Austria for selected customers. Previously Azelis only distributed part of the product range in Germany.

Dr. René Manski, Regional Business Manager Azelis Coatings DACH states, "Our dedicated coatings team

will use market and product knowledge, backed by Allnex' technical expertise, to help our customers anticipate market expectations and give them a competitive advantage."

Azelis is now able to distribute high performance waterborne, solventborne and phenolic resins, as well as additives and crosslinkers from Allnex.

The Azelis Coatings Lab will also provide further technical support including formulation and application testing. (mr)

BASF Starts Plant in Kenya

BASF has started up a new plant for concrete admixtures at Mlolongo, Kenya. The facility for which no capacity has been named supplies chemical solutions for new construction, maintenance, repair and renovation of structures among them concrete admixtures, and cement additives.

Up to now, the Ludwigshafen group has been exporting construction chemicals to Kenya from its headquarters in Germany. The new plant will allow it to better meet the increasing demand for construction

chemicals of customers in eastern Africa as it seeks to position itself for the ongoing infrastructure projects in the country.

Graham Dean, country group manager in Kenya said BASF is targeting the ongoing road, rail and airport construction in the country. He added that the plant will strengthen the product portfolio in the region and will meet the demands for multi-story buildings and long lasting infrastructural constructions. It will also increase efficiency and lower production costs. (dw)

Exhibition and Networking

The three-day exhibition of supplies and services available to the fabric and home care industries is an integral part of the World Conference. It will feature more than 45 companies showcasing manufacturing and technological solutions and will be a centralized hub for networking.

Montreux 2014 will feature ample opportunities to network with peers, meet with fellow fabric and home care professionals, strengthen connections and make new contacts; for instance, an Oktoberfest-style reception on Monday, Oct. 6; a luncheon and a post-session reception on Tuesday, Oct. 7; and a dinner cruise on Lake Geneva on Wednesday, Oct. 8, 2014.

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Sustainability: How the Cosmetics Industry is Greening Up

Editor | AMARJIT SAHOTA
President, Organic Monitor, London, UK

Sustainability has come to the fore in the cosmetics and personal care industry. Rising ethical consumerism and the need for resource efficiency are making cosmetic companies – small, independent firms to global giants – take steps towards sustainable development.

Sustainability: How the Cosmetics Industry is Greening Up discusses the growing importance of sustainability in the cosmetics industry, highlighting the various ways organisations can address the economic, environmental and social challenges. How can the cosmetics industry make a difference in terms of ingredients, formulations, packaging, CSR, operations, and green marketing?

Topics covered include:

- Environmental and social impacts of cosmetic products
- Ethical sourcing and biodiversity
- Renewable energy and waste management
- Green formulations and ingredients
- Green marketing issues and consumer behaviour
- Green standards, certification schemes and indices in the cosmetics industry

Industry experts share their experiences on how they are tackling the challenges of sustainability; from raw material procurements, manufacturing, business processes, to distribution and marketing to consumers. The book concludes with some future growth projections; what are some of the shortcomings in sustainability in the cosmetics industry and what can we expect to see in the future?

Sustainability: How the Cosmetics Industry is Greening Up discusses business and technical issues in all areas of sustainable product development, from sourcing ingredients, to formulation, manufacture and packaging. Covering a diverse range of subjects, this book will appeal to professionals in many key sectors of the cosmetics and personal care industry; cosmetic chemists, formulation scientists, R&D directors, policy makers, business and marketing executives. It will also be of relevance to academic researchers working in cosmetic chemistry and sustainable process development.

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Plastic Electronics Manufacturing

Can the Internet of Things Lift This Emerging Industry to the Next Level?

Currently, we do not get around technology presentations without the Internet of Things (IoT) praised as one of the drivers of future growth. There are billions of units of devices used in every part of our private and working life.

These devices will have some kind of input (sensor) including a small portion of logic inside. Further there needs to be a wireless building block enabling the drive to hook up to the net. But what will be the manufacturing business resulting from these new applications? Which technology would allow a required very low cost manufacturing of these devices? It could likely be that Plastic Electronics (or Printed Electronics) will play a major role in this new business due to the enormous cost pressure on the IoT business model.

Electronic Functions Implemented by Organic Materials Instead of Silicon

This has been the vision of technologists and researchers for more than ten years now. Organic electronics are based on carbon (hence the term "organic") and open the door to a world of cheap, flexible devices — in theory. In contrast to the classically silicon-based devices, organic "chips" are not manufactured in extremely capital-intensive semiconductor wafer fabs with sophisticated and expensive lithography machines, with dozens of consecu-

tive processing steps of exposure, deposition, removal, patterning and so on. Silicon-based devices are manufactured in cleanrooms meeting extreme requirements whereas organic electronic circuitry, at least according to the vision of scientists, can be produced quick and easy in simple printing processes, much like today's inkjet printers we encounter in many office environments.

This used to be the vision of plastic electronics protagonists. However, it turned out to be much more difficult to actually produce operating devices that could be used in real-world applications. Now, after many years of intensive research, it seems like the polymer electronics (another term for the same thing) is gradually reaching a point where researchers can start discussing questions of manufacturability, where business joins science. This rating is reflected in the program of the upcoming Plastic Electronics Conference 2014 (PE2014), one of the most important meetings of the organic electronics scene in Europe. As part of the Semicon Europa 2014 event in Grenoble, PE2014 brings together experts and practitioners of both — the traditional silicon-based technology as well as the proponents of polymer-based electronics. And this is what makes this event so interesting for applications for the IoT.

In 2014 the level of maturity reached by organic and large area electronics, or plastic electronics in general, shows a clear and important shift from the research level to industrial relevance. Mass manufac-



turing of applications in areas such as OLEDs for display and lighting, flexible photovoltaics and organic and hybrid based integrated smart systems, has definitely become reality and is projected to expand very rapidly in the consumer market sector, as well as in other markets, such as healthcare, automotive, home and industrial manufacturing. The real opportunities and challenges in organic and large area electronics are in the co-integration of proven

semiconductor technology and plastic electronics into new applications and products with higher functionality at a lower price-point.

Heterogeneous Integration

Heterogeneous integration is an important enabling technology to achieve the performance levels that are needed and to facilitate commercialization — or in other words "to choose the best of two worlds".

By joining forces and overcoming the challenges of electronic co-design and manufacturing, commercialization can be accelerated and solutions which are meeting the needs from today's applications for the mass market can be developed.

Meeting Point of the Organic and Semiconductor Worlds

Fiddian Warman, who is the founder and managing director of SODA, a

company developing creative tools that help schools, communities and businesses to work, play and learn together, will give the first keynote at the conference. John Heitzinger, president of Soligie will, in a second keynote, elaborate about Advances in Additive Manufacturing of Electronics. Soligie is a company that provides custom, robust, repeatable manufacturing solutions for printed electronics by leveraging multiple printing platforms and a deep materials knowledge and experience.

The conference will further have high level speakers looking into business cases, manufacturing aspects, materials and technologies of the plastic electronics industry. The list also includes the following companies and organizations: Applied Materials, Arizona State University, Arkema, Beneq, CEA, CEA LITEN, Corning, DuPont Teijin Films, European Commission, Fraunhofer IZM, Ghent University, imec, ISORG, Joanneum Research Forschungsgesellschaft, Philips Research, Robert Bosch, Roth und Rau, STMicroelectronics, Sunchon National University, Universal Laser Systems, University of Cambridge, Valeo, VTT, Ynvisible and Yole Développement.

With 400 exhibitors Plastic Electronics Conference and Semicon Europa will take place from 7-9 October, 2014 in Grenoble/France. 4,000 visitors from more than 40 countries are expected to join the event.

► www.plastic-electronics.org

Progress with Printed Electronics

Enabling Technologies for Consumer Goods and Healthcare Applications

Printed Electronics is an old embryonic technology. It is an umbrella term used to describe electronics that can be flexible, printed and/or based on organic materials. It consists of a wide range of enabling technologies, each at different points of maturity, growth and development.

Among others, printed electronics technologies are used for components in consumer goods and healthcare applications like displays, power and other components such as logic, sensors, and conductive inks.

Display Applications

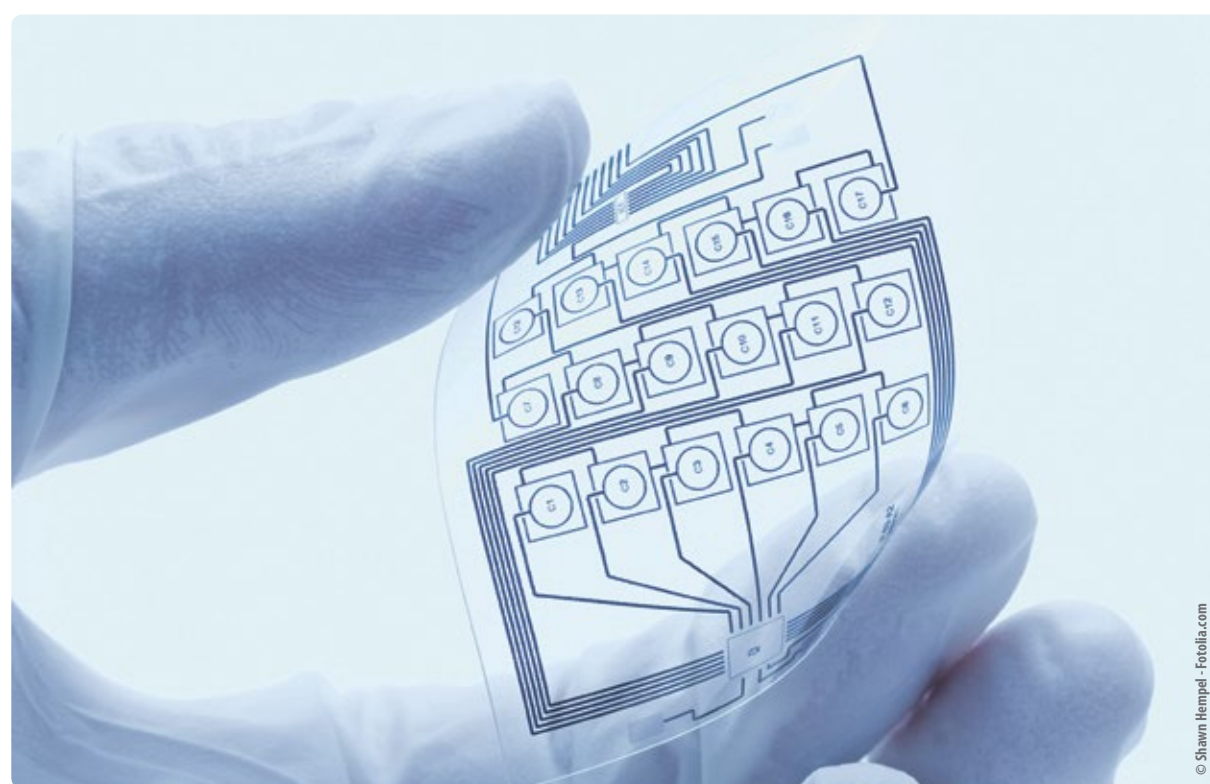
AC Electroluminescence Displays

AC Electroluminescent Displays are simple, screen printed light emitting displays that require an AC power source. They are built of low cost, light emitting segments that can be relatively thin and conformable.

Examples of cases studies include moving images on labels for rum and whisky promotional bottles, as well as boxes and other promotional off-package signage (posters etc.). EL displays are also widely used on wearables such as promotional/novelty T-shirts.

Electrochromic Displays

Electrochromic (EC) displays are very simple, screen printed structures, characterized by low power consumption. They are low cost reflective displays that have been used in promotional material such as gift cards and magazine covers. Beyond those, it's mostly been prototypes so far, such as displays for smart cards, gift cards etc. Holding it back is the



limited choice of colors but chemical companies are working on a broader color range which will enable more applications.

Electrophoretic Displays

Electrophoretic displays (EPDs) have been extensively used in e-readers such as the Amazon Kindle, but this is a market that is currently in decline as consumers opt for color LCD versions. Consumer goods and healthcare applications have seen e-paper displays as one-offs in magazines, POS posters, in products such as key fobs, memory sticks, locks etc. These have been fairly niche applications so far, but technology developers are looking to push further adoption in these markets due to the slow-down in the e-reader space. In addition, there is work on color versions, with striking red recently demonstrated along with grayscale.

OLED Displays

OLED Displays are light emitting. They can be flexible and printed but are currently mostly made by vacuum processes. Printing is possible and extensively researched but not in commercial products yet. The materials are light emitting materials characterized by low power consumption and excellent color range but are still very expensive.

Best known is their use in smart phones and televisions: OLEDs are already a \$15.7 billion market in 2014 for cell phone displays, OLED TVs were launched in 2013. In the CPG space there have been very limited demonstrations. Drawbacks for further adoption beyond consumer electronics include:

- Costs are still high, approx. \$30 for a cell phone display including backplane.

- Lifetime for flexible versions is very poor unless a large amount of money is spent on good flexible barriers (which cost more than glass)
- Focus is to make high volume, high margin products like consumer electronics for now to recoup high R&D spend rather than low margin products.

Power Applications

Printed Batteries

Thin film batteries — usually MnOZn chemistry when printed (but rigid, lithium ion solid state versions are also available) are very important components since all devices need a power source which needs to be safe and as "green" as possible. Skin patches and audio paper/recording gift cards have been successful applications. In particular, in a skin

patch the battery puts a voltage potential over the skin so that the pores open up and cosmetic goes in about 10 times more quickly — used for fast anti-wrinkle treatments.

Costs are a few tens of cents each in low volume. Lifetime and power output are not as good as a coin cell — if a coin cell can be used, it probably will be preferred over the form factor benefits of a thin film cell until volume sales are achieved. Driving applications are the need for thin, flexible batteries such as in wearable electronics.

Photovoltaics, OPV & DSSC

In the photovoltaics space, Organic PV and dye sensitized solar cells (DSSCs) can perform optimally in indoor applications (i.e. lower levels of light intensity) where other PV technologies can struggle. Companies are pursuing these to power electronic shelf edge labels to signage, as they work well at low light levels and the solar cell can be designed around the bezel and even colored to look better than conventional PV cells. Reducing costs and optimizing lifetime and efficiency remain the biggest challenges for these technologies so far.

Wireless Power Transfer

Wireless Power e.g. via NFC would remove the power source cost component which would enable smart packaging features at lower costs. Demonstrations such as interactive packaging that is powered wirelessly via induction have already been showcased.

Other Components

Logic

Printed or organic low cost, low transistor count devices would satisfy the needs for logic required for many mainstream applications. There has been efforts to print RFID tags but

although these have been demonstrated, they are not commercial yet. The industry is working on many product prototypes and smart packaging concepts such as winking gift cards, interactive bottle labels with LED lights, or printed time temperature indicator labels, incorporating printed memory, logic, temperature sensors, battery and display.

Conductive Inks

The application here is printed ink for simple conductors, resistors, capacitors and heating elements. Innovations include printed conductors on a card that can be "read" by a multi touch screen and launch a program or smart shelves to monitor stock units. Costs are variable depending on the device made, and many devices today are hybrid devices, with several very different technologies integrated, where ink is not the dominant cost.

Sensors

The biggest success has been glucose test strips, a multi-billion dollar market that uses printed conductor electrodes on each strip. Beyond that there are many other types of sensors coming to market. Demonstrators/prototypes are available such as motion sensors that detect someone's presence, or temperature sensing.

Many of the products mentioned here will be showcased at the forthcoming Printed Electronics USA 2014 trade show and conference on November 19-20 in Santa Clara, California, USA.

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EVENTS

29th EU PVSEC 2014, 22–26 September, Amsterdam, The Netherlands

The European Photovoltaic Solar Energy Conference and Exhibition features 1,500 presentations from 71 countries which cover the entire scope of innovations in PV technologies, applications, markets and policies. Within the framework of this event the 4th edition of the Special Session Photovoltaics | Forms | Landscapes will take place on 24 September. This series of annual events serves as a discussion framework to investigate new phenomena associated with the rapid spread of large photovoltaic systems. The upcoming edition wants to demonstrate the “Beauty and Power of Designed Photovoltaics” and presents concepts for making PV systems a new cultural experience which enhances the relationship between the citizens and the energy environment.

► <https://www.photovoltaic-conference.com/>

EPCA 2014 Annual Meeting, 4–8 October 2014, Vienna, Austria

The annual meeting of the European Petrochemical Association (EPCA) provides a platform for the global chemical business community to network, discuss collaborations and developments and hear from an impressive line-up of world-class speakers. Participants have the opportunity to network with peers and discuss business development opportunities. The list of eminent speakers includes Prof. Joseph E. Stiglitz, Nobel Laureate and Economics Professor, Xavier Sala-i-Martin, Chief Economist & Senior Director at the World Economic Forum, Patrick Thomas, CEO at Bayer MaterialScience, and Graham van't Hoff, Executive Vice President at Shell Chemicals.

► <https://epca.eu/annual-meeting-workshop>

OpEx 2014, 14–15 October 2014, Abu Dhabi, UAE

Operational Excellence in Oil, Gas & Petrochemicals (OpEx) focuses on the topic of Operational Excellence for the Oil, Gas and Petrochemicals sector. It will include a new emphasis on corporate strategy excellence, sustainability and safety, as well as the “People”, “Assets” and “Technology” themes covered in last year's event. Companies are increasingly aware that to survive and thrive, operational excellence must become a way of life. The conference will provide a platform for sharing best practices and staying up-to-date with current thinking from the leading industry players and will present practical ideas for implementing excellence strategies.

► <http://www.eurochem.com/en/opexmena14>

Science Driving Consumer Protection: How Plastics Deliver, 20–21 October 2014, Berlin, Germany

Under the title “Science Driving Consumer Protection: How Plastics Deliver”, PlasticsEurope will hold a scientific conference to provide insight on how industry, authorities and research institutes address, deliver and cooperate in the area of science and research behind consumer protection. The event will gather key speakers from the public authorities, health agencies, academia and the industry to cover a wide array of burning topics be it on food contact materials, drinking water, indoor air quality, and cosmetics packaging.

► <http://www.plasticseurope.org>

Biocides, 10–12 December 2014, Vienna, Austria

The conference focuses on key aspects of Regulation (EU) No. 528/2012 concerning the approval of active substances and authorization of biocidal products. Presentations will include the latest developments from the European Commission and EU authorities on the core procedures and features of this nascent legislation. Besides details of this complex law, speakers will address topics such as nanomaterials, the impact of the CLP Regulation, and fees. The program also includes views of the regulatory scene in the US and Turkey. Two half-day workshops on topics of key interest will follow the conference. The first workshop focuses on efficacy testing for disinfectants and preservatives. The second workshop looks at efficient use of R4BP.

► <http://www.europeanbiocides.net>

CESIO, 1–3 June 2015, Istanbul, Turkey

The 10th CESIO congress will showcase an extensive scientific program on the main theme “Surfactants in a Globalising World — Creating new Possibilities”. In addition, business convention facilities will be offered to all participants and their companies to do business effectively and efficiently. Sessions, posters and exhibition will cover the scientific, economic, technical, as well as safety and regulatory aspects of surfactants and surfactant applications in the industry and consumer products. CESIO provides a good opportunity to meet with key contacts along the surfactant value chain to exchange information associated with technical, application and regulatory matters on the basis of the functionalities of surfactants.

► <http://www.cesio-congress.eu>

CPhI Worldwide 2014

With 30,000 senior pharma professionals from 140+ countries attending and 2,200 exhibitors presenting pharmaceutical ingredients, excipients, APIs, finished dosage forms, contract services, packaging, machinery and more in 20 dedicated zones, CPhI Worldwide is the leading pharma sourcing event. The annual trade show including concurrent exhibitions ICSE, P-MEC Europe and InnoPack will return to Paris Nord Villepinte on 7–9 October, 2014.

Pharmaceutical ingredients businesses that are divided into different zones on the show floor cover APIs, fine chemicals such as pharmaceutical intermediates, regulated fine chemicals, natural extracts, biopharmaceuticals, excipients, and services such as formulation or

Custom Manufacturing and exclusive synthesis.

Comprised of modules on the latest and hottest topics in the industry, the Pre-Connect Congress offers an opportunity to meet senior executives and influential speakers from across the pharma industry.

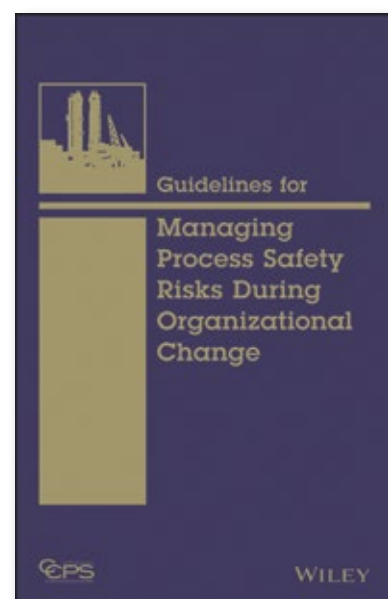
At an extra meeting place between exhibitors located on the show floor, speakers will educate the industry about products, services, new launches, innovations and news in over 100 free seminars.

CPhI Worldwide and co-located ICSE, P-MEC and InnoPack will also present a new series of Pharma Insight Briefings comprising in-depth sessions on regional updates and specialist topics.

► www.cphi.com

Managing Process Safety Risks

An understanding of organizational change management (OCM) — an often overlooked subject — is essen-



tial for successful corporate decision making with little adverse effect on the health and safety of employees or the surrounding community. Addressing the myriad of issues involved, this book helps companies bring their OCM systems to the same degree of maturity as other process safety management systems. Topics include corporate standard for organizational change management, modification of working conditions, personnel turnover, task allocation changes, organizational hierarchy changes, and organizational policy changes.

► Guidelines for Managing Process Safety Risks During Organizational Change
Center for Chemical Process Safety (CCPS)
John Wiley & Sons
Price: \$102.95
ISBN: 978-1118-379097

Handbook of Chemical and Biological Plant Analytical Methods

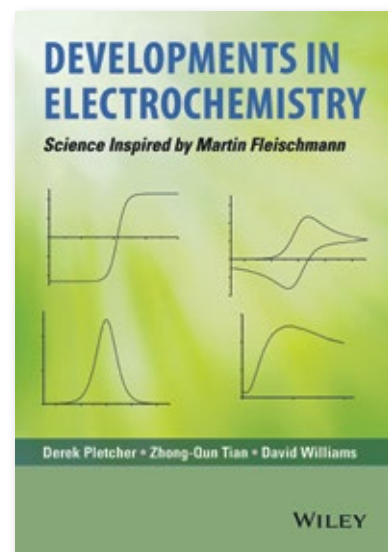
Plants and plant-derived compounds and drugs are becoming more and more popular with an increasing numbers of scientists researching plant analysis. The quality control of herbal drugs is also becoming essential to avoid severe health problems, and in the future many more new drugs will be developed from plant sources. This three-volume Handbook, featuring 47 detailed review articles, is unique as it deals

with chemical and biological methodologies for plant analysis. Its aim is to present the most important and most accurate methods which are available for plant analysis.

► Handbook of Chemical and Biological Plant Analytical Methods
Shilin Chen, Andrew Marston, Hermann Stuppner
John Wiley & Sons
Price: 640,- Euro
ISBN 978-1-119-95275-6

Developments in Electrochemistry

Martin Fleischmann was truly one of the ‘fathers’ of modern electrochemistry having made major contributions to diverse topics within elec-



trochemical science and technology. These include the theory and practice of voltammetry and in situ spectroscopic techniques, instrumentation, electrochemical phase formation, corrosion, electrochemical engineering, electrosynthesis and cold fusion. While intended to honour the memory of Martin Fleischmann, Developments in Electrochemistry is neither a biography nor a history of his contributions. Rather, the book is a series of critical reviews of topics in electrochemical science associated with Martin Fleischmann but remaining important today.

► Developments in Electrochemistry
Derek Pletcher, Zhong-Qun Tian, David Williams
John Wiley & Sons
Price: 87.90 Euro
ISBN: 978-1-118-69443-5

PEOPLE



Gordon Sangster

Gordon Sangster has joined Codexis, a developer of biocatalysts for the pharmaceutical and fine chemical industries, as Senior Vice President & Chief Financial Officer on August 18, 2014. He will manage all aspects of Codexis' financial and accounting functions and will report to President & CEO John Nicols. Prior to signing with Codexis, the native of Edinburgh, Scotland, has served as CFO at multiple public and private life science companies for the last fourteen years, most recently at Nitinol Devices & Components. Prior to that role, he was CFO of ITC Nexus-Dx, Micrus Endovascular, HemoSense, and AP Pharma, respectively.

Dr. Susan Turner has joined BioConsortia as Senior VP Research & Development effective August 15th 2014. Turner has more than twenty years of research experience in the field of applied microbiology, beginning her research career at the University of Auckland, from where she holds a PhD in Biological Sciences. She was one of the founding scientists of biotech startup ZyGEM. Another addition to BioConsortia's executive team is Christina Huben as Senior VP Operations & Administration. Huben has over twenty years of business and legal experience, having worked at the New York law firm Breed Abbott & Morgan, followed by senior roles at EnviroSource, Chemtura, AgraQuest and Bayer CropScience. Most notably, Huben was a driving force on the leadership team at AgraQuest, instrumental in delivering many of the collaboration agreements and helping lead the transformation of the biopesticide industry, culminating in the company's acquisition by Bayer CropScience in August 2012.



Luis López-Remón


Luis López-Remón is heading the business unit Leather of Lanxess since July 1, 2014. He succeeded Markus Eckert, who is now fully concentrating on his role as head of the group function Corporate Development (DEV). López-Remón was born in Spain in 1957 and studied economics at the University of Wuppertal, Germany. He began his professional career in 1984 at Pall and worked for Air Products and Chemicals between 1986 and 2003. López-Remón joined Bayer Chemicals as head of Regional Coordination in 2003. From January 2004 until the end of 2006, he headed up Lanxess' Textile Processing Chemicals business unit and since 2007 was head of the Rubber Chemicals business unit.



Dr. Jens Oldendorf


Dr. Jens Oldendorf has joined WeylChem International on August 1 as global director sales and marketing Advanced Intermediates and Reagents (AI&R). He holds degrees in business, economics and a PhD in chemistry. Oldendorf (40) has many years of experience in the global chemical industry. He previously worked at Solvadis as head of business unit solvents and prior to that spent more than ten years at BASF in different marketing, sales, purchasing and communication roles. At WeylChem he will be responsible for the marketing and sales of line products manufactured at several WeylChem Companies across Europe and the US.

Jeff Testerman has been appointed to the position of senior sales representative at Emerald Specialties Group, a business group of Emerald Performance Materials. Testerman has 20 years of experience in the graphic arts and coatings segments, where he served in both sales and technical roles. He comes to Emerald from IGM Resins, where he was a technical sales account manager. His previous experience also includes his work as technical sales manager at EMS-Primid and product development manager of UV/EB inks & coatings at Handschy Industries. Testerman holds a B.S. in Chemistry from Austin Peay State University.



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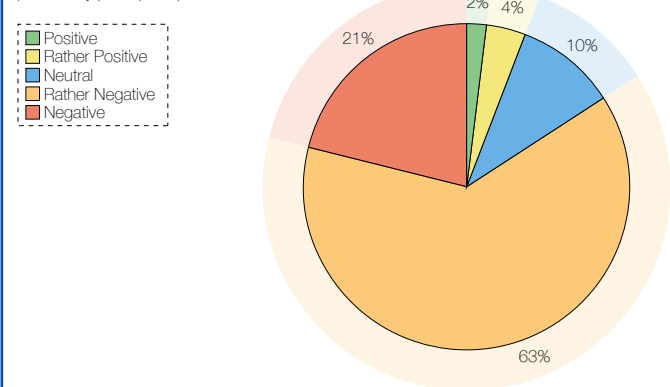


NÜRNBERG MESSE

Impact of American Shale Gas Boom on Europe's Chemical Industry

Impact of North American shale gas on European chemical operations

(% of study participants)



Source: Shale Gas Study, Stratley AG, a subsidiary of KPMG AG Wirtschaftsprüfungsgesellschaft © CHEManager International

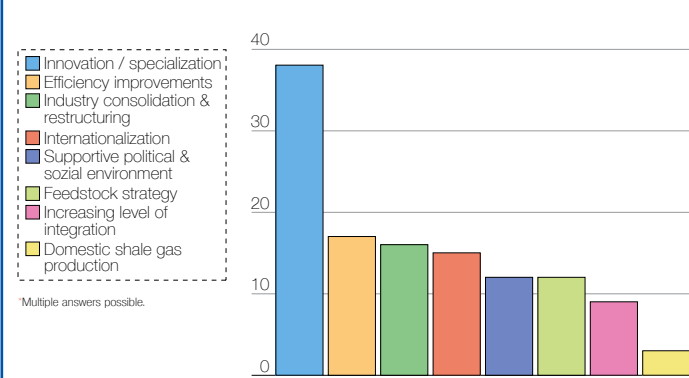
Fig. 1

Rough Times

The North American shale gas boom is a major topic for managers in the European chemical industry and is expected to cause substantial competitive disadvantages for the European business. According to a recent study conducted by Stratley among 60 operations executives and top managers from over 30 companies in Europe, more than 80% of the participants believe that North American shale gas will have negative impacts for the European chemical industry (fig.1). Furthermore, they believe that the European petrochemical and basic chemicals industries face particularly rough times. Expected scenarios range from the closure of individual assets to a drip by drip erosion of the entire petrochemicals and basic chemicals industries.

Strategies to cope with increasing competition

(% of study participants)



Source: Shale Gas Study, Stratley AG, a subsidiary of KPMG AG Wirtschaftsprüfungsgesellschaft © CHEManager International

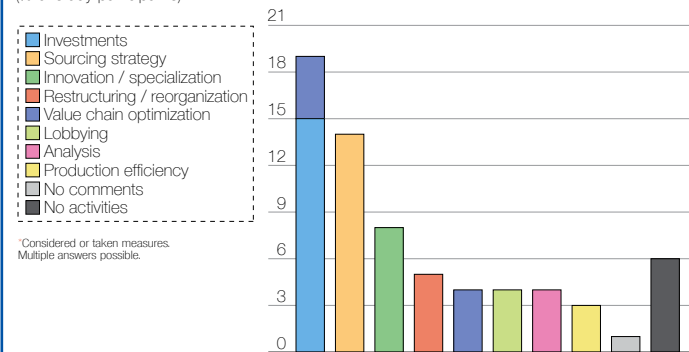
Fig. 2

Survival Strategies

A considerable number of the interviewees demand a more active approach to changes in global competition and call for stronger use and expansion of the European chemical industry's strengths. Differentiation through specialization and innovation is at the top of manager's lists (fig. 2). This includes more emphasis on specialties but has also to do with processes, services and business models which drive differentiation and help increase competitiveness. After differentiation, increasing efficiency is the next most important topic for managers. The objective is to reduce costs — through improved processes, less material and energy inputs, optimized processing. A continuing trend toward clusters and Verbunds within the regions is also expected.

What measures has your company already taken due to North American shale gas?

(% of study participants)



Source: Shale Gas Study, Stratley AG, a subsidiary of KPMG AG Wirtschaftsprüfungsgesellschaft © CHEManager International

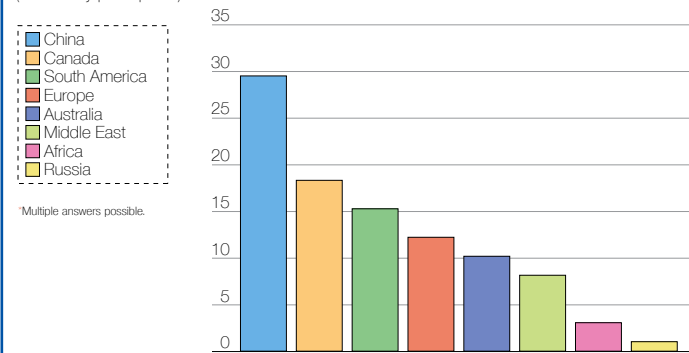
Fig. 3

Strategic Measures

The position of a company in the value chain influences the activities it pursues as a reaction to shale gas. Those who are directly impacted by the shale gas boom are trying to participate in the attractive North American production conditions — where possible. Upstream companies are investing — either in North America to convert crackers to use ethane as a raw material, or in Europe to facilitate access to less expensive raw materials. Both courses of action aim to ensure competitiveness in ethylene (fig. 3). Other investments at European petrochemicals sites aim to optimize product output or forward integration to improve value creation. This applies in particular to monomers. Besides the raw material costs, investments in new as well as existing plants and assets are necessary.

Which countries/regions will become the next main producers of shale gas?

(% of study participants)



Source: Shale Gas Study, Stratley AG, a subsidiary of KPMG AG Wirtschaftsprüfungsgesellschaft © CHEManager International

Fig. 4

Next Major Producers

European Managers feel that other regions have progressed further in developing fracking technology and implementing it in commercial scale extraction. China is seen as the next major producer of shale gas (fig. 4) mainly due to resource size, political supports and high energy dependence on coal. However, it is unlikely that the North American shale gas boom can simply be copied because of the challenging geological formations combined with the lack of infrastructure in China. Together with China, Canada and South America will initiate large-scale shale gas production. In the interviewee's opinion, Australia is, as yet, behind Europe due to its large conventional gas reserves. The Middle East and Africa are expected to follow later on.

Red Flags Raised on Fracking Fluids

As the oil and gas drilling technique called hydraulic fracturing (or "fracking") proliferates, a new study on the contents of the fluids involved in the process raises concerns about several ingredients. The scientists who presented the work at the 248th National Meeting & Exposition of the American Chemical Society (ACS) said that out of nearly 200 commonly used compounds, there's very little known about the potential health risks of about one-third, and eight are toxic to mammals.

William Stringfellow, PhD, said he conducted the review of fracking contents to help resolve the public debate over the controversial drilling practice. "As scientists, we looked at the debate and asked, 'What's the real story?'" Stringfellow said.

To find out, Stringfellow's team at Lawrence Berkeley National Laboratory and University of the Pacific

scoured databases and reports to compile a list of substances commonly used in fracking. They include gelling agents to thicken the fluids,



biocides to keep microbes from growing, sand to prop open tiny cracks in the rocks and compounds to prevent pipe corrosion.

What their analysis revealed was a little truth to both sides' stories — with big caveats. His team found that most fracking compounds will require treatment before being released. And, although not in the thousands as some critics suggest, the scientists identified eight substances including biocides that raised red flags. These eight compounds were identified as being particularly toxic to mammals.

They're also looking at the environmental impact of the fracking fluids, and they are finding that some have toxic effects on aquatic life.

In addition, for about one-third of the approximately 190 compounds the scientists identified as ingredients in various fracking formulas, the scientists found very little information about toxicity and physical and chemical properties. "It should be a priority to try to close that data gap," Stringfellow said.



Trend sport — Stand-Up-Paddling (SUP) is the fastest growing water sport in the world right now. No wind or waves required, one stands on a longboard and uses an elongated paddle to propel oneself through the water. What may look like a sightseeing cruise is actually real physical work-out and a great way to improve one's core strength and balance. Altugas, a subsidiary of Arkema, has developed a high-performance acrylic resin that is used by BIC Sport for the manufacture of SUP boards. The Altugas HF110 UVP10 PMMA resin, intended for co-extrusion on ABS, gives a high gloss surface finish with great depth of color. It protects the underlying layer of ABS and offers the optimum trade-off between resistance to shocks and scratches and climatic ageing, giving the SUP board an exceptional stability of appearance.

Coming Up in the October issue of CHEManager International

- Today's Realities and Tomorrow's Visions: How Pharma Can Overcome Today's Challenges and Successfully Commit to Innovation Again
- A Reliable Supply of Medications: The International Society for Pharmaceutical Engineering, ISPE's Drug Shortages Prevention Plan
- Safe From The Start: How Pharmaceutical Excipient Suppliers and Users Can Secure Their Supply Chain and Save Audit Costs
- Pharma Market USA: A Safe Place to Undertake Research, the USA Draw the World's Most Innovative Pharma Companies
- Safer, Greener and More Efficient: High-tech Materials Revolutionize Future Mobility and Transportation Concepts
- Taking Center Stage: Structural Adhesives Help the Automotive Industry to Integrate Lightweight Materials
- Opportunities vs. Hurdles: Polycarbonate Compounds in Automotive Glazing Applications

Don't miss the Pharma and Plastics Double Feature in the October issue of CHEManager International. Hot off the press on October 2, 2014.

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