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Cheap oil gives scope to chemical companies to help cut production costs

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THE NEWSPAPER FOR THE
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LIFE SCIENCE MARKETS

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Recent developments and current trends in the chemical plant manufacturing industry

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Harvest Season

After a Period of Intensive Investments, Perstorp Enters Next Development Phase

Perstorp has been a well-known name in chemistry for over 130 years. Founded in 1881 as a producer of acetic acid and later formalin, the Swedish company went through an eventful 20th century. In the past two decades, Perstorp has gone through some ownership and portfolio changes and, today, is focusing on specialty chemicals for the coatings & resins, plastics, feed & food, fuels and synthetic lubricants markets. Having joined Perstorp as President and CEO in September 2013, Jan Secher is leading the company, which reported 2014 revenues of € 1.2 billion, through its next stage of development. Michael Reubold spoke with him about the most recent developments and his future growth strategy for Perstorp, his experiences from prior engagements, and his views about sustainability and the chemical industry's public image.

CHEManager International: The most recent period at Perstorp is characterized by significant investments and the development of sustainable products. Could you briefly update us on the current situation of the company?

J. Secher: We are currently concluding a very interesting phase in which we have been investing quite heavily in certain areas of our technology portfolio. During this four- to five-year period we have invested in round numbers 200 million euros – firstly

into our caprolactones capacity and product development, secondly into a new plant for neopentyl glycol in China that we started up a year and a half ago, and thirdly into our new butene-based oxo platform in Stenungsund in Sweden with significantly increased capacity for high-performance cost-effective plasticizers, but also other products like 2-propylheptanol or valeric acid for other key application areas such as surfactants and synthetic lubricants. This investment into oxo chemicals is the single-largest investment in

the history of Perstorp and opens up a new platform for us, in parallel with the others that we have.

So, we are concluding this quite intensive investment period and moving on into a period of reaping the fruits from those investments. So from a CAPEX point of view we sort of passed the peak and are entering into more of a cash-generative period going forward.

You said that you are now entering into a cash-generative period. What is your strategy to lead Perstorp through this next phase?

J. Secher: Given that we have invested as much as we have over this four-, five-year period, the focus now is definitely on organic growth. In parallel with these investments we have done smaller bolt-on acquisitions. For instance, in 2011, we bought the pentaerythritol business from Ashland in the US, and last year we acquired the penta and calcium formate businesses from Chemko in Europe.

Continues Page 4



Jan Secher,
President and CEO, Perstorp

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NEWSFLOW

M&A-News:

Alexion is paying \$8.4 billion to acquire its compatriot Synageva.

Monsanto is set to press ahead with the targeted takeover of Syngenta.

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Pharma:

Johnson & Johnson plans to seek regulatory approval for more than 10 new drugs up to 2019.

Actavis will have to continue selling its Namenda IR drug for treatment of Alzheimer's type dementia.

More on Page 7

Investments:

Perstorp has inaugurated its new oxo plant at the Stenungsund site in Sweden.

W.R. Grace and Chevron plan to invest \$135 million in a hydroprocessing catalyst plant and additional alumina facility in the US.

More on Pages 17 and 18

People:

Wayne T. Smith has been appointed chairman and CEO of US-based BASF Corporation.

More on Page 23

DuPont Wins Battle with Activist Shareholder

DuPont has emerged bloody but apparently unbowed from its battle with activist shareholder Nelson Peltz and his \$11 billion hedge fund Trian Fund Management, which owns an estimated 2.7% of the US chemical group's capital.

Preliminary results from the DuPont annual general meeting on May 13 indicated that shareholders approved all 12 of management's candidates, while Peltz and his nominated candidates fell short.

The Trian principal had sought four seats on the DuPont board, including one for himself. He had proposed to split the company, while cutting costs, increasing efficiency and improving corporate govern-



Ellen J. Kullman, CEO, DuPont

ance. This had raised fears within DuPont that the moves would destroy its innovation platform.

Reports said DuPont management had unsuccessfully tried to broker a compromise earlier this year, by nominating one of Trian's board candidates although not Peltz himself.

In the end, commentators said the victory, though narrow, was nevertheless a huge one for DuPont's board and CEO Ellen Kullman.

According to some reports, retail shareholders – who hold about a third of the company's capital – rather than institutional investors voted overwhelmingly for the DuPont slate. Analysts said, however, that Kullman's open dialog with big shareholders, including Vanguard, State Street and BlackRock, was instrumental in the win.

Ahead of the meeting, two proxy advisory firms, including Institutional Shareholder Services (ISS) and Glass Lewis & Co, had backed one or more of the Trian-proposed candidates.

DuPont said it spent \$15 million on its shareholder campaign, with Trian's cost for the battle pegged at slightly more than half that. In a statement, Trian said, "We are proud of the role we played as a positive change agent at DuPont. (dw) ■

BASF to Sell Businesses to Siegfried

BASF has announced that it will sell its custom synthesis business, part of its Nutrition & Health division, and parts of its current active pharmaceutical ingredients (APIs) business to Zofingen, Switzerland-based Siegfried Holding.

Following the divestment, for which an enterprise value of €270 million has been named, BASF said it will focus on products for which it has a leading market position.

Siegfried will acquire APIs such as ephedrine, pseudoephedrine and caffeine, with annual sales of around €270 million, while BASF will retain its excipient portfolio and selected APIs, such as ibuprofen, omega-3 fatty acids and polyethylenglycol (PEG).



Dr Rudolf Hanko, CEO, Siegfried

The transaction, still subject to consultations with employee representatives and approval by regulatory authorities, also includes production sites in Minden, Germany; Evionnaz, Switzerland and Saint-Vulbas, France. All affected employees will be offered transfers.

A syndicate of Swiss banks will handle financing of the handover, and following completion, Siegfried plans to issue a hybrid bond for partial refinancing.

Through the acquisition, the Swiss company "will reach the critical size to play a leading role in the supplier market as a recognized partner for the pharmaceutical industry," said CEO Rudolf Hanko. It also "demonstrates the growth potential for the Siegfried Group," he said.

Michael Heinz, BASF managing board member with responsibility for the Performance Products segment, which includes the Nutrition & Health division, said the sale is in line with BASF's strategy of actively managing its portfolio and will further sharpen the focus of the Performance Products segment on growth and high margin core businesses. (dw) ■

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CU Chemie Uetikon Sold to Novacap

Private equity investor Equistone Partners Europe has sold its majority shareholding in German fine chemicals and pharmaceutical ingredients manufacturer CU Chemie Uetikon to French chemicals producer Novacap. Novacap is majority-owned by Paris-based private investment company Ardian, which is active in various industry sectors.

Based at Lahr, near the Swiss border, CU Chemie Uetikon specializes in custom synthesis of complex multi-step intermediates and pharmaceutical substances, supplying leading global pharmaceutical companies from its cGMP multi-purpose production facilities.

Equistone acquired a majority shareholding in the fine chemicals producer as part of a management

buyout in November 2011. In the interim, the company has grown into a global player with annual sales revenue of around €40 million and around 135 employees.

"Since taking a shareholding in CU Chemie Uetikon, we have specifically enhanced and expanded the management team and have invested in a sustainable strategy for growth," said Philippe Stüdi, Equistone's managing director, Switzerland.

"Since the acquisition in 2011, Equistone has consistently given us valuable input that has helped drive our growth," said CU Chemie Uetikon CEO Thomas Seeler. "As the new owner, Novacap will now be able to build on this foundation in order to conquer new market segments." (dw)

BASF has agreed to acquire the polyisobutene business of compatriot chemical producer Lanxess for an undisclosed sum. The two companies said the deal concerns for the most part intellectual property for a new, innovative technology to produce high molecular weight polyisobutene (HM PIB). Under the terms of the transaction, Lanxess will produce the new HM PIB for BASF in its existing facilities under a long term toll manufacturing agreement, and BASF will market the products under the "Oppanol" trademark.

The Ludwigshafen chemical giant said its other PIB offerings, including medium molecular weight PIB

(MM PIB) and highly reactive PIB (HR PIB) will not be affected by the arrangement.

With more than 75 years of experience in producing polyisobutylene with different molecular weights, BASF claims to offer the broadest range worldwide.

Martin Widmann, senior vice president of BASF's global business unit Fuel and Lubricant Solutions, said acquiring the Lanxess technology will result in enhanced security of HM PIB supply as it provides the basis for a long term oriented sustainable growth with high quality products for a broad range of applications. (dw)

BASF Acquires Lanxess Polyisobutene Knowhow

Perrigo Acquires Patheon's Mexican Operations

Former US-based generics producer Perrigo, now headquartered in Ireland, has acquired the Mexican operations of contract drug development and manufacturing services provider Patheon, based at Durham, North Carolina in the US.

Perrigo said it expects the acquisition for \$34 million in cash to be immediately accretive to its 2015 adjusted per-share earnings after the exclusion of estimates for intangible amortization and transaction-related costs.

CEO Joseph C. Papa said the addition of Patheon will provide "many benefits" for Perrigo, adding that his company also believes the acquisi-

tion will serve as "an ideal entry point" into the softgel sector which it has eyed for some time.

Papa said Perrigo sees itself as "uniquely positioned" to maximize the potential of the former Patheon business as it can leverage its own Mexican operations to drive growth and value for customers and shareholders.

Perrigo is in the process of acquiring Belgium's Omega Pharma for €2.48 billion, excluding debt, and is at the same time fighting a hostile takeover bid from Netherlands-based drugmaker Mylan.

Mylan itself is being pursued by Israeli generics giant Teva. (dw)

Solvay Completes Sale of Refrigerants to Daikin

Closing a transaction announced in late January, Solvay has completed the sale of its German-based refrigerant activities and pharma propellants to Daikin of Japan.

The sale, which includes all of the Belgian group's Special Chem activities based at Frankfurt, Germany, and the transfer of about 75 employees to Daikin, is part of the plan to refocus the newly created global

business unit toward selective high value-added segments in the growing automotive and electronics markets.

Headquartered in Seoul, South Korea, Special Chem with €850 million in sales annually and 3,100 employees worldwide, encompasses Solvay's Special Chemicals, Rare Earth Systems global business units as well as the fluorine business of its Aroma Performance unit. (dw)

Dow Finds Buyer for Agrofresh Food Packaging Maker

In a deal set to close in the third quarter, Dow Chemical plans to sell its Agrofresh food-packaging business to Boulevard Acquisition, the public investment vehicle of Avenue Capital, for a total consideration of around \$860 million.

Boulevard has agreed to pay \$626 million in cash and 18.4 million of its own shares. Dow will initially hold a stake of about 40% and Boulevard investors will own around 60%.

Agrofresh was one of the first businesses put up for grabs by Dow CEO Andrew Liveris in an asset sale now expected to generate revenues of around \$11 billion.

Under pressure from activist shareholder Daniel Loeb and his Third Point hedge fund, Dow recently also agreed to sell its chlorine business to Olin Corp. for about \$4.2 billion. It now says the move will cost up to 1,750 jobs. (dw)

J&J Settles Risperdal Lawsuit for \$7.8 Million

US pharmaceutical giant Johnson & Johnson has agreed to pay \$7.8 million to settle a lawsuit over the marketing of its antipsychotic drug Risperdal to doctors in the US state of Arkansas. The company said the settlement did not constitute an admission of wrongdoing.

According to the newspaper Arkansas Democrat-Gazette, which reported on the court filing, \$2 million will go to a Texas law firm that represented Arkansas in the lawsuit filed more than seven years ago.

In 2012, a jury in Arkansas' Pulaski County ruled that the company, through its Janssen Pharmaceutical subsidiary, committed Medicaid fraud and violated a state law in its labeling and marketing of Risperdal.

The jury's \$1.2 billion fine imposed on Johnson & Johnson was later overturned by the Arkansas Supreme Court.

Risperdal, first approved by the FDA to treat schizophrenia in 1993, has been linked by some to serious side effects. (dw)

Alexion Paying \$8.4 Billion to Acquire Synageva

US-based Alexion Pharmaceuticals is paying \$8.4 billion to acquire compatriot rare disease specialist Synageva BioPharma. The deal expected to close in mid-2015 has raised considerable interest because Synageva as yet has no products on the market.

The price tag, which includes \$115 in cash and a portion of Alexion stock for each Synageva share, represents a premium of about 136% to the \$95.87 closing price of Synageva immediately before the deal was announced, putting the total per-share price at about \$226.

Alexion, which manufactures Soliris, a drug approved to treat the rare, life-threatening blood disorder paroxysmal nocturnal hemoglobinuria, said buying Synageva will help it accelerate and diversify its revenue growth while also expanding its manufacturing base.

The boards of the two New England companies – Alexion is based in Cheshire, Connecticut, Synageva

in Lexington, Massachusetts – have already approved the takeover. Alexion said it has lined up \$3.5 billion in financing from Bank of America Merrill Lynch and J.P. Morgan.

Synageva reported a loss of nearly \$60 million for the first quarter of 2015, while generating \$927,000 in royalty revenue. However, the biotech firm's pipeline of drugs in development is said to be promising. One of its top prospects is Kanuma, which has been granted priority review by the US Food and Drug Administration.

The drug is aimed at treating lysosomal acid lipase deficiency, a disease that causes the buildup of fatty material in the liver and blood vessels and can cause serious health problems or death.

The FDA is expected to rule on the indication by September of this year, with a decision by European regulators at about the same time. (dw)

Lanxess Realignment Progressing Rapidly, CEO Says

The three-phase realignment program initiated by German chemical producer Lanxess in 2014, following the return of former chief financial officer Matthias Zachert to the Cologne-based company as chief executive, "continues to progress rapidly," Zachert said in a conference call to present first-quarter 2015 results.

Cost savings projected for the quarter materialized, especially as regards administrative and selling cost reductions outlined in the first phase of the program, the CEO said.

Lanxess is now well into the second phase of the scheme aimed at improving operational competitiveness. Under the plan, it is realigning its production networks for ethylene propylene diene monomer (EPDM) rubber and neodymium-based performance butadiene rubber (Nd-PBR).

In a third phase, the rubber specialist will focus on improving the competitiveness of its business portfolio, especially through cooperation with partners in the rubber business, as announced last year. Zachert confirmed that the company is currently in talks with potential

partners and "will report on further steps in the second half of 2015."

Lanxess' figures for the first quarter show sales "nearly stable" at €2.038 billion (€2.043 billion) and EBITDA pre-exceptionals almost 12% higher at €229 million. The positive results, which Zachert said resulted not only from external effects but from the company's own realignment efforts, "show that we are on the right track."

For 2015 as a whole, management has increased its guidance and now expects EBITDA pre-exceptionals to be in the range of €820-860 million. The CEO said full-year sales for 2015 could be lower than in 2014, however, due to the fall in raw materials prices.

Commenting on the outlook for the workforce, Zachert said it is "not unthinkable" that additional layoffs could be on the agenda as the realignment scheme progresses further. In late 2014, Lanxess said it would slash 1,000 jobs – around 6% of its 16,700-member workforce – up to 2016. In March it announced an additional 140 layoffs. (dw)

Brenntag Buys Spanish Industrial Chemicals Distributor

Germany's Brenntag has acquired Quimicas Meroño, a distributor of industrial chemicals based near Cartagena, Spain, with effect from May 13.

The Spanish distributor with 2014 sales of €12.7 million has a strong focus on logistics, blends and storage services for industrial customers.

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

said the acquisition "perfectly complements Brenntag's regional distribution network in western Spain."

"With Quimicas Meroño," Beckmann added, "Brenntag will gain access to various key European accounts and additional growth opportunities, especially in key industry sectors such as Food and Oil & Gas." (dw)

AkzoNobel Completes Sale of Paper Chemicals to Kemira

AkzoNobel has finalized the €153 million sale of its global paper chemicals business to Kemira, completing the deal first announced in July 2014.

Niek Stapel, managing director Pulp and Performance Chemicals at the Dutch specialty chemicals producer, called the divestment "another important step in our strategy to focus on leading positions in bleaching chemicals, colloidal silica and expandable microspheres."

"The deal includes an agreement for distribution of colloidal silica to the paper industry and we are looking forward to future growth of this product line," Stapel added.

AkzoNobel said it will continue to maintain a strong presence in the pulp industry as the leading global supplier of chemicals and customized solutions for bleaching pulp, marketed under its Eka brand. (dw)

Chemours Closes on Notes, Credit Facilities

Chemours, DuPont's new stand-alone incorporating its Performance Chemicals business, has completed an offering of \$1,350 million 6.625% senior notes due in 2023, \$750 million 7% senior notes due in 2025 and €360 million 6.125% senior notes due in 2023.

The company, which will be formally spun off from the US chemical giant on July 1 of this year, also has entered into a credit agreement with a syndicate of banks providing for a seven-year \$1.5 billion senior secured Term Loan B Facility and a five-year \$1.0 billion senior secured Revolving Credit Facility.

Proceeds from the transactions have been used to fund a distribution to DuPont of approximately

\$3.9 billion, in recognition of the assets the former owner contributed.

"It is critical to get the backing from the debt capital markets as we near the launch of The Chemours Company as an independent company on July 1. We are pleased with the market reception following our debt roadshows, which has been very favorable and supportive of our strategic plans for Chemours," said CEO-designate Mark Vergnano.

The company also has announced the appointment of E. Bryan Snell as president of its Titanium Technologies business, with immediate effect. Snell, who joined the former DuPont division in 1992 as production unit manager, replaces BC Chong, who led the business since 2011. (dw)

Dow Completes Buyout of ExxonMobil's Univation Stake

Dow Chemical has completed its acquisition of ExxonMobil Chemical's share of US technology licensor Univation Technologies for an undisclosed sum.

Previously a 50:50 joint venture of the two US chemical groups, Univation licenses the widely used Unipol polyethylene process and also is a leading manufacturer of catalysts for the process that permits plant operators to swing between production of linear low density and high density PE grades.

The technology firm also develops and supplies catalysts, includ-

ing UCAT Conventional, Acclaim Advanced Unimodal, XCAT metallocene and Prodigy bimodal catalysts.

Dow said the purchase of its partner's stake reflects its strategic focus on investing in businesses with strong competitive positions in attractive markets.

Univation Technologies will operate in future as a wholly-owned subsidiary of Dow, led by its president, Steve Stanley, and will continue to be based in Houston, Texas. (dw)

AbbVie Completes Pharmacics Acquisition

AbbVie has completed the acquisition of Pharmacics, a deal the Chicago-based US drugmaker says enhances its scientific and commercial presence in oncology. As a wholly owned AbbVie subsidiary, Pharmacics will continue to be based at Sunnyvale California.

The deal, as previously announced, values the takeover candidate at around \$21 billion.

Pharmacics is recognized as a leader in the hematological oncology market with its Imbruvic (ibrutinib) BTK-inhibitor used to treat hematological cancers. Approved for use in four indications in the US, Imbruvic is claimed to be

the only product to have received three Breakthrough Therapy designations by the Food and Drug Administration (FDA). In partnership with Johnson & Johnson's Janssen subsidiary Janssen Biotech the drug is now approved in nearly 50 countries.

"The companies' shared expertise, combined with AbbVie's broad late-stage oncology pipeline, has the potential to transform the cancer treatment landscape for hematological malignancies and improve patient outcomes and quality of life," said Richard A. Gonzalez, CEO of AbbVie, which will market the drug in the US. (dw)

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Continued Page 1

Both acquisitions have been part of our investment campaign to increase the polyol capacity. And there might be a few additional bolt-on acquisitions of that nature also in the future, but the fundamental strategy is to now really reap the benefits from the investments that we have made.

For such bolt-on acquisitions, do you rather look at certain geographies or at opportunities where to add something to your portfolio?

J. Secher: There are three dimensions to that. The first dimension is technology; the second one is geography; and the third one is market position. We always look for interesting opportunities as additions to our current technology platform. There our focus would be more on the specialties side rather than on the intermediates volume products. In terms of geography, our strategic direction is that we want to grow outside of Europe what currently accounts for about 60% of our business. And thirdly, you know, we have very strong market positions and the penta deals are a good example of our intention to always look for opportunities to maintain and even strengthen those leadership positions. In 80% of our businesses we are amongst the three leading players. I truly believe that one should really make sure to nurture leading market positions because they are difficult to reach, and once you are there you got to make sure that you defend them.

The new state-of-the-art oxo plant at Stenungsund, Sweden, has been inaugurated only a couple of weeks ago. What about the project

has been special and how can you guarantee a competitive cost basis for the facility?

J. Secher: Our internal project name for this investment is Valerox and it represents a milestone for us that we have passed three months ahead of schedule and under budget. So it has really been a very successful and well-managed project as such. Regarding the cost basis, I think it is important that we are operating this plant in close collaboration with our raw material feedstock supplier Borealis. We are basically over the fence from their naphtha cracker in Stenungsund, which is a strategically advantaged cracker to be a cracker in Europe. As you know, the cracker market in Europe is quite difficult at this point in time, in particular with the low-cost competition from North America right now. But Borealis is now actually bringing in ethane from the US that makes them a strategically well positioned raw material supplier for us. Thus, we are quite convinced that becoming a fully integrated supplier as well as moving to butene-based plasticizers will position Perstorp cost-competitive-wise quite well in the global perspective and we feel definitely



Sustainability is driven more by convictions than by economics.

Jan Secher, President and CEO, Perstorp

that we can be competitive with the products produced in the new plant.

Before taking the helm at Perstorp you had been CEO of Clari-

and engineering industry are helpful in your current position?

J. Secher: There are quite a few experiences that I can apply and use.



ant, SIPCA and Ferrostaal and held leading positions at ABB. What experiences and skills you acquired during your career in the chemical

I did not grow up in the chemical industry and I find that the chemical industry tends to have quite an inside-out mentality. You have your technology, you have your plants, and you optimize around that. But there is too little thinking of where is my market, what who are my customers, what issues do they deal with today and what demands do they receive from their customers further down the value chain.

The chemical industry is often situated so far up in the value chain, therefore you need to constantly look forward and try to understand what the end user requirements are coming at us through this value chain. Because eventually it will reach us. And to be driven from the outside-in rather than from the inside-out is something that we are today applying to Perstorp quite successfully, I would say. And it is my experience from the previous positions that led me to that understanding quicker than I would have gotten there without that experience.

Would you say that the chemical industry needs to become more customer-centric?

J. Secher: One should be careful of generalizing and so this needs to be put into context. But generally speaking I find still today there are situations where we understand the chemistry and we have figured out what the molecules do and don't do, and we are very proud of that, but we have not necessarily understood the full extent of how it can be used. And far too often I see that it is the inside drive that leads us to a new development rather than the demand and the problem. I sometimes use the analogy: 'we have the perfect solution; the only thing missing is the problem'. There are still examples of that.

And at Perstorp you have implemented the outside-in look?

J. Secher: What I just said is a bit black or white, but at Perstorp we are trying to create a more healthy balance between the two drivers. I am the first to underline that there is a need to properly optimize the utilization of your assets. We are an asset-heavy industry compared to a true service industry which is very asset-light. So for sure, we got to always look at how we can make better use of the assets that we have. But staring yourself blind of that, there are many opportunities going by out there and you will not see them.

How do you make sure that Perstorp will not miss too many of these opportunities?

J. Secher: When I arrived, we did first of all a rather thorough data-driven analysis of where are we in terms of competitive positions, and really try to understand the markets and the go-to-market strategies that we had. And we came to the conclusion that we have two types of businesses. One is a supply-de-



We are currently concluding a quite intensive investment period.

mand-driven type of business that we call Intermediates & Derivatives. Very advanced products as such, but we don't differentiate substantially by means of our product. The other type of business is much more specialized. This business is called Specialties & Solutions. We have a true differentiation there, we have something unique.

So, we have two business areas. One is Intermediates & Derivatives, and one is Specialties & Solutions. And that is part of the strategy how to make ourselves more outside-in and market-driven, so to speak. We also have to make sure that our innovation organization that is working very closely with the two business areas gets really closely linked to the customers, but still in a structured way.

Next, we are going through a commercial excellence program that we run with our entire sales force, which we have separated into the two business areas. So there is a lot of work going on right now to really reach commercial excellence in the organization.



The chemical industry tends to have quite an inside-out mentality.

Perstorp's mission – according to your website – is to provide sustainable solutions through innovative chemistry. Does sustainability mean more to you than being a buzzword?

J. Secher: For us as a company it does, and for me personally it does, too. I don't think we are going to see a step change but I think that sustainability is something where we see an increasing interest up to a point where it is slowly starting to develop into a demand. But the real change will only come when further down the value chain customers are starting to demand products that

are more and more made from renewable resources, and also be prepared to take the renewable alternative even if that cost them 3% more. Today it is questionable if the purchaser would pay extra. And until that actually happens you are going to have the pace of the change as you see today. It is driven more by convictions than by economics. But at some point in time those two drivers need to come together. And then we will see an accelerated change.

I am personally very engaged in this. We are taking steps in that direction, for instance, we have started a taskforce to establish our future direction with this. And we have a lot of good examples already. It is a matter of bringing them under one umbrella and making this more of a corporate visible strategy. And that is something that we are working on.

Sustainability is not just about the feedstock, renewable resources, but it is also about what your products are doing in the applications they are meant for.

J. Secher: Yes, take for instance our Capa products that help coatings manufacturers to reduce energy consumption and emissions. There are so many examples where chemical products directly influence the downstream use of energy and ul-

timately CO₂ footprint. And actually, I think that if you were to look at what is the carbon footprint of the chemical industry versus what we help other industries save as a result of the products we manufacture, it is a factor of 1 to 2. This means that — speaking about the European chemical industry as a whole — our products help other industries reduce their footprint double the size of our own. This fact needs to be put out there a bit more visibly.

Being that far up the value chain is also a reason why the solutions chemical products are enabling in industry or consumer goods – for instance in improving performance, energy efficiency or environmental impact – usually don't get mentioned. Do you think that the chemical industry is actually rewarded by the customers or by the public?

J. Secher: Definitely not. I think as an industry we are a poor communi-

tor. Actually, we are all 'engineers', so, sometimes, not always, we take too much of a factual approach in our communication, because that is what we think is right. We are sending messages about all these numbers and how good we are and how we decreased our footprint and how much investments we made. And you can come with how many rational arguments as you like, but you are not communicating, you are not connecting. Because this is an emotional discussion and we need to meet it with emotional arguments — not always, but sometimes — in order to create the connection.

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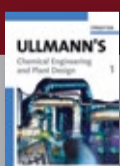
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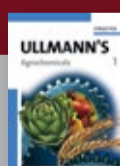
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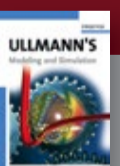
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New Openings for Oil and Gas Chemicals

Cheap Oil Gives Scope to Chemical Companies to Help Cut Production Costs



The outlook for producers of chemicals used in the exploration and production of oil and gas has not been promising after the crash in oil prices in the second half of 2014. However, cheap oil could offer opportunities for suppliers of these chemicals as operators of oil and gas rigs across the world seek ways to adjust their oil production costs to the lower prices for crude.

"We need to be getting more out of less," Robert Frimpong, managing director, Wintershall Noordzee, Netherlands, part of BASF's oil and gas Wintershall operation, told a BASF Science Symposium in Ludwigshafen in March.

The 50% drop in oil prices from mid-2014 to early 2015 did not have an immediate effect on the output of oil. In fact some producers of oilfield chemicals seemed to be hoping they could continue to achieve the high growth in sales of recent years.

Small Oil Decline

Saudi Arabia's oil production was predicted in March to be heading for an average 9.8 million b/d in 2015 against 9.6 million b/d last year.

In the US, whose oil and gas sector has been expected to be hit the hardest by the oil price collapse, output started to decline slightly only in late March.

However, capital expenditure has been going down in high-cost sectors like onshore shale gas and tight oil in North America, deepwater offshore reservoirs around the world, and areas of depleted reserves such as the North Sea. Shell announced earlier in the year that it would cut capital spending over the next three years by around \$15 billion.

Schlumberger, one of the world's leading oil and gas services companies, has estimated that in 2015 capex in oil and gas exploration and production (E&P) will fall by an overall 10% to 15%.

Shale Capex Cuts

Expenditure will drop sharply in onshore oil production in the US, especially in its shale sector, following

a doubling of expenditure to \$125 billion in the six years to 2014.

"The Eagle Ford Shale in the US has seen capex cuts by operators while reductions are also being seen in other major plays," said Paul Gould, global head of marketing at Clariant's Texas-based oil services business. "As a result of capex cuts, analysts estimate that domestic onshore oil and gas activity (in the US) may be reduced by 40% compared to the level in 2014."

However, in regions like the Middle East, capex could actually increase as Arab producers remain intent on keeping their global market share rather than reducing their production capacity. Across much of the world, investment in projects that require the application of expensive enhanced-oil-recovery (EOR) techniques will inevitably be cut back. Unfortunately for chemical companies, EOR, which is used in oil or gas reservoirs deep under the seabed or trapped in tight rock formations, has a big demand for chemicals.

Providing Chemical Solutions

Nonetheless there will be a lot of scope for chemical producers able to provide solutions that cut costs, particularly those of existing, less expensive projects. Enough oil still has to be produced to meet growth in global oil consumption of around 2% to 3% annually.

"There will be a strong focus on reducing cost per barrel," Paal Kibsgaard, Schlumberger's chief executive, told an energy conference in New Orleans in March. "This will result in) increasing production from shallow water and conventional land fields, as more investments are likely directed towards these resources

types in the short term to meet the ongoing growth in demand."

The priority for many producers will be to raise the productivity of individual existing wells that have the potential for high total output as a percentage of the total oil embedded in the rocks. This could mean pushing the output from an average of around 40% per well to 60% or more.

"What is needed are chemical and other technologies which optimize the levels of production in current wells," said one oil executive. "This could mean the application of EOR or other techniques. With wells whose infrastructure has already been installed, EOR technologies become more economical."

Meeting Challenges

Some of the companies with major oil and gas chemicals businesses seem confident that they can meet the challenges posed by cheap oil.

Clariant, No. 3 in the global oil services market for chemicals, is predicting 6% - 7% annual increases in sales after achieving a double-digit sales growth in 2014 in its Oil & Mining Services unit. Most of the business' sales have been in oil and gas with a large proportion stemming from innovations.

"With the low price of oil, Clariant has focused efforts on improving productivity through innovation, without generating additional capex investment," Gould said. "We partner with our customers to analyze declined production curves, identify the root causes and develop safe and sustainable solutions utilizing (our own) production optimization system."

Kemira, another top supplier of oil and gas chemicals in North America and the Middle East, is also optimistic that it can at least maintain sales levels after oil and mining revenues jumped by 23% last year.

Ensuring Flow

For rig operators, ensuring a smooth flow of oil and gas to the wellhead

and then onto the processing facilities is a key factor in raising productivity. Hydrocarbon fluids in well pipelines will usually contain a mixture of crude oil, natural gas, water and additives and materials, some of which have been used as an aid in the early stages of production but can inhibit flow nearer the wellhead.

Sand, for example, is applied as a fracture proppant in hydraulic fracturing of shale gas and oil. But within pipelines it can cause severe erosion and even the failure of a whole piping system. Other factors hampering flow include the length of the pipeline, extreme temperatures, and formations of hydrocarbon deposits such as hydrates, waxes, paraffins and asphaltenes.

Clariant markets a variety of treatments for removing and preventing asphaltene and paraffin deposits and for breaking up emulsions that have formed in a pipeline. The collection also includes a drag reducer, which increases the amount of fluid being transported.

Scale Treatment

The company is planning to launch a treatment soon for preventing the formation of iron sulphide (FeS) scale in mature water-filter systems and injector wells.

"(The product) adds a novel booster to an existing technology, reducing FeS scale control spend by over 30%," Gould said. "Lower injection-well failure rates (during tests) resulted in an increase in overall injection volumes, (which) led to an increased oil production."

Kemira recorded a 40% increase in revenue in the Americas last year mainly due to the success of its polyacrylamide polymers as flow aids for reducing friction. The company has a 20% share of the North American polyacrylamide oil and gas market. It is also the world's second-largest dry and emulsion polyacrylamide producer.

Its medium-term objective is for enhanced oil recovery to account

for nearly half of its predicted polyacrylamide sales of €4.5 billion in 2020 against around a fifth in 2013 with the rest used in drilling and stimulation. This will require a fourfold increase in sales of polyacrylamides for EOR in seven years.

Value Chain

BASF's recent combining of its water, oilfield and mining businesses into a single unit has strengthened its position in the polyacrylamide segment.

"As all three businesses include parts of the polyacrylamide value chain, our operations, including those in North America, can now be jointly managed, and customers will benefit from proximity, market intelligence and a specific business focus," a BASF spokesperson said.

The company has also been developing a glyoxal dialdehyde for cross-linking polymers to improve their viscosity as fracturing fluids so that they can infiltrate sediment pore to release crude.

Applications of polymers and other chemicals for flow assurance purposes will benefit from an increase in the development and application of monitoring and modeling of the use of chemicals in oil and gas exploration and production.

Modeling Real-Time Data

Computational fluid dynamics (CFD), an aspect of fluid mechanics, are now providing algorithms, often based on the modeling of large amounts of real-time data, which is improving the efficiency of flow assurance polymers and other chemicals. Research with the help of CFD has demonstrated ways of raising the efficiency of viscoelastic polymers like hydrolyzed polyacrylamide (HPAM) in displacing oil from rock fractures.

Studies by the Center for Petroleum and Geosystems Engineering (CPGE) at the University of Texas have shown how CFD modeling can

determine how the polymers can be formulated to apply sufficient pressure on oil droplets to remove them. Those at the center, who reckon that viscoelastic polymers can already increase oil recovery by 20%, believe they can be applied to billions of barrels of oil that are currently unrecoverable.

Researchers in the oil sector are also continuing their work on the application of new biochemicals and biological compounds in oil and gas production despite their tendency to be more expensive than mineral-oil-based equivalents.

Fungus-Based Polymer

BASF, which last year started producing bioacrylamide at Suffolk, Virginia, has jointly developed with its oil and gas subsidiary Wintershall a fungus-derived polymer thickening agent called Schizophyllan. The biopolymer, which is now being tested by Wintershall in the field, raises the viscosity of water 25 times to make it more effective as an oil displacement agent. At a time when environmental regulations on use of contaminants in oil and gas production are becoming stricter across the world, Schizophyllan has the advantage of being absolutely eco-friendly.

"The first indications in the test field are that the biopolymer could have a positive impact on crude oil production," said Burkhard Ernst, Wintershall's general project manager.

When judging the commercial viability of new bioproducts such as Schizophyllan, a delicate balance has to be found between cost effectiveness and environmental compatibility. While oil prices remain low, an innovation's cost is likely what will make it a success.

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Ineos Completes Buy of Fracking Permits from IGas

Swiss-based petrochemicals mammoth Ineos has completed its planned purchase of shale gas exploration permits in England and Scotland from IGas and now claims to be the UK's third largest shale gas company.

Ineos is paying IGas £30 million in cash for the permits while also agreeing to fund a two-phase site development scheme expected to cost as much as £138 million. IGas will reimburse Ineos for its share of the scheme to Ineos when commercial production begins.

The deal includes the acquisition of a 50% share in seven IGas shale gas licenses England's northwest (the so-called Bowland licenses).

With the Bowland licenses, the petrochemicals group is picking up a 60% interest in three Petroleum Exploration & Development Licenses (PEDLs 145, 193 and EXL273) as well as a 50% interest in four additional licenses (PEDLs 147, 184, 189 and 190).

Ineos plans to assume operatorship of PEDLs 145 and 193 and EXL 273 in stages, along with the PEDL

133 Grangemouth license it has acquired from IGas in Scotland. The latter will give it 100% ownership of the franchise to frack the area surrounding its refinery and petrochemicals site of the same name located on the Firth of Forth.

Additionally, the company has secured an option to acquire 20% in two IGas shale gas licenses in England's East Midlands (PEDLs 012 and 200).

Fracking is expected to be a hot topic in the run-up to next year's Scottish Parliament elections. (dw) ■

BASF's oil and gas subsidiary Wintershall is pulling out of its gas exploration activities in Qatar. The company said it is returning Block 4 North near the North Field off the Qatari coast and closing its office in Doha.

The company, which made the "Al Radeef" gas discovery off the coast of Qatar in 2013, blamed the Qatari government for not granting it access to local infrastructure.

"During the development planning, it was always clear to us and our partners that an economic development of the discovery, includ-

Wintershall Pulling out of Qatar Gas Exploration

ing the processing of the gas, would only be possible if we have access to local infrastructure. This access was not granted. That is why we have decided to take this step," said Wintershall managing board member Martin Bachmann, who is responsible for exploration and production in Europe and the Middle East.

Wintershall said its other activities in the Middle East region are not affected by the withdrawal from Qatar. The company's current focus is on the United Arab Emirates but it is also closely following the devel-

opments in other countries in the region, Bachmann said.

"The challenges in the region are increasing with local energy consumption growing rapidly. In order to maintain production in the long term, fields must be exploited more efficiently and technically more complex fields need to be developed," the board member added.

Wintershall has said it wants to increasingly leverage its considerable experience in deploying the Enhanced Oil Recovery (EOR) technology in the Middle East. (dw) ■

CVC Planning to Sell Another Chunk of Evonik

Speculation that German chemical producer Evonik is priming itself for a major acquisition or restructuring continues apace.

Following an announcement in February by the company's largest shareholder, the German coal mining drawdown fund RAG, that it was increasing equity by €400 million through the issue of a bond with maturity in 2021, Evonik's other major shareholder, private equity fund CVC now says it will unload a further 2 million shares valued at €700 million.

With the deal, the fund will reduce its stake in Evonik by about a third, from 14% to 9.4%. JP Morgan and Bank of American Merrill Lynch are handling the sale of the shares, which are priced at €31.85 each.

In March, taking advantage of a 15% rise in Evonik's share price over the preceding three months, CVC sold shares worth 3.9% of the German company's equity, but netted a disappointing €29.15 per share.

RAG, which owns 68% of Evonik, has stressed that it does not to divest any shares, but plans to remain a long-term shareholder. In the past, the coal fund had said it would reduce its engagement gradually to diversify its portfolio.

The fund, which evolved out of a forming coal mining company, is responsible for footing the bill for Germany's exit from coal mining up to 2018. (dw)

Siltronic Aims for Stock Listing Before Summer

Siltronic, electronics subsidiary of Munich-based Wacker Chemie and the world's third-largest maker of the silicon wafers used in semiconductor chips, aims to raise more than €150 million from an initial public offering planned to take place before the European summer holidays.

The German wafers producer said it will issue new shares as part of an equity increase, while parent Wacker will separately sell existing shares in the company to private and institutional investors on the German and Luxembourg stock market. Shares also will be offered for subscription in private placements outside the stock market.

Wacker intends to retain a majority stake in the electronics offshoot, at least for the short term.

Siltronic said it would use proceeds from the listing to reduce its

debt. In a statement, CEO Christoph von Platho said the company has "worked hard" to prepare for the ipo, implementing cost cuts totaling €135 million over the past two years.

Like its rivals in other countries, foremostly Japan, the Munich company has struggled with falling prices for silicon as personal computer markets have matured, limiting demand for microchips.

The worldwide silicon wafer market peaked at around \$12.5 billion in 2007 but sales have plunged by more than a third since then, according to figures compiled by Gartner Inc. The market collapse has triggered a wave of consolidation in the global industry, necessitating plant closures at Siltronic. (dw)

J&J Drugs Arm Announces 10 Blockbuster Filings by 2019

Johnson & Johnson's Janssen Pharmaceuticals offshoot has told analysts it plans to seek regulatory approval for more than 10 new drugs up to 2019, each with the potential to generate at least \$1 billion annual sales.

This would come in addition to more than 40 line extensions of existing and new medicines. The

US pharmaceutical major said it expects top-line growth above the industry average through 2019.

Janssen's portfolio focuses on the five core therapeutic areas: immunology; infectious diseases & vaccines; neuroscience; cardiovascular & metabolism and oncology.

Since 2009, the drugmaker has launched 14 new products (dw)

Actavis Ordered to Keep Selling Alzheimer Drug

Under a ruling by a US court of appeals upholding a preliminary injunction dating from December 2014, Actavis will have to continue selling its Namenda IR tablets for treatment of moderate to severe Alzheimer's type dementia.

The ruling puts paid to a plan by the company to pull the drug, which will face generics competition from mid-July, from the market and

switch patients to Namenda XR, a higher dose, once-daily formulation.

Actavis has appealed the decision to the next instance, but analysts said a "second opinion" could come too late to stop the generics competition in its tracks.

The drugmaker wants to ensure that the court's decision has little to no impact on its earnings targets. (dw)

Ex-La Seda CEO Gets off Light in Embezzlement Case

Due to successful plea bargaining, two executives of former Spanish PET producer La Seda de Barcelona – including former CEO Rafael Español – have escaped severe penalties for embezzlement of company funds and may possibly avoid jail time altogether, Spanish reports say.

Español has pleaded guilty to misappropriation of funds, a charge that carries a penalty of 11 months

and 15 days. The prosecutor in the case being heard a Barcelona court had asked for a sentence of 27 years and six months.

The ex-CEO has agreed to pay a fine of €702 million, which is in part restitution for tax evasion. Español and another manager, Antonio Comadrán, are said to have admitted diverting €12.2 million from La Seda's corporate coffers. (dw)

Clariant Sees Shareholders as Bulwark Against Takeovers

Swiss specialty chemical producer Clariant is certain that its large shareholders – including those of Süd-Chemie, who hold 14% of the company's shares – will support management's plan to remain independent, CFO Patrick Jany recently told the news agency Reuters.

In late March, market rumors surfaced that German chemical producer Evonik could be planning to launch a bid to buy Clariant and create a much larger specialty chemicals producer with annual sales of around €20 billion.

The rumors apparently were sparked by Evonik management's remarks that it was looking to add €3 billion in annual sales by 2018 by focusing on products with high barriers to entry and would consider acquisitions to meet the target.

The German group, whose name has also been mentioned as a prospective buyer for Dutch chemical producer DSM, has been actively searching for takeover candidates, reports say.

Clariant CEO Hariolf Kottmann has stressed repeatedly that the Swiss company does not want to be taken over. The Swiss specialty chemicals producer itself has been fairly active on the M&A scene, following up its 2013 acquisition of Süd-Chemie with several other bolt-on deals.

Kottmann also has questioned the logic behind an Evonik acquisition in Europe, where the Essen-based group as well as the mooted takeover candidates are overrepresented.

For the first quarter of 2015, Clariant reported a 4% rise in sales from continuing operations denominated in local currencies. In Swiss francs, sales fell 2% to 1.465 billion from 1.492 billion. EBITDA before exceptional items receded by the same margin to 206 Swiss francs, and the EBITDA margin before exceptionals was flat at the Q1 2014 level of 14.1%. (dw)

First Clariant, now DSM is rumored to be in the crosshairs of German chemical producer Evonik, which appears to be in the market for a major acquisition.

Evonik is said to be in talks with advisers about a deal for the Dutch group that would create a new chemicals player with sales of around €22 billion annually.

DSM is said to have turned thumbs down on an earlier offer by the German group, in part because it did not want to relocate headquarters across the River Rhine. Market talk has it that Evonik would be willing to buy all of DSM, which has a market value of €9 billion. However its primary interest is said to concern the company's nutrition division, which makes food supplements.

Both companies are active in the saturated market for polyamide feedstock caprolactam, so that Evonik would find little interesting there. The two European chemical players also have been trying to diversify away from petrochemicals.

An Evonik spokeswoman told the news agency Bloomberg that there are no plans or considerations to buy DSM and that "there are no talks" between the two companies.

New York hedge fund Third Point, which has been hounding Dow Chemical of late, has also taken DSM into its line of vision, with fund chief Daniel Loeb highlighting the large potential value to be realized by splitting the materials and nutrition divisions and focusing on the latter.

Third Point is now one of DSM's largest shareholders, with a stake of more than 3%. Bloomberg said DSM's chief executive CEO Feike Sijbesma and his board would have to support any bid because of the company's shareholder structure, which includes a foundation that has the right to issue shares if the group is the target of an unwanted approach.

Dutch analysts have commented that a takeover is unlikely to take place, as buying DSM as a whole is too big an acquisition for Evonik. (dw)

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'A Right to Play and a Right to Win'

Chemtura's Organometallics Specialties Business is a Focal Point of Future Growth

Chemtura Corporation is a global specialty chemicals company with leading positions in diversified markets and net sales of \$2.2 billion in 2014. Formed in 2005 through the merger of Great Lakes Chemical and Crompton, the Philadelphia, Pennsylvania-based company looks back on a history of almost 180 years. After the divestiture of its AgroSolutions business in 2014, Chemtura now focuses its business on two segments: Industrial Performance Products (IPP) and Industrial Engineered Products (IEP). Major industries served by IPP and IEP include transportation and energy & electronics. Within IEP, the Organometallics Specialties (OMS) business unit is slated to have a significant impact on the segment's overall performance and profitability in 2015 and beyond. It has, thus, become a focal point for the company's future growth. Ralf Kempf and Michael Reubold spoke with Alan M. Swiech, executive vice president and general manager of OMS, about recent achievements and his further strategy.

CHEManager International: In the past several years, Chemtura has invested nearly \$80 million in OMS capabilities and infrastructure. What have been the key drivers for these investments?

A. Swiech: The past several years have seen great change at Chemtura, and for our Organometallics business and its customers that change will be very positive. OMS supports a wide array of industries and markets. The cornerstone of our business – impacting both our base business and our growth opportunities – is the polymer industry, which includes the manufacturers of polyolefins and the producers of elastomers and rubber. We produce a number of metal alkyls for processes operated with Ziegler-Natta catalyst systems, but we see our best opportunities for future growth with the single-site catalysts designed for



Alan M. Swiech, executive vice president and general manager, Chemtura Organometallics Specialties

advanced engineered plastics. Our offerings for this growth market include proprietary and custom-made

metallocenes and aluminoxane activators, which was a driver of our MAO investment. MAO is a critical component of our growth strategy going forward. Overall, our recent investments in the OMS business have been focused on products that support global megatrends like renewable energy generation and energy efficiency.

Which products and applications in particular?

A. Swiech: We are talking primarily about products like diethylzinc (DEZ), trimethylaluminum (TMA), and methylaluminoxane (MAO). These specialty organometallic products are used – among others – in polymer production, in processes for production of semiconductor devices and photovoltaic modules. Electronics – optoelectronics in particular – and very-high-purity precursors that support the semiconductor market are important application areas for Chemtura Organometallics' products. Right now, we are targeting the rapidly growing LED market – the future of energy-efficient commercial and domestic lighting. The market for photovoltaic applications, as well, is very important for us, especially solar panels. There are two different technologies being deployed in the photovoltaic area for thin-film crystalline solar panels – chemical vapor deposition and atomic layer deposition. The improvements in both technologies have created a demand for our TMA and DEZ investments. A large part of the investment we have made in the



Organometallics Specialties business was to create those backbones – TMA in particular, but also DEZ capabilities. We are now positioned as a key supplier of precursors to both of those applications.

substitution of traditional lighting with LED technology. Solid-state household applications, automotive and general lighting – we see these segments growing at 12 to 14% a year. What is also developing now

The pharma industry is far different compared to the electronics industry, but there are attributes of this market that are very encouraging for us and that fit what we do well.

Finally, less profitable but important to base load and important to our overall business structure, are the vinyl additives producers, in particular manufacturers of PVC tin stabilizers.

What is your strategy for further growth and supporting the growth of the OMS business?

A. Swiech: Our focus is on emerging growth markets such as the ones discussed. I think we very much have a right to play and a right to win in these areas. Focusing on these markets where there is substantial growth gives us a very good position to win. We believe that we are positioned very well to take advantage of those opportunities. So we have high hopes and expectations for our ability to succeed there.

Another strength of Chemtura Organometallics Specialties is our R&D expertise. We do not have a big R&D center; we are fairly "lean

We have huge expectations in the LED market.

These products just mentioned and the acquisition of UP Chemical's 50% stake in our joint venture DayStar Materials make up the vast majority of the recent investments. We have also made important investments in the next generation of tin intermediate feedstocks.

Talking about DayStar, can you share a few details of the transaction with us?

A. Swiech: Formed in 2011 as a joint venture of Chemtura and UP Chem, DayStar is a South Korean manufacturer and marketer of high-purity metal organic precursors for the LED market. We executed a buy-out of the JV partner in May of 2013. Chemtura now owns a 100% interest in the company, which has been integrated into the Chemtura Organometallics business. Our intention is to establish fully integrated manufacturing, quality, service and distribution capabilities in Asia supporting our electronic-grade trialkyl product portfolio of trimethylgallium (TMG), triethylgallium (TEG), and trimethylindium (TMI).

One of the reasons we chose to take full ownership of DayStar is the fast-paced nature of the electronics industry. Opportunities can appear and disappear quickly, and we felt DayStar would be more agile under Chemtura's sole control. If you are positioned as a reliable, capable producer of these high-purity precursors, you have a great opportunity to make some money. But competitors jump into the arena very quickly, and things get commoditized. With the joint venture structure it was challenging to move quickly. One of the lessons we have learned was that the LED market for flat-panel backlight TV screens was a huge opportunity and we did not participate in that market at the point where we wanted to.

With full ownership of DayStar Chemtura is now better positioned to participate in the future growth of the LED market?

A. Swiech: Yes. The next wave of LED growth is with the growing global

are several advanced LED technologies: UV LED, purification through lighting rather than conventional methods of killing pathogenic germs, is rapidly evolving. And that has the potential for significant double-digit growth rate over the next years. So we have huge expectations and are very bullish on the LED portion of the semiconductor market over the next five to ten to fifteen years.

The growth prospects of the LED market have been the reason for our DayStar investment including the full range of LED precursors in Korea with complete backwards integration into the essential TMA

We have very much a right to play and a right to win.

feedstock that we produce at Bergkamen, Germany. From TMA we create the whole family of high-purity electronic-grade products—TMG, TEG and TMI—to satisfy the optoelectronics markets.

Thus, the technologies where we have focused most of our recent investments tie back to these global megatrends we have been talking about. The significant investment in these technologies and product lines has increased our capability to address what we believe are major growth areas for the next decade and beyond.

Besides the megatrends mentioned, what other applications is Chemtura Organometallics serving?

A. Swiech: The market for pharmaceuticals and fine chemicals represents a smaller portion of our overall portfolio, but they are important parts of our growth initiatives. Our metal alkyls like DEZ and also our organotin compounds are used as reagents to make active ingredients or key building blocks for both industries. I believe that we have the broadest portfolio of precursors that are qualified in the pharma drug master file.

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Protecting Environment and Yields

Innovative Crop Science Helps Optimize Crop Yields Sustainably

With global population expected to increase by nearly 40% during the next 85 years, optimizing arable land and securing food supply is a necessity. Crop protection is essential in safeguarding the world's food supplies. Currently around 6,000 custom-made crop protection systems are available for combating the threat posed by pests, weeds, fungi, bacteria and viruses.



Oliver Kinkel, Clariant



Michael Willome, Clariant

While their efficiency has evolved considerably in recent decades, the use of chemical crop protectants creates conflict in regard to securing agricultural yields and impact on the environment and society. New options exist to help farmers respect this balance and improve yields.

Adjuvant with a Green Heart

For a crop protectant to be effective at all, it needs auxiliary substances known as adjuvants to transport the active ingredients to the plant. To meet the requirements of modern, sustainable farming, these should avoid potential health or environmental hazards. The goal should be to achieve maximum harvest yields and highest qualities with the smallest possible rational amounts of active ingredients.

Methylated seed oil (MSO), derived from plant oils such as canola, sunflower or soybean oil, is already widely used in agriculture. As an efficient penetration enhancer it ensures rapid penetration of the active ingredient into the leaf interior. MSO must be combined with emulsifiers in order to mix well with the aqueous spray used by farmers. However, many emulsifier combinations used so far are health hazardous or poorly biodegradable, or the natural ingredients prove difficult to combine because of differing solubility. The dose rates of current MSO products are also often relatively high.

Clariant has developed a new biodegradable adjuvant called Synergen OS, which offers a highly versatile solution to this issue. For the first time, it combines the natural-based ingredients MSO and a tailored polyglycerol ester (PGE), an emulsifier with no health or environmental hazard produced from coconut oil. The resulting adjuvant for both crop protection formulations and tank mixes is harmless to health and particularly well-tolerated by plants. It also considerably enhances the performance of the active ingredients with lower dosage.

Monsanto Vows Divestments for Syngenta Green Light

It has gone quiet around the targeted takeover of Swiss agrochemicals giant Syngenta – Europe's largest player in terms of overall sales – by GMO titan Monsanto. Behind the scenes, however, the largest US and dominant global player is said to be working feverishly to push its plan forward.

An initial offer of 449 Swiss francs per share, representing an enterprise value of around \$45 billion at current exchange rates, was rejected earlier by the Swiss player's board, which said it "fundamentally undervalued" the business and underestimated the "serious execution risks."

In exchange for a green light from Switzerland and a thumbs up from international regulatory au-

Low Dosage, Less Pollution

When the adjuvant is added to a crop protectant, its PGE content acts as a mediator between the aqueous and oily components to form an even dispersion or fine emulsion in the spray liquid. The MSO swells the network structure of the topmost layer of the leaf, which becomes more permeable; this enables the active molecules to rapidly penetrate into the leaf. Thus food production yields can be increased while the use of polluting pesticides can be minimized through increased efficacy.

Spray application is also improved. The adjuvant has optimally sized droplets, which ensure the spray lands on the crop and the potential for wind drift is lowered. This means that the distance to neighboring fields and bodies of water can be significantly reduced during application, and the amount of usable farm can therefore be expanded.

Expanding Arable Land and Yield

The discussion of better, and more environmentally responsible, use of agricultural land and increasing yield per hectare is also linked to agricultural films. Plastic films first appeared in agriculture in 1948, and are today used in greenhouses, as mulch films, and in silage production. According to the market research firm Transparency Market Research, in 2012 the global demand for agricultural films was 4.4 million tons, and it is predicted to show a growth rate of 5.7% by 2019.

Cultivation in greenhouses helps achieve the needed increase in yields, and several harvest cycles can be realized each year. The control of temperature, sun radiation and humidity allows for a reduction of supplied water. For example, a tomato grown indoors requires six to eight times less



water than a tomato grown outdoors. Compared to exposed outdoor cultivation, fertilizer and pesticide use is also reduced. All good news from an environmental perspective.

The use of films in the agricultural sector, whether indoor or outdoor, improves the world's nutritional situation. However, these plastic films are sensitive to sun exposure and aggressive pesticides. Aged films mean lots of plastic garbage and pollution if incorrectly disposed of through uncontrolled burning. Also, bees require specific light waves for orientation. If this range of UV radiation is filtered out by the film, the bees' mobility and thus pollination are impaired. The priority is to optimize the resistance of these films and increase their lifetime.

Bee-Friendly Agro-Films

Film producers can now take advantage of an innovative amino ether hindered amine light stabilizer (HALS) technology from Clariant, which offers not only high UV protection but also strong resistance to pesticides. Furthermore, products are available that do not filter out UV rays needed by bees.

Hostavin NOW presents a step forward from conventional HALS technology, which is deactivated by agrochemicals. It can be directly added during the production process of agricultural films, saving production costs. It becomes firmly

embedded in the film and cannot be released into the environment, and does not cause obnoxious odors or vapors during production.

The finished films demonstrate a significantly higher resistance against aggressive pesticides, strong sun exposure and high temperatures compared to films produced with conventional HALS. Compliance with standards, such as the CEPLA Di-

rective, with a film lifespan of three years and the use of over 3,000 ppm sulfur as pesticide, not only lowers the environmental effect caused by films thanks to a significantly reduced need for replacement, but also saves time and energy.

Specialty chemicals companies will continue to support farmers in improving yields with minimal environmental effect.

Oliver Kinkel, head of business unit Additives, and Michael Willome, head of business unit ICS; Clariant, Muttenz, Switzerland

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Enriching the Microbiome

BioConsortia Identifies and Develops Teams of Microbes that Help Boost Crops' Yield and Survival

BioConsortia celebrated its first anniversary in March. The innovative agricultural biotech company focuses on the discovery and development of beneficial microbial consortia for improving plant traits and increasing crop yields. Following a funding of \$15 million in March 2014, BioConsortia built state-of-the-art R&D laboratories and brought together a team of biological scientists and agricultural industry executives to further develop its Advanced Microbial Selection (AMS) technology. CHEManager International asked CEO Dr Marcus Meadows-Smith about his strategy to further develop the company and its innovative technologies.

CHEManager International: March marked the one-year anniversary of BioConsortia as the parent company to New Zealand-based subsidiary, BioDiscovery. What have been the most important milestones BioConsortia has reached during the past year?

M. Meadows-Smith: In brief: We completed first-year field trials in corn and wheat with good results and a high degree of consistency, and are expanding on these initial trials in 2015. We built state-of-the-art R&D laboratories and offices in Davis, California. We hired an experienced team of top ag industry executives and accomplished biological scientists. And we raised \$15 million Series B from two long-term sophisticated investors, Khosla Ventures and Otter Capital, to fund our activities and global expansion.

The US organization complements the R&D team and work in New Zealand, where the breakthrough conception of the AMS process was



Dr Marcus Meadows-Smith,
CEO, BioConsortia

made in 2009. What is AMS and how does it work?

M. Meadows-Smith: Advanced Microbial Selection – AMS – is the identification and isolation of strong microbial consortia that are responsible for the expression of targeted traits in plants. AMS is an iterative



process of microbe capture and phenotypic selection, which uses the idea of 'directed selection' to drive a shift in crops' trait performance toward improved yields and survival. Plants naturally accumulate microbes when planted in soil and may attract organisms with a multitude of effects. AMS enriches

this microbiome to identify consortia of the most beneficial microbes. Plants expressing a superior phenotype are chosen and the associated microbes are isolated and identified.

You have done field trials on corn and wheat in the US. What are the results of these tests?

M. Meadows-Smith: Our 2014 testing program consisted of seed treatment trials in corn and wheat across a range of sites in the Midwest. Corn leads were tested in combination with standard chemistry on two different hybrids, resulting in yield enhancement with commendable consistency. Two consortia were tested on wheat in one location, giving double-digit yield increases. The tested consortia were isolated from an AMS process run on corn seed in New Zealand.

Are you developing your process for other plants or crops, and other geographies, too?

M. Meadows-Smith: Yes, the AMS process is applicable to many crops and many traits. Our current focus lies around corn, wheat, soybean, leafy vegetables, tomatoes and pasture — with trials planned in the US, New Zealand, Europe and Latin America.

What topics is your R&D team currently focusing on, and what are your plans to expand your portfolio?

M. Meadows-Smith: Current R&D research is focused on developing consortia to enhance fertilizer use efficiency, general growth and abiotic stress tolerance, such as cold-and-wet and drought resistance. We plan to pursue targets for metabolite expression and biotic resistance in collaboration with others or after our own expansion in the future. For example, corn rootworm is an obvious target in the market, and we believe microbes can provide resistance against this pest.

Given the serious global issues of population growth, malnutrition, climate volatility, and dwindling exploitable resources, do you think that microbial consortia products that enhance crop pro-

ductivity will be able to make a significant impact on these issues?

M. Meadows-Smith: Yes, the products we are developing are designed to help in these critical areas: to fur-

M. Meadows-Smith: Our products are natural probiotics for plants with a scientific rigor that has gone into their discovery and development to ensure they are safe for use in agriculture. The products are produced in a similar way to yogurt and beer,

Markets for microbial biopesticides and biostimulants both have been growing at 10%-15% for the past five years.

ther increase yields in high-production agriculture and the major row crops; help plants tolerate abiotic stress brought about by climate volatility, such as drought or cold and wet spring weather at planting time; and improve use of resources, land and environment with fertilizer use efficiency products.

What is your expectation for the market growth potential of these products?

M. Meadows-Smith: The markets for microbial biopesticides and biostimulants are \$2 billion and \$1 billion respectively; both have been growing

Our products address a need for microbes developed to improve plant traits and increase crop yields.

at 10%-15% for the past five years. We believe the entry of companies such as Bayer, Monsanto and BASF will only accelerate grower adoption and market growth.

Our products fit into these two fast-growing markets, but also address an unmet need for microbes that have been specifically developed to improve plant traits and increase crop yields. As such, we see our products becoming adopted in the \$50 billion seeds and \$160 billion fertilizer businesses, as well as the \$50 billion crop protection and \$2.5 billion specialty fertilizer markets.

There is some consumer concern about agricultural chemistry products such as pesticides, even if they contain the word "bio." What is your response to such concerns?

M. Meadows-Smith: We now have a number of greenhouse, field trials and collaborations underway with leading seed/traits and crop protection companies looking at combinations of their seed with our microbes, looking at improved tolerance to abiotic stress and increased yield. We are also looking at the positive impact of our microbes on non-core crops. All these are covered by confidentiality agreements at this stage. The only collaborations that we have announced is with Ballance Agri-Nutrients, the largest fertilizer company in New Zealand, to jointly develop a microbial product for pasture grass.

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Digital Information in Life Sciences

Is Big Data the Next Big Thing?

The volume of digital information on patients and healthcare systems is growing rapidly. The ability of Big Data analytics to detect patterns, generate predictions, assess risks and test hypothesis based on this enormous volume of data, is turning this technology into a key management decision tool for Life Sciences companies, both in the R&D and the commercial context.

Big Data can be used in a variety of ways to gain insights and support business decisions.

Product Traceability

Today's industrial production lines are constantly monitored by computer controlled sensors while modern logistics systems ensure the real time traceability of products during distribution up to the point of sales. As digitization continues, both manufacturing and distribution processes, will generate increasingly large internal and external data sets. Given accessibility and adequate integration, these data sets can be used to trace each product component back to its source and date of production/purchase, thereby enabling maximum transparency and control in the case of product quality issues/recalls.

Big Data has developed from a trendy catchphrase of the digital age into an increasingly important source of value.

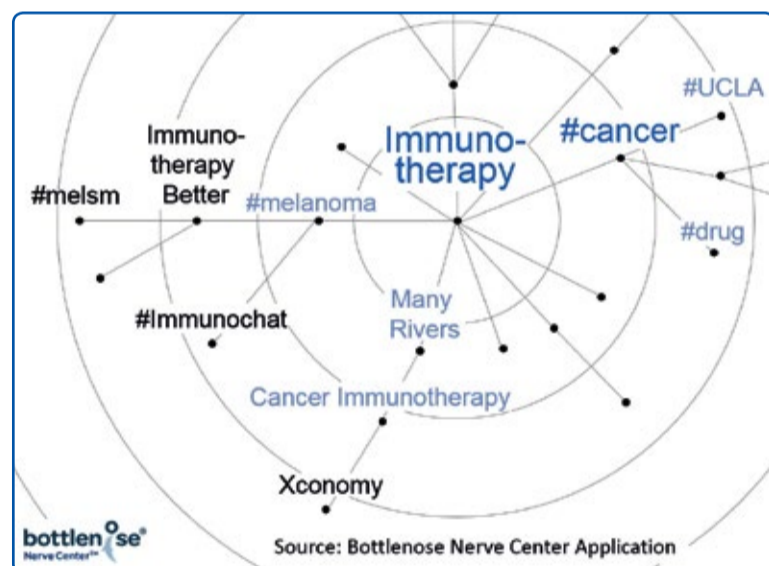
Vir Lakshman, KPMG

Third Party Risk Management

Third party due diligence analytics use external and internal data sources to generate and analyse indicators which allow a quantitative and qualitative assessment of third party risks. Such algorithm-based assessments enable staff to focus on those third parties that require individual in-depth reviews. This reduces the amount of time required for third party due diligence and improves the quality of outcomes.

Real-time Social Media Analysis

Social media data is generated by people whose circumstances, motives and objectives are unknown and might change suddenly and frequently. In this quagmire of social media data lies its value. Targeted systematic social media crawling is able to provide a continuous stream of information on new market trends, changes in consumer behaviour, consumer perception of products, marketing campaigns etc. This technology can provide unprecedented insights into business trends: for instance, the "sonar map" developed by the Bottlenose social media sentiment-analyser highlights connections that might not be obvious at first glance.



It is important to integrate the underlying tools into the wider IT and organizational set-up. From an organizational perspective, it is essential that these technologies are embedded into existing processes – who uses the tool, for what purpose and what are the information flows?

The possibilities are endless. The tools are available. It simply needs a coordinated approach to harness the power of Big Data in Life Sciences.

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PwC Sees Pharmaceuticals, Life Sciences in M&A Surge

The pharmaceuticals and life sciences sectors saw 35 mergers and acquisitions worth \$166.3 billion in the first three months of 2015, a value that eclipsed transactions from all of 2014, says PricewaterhouseCoopers (PwC) in its Pharmaceutical and Life Sciences Deals Insights Quarterly.

According to PwC, the deal value amounted to four times the amount in the previous three-month period

despite the fact that there were only four additional mergers.

By comparison, in 2014 as a whole, 161 transactions totaling \$150.1 billion in value were recorded in those industries.

The analysis also did not include the 49 still-pending deals announced in the first-quarter. These would add another \$76 billion.

In the pharmaceutical industry alone, PwC says the first quarter

saw 18 transactions worth altogether \$97.4 billion. Another 21 pharma deals worth \$62.1 billion were announced in the three-month period, including takeovers of Pharmacyclics by AbbVie and Hospira by Pfizer.

PwC's analysts expect merger activity to remain robust throughout 2015 as companies seek stronger pipelines and expanded capabilities.

The report adds that company divestitures should open more ac-

quisition targets as restructuring in generic pharmaceuticals proceeds. The strength of the dollar is expected to generate additional targets outside the US, while industry consolidation and asset swaps should remain prevalent.

PwC additionally lists disclosed mergers and acquisitions worth at least \$15 million, involving US-based companies active in several areas. (dw)

GSK Chief Witty Questions Pharma M&A Economics

In an interview with the British business daily Financial Times (FT), Andrew Witty, CEO of GlaxoSmithKline (GSK), has questioned the economics of the current wave of mergers and acquisitions sweeping the global pharmaceutical industry.

Witty blames in particular ultra-low interest rates that he says have reduced transactional discipline. "Some of these valuations look stretched," he told the newspaper. "We're not going to get drawn into the idea that just because money is cheap we can do anything."

"Not all new drugs will obtain the high prices needed to justify current valuations," Witty added. "Either only a few will make it and you get really good rewards, or lots will make it, in which case competition is going to bring the price down."

"Believing the pharmaceuticals industry can carry on relying on pricing power and believing, no matter how high the price, no matter how small the patient base, that it is going to be paid for; it is quite hard to see how that carries forward."

The Glaxo chief told the FT that the "artificial high" companies receive from a takeover deal in his view is often not worth the cost. GSK, which largely has stood on the sidelines of the recent M&A rounds, has made "enormous progress" replacing sales lot to generics, but "we've done it without a big deal," he said.

While the approach the UK's biggest drugmaker has taken is more cautious, "I think it is the right one," Witty asserted.

At GSK's press conference to present first-quarter 2015 results, Wit-

ty said the company believes price pressure in the US and European prescription drugs markets will increase because of fiscal constraints and strain on healthcare systems from an aging population.

The CEO said also that GSK's £1 billion cost-saving scheme will be accelerated to deliver its full benefits a year early in 2016, with total annual benefits of £3 billion from restructuring and synergies expected by 2017. Witty also stated that the company has dropped plans to sell part of its HIV drugs unit. (dw)



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Royal Society of Chemistry Symposium
Right on Target: Sector Specific Formulation
This two day international symposium organised by the Speciality Chemicals and the Formulation Science and Technology Groups of the RSC in association with The Knowledge Transfer Network will be held in conjunction with the 2015 Chemspec Europe and Chemsource Exhibitions organised by Quartz Chemicals. It will explore approaches to the control and targeting of chemical delivery to optimise the effectiveness of speciality chemicals in agrochem, biocide, performance chemical, personal care and pharma applications.

Pharma Outsourcing Panel Discussion
The session will discuss approaches to developing global outsourcing strategies, identifying outsourcing partners, identifying approaches to mitigate risks, and addressing challenges associated with outsourcing and how to effectively manage partnerships. Chaired by Dr. Magid Abou-Gharbia, Associate Dean for Research,

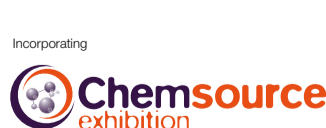
Professor of Medicinal Chemistry and Director of the Moulder Center for Drug Discovery Research (MCDDR) at the School of Pharmacy, Temple University, Philadelphia this debate features a world-class panel of speakers.

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The Future: a Patient-centered Distribution Network

Camelot's Survey Will Give Good Insight into Trends of the Pharma Logistics Industry

Camelot Management Consultants conducted a survey that provides insights into the actual pharma business climate and trends from a global perspective. For CHEManager International, Sonja Andres asked Andreas Gmür, partner and head of logistics practice, Camelot Management Consultants, and Constantin Reuter, principal and head of competence center logistics solutions, Camelot Management Consultants, about the main results of the survey and the different interpretations of pharma logistics necessities around the globe.

CHEManager International: Camelot did a new survey in 2014-2015 about the topic pharma logistics. What has been one of the most surprising results?

A. Gmür: Camelot does a biannual survey on the actual pharma business climate and trends. This issue was focusing additionally on the actual trends for pharma logistics. For me, the most surprising result was to see that approximately two-thirds of the pharma companies that answered the survey have currently ongoing initiatives in changing logistics organization and process setup. Approximately half of the respondents have additionally ongoing initiatives on network redesign and logistics IT setup.

C. Reuter: This is confirming what we have observed in recent projects, where we recognize that logistics topics have increased in significance for the pharma companies. We can see a trend to more regional and global organization for logistics,

compared with the past where distribution was focused more strongly on local or country setup.

A. Gmür: Asking the companies for their key logistics market trends impacting the logistics at the moment the majority is seeing a challenge in products, which required active temperature control as well as traceability and security requirements.

Looking at pharma logistics, what are the main differences comparing with other industries, like automotive or even chemistry?

A. Gmür: Well, the main difference is here the direct impact to the patient, if logistics fails. He or she can decrease his or her life experience dramatically — in the worst case he or she can die! Let me explain this with the example of vaccines. You have products, which have to stay within a temperature range of 2 to 8°C; otherwise a protein chain in the drug could “break” and the product



Andreas Gmür, Camelot

is not able to function anymore as it should in the human body. You may have only one chance to take the drug — so it is all about quality. Quality you have to ensure and to monitor over the whole process starting from sourcing, production, storage and distribution. There is not always an airbag for a second chance.

C. Reuter: Organizing and monitoring these quality requirements along the whole supply chain is a real challenge for the pharmaceutical industry in our days. It is important to understand the logistics market and anticipate the latest available technology into your supply chain.



Constantin Reuter, Camelot

Though, always bear in mind that using a new technology with the target to enhance the logistics and supply-chain quality comes always with a risk, which you have to evaluate and to ensure that it is ready for pharma use. To mention some: central real-time vehicle transport temperature monitoring, new packaging solutions to guarantee temperatures, serialization and cross-company standard barcode usage on labels to prevent mix-ups, and so on.

This in a highly regulated environment of local and international health-care authorities — everything has to be documented according to compliance and quality rules. Not to forget the risk of counterfeit products — so I see security along the supply chain as another important topic for pharma logistics, which was confirmed in our survey.

Can you tell us about the market potential of pharma logistics in Germany, Europe and worldwide?

C. Reuter: We are very excited to see how the logistics market is going to develop in the next five to eight years. We see it as a very prosperous market for the logistics players. For example, the enhanced GDP — good distribution practice — requirements foster a temperature-controlled distribution network offer for 15 to 25°C — not always available in all countries yet. The new development for a more patient-centric distribution and service-focused network strategy of the pharma industry requires other distribution services to the patient. This offers great opportunities for the players to enhance and offer their logistics service portfolio.

A. Gmür: We see three key types of players in the pharma market:

Pharma companies, which organize primary transportation and their manufacturing network themselves; smaller, specialized logistics providers, which are close to pharma companies and often have grown with the pharma company or joint ventures; and pure logistics service providers (LSPs) for warehousing and/or transportation are covering primary and/or secondary distribution services.

C. Reuter: Not to forget, of course, distributors and wholesalers, which also offer logistics service and cover the last mile.

A. Gmür: The market is enormous and the margin very interesting for classical LSPs compared with their classical business. In our study we have seen that the majority of the pharma logistics is already outsourced and approximately a third of the respondents are expecting to increase outsourcing to logistics providers until 2020. The question is how the logistics players are developing their business concept — keyword horizontal and vertical growth.

Is outsourcing still on the radar of pharma logistics as part of the supply-chain strategy?

A. Gmür: Outsourcing is already a fixed part in the supply-chain setup of most companies. Mainly transportation services are outsourced, followed by warehousing and OTC services. A new exciting area is showing up slowly at the horizon — value-added services resulting from enhanced postponement strategies of the companies. A very exciting concept for the potential of decreasing logistics cost and it provides a faster reaction to the market. We feel this will be a focus topic for pharma logistics driven by a more patient-centric distribution network — that is the future!

Patient-centric distribution network sounds unfamiliar to me — please give some more details.

A. Gmür: Several trends in the pharma landscape drive the appearance of patient-centric models' respective “beyond the pill” services. Patient-centric models gain added value by providing extended services for patients and stakeholders acting directly around the patient. In our pharma survey we asked the participants about the key market trends for the next three to five years. Key new market trends compared with

the current situation identified were an expected increase of patient individualized treatments/medications versus standard drugs and an increase of additional patient-specific services, e.g., prescription management, consulting services, products kits, and so on.

C. Reuter: Digital transformation — also on the customer side — will make new information available that can be used to modify business models or their outcome. Imagine what the new wearables, smart watches, could do in the future, starting from measuring patient pulse and temperature, reminding to take medicines or order new ones, tracking the location and delivering differently and more directly to the patients! This will change the business and intra-company collaboration.

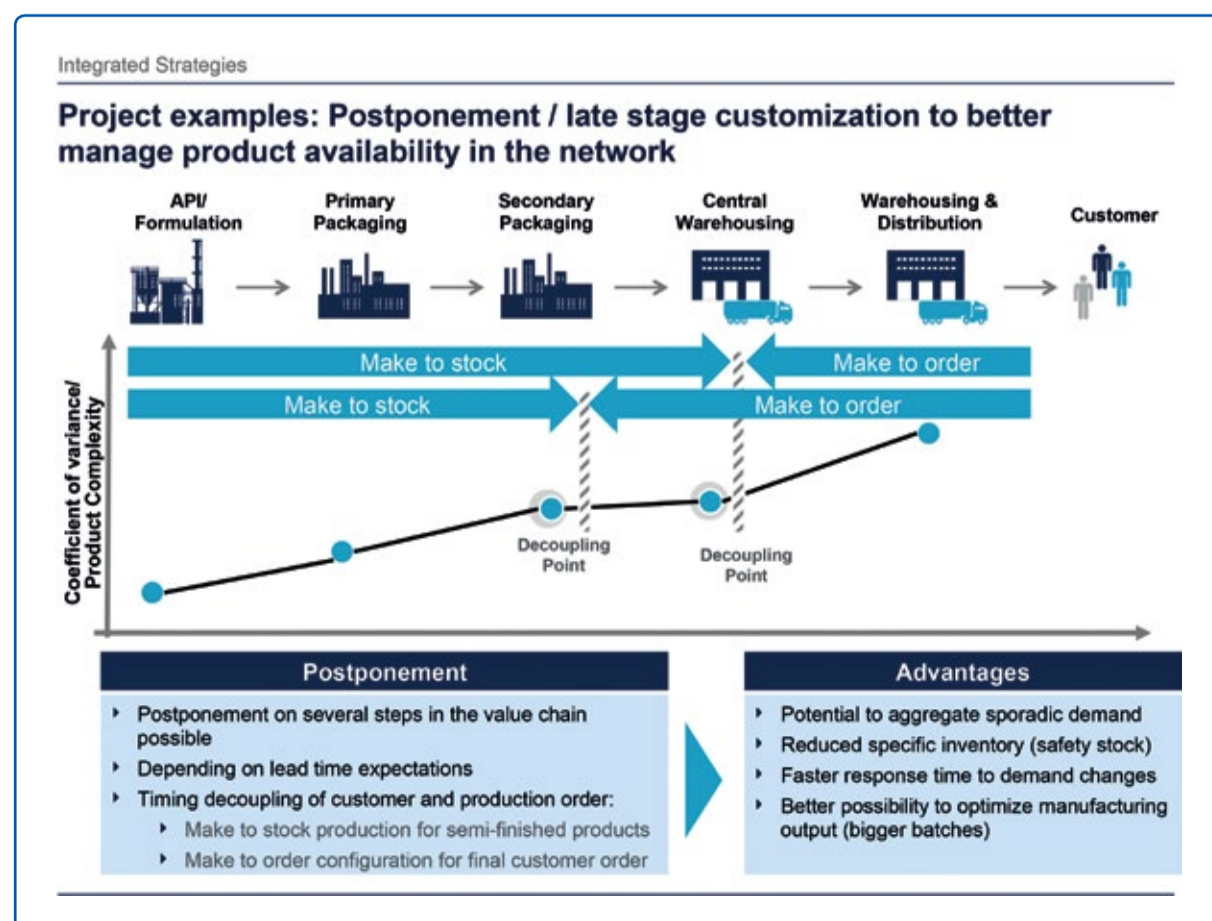
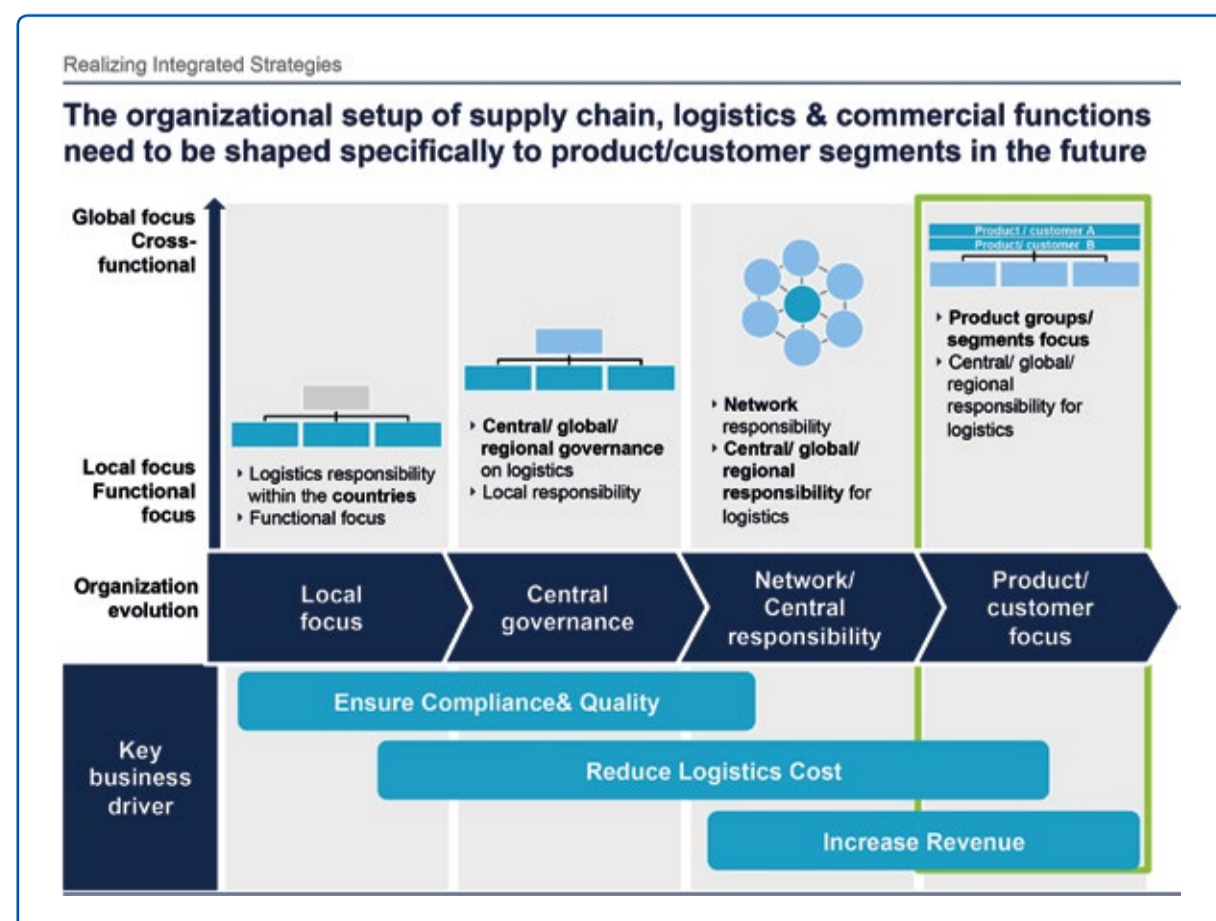
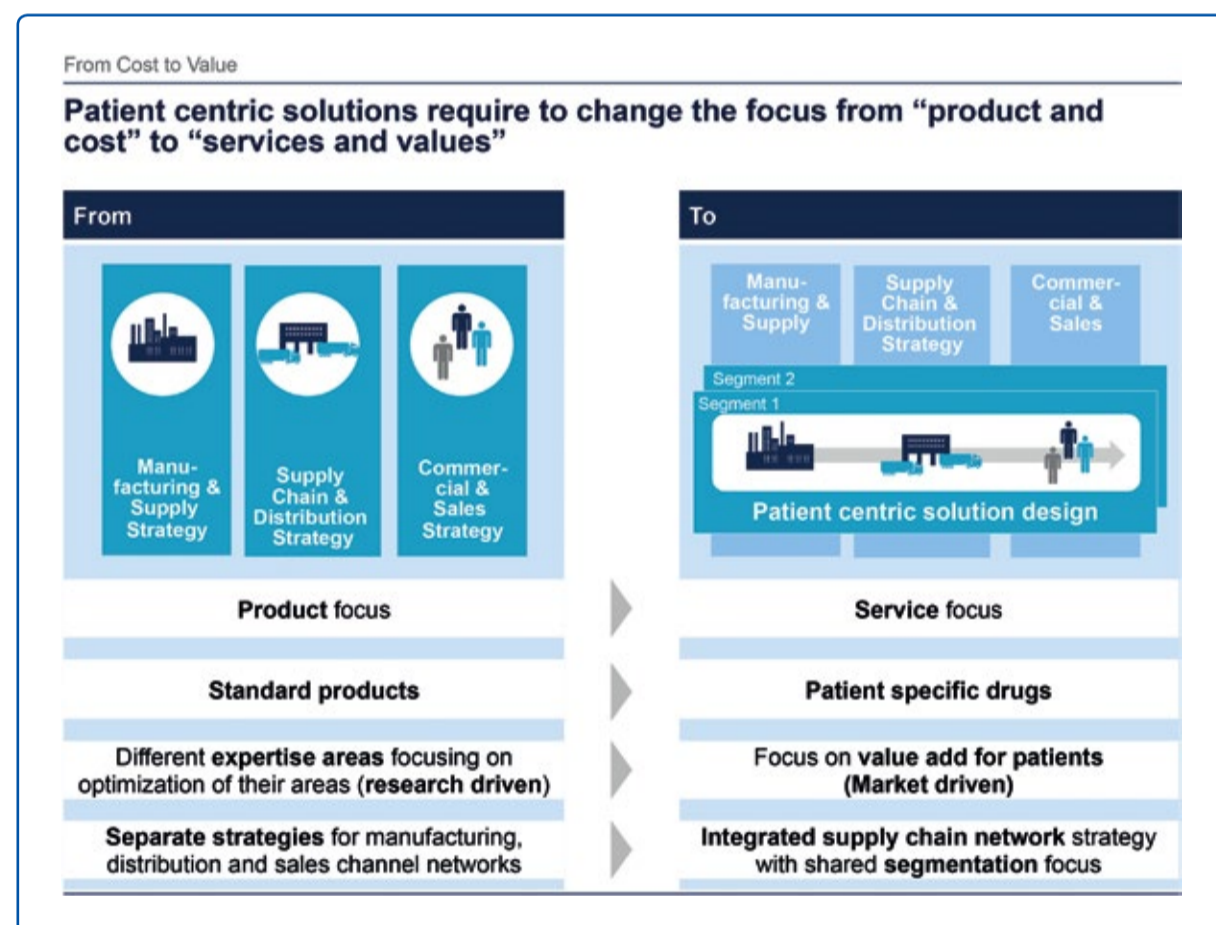
Collaboration is the key, sure. But what will change in the company's organization?

A. Gmür: Today many of the pharma companies still have silo thinking and have, for example, individual strategies for their supply network and distribution network. Our observation, which was confirmed in the survey, is that many companies also have no regular process to align commercial and sales strategies with distribution or supply strategies. Coordination between these organizational silos is for many companies done on an ad-hoc basis. However, a patient-centric solution needs a cross-silo design to be successful — meaning you have a vertical management coordinating over the silos.

Will this development impact the thinking of how logistics as part of SCM should work in the future?

C. Reuter: Of course — transition from a cost focus to value/service focus requires new end-to-end solutions. Paradigm shifts will be the consequence for the supply chain. Closer integration of commercial, distribution, supply-chain and manufacturing strategies is the key to generate additional revenue. Deriving integrated strategies and implementation require organizational and mindset transitions — overcome functional silos. Changes in organization, processes and self-understanding need a clear and well-timed road map.

Read the complete interview on www.chemanager-online.com/en/tags/camelot





Modelling and Simulation

Software tools, computer models increase efficiency and flexibility in process engineering

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Chemical Processes

Process intensification addresses cost, raw material, energy and environmental issues

Page 18

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Pharma Production

Regulations shape the future of pharmaceutical manufacturing, formulation and packaging

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Mega Projects and Complete Packages

Recent Developments and Current Trends in the Chemical Plant Manufacturing Industry

Stagnant growth, a number of regional conflicts and falling prices in global commodity markets had a major impact on the business climate in the German chemical plant manufacturing sector in 2014.



Klaus Gottwald, German Large Industrial Plant Manufacturers' Group (AGAB)

The net result was a curb on demand. Order intake by chemical plant manufacturers which are members of the German Large Industrial Plant Manufacturers' Group (AGAB) fell 12% to €3.1 billion.

Germany No Longer a Core Chemical Plant Manufacturing Market

The industry reported domestic order intake of €167 million in 2014. Compared to 2013 (€117 million), bookings were up 43%, but that needs to be seen in perspective. It is still only roughly half the ten-year average of €320 million. The industry did not really benefit from the roughly €3.5 billion which chemical producers in Germany invested to expand their production capacity in 2014. So why not?

For one thing, chemical producers have their own engineering teams. Third-party large industrial plant manufacturers only get a slice of the project business if special expertise is needed or if companies need help to overcome resource constraints. In addition, most of the expansion and refurbishment projects are below the €25 million threshold. The core expertise of the AGAB member companies which are active in the chemical sector is directed at projects with contract values far above that level. There are a number of engineering service providers in Germany which specialize in small projects and are not members of AGAB, which is a sector group of the German Engineering Association (VDMA). In this segment Germany is no longer a core market for the member companies of the Large Industrial Plant Manufacturers' Group.

International: Large Projects in Russia and the US

Approximately 95% (€2.9 billion) of the order total was placed in international markets. The major growth markets in the chemical plant manufacturing industry were in Eastern Europe. Several large petrochemical projects pushed Russia to the top of the sales rankings worldwide. However the outlook for



2015/2016 is subdued and there are no other large projects on the horizon. Declining commodity prices and EU economic sanctions are exacerbating existing structural problems in the Russian chemical industry such as its strong focus on certain end products and dependency on specific export markets. As the economic situation worsens and investors pull back from Russia, there is currently little likelihood that the modernization projects which are urgently needed will be carried out.

New orders in the US were down from the record level in 2013. However at roughly €400 million, order intake was still very substantial. Low gas prices are stimulating demand, particularly in the fertilizer sector, and AGAB member companies succeeded in acquiring some large contracts in that industry. Follow-on projects in the US and Canada are also expected in the years ahead. Other petrochemical, natural gas liquefaction and synthetic fuel projects are on the horizon. Finally, demand for electrolysis production facilities is also expected to increase. Given the high construction and installation costs and the current decline in oil prices, it remains to be seen whether all of the projects will come to fruition as planned.

AGAB member companies reported a decline in order intake in most of the other chemical plant manufacturing markets in 2014. This was the case in the large emerging markets China and India as well as in Africa and South America. In Brazil,

protectionist tendencies are making the import of foreign industrial goods including chemical plants and equipment increasingly difficult.

Mega Project and Complete Package Trend Continues

The trend towards larger green field projects continues. Demand for these megaprojects is strongest in the Middle East and the US. Although AGAB member companies have acquired some large contracts in the US, general contracting work has been difficult to find in the Middle East. The enormous scale of the projects, the resulting demands on financial resources and execution capabilities and strong competition from Asian industrial plant manufacturers have made it more

difficult to acquire business on the Persian Gulf.

In order to become more competitive in this market environment, chemical plant manufacturers are making massive investments to enhance their EPC (engineering, procurement, construction) expertise and expand their construction and installation capabilities. Utilization of complex IT programs to track progress at the construction sites and the acquisition of construction and installation expertise in core markets such as the US are two of the major challenges. None of this will be possible without a skilled workforce. The industry will have to work in partnership with universities to set up courses of study which meet the needs of the large industrial plant manufacturing industry.

Demand for Local Content

Chemical plant manufacturers are finding themselves increasingly confronted with customer demand for local content. Customers in emerging and developing countries in particular want more and more of the goods and services to be provided in country. In the past that was normally limited to the construction phase, but expectations now extend to material procurement, engineering services and plant staff training. The industry is reacting to these demands by setting up subsidiaries in major core markets. International expansion is generally reflected in the growing number of foreign employees in the German chemical plant manufacturing industry. Besides the 6,200 employees who are based at the sites in Germany, an additional 8,000 people work for these companies at international locations.

Ongoing Expansion of Service Business

In addition to global procurement and the development of modularization strategies, expansion of the service business provides a major opportunity to improve earnings in the chemical plant manufacturing industry. From the industry perspective, this means a package of services for the operational phase such as process optimization and strategies to increase energy efficiency. The service business currently generates around 10% of total turnover

in the chemical plant manufacturing industry. The companies intend to raise that figure above 15% by 2018. There are many reasons why the service business is becoming increasingly important. One advantage is the greater immunity to economic cycles along with bigger margins compared to the conventional plant manufacturing business. It creates the need for a local presence which can unlock the door to future projects and help put EPC capabilities in place in foreign markets. Finally, the provision of support during ongoing operations can help companies quickly identify opportunities for process improvement so that they can optimize their own equipment.

Innovative Strengths and Technology Leadership are Trademarks

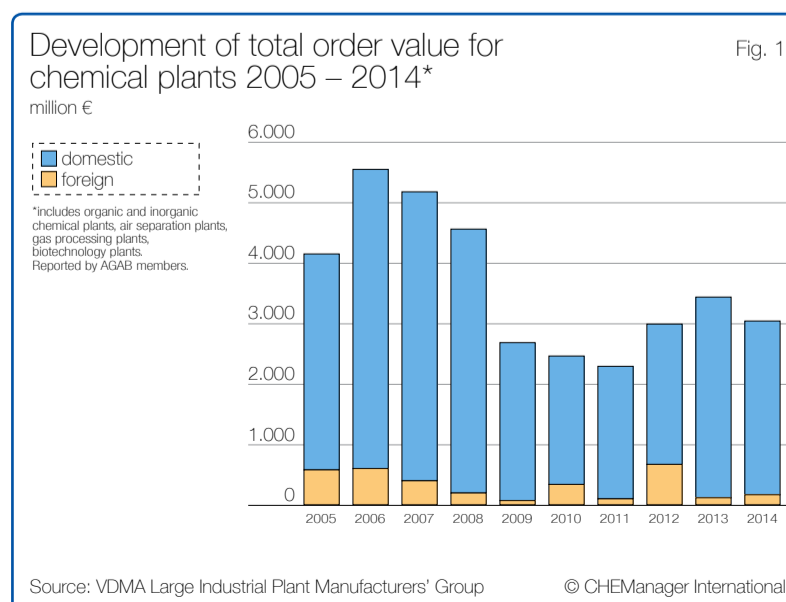
Innovation and technology leadership are still the principle factors which differentiate German and European industrial plant manufacturers from their execution-driven competitors based in North America and the Far East. The challenge remains, however, to convince customers to order leading-edge German equipment which comes with a big price tag. Lower operating costs, higher availability and lower maintenance and repair requirements compared to the competitors are good sales arguments. In addition, industrial plant manufacturers which are members of AGAB also have the capability to maintain and in some instances even operate the equipment which they supply. Demand for these services is increasing, particularly from customers that do not have a lot of engineering depth.

Cautious Outlook

The medium-term market expectations in the chemical plant manufacturing industry remain subdued. A large majority of AGAB member companies expect demand to remain stable at best during 2015. Muted growth prospects in core markets such as Brazil, China and Russia along with a significant number of local trouble spots are the main reasons for the cautious attitude. However, there are opportunities as well. The weak Euro increases the competitiveness of German suppliers compared to companies based in the US and Asia. Lower commodity prices, particularly in importing countries, creates greater room for investment. Reindustrialization in the US has spawned a number of plant construction projects. Finally, the service business is expected to generate sustained growth.

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Weathering Through Market Storms

For E&C Companies Flexible Technology can make the Difference between Success and Failure

With the plunge in oil prices, big operators' oil & gas capital spending is coming under increased scrutiny. Therefore, engineering and construction companies (E&Cs) have a greater need to be more flexible, remain profitable and manage their business through market turbulence. To survive and thrive, contractors need to innovate dynamically across all aspects of their operations and deliver high-quality services in line with market forces. So, how can E&Cs weather market storms and address both operational and commercial needs?

As the relationship between E&Cs and owner-operators changes, contract conditions need to be more closely aligned to the interests of both parties to ensure project scopes are clear and costs do not overrun. Also, when engineering expertise is tight, the workforce tends to be stretched to achieve more with less resource. Owner-operators consider standardized designs as one option to minimize costs. Therefore, partnering with

the right technology vendors with flexible business models can make the difference between success and failure during these uncertain times.

Simplification and Effective Execution

The dynamics of the market reflect a paradigm shift as old plants are phased out in Europe and Asia, while new plants are built in the Middle East, China, Russia and the



Steven Kratsis, AspenTech

US Gulf Coast. This brings great opportunities for E&C companies.

Managing risk plays a key part in the strategy to decrease uncertainty and ensure project estimates track to project performance. Many E&Cs have limited resources. As projects unfold, companies need to do more with less to complete them on time. By improving the bid process, E&Cs can win contracts with more accurate estimating and project execution performance. Project managers can reduce risk and

uncertainty by tracking estimates against performance. By simplifying execution, global teams can contend with resource shortages. However, this can only be done by partnering with vendors who can reliably help throughout the project lifecycle, while maintaining quality standards.

Those E&Cs that can diversify their operations from the oil & gas sector to other markets, like chemicals and mining, will capitalize on delivering high-quality, reliable services to meet client objectives. With the optimism in emerging markets and the positive effect of technological advances, E&Cs see infrastructure development as pivotal to growth. Projects are diverse, ranging from transportation systems, including rail, road, air and shipping networks, through to design and supply of direct fired heaters, complex construction projects for chemicals and refining and project

execution expertise to the minerals and metals sector.

According to a recent study by PWC, "engineering and construction CEOs see technological advances as the top trend which will transform their business. Many called some aspect of technology the "next big thing" to impact their business, citing everything from new applications for formwork to techniques to better manage and utilize data. Most engineering and construction CEOs are optimistic about their ability to keep up—only 33% are concerned about the speed of technological change, compared to 47% overall".

Competitive Differentiator

E&Cs compete on a global basis bidding and executing on complex, large-scale projects. By having an integrated software environment, companies can produce optimal

plant designs quickly and efficiently, incorporating highly accurate cost estimation technology. In addition, these projects require software that enables significant collaboration internally with the owner-operators. For engineers and project managers, having control over changes to specifications or projects is essential in mitigating risk. Engineering projects need to maintain maximum flexibility early in the project cycle.

Technology should be seen as a competitive differentiator and not simply a cost of doing business. Advances in areas like process optimization software help E&Cs broaden their global footprint and strengthen their competitiveness in high-growth, emerging markets. Many companies have adopted the AspenOne Engineering software suite to optimize process designs

Continues Page 15 ▶

Modelling and Simulation

Computer Models Reduce the Need for Real-World Testing in Chemical Process Engineering

As engineers and scientists strive to do more with less, computer modelling has become essential to cut costs, speed development and reduce uncertainty when designing everything from processes to molecules. Flowsheet simulators, a defining tool for every chemical engineer since the 1990s, have seen incremental improvements in power and usability over recent years. Computational fluid dynamics and molecular modelling, in contrast, have had more room to advance, and are now able to replace a great deal of experimental work. Open source simulators offer a serious alternative to commercial software in several areas, while powerful general-purpose modelling tools and "multi-scale" models are blurring the boundaries between different types of simulation.

Prediction is a vital part of the scientific method. Only when we can forecast how a process or a molecule will behave, independently of experiment, can we claim real understanding. Accordingly, mathematical models of physical, chemical and thermal phenomena lie at the core of engineering, many branches of chemistry, and increasingly the biological sciences too.

Much of the mathematics underlying heat and mass transfer dates back to the 18th and 19th centuries. But since it is often easier to write differential equations than to solve them, practical solutions to many engineering design problems had to wait until computers could provide brute-force solutions ("numerical methods").

Since then, advances in computer power and mathematics have enabled both highly complex time-independent optimizations such as protein folding, and also dynamic simulations of gas flows, combustion modelling, and advanced process control.

Multi-purpose Simulators

For many decades, libraries of numerical methods were available on mainframes and minicomputers to anyone with the skill to write their own mathematical models. But this was difficult stuff, often left to departmental experts and not for one-off use.

In the early 1980s the first spreadsheets — VisiCalc and Lotus 1-2-3 — made microcomputers a practical everyday tool for chemical engineers. Spreadsheets made it much easier to solve the com-

plex sets of simultaneous equations that characterize plant flowsheets, and enabled design improvements through a series of "what-if?" calculations.

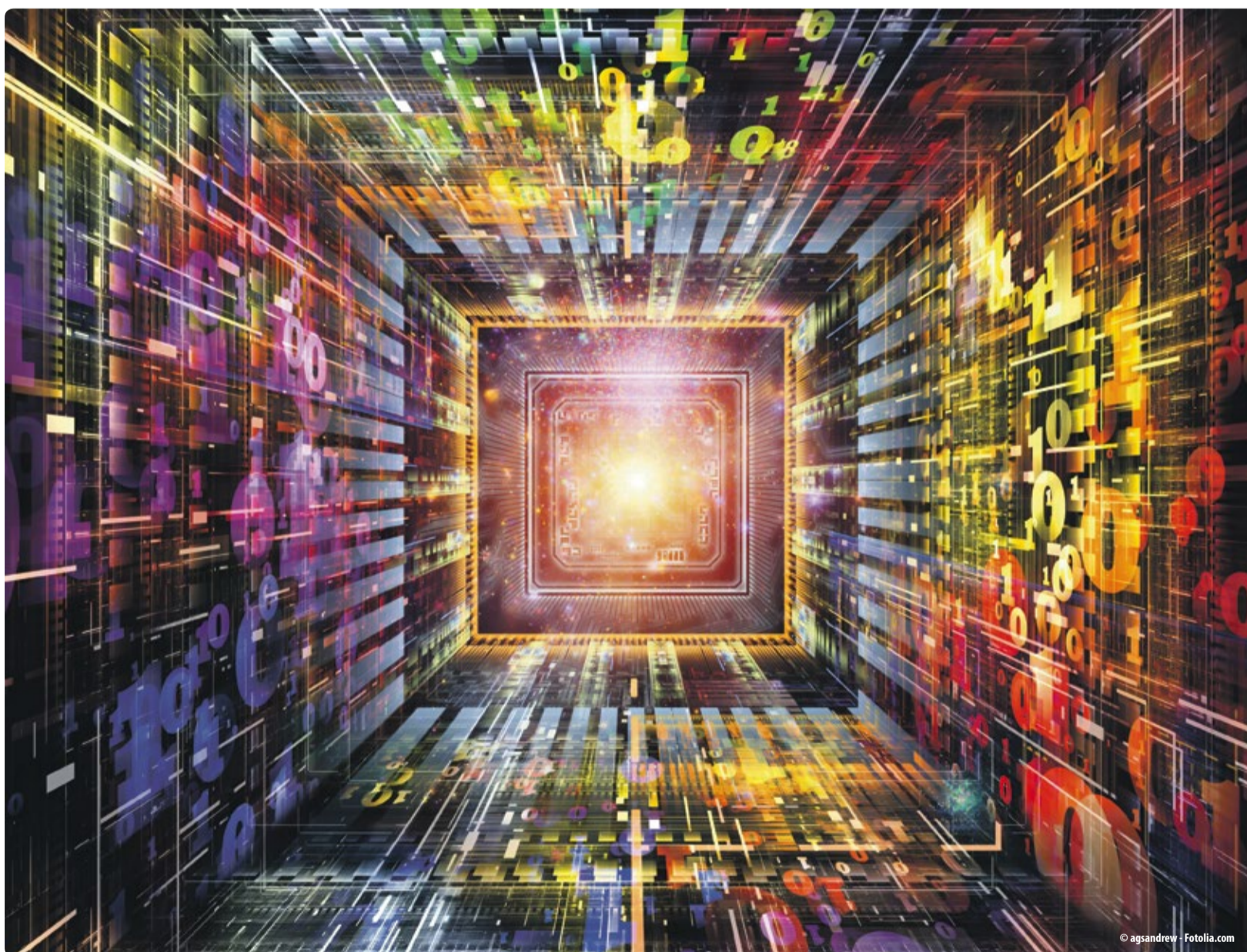
Spreadsheets have now been joined by multi-purpose modelling environments such as Mathematica/Wolfram SystemModeler (Wolfram Research, USA), Matlab/Simulink (MathWorks, USA), and dozens of alternatives. Combining flexibility with great power, these can model mathematical functions, process plants, mechanical devices and electrical systems.

The open source Modelica modelling language, for instance, allows users to create and link blocks of equations describing, say, individual items on a flowsheet. In turn, Modelica can be used with a number of commercial front-ends including Wolfram SystemModeler and SimulationX (ITI, Germany).

For the most difficult tasks, multi-purpose simulators can run on high-performance computing (HPC) clusters, often taking advantage of each server's graphics processing unit (GPU) as well as the main floating point processor (CPU). The most powerful multi-purpose simulators offer ideal platforms for the new trend towards multi-scale modelling (see below).

Computational Fluid Dynamics

Computational fluid dynamics (CFD) uses equations describing turbulence and heat transfer in bulk fluids to model engineering problems involving fluid flow. Applications include aerodynamics, complex flows in reactors and packed beds, dryers



and heaters, and combustion processes, including explosions.

20 years ago the first commercial CFD programs were time-consuming to set up and took days or weeks to solve practical problems. As a result, CFD was used only to confirm final designs or as a troubleshooting measure. Today, software advances and affordable HPC allow CFD to provide useful input much earlier in the design process, and to optimize

designs via repeated simulations, with minimal input from engineers.

Denmark-based hygienic processing specialist GEA Process Engineering, for example, uses CFD to design and troubleshoot spray dryers and mixers for the food and pharmaceutical industries. The company's Drynetics modelling technique, introduced in 2008, combines CFD with real-world measurements on actual droplets and particles.

Simulation is done on a new HPC cluster with 512 cores, 90 TB of disk space and 2 TB of RAM.

Just as with molecular modelling, CFD has now expanded its reach to multiple engineering disciplines and size scales. In fact, the lines between CFD and structural mechanics — finite element analysis (FEA) — are now so blurred that it makes little sense to refer to "CFD" at all, claimed Bill Clark, Executive Vice President of US simulation company CD-Adapco recently.

As simulation increasingly replaces physical testing, simulation specialists face a great deal of responsibility to come up with the right answers. At the same time their jobs are becoming harder as the problems get bigger. "Custom-

ers want to see the big picture, with whole systems rather than individual components, and there are really no easy problems left to solve," Clark said.

CFD codes such as Star-CD and Star-CCM+ from CD-Adapco, and Fluent and CFX from Ansys (USA), the largest commercial CFD supplier, combine good performance with an all-in-one approach that can make them a good choice for firms new to CFD, notes aerospace CFD expert Dr Chris Nelson. On the other hand, solutions based on separate components — grid generator, flow solver and post-processor — can be more powerful.

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Achema Trend Report

The article is based on a trend report commissioned by Dechema and written by international trade journalists. Dechema brings together experts from a wide range of disciplines, institutions and generations to stimulate scientific exchange in chemical engineering, process engineering and biotechnology. Dechema is globally known as the organizer of Achema. The world forum and leading trade show for the process industry will again take place 15 – 19 June 2015 in Frankfurt, Germany.

Continued Page 14

for energy use, capital and operating costs and product yield through the use of activated energy, economics and equipment design during the modelling process. AspenOne Engineering enables E&C companies to bid and perform projects with lower cost and company risk.

In addition, partnering with a technology vendor brings significant commercial benefits in the form of its business model. With AspenOne Licensing Model, E&Cs have access to all products in the AspenOne suite and can use software tools on a 'check out - check in' basis and track the usage whilst adjusting when and where the software is used based on their changing business requirements. As business priorities evolve, this flexible software model transforms the way companies can conduct business, whether the software is installed on premises or in the cloud, customers have access to the full range of innovative software applications to meet project demands.

For example, if an E&C is using Aspen Hysys to produce engineering models for the oil & gas market, they can switch their tokens to

adopt Aspen Plus to produce and optimize process models, including best-in-class physical properties, to support customers in the chemical industries. Common and intuitive user interface with the tools allow engineers to easily switch between applications. Embedded training in the software tools allows quicker learning and interaction to help speed up knowledge when engineering staff may be new to the company or unfamiliar with key project software technology.

A leading European E&C recently demonstrated the principle dynamics of diversification by using the AspenOne suite to adapt and support its commercial needs. In 2012, when the oil price reached a high of \$125 per barrel for Brent, the focus of engineering tools used was on hydrocarbons. Crude oil prices fell during the second quarter of 2012 as a result of lower oil demand and the global economic slowdown. By the end of 2014, Brent crude oil prices ended at around \$58. Reflecting this trend, the large European E&C's software usage shifted towards a more diverse range of tools to support other industries, including chemicals, metals and



mining, heat exchanger engineering projects through to the use of more dynamic simulation software. This proved to be an enormous commercial advantage, using both the AspenTech License Model and the comprehensive software suite of

tools to help mitigate risk and adapt to market fluctuations.

Innovation and Business Growth

The engineering design and construction industry is rapidly changing

against a backdrop of fluctuating oil prices and intense competition. Today, the markets are open to global trade allowing capital investment, skills and technology to move freely across borders and increase business opportunities. Agility is essential to

respond quickly to change and being flexible requires organizations to build long-term partnerships with technology vendors to meet demand and support customer needs. Crucially, with the right software tools E&Cs can successfully achieve competitive edge. The biggest capital project opportunities worldwide exist in the midstream and upstream, including gas production, oil production and gas processing. This requires better and more efficient ways of executing projects. As the market continues to show signs of turbulence, flexibility in the engineering of facilities is extremely important.

Business is becoming more complex. If E&Cs are to weather the storm in the energy markets, access to a flexible and scalable software model helps E&Cs compete and survive while capitalizing on growth opportunities in established and emerging markets alike.

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Also to consider are the many excellent open source CFD codes, of which OpenFOAM (ESI Group, France) is possibly the best known. Dr Ma Shengwei of the Institute of High Performance Computing, Singapore, says that open source CFD can be just as good as the commercial version ("there are almost no secret recipes"), but depends on skilled personnel and so is not necessarily cheaper.

Flowsheet Simulation

Flowsheet simulation lies at the heart of chemical engineering. Its foundations are mass balances, energy balances, mass transfer, heat transfer, phase equilibria, and reaction modelling.

Compared to molecular modelling or CFD, steady-state simulators are relatively undemanding in terms of computing power. Combined with their smaller market, this means that vendors are more likely to differentiate themselves on the basis of industry focus, ease of use, customer service and license costs than on pure technical performance.

For the oil, gas and chemical industries the traditional market leaders are Aspen Hysys (hydrocarbons) and Aspen Plus (chemicals) from AspenTech; UniSim (developed from the same code base as Hysys) from Honeywell; and SimSci Pro/II from Schneider Electric. ProMax from Bryan Research and Engineering is a strong challenger to Hysys and UniSim, especially among smaller customers. Other important players include ChemCAD (Chemstations), Design II (WinSim), ProSimPlus and the Simulis family (ProSim), and VMGSim (Virtual Materials).

Alongside their flowsheet simulators, all the large vendors supply packages and tools aimed at specialist industries (e.g. fuel cells), processes (e.g. crude units), equipment items (e.g. heat exchangers), and design techniques (e.g. heat recovery networks and financial analysis). Since flowsheet modelling depends on accurate characterization of individual feedstocks and products, databases of physical properties and predictive "equations of state" are key to every simulator. The gap between physical property data within any database and the models within the simulators can either be closed by us-

ing specialized software tools like Dechema's Data Preparation Package DPP (Dechema) or in most cases also with inbuilt tools from the different vendors.

Several of the original flowsheet simulators, notably Aspen Plus, have their roots in publicly funded research projects, and open source competitors are available, though not to the same extent as in CFD. A recent review of the open source DWSIM simulator rated it comparable in some ways to Aspen Hysys, ProSim and VMGSim. Both DWSIM and another open source simulator project, EMSO, originate in Brazil.

Different from open source software, but with a similar aim of promoting transparency, is the veteran Cape-Open project that sets standards for the interchange of data in chemical process modelling. A simulation package that complies with Cape-Open standards, for instance, can draw on different physical property databases and add in third-party unit operations such as novel reactor types, as long as these too meet Cape-Open standards.

Process plants rarely operate entirely under steady-state conditions. For complex processes, dynamic effects may dominate operability and safety, especially during startup and shutdown. Many vendors therefore offer dynamic modelling capabilities through either their standard flowsheeting tools or dedicated products. An example of the latter from AspenTech is Advanced Process Control, part of the company's AspenOne suite, which aids the design of complex control strategies to keep processes running under optimum conditions. Operator training is another important sector for dynamic simulation.

The multi-physics and multi-scale modelling discussed above has direct application to process plant modelling, too. A leading proponent of this "advanced process modelling" approach is Process Systems Enterprise (PSE, UK), with its gPROMS product. Through system-wide optimization based on first-principles models at multiple scales, PSE claims that gPROMS can create benefits beyond the scope of traditional flowsheet simulators.

Dechema Gesellschaft für Chemische Technik und Biotechnologie e.V., Frankfurt am Main, Germany

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Sophisticated Process Technology in Biogas Plants

Gas Measuring Devices Assure Process Flow and Gas Quality

The liberalized gas market is providing new marketing opportunities for biogas plant operators. Linked to that is the increasing importance of suitable gas measuring technology. Powerful, easy to handle, and reasonably-priced devices are available for this.

Biogas plants are often not, or not yet, perceived for what they really are — namely, an important factor in the effort to achieve a secure and increasingly renewable energy supply. The 8,000 plants in Germany today represent an electrical capacity of almost 4,000 MW, which corresponds to the capacity of several nuclear power plants. You can't tell by looking at these compact plants, which are often integrated in the landscape, that a technologically sophisticated and economically important process is running there day after day.

Liberalized Gas Market Provides Opportunities

The importance of biogas plants has further increased since the "Internal energy market in the European Union" was regulated by Directive 98/30/EC and later by Directive 2003/55/EC. These rules apply to the gas market, which is understood to

include natural gas, liquefied natural gas (LNG), biogas, and gas from biomass. The Directive expressly provides for the right of free access to natural gas networks and LNG plants by third parties ("liberalization of the gas market"). Accordingly, the EU member states must ensure that suppliers of gas from biomass and other gas types, taking into account quality and safety requirements, can freely access existing natural gas networks for feed-in of their products.

Some German biogas plant operators have already taken this path. Others will follow in view of the now unhindered network access. All will be obligated to control their plants in such a way that the biogas, or biomethane end product derived from it, meets the specification of the respective system operator prior to feed-in. This calls for the use of measuring technology to determine the gas composition and other gas parameters at various points of the plant.

Behind the often simple appearance of a biogas plant is a sophisticated process technology that produces high-quality combustion gases from manure, waste materials, and/or plant material. This multi-stage, time-consuming conversion process (fermentation with hydrolysis and methanation) runs largely automatically, given the right process conditions: temperature and pressure,



raw material feed, gas composition, fraction of contaminants and inhibitors, and much more. "Everything has to be right" — that is the responsibility of the measuring technology, which keeps the whole process under control and signals automatically if anything gets out of control. This enables prompt counter measures to be taken and protects the operator from high financial losses, where applicable.

Powerful and Affordable

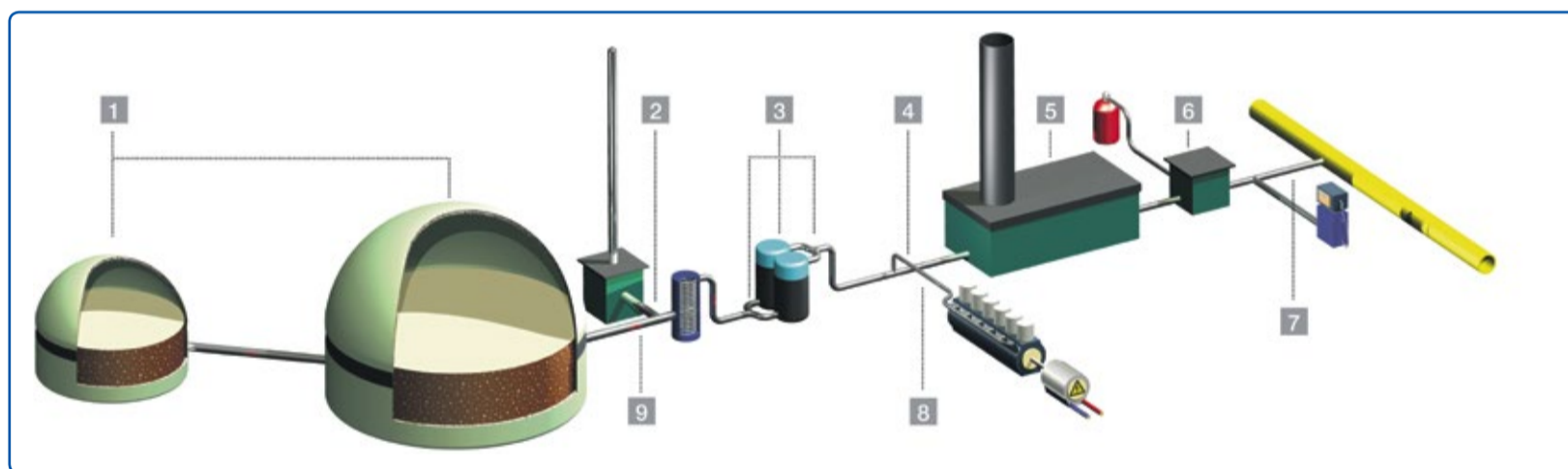
Users have had and continue to have different views of the importance of measuring technology in biogas plants. Some take the use of modern measuring technology for granted (as is the case throughout the process industry) when it relates to safety, quality, and economic operation of a production process. Others view measuring technology

as complicated and expensive and unnecessary in many cases. The truth is that correctly dimensioned

sign suitable for use in harsh environments and can be adapted to the particular application. Technological highlights include the continuous direct measurement of the Wobbe index, a patented measuring technology for analyzing the H₂S concentration, and the miniaturization of gas detectors with calibration stored directly on the detector unit.

There is a need for reliable and cost-effective monitoring of the composition, energy content, and volume of biogas and biomethane at various points in a biogas plant, including at the fermenters, flare, gas purifier, and gas engine and where the biogas is processed into biomethane and fed into a gas system. That is familiar terrain for Union Instruments. The highly reliable, moderately priced devices of the INCA and CWD series configured for the specific application have proven very effective here. The two devices cover all gas analysis requirements of a modern biogas plant. Sample stream switchover enables one device to monitor multiple measuring points. The "everything from one

Behind the often simple appearance of a biogas plant there is a sophisticated process technology.



Gas analysis measuring points of a biogas plant: 1: Fermentation (INCA), 2: Flare (INCA), 3: Gas purification (INCA), 4: Raw gas billing (CWD), 5: Processing (INCA), 6: Conditioning (INCA), 7: Biomethane feed-in (INCA, CWD), 8: Gas engine monitoring (INCA), 9: Raw biogas volume measurement

and operated measuring technology works reliably, assures the process and the product quality, prevents bad batches, and is, above all, affordable, as shown by the devices of Union Instruments, for example.

This 90 year old German company has concentrated from the outset on development and production of measuring devices for the gas market with special emphasis on the mine gas market in the steel and glass industries and, for over 10 years, on the biogas market. The modular CWD (continuously measuring combustion calorimeters) and INCA (extremely flexible gas analyzers) device series have a robust de-

source" concept also includes the supply of occasionally needed gas volume measuring technology and a recently introduced service offer that provides periodic services at attractive prices, thus further increasing the operational reliability of the plant.

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Oman Oil and Oxea in Graduate Program With GÜtech

Oman Oil Company (OOC) and its chemicals subsidiary, German chemical producer Oxea, have agreed to establish a graduate program with the Germany University of Technology (GÜtech) in Maskat, Oman.

As part of the program, the Omani students of engineering, finance, marketing and sales from Oman will spend time at OOC, learning the company's technology and improving their German language skills at GÜtech, before transferring to Ger-

many or the US for at least two years to further their education and work at one of Oxea's production sites.

Following their return to Oman, the students will be expected to support the development of the country's Duqm economic zone, where a refinery and petrochemicals complex currently taking shape is hoped to attract thousands of dollars in investment and create thousands of direct or indirect jobs in the coming years. (dw)

DuPont Faces Fines in Safety Investigation

The US Occupational Safety and Health Administration (OSHA) has announced an enforcement action against DuPont in connection with an incident that killed four workers at its La Porte, Texas, plant in November 2014. OSHA also identified a number of unspecified safety upgrades DuPont must implement to prevent future accidents.

The workers who died were exposed to methyl mercaptan gas when opening a drain on a vent line, the investigation showed.

DuPont was cited for 11 violations, one repeat violation, nine

serious violations and one "other than serious" violation. The repeat violation pertained to the lack of training for employees on using the building's ventilation system and other safety procedures — for which the company was also cited in July 2010.

The agency has proposed penalties totaling \$99,000.

The La Porte accident, one in a series of serious and less serious mishaps at DuPont's US plants in the recent past, according to news reports, was also being reviewed by the US Chemical Safety Board. (dw)

DSM and Ascend in Global PA 6.6 Compounds Alliance

Dutch chemical producer DSM and US-based Ascend Performance Materials, the former Solutia polyamide business currently owned by private equity investor SK Capital, have formed a global strategic alliance for compounds based on PA 6.6.

Ascend will become the strategic supplier to DSM for base polymer used to produce its Akulon PA 6.6 compounds for engineering plastics applications. At the same time, the Heerlen-based company will globally distribute Ascend's portfolio of PA 6.6 compounds sold under the brand name Vydyne.

DSM is already a major developer and global supplier of polyamide engineering plastics with a portfolio including in addition to PA 6.6 several other high performance polyamides such as its Stanyl brand PA 46, its Stanyl ForTii and EcoPaXX.

Harwick Standard to Distribute Lanxess Elastomers in Eastern US

Lanxess Corp. has named Harwick Standard Distribution Corp as its distributor for high-performance elastomer products in the eastern US region. The distribution pact

a bio-based PA claimed to be completely carbon neutral.

In addition, DSM manufactures thermoplastic polyesters PBT and PET (Arnite) as well as TPE (Arnitel) for engineering applications.

One of the largest producers of PA6.6 resin worldwide, Ascend is fully back-integrated into the key chemical intermediates adiponitrile, hexamethylene diamine, and adipic acid.

Through its Vydyne PA66 resin and compounds, the US company said it is focused on growth in engineered plastics applications.

At Pensacola, Florida, on the US Gulf Coast, Ascend operates what it claims is the largest integrated site for PA 6.6 worldwide. Also in the US, the company recently added a state-of-the-art 30,000 t/y compounding plant at Greenwood, South Carolina. (dw)

Songwon Agrees One-Pack Systems JV in China

Korean chemical producer Songwon has signed a joint agreement with China's Qingdao Long Fortune Chemical & Auxiliary (QLF) covering production and sale of its One Pack Systems (OPS) and the sale of polymer stabilizers in China.

The JV will be based in the Qingdao area of eastern China, and the agreement further includes investment in a state-of-the-art OPS plant in the Pingdu County industrial park. Construction is planned to start at the end of the second quarter with full run expected by the end of the first quarter of 2016.

Songwon said the new facility will provide customers with

innovative additive formulations in customized, dust free and easy disposable product forms. This, it said, positions the JV to become a preferred supplier to the polymer industry in China.

Jongho Park, CEO of the Korean company, said the partnership with "a competent partner that has such a superb reputation among all the major Chinese polyolefin manufacturers" offers Songwon the opportunity to build a manufacturing presence in China and further strengthens its ambition to become a leading polymer stabilizer supplier in this important region. (dw)

Nippon Shokubai to Upgrade Antwerp Acrylics Output

Nippon Shokubai has earmarked €350 million for the expansion of its production facilities for its super absorbers and construction of an acrylic acid plant at Antwerp, Belgium.

The planned expansion adding 100,000 t/y is due to start up in May 2018, nearly tripling the current 60,000 t/y capacity at the site. Overall, the project will lift Nippon

Shokubai's global super absorbers and acrylic acid capability to 710,000 t/y and 880,000 t/y respectively. The Japanese producer is also planning to build a new 50,000 t/y plant for super absorbers at Himeji, Japan, which is due to be completed in June 2016. Nippon Shokubai estimates steady demand for the absorbent polymers used in disposable diapers. (dw)

Perstorp Inaugurates New Oxo Plant in Sweden

The expanded oxo capacity at Swedish chemical producer Perstorp's Stenungsund plant is now operating at full run, the company said (c.f. interview on page 4).

The plant, touted as the single largest investment in Perstorp's history, will significantly boost its output of valeraldehyde and 2-propyl heptanol (2-PH), two key raw materials for the general purpose PVC plasticizers marketed under the Emoltene 100 and Pevalen brand names.

Perstorp now claims to have one of the few fully integrated platforms in Europe providing ready access to high performance, sustainable and cost-effective plasticizers. The 2-propyl heptanol made in the new plant will feed production of lubricants, adhesives and surfactants. The company's renewable n-valeric acid, made directly from valeraldehyde, is an important raw material for lubricants, pharmaceuticals and fragrances.

Jerker Olsson, vice president of the Oxo business unit, said the up-



stream integration into essential raw materials, which raises Perstorp's total oxo capability by 150,000 t/y, "greatly strengthens its position as a reliable supplier of innovative plasticizers to the PVC market."

Emoltene 100, based on DPHP and used in cables, wires and roofing membranes, "is one of the thoroughly tested phthalate plasticizers on the market," Perstorp asserts.

The non-phthalate plasticizer Peval meets the safety and performance requirements of close-to-consumer PVC applications such as flooring and coated fabrics, it adds.

The Swedish Chemicals Agency has urged the phase-out of a number of phthalate-based plasticizers but has listed the less toxic phthalates DIHP, DINP, DPHP as possible alternatives. (dw)

Air Liquide Adds Third US CO₂ Liquefaction Plant

Air Liquide Industrial US LP has commissioned a new 450 t/d carbon dioxide liquefaction plant in Tulare County, California, bringing to three the number of carbon dioxide liquefaction facilities it owns and operates in the state.

The new state-of-the-art facility captures CO₂ emissions from an ethanol plant owned by Calgren Renewable Fuels, then purifies and liquefies it to meet the specifications of the di-

verse food, beverage and manufacturing industries in the region.

Liquid carbon dioxide provides manufacturers the benefit of quickly freezing and preserving their products and also helps maintain safe temperatures that improve quality in certain manufacturing processes, the US subsidiary of the French gases producer explains.

Air Liquide owns and operates 11 other carbon dioxide liquefac-

tion facilities in the US, all of which have received the Food Safety System Certification 22000 („FSSC 22000“), an internationally recognized standard for food safety systems.

The plants are located in Delaware City, Delaware; Martinez, California; Sioux City, Iowa; Wood River, Illinois; Washington, Indiana; Wilmington, California; and, Donaldsonville, Louisiana. (dw)

Jacobs Wins EPCM Services Contract for Sadara

Sadara Chemical Company, the joint venture of Saudi Arabian Oil Company (Saudi Aramco) and Dow Chemical, has awarded a four-year contract for engineering, procurement and construction management (EPCM) services at Saudi Arabia's Jubail Industrial City II to Jacobs Engineering of the US.

With a total investment sum of \$20 billion, Jubail is being billed as the world's largest chemical complex

to ever be constructed in a single phase. It will be home to 26 world-scale manufacturing plants with altogether 3 million t/y of capacity.

The vast site, which Sadara claims will "transform the chemicals landscape of the Kingdom," will supply a wide range of upstream and downstream products, including many not previously produced in Saudi Arabia. These will include the country's first isocyanate and polyol

plants, whose output will be used in polyurethanes production.

Under the terms of the contract, for which no value has been disclosed, the US engineering group said it will provide both In-Kingdom and Out-of-Kingdom EPCM services to Sadara. The In-Kingdom input will be delivered from Jacobs' local operations in Saudi Arabia with support from its extensive global network. (dw)

Dow Starts Polyols Plant in Thailand

Dow Chemical has started up a new 200,000 t/y polyether polyols plant at Map Ta Phut, Thailand.

The facility using DMC catalyst technology will join a propylene glycol plant opened earlier at the integrated Thai site. Together, the two production units will provide a captive outlet for propylene oxide produced there.

Start-up of the polyols plant completes Dow's site integration model and further strengthens its presence in Asia-Pacific, said Peter Sykes, president of Dow Asia Pacific. "In view of the rapid market growth in the region, the US chemical giant is constantly striving to meet evolving

market needs while identifying new ways to accelerate its own growth," he remarked.

Through the use of "cutting-edge technologies," facilities such as these can reduce their energy consumption and waste water generation by 50-70% and eliminate 100% of solid waste, said Jirasak Singmaneechai, managing director of Dow Thailand.

Dow recently expanded its global polyols capacity through debottlenecking at Freeport, Texas, in autumn 2014. In 2016, the group plans to bring on stream a new 390,000 t/y polyether polyols plant at its Sadara joint venture with Saudi Aramco. (dw)

AkzoNobel to Build €30 Million Coatings Plant in Thailand

Dutch chemical producer AkzoNobel has announced it will spend more than €30 million on a new Performance Coatings plant in Thailand to support regional growth of the business. The project is being supported by the Thailand Board of Investment.

The new facility with an initial capacity of 45,000 t/y will be built on a 120,000m² site in the Hemaraj Eastern Seaboard Industrial Estate in Chonburi. Start-up is scheduled for the third quarter of 2016.

Akzo said the new plant will support several of its Performance Coatings businesses, including Metal Coatings, Protective Coatings, Spe-

cialty Coatings and Marine Coatings, as well as certain products from its Decorative Paints business.

"By investing in this new facility we are supporting our continued growth within Thailand, as well as making progress with our regional business expansion strategy," said AB Ghosh, managing director of the Metal Coatings business. "A number of existing operations will be consolidated into the new site, allowing us to achieve world class operational standards," he added. Thailand is a key market for the Dutch company, said Conrad Keijzer, executive committee member responsible for Performance Coatings." (dw)

German Plastics Output Declines

German plastics production volumes declined by 2.5% to 19.4 million t in 2014, the national sub-group of PlasticsEurope said in its annual report. Full-year sales revenue across the industry increased by 1% to €27 billion.

Exports of plastics made in Germany rose by 2.7% to 12.6 billion valued at €23.5 billion. In volume terms, imports of plastics into the country rose by 3.4% to 8.8 million t, valued at €15.1 billion.

In line with previous years, some 72% of German plastics sales outside its national borders went to the EU 28, with Italy, France, Poland and the Benelux countries the most important customers. Nearly 90% of plastics imports came from the EU 28, led by Belgium and the Netherlands.

The figures also encompass companies' internal product movements.

Commenting on the climate for the German plastics industry, Josef Ertl, president of the PlasticsEurope sub-group and CEO of PVC producer Vinnolit, said producers are still having to contend with price and currency fluctuations within Europe and elsewhere as well as a slowdown in growth in major emerging markets such as China and geopolitical issues.

Noting that conditions for producing plastics in Europe have deteriorated, Ertl blamed excessive regulation, high energy prices and competition with US producers having access to cheap feedstocks as well as competition with cheaper Asian producers. (dw)



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Looking Forward

VEGA

New Challenges Demand New Processes

Process Intensification Addresses Pressures on Cost, Raw Materials, Energy and Environmental Issues

Despite their innate conservatism, the chemical, pharmaceutical, oil and gas industries are always looking for new products that are more effective than those they replace, or cheaper, more environment-friendly routes to existing products. Developing a new process can take up to a decade and requires co-ordination between professionals from several different cultures, often spread across the globe. New computer simulation techniques work alongside traditional scientific and engineering creativity to develop safe, economic and sustainable manufacturing processes.

Process development bridges the gap between laboratory test-tubes and commercial-scale plants. The substance being manufactured could be a bulk chemical to be shipped in thousands of tons, or a biopharmaceutical made on a kilogram scale.

If the product is new to the market, the aim is to develop a process that is acceptable in terms of product quality; plant safety and environmental impact; capital and operating costs; and commercial risk, including time to market.

If the product is well-established, the developers will typically strive for a process that out-performs the established route. They may also wish to bypass intellectual property (IP) restrictions that tie a particular process to a competitor, assuming the product itself is not patented.

Process development is grounded firmly in science and engineering, but its broad scope, multi-disciplinary nature and creative content require a lot of management skills too.

Oil refiners and manufacturers of bulk chemicals face huge pressures on cost and reliability, so they need to get their process designs right first time. Drugs manufacturers have the extra constraint that pharmaceutical processes are very hard to change once they have been validated by the regulators. Between these size extremes, makers of fine chemicals need flexible plants to accommodate frequent changes of product and process.

Measuring their development cycles in years and their plant lifetimes in decades, the process industries are famously conservative when it comes to adopting new technologies. Process designs do evolve, however, driven by factors including:

- improved unit operations (process intensification) and catalysts;
- new design methods (computer simulation and equipment networks);
- new methods of monitoring and control;
- new constraints on raw materials and utilities such as energy and cooling water;
- new pressures on safety and environmental performance, including the trend towards bio-based feedstocks;
- new business and legislative pressures (e.g. the need to get to market faster).

Unit Operations and Improved Chemistry

Unit operations such as chemical reactions, mixing, liquid-liquid extraction, filtration and drying form the heart of every traditional chemical process. Changes at this fundamen-

tal level tend to have the biggest effects on process development.

Batch reactors are flexible and aid product traceability, so they are traditionally favored for fine chemicals and pharmaceuticals. Continuous reactors, on the other hand, are inherently more cost-efficient, easier to scale up, and often safer. Recent news of continuous processes for aromatic amines in the pharmaceutical industry, and intermediates used to make the herbicide glyphosate, show that the decision to use batch or continuous is still not always clear-cut.

Catalysts are a vital part of many industrial processes and an area of rapid development thanks to improved computer simulation and automated screening technologies. A more selective catalyst can increase yields and eliminate the need for a downstream separation stage, while new catalysts can create new products. For instance, Jowat (Detmold, Germany) is using a process developed by Novomer (Waltham, USA) to produce polypropylene carbonate (PPC) polyol, a "green" polymer that can be made from recovered carbon dioxide. The Novomer process depends on a proprietary cobalt-based catalyst. "Process intensification" refers to techniques for reducing plant footprint or energy use by combining operations or increasing driving forces. An example is reactive distillation (see below), which can reduce plant complexity by performing chemical reaction and separation in the same column.

Machines that combine mixing, thermal processing and evaporation of viscous products are a specialty of the German-speaking countries. By replacing multiple separate items of equipment and reducing or eliminating the need for solvents, these can simultaneously yield better product quality from simpler, more economical processes.

Going a step further, "reagentless synthesis" seeks to eliminate not just solvents but also reactive chemicals from the mix. Instead, reactions are driven by electricity, light, or ultrasound.

In complex plants, re-using waste heat is key to good energy efficiency, while the same is true of water re-use in regard to environmental performance, especially in regions where water is scarce. However, it is



often not obvious how best to do this. The design methodology known as "pinch" can greatly improve re-use rates by matching requirements for heat and water to potential sources.

Characterization, Simulation, Measurement and Control

Scale-up is the central engineering problem in developing a new process. A simple example concerns a heat-producing reaction such as a nitration: going from a 100 g laboratory batch to a 1 t factory vessel of the same proportions means 10,000 times as much heat to remove, but less than 500 times the available surface area. The heat transfer process therefore needs to be 20 times as effective as in the lab.

The starting point for scale-up is a thorough understanding of the physical and chemical properties of the raw materials, the final products, and any intermediates and by-products. In this area, reaction calorimetry and measurements of the physical properties of powders are examples of characterization techniques that have seen recent progress.

However, it will never be possible to measure every relevant property in the lab. Data gathered from pilot plants (see below) and existing production plants is therefore often at a premium, and new technology can help here too. Modern process control systems and wireless net-

works can collect process data from even hard-to-reach locations. Techniques such as tomography, acoustic analysis, and online spectrometers and mass spectrometers — known as "process analytical technology" (PAT) in the pharmaceutical industry — help to reveal what is really going on inside steel pipes and vessels.

Of course, engineers also need a detailed understanding of the full-scale process equipment they propose to use. Mathematical modelling is increasingly helpful here, in the form of traditional process simulation (both static and dynamic), computational fluid dynamics (CFD), and the newer "multi-scale" or "multiphysics" modelling techniques.

Improved modelling also translates to better process control. At the 2014 Process Development Symposium of the American Institute of Chemical Engineers (AIChE), Prof. Juergen Hahn, a native of Germany now at the Rensselaer Polytechnic Institute (Troy, USA), described how modern control methods can turn reactive distillation from an academic curiosity into a practical technique. In refineries, Prof. Hahn said, reactive distillation is a promising way to remove benzene from reformat — but the close coupling between reaction and mass transfer creates complex dynamics that traditionally have been hard to understand and control. Dynamic simulation using the gPROMS modelling environment from Process Systems Enterprise (London, UK) makes this task much easier.

The Continuing Role of the Pilot Plant

No matter how carefully materials are characterized in the laboratory, new and sometimes hazardous behaviors will show up at larger

scales. Their causes include contamination, corrosion, fouling, and differences in patterns of flow, mixing, and heat transfer.

Process development therefore traditionally includes a "pilot" stage between the lab and the full-scale plant. Pilot plant scales range from a few kilograms to a few tons, depending on the product. Though better modelling may allow the pilot stage to be scaled down or even skipped altogether, pilot plants will remain important for the foreseeable future.

Companies may use pilot plants for three basic reasons: to show that new processes are viable, to generate data for scale-up, and to produce enough product to interest potential customers. The latter is especially important in the pharmaceutical industry, while proof of concept and data generation are the main drivers in refineries and petrochemical plants.

Back in 2005, the AIChE announced the results of a pioneering study of how companies use pilot plants. The three-year study gathered information from 30 North American companies in the chemical, pharmaceutical, oil and gas industries. Some firms said they piloted all new processes. Others were more selective, assessing the degree of risk in scale-up through individual judgment, systematic reviews, or "stage gate" techniques in which research ideas have to pass a series of formal reviews. Unit operations such as liquid-liquid extraction and liquid mixing are still hard to model, the participants said, so pilot plant data is important for scale-up.

The Drive For Sustainability

Many of the design techniques discussed above improve the environmental performance of plants by reducing waste, cutting process complexity, or in the case of new catalysts by allowing processes to work at lower temperatures.

On top of this, the drive to create a bio-based chemical industry is already driving the development of many new processes. As one example of many, Bayer MaterialScience (Leverkusen, Germany) recently announced that it will make pentamethylene di-isocyanate, a new cross-linking agent for coatings and adhesives, with 70% of the carbon content coming from biomass. Production of up to 20,000 t/y is scheduled for 2016. The need to make ethanol from cellulosic waste instead of food crops depends heavily on the development of new enzymes and other separation techniques to break down woody materials.

The desire to reduce environmental impact and the need to operate in arid regions — worsened by the prospect of climate change — encourages the design of "zero liquid discharge" (ZLD) plants. Air-cooled heat exchangers and membrane-based wastewater purification processes are examples of the design techniques needed for ZLD plants.

Environmental aspects are also important in the growing use of structured software tools alongside the "soft" management skills needed to integrate the contributions of chemists, biomedical researchers, chemical engineers and other disparate cultures who join forces to develop new processes.

Shaibal Roy of DuPont in the US pointed out to the AIChE process development symposium that sustainability has now joined technical and economic feasibility as a key requirement for new processes. Successful process industries cannot miss out on any one of these three aspects.

Achema Trend Report

The article is based on a trend report commissioned by Dechema and written by international trade journalists. Dechema brings together experts from a wide range of disciplines, institutions and generations to stimulate scientific exchange in chemical engineering, process engineering and biotechnology. Dechema is globally known as the organizer of Achema. The world forum and leading trade show for the process industry will again take place 15 – 19 June 2015 in Frankfurt, Germany.

Grace-Chevron JV to Build Catalyst Plant in Louisiana

Advanced Refining Technologies (ART), the catalyst joint venture of chemical producers W.R. Grace and Chevron, has announced plans to spend around \$135 million on a hydroprocessing catalyst plant and additional alumina facility at an existing Grace site in Lake Charles, Louisiana. Production is set to begin in 2018. The JV cites "an ever-increasing global push for bottom-of-the-barrel

upgrading," which it said is leading to a "significant increase in investment by refiners for hydrotreating and hydrocracking process technologies."

Grace's Lake Charles site, home to what is claimed to be one of the world's largest refining catalysts plants, represents a significant portion of Grace's refining catalyst manufacturing capacity. The 120-acre site consists of four major op-

erations producing fluid cracking catalysts, hydroprocessing catalysts and other intermediates.

In the past six years, Grace said it has invested more than \$100 million at Lake Charles. New facilities include an expansion to enable increased production of specialty aluminas, a key raw material in fluid cracking and hydroprocessing catalysts. (dw)

Archroma Grants Patent License to Blankophor

Archroma announced that it has entered a license agreement with Blankophor for Archroma's patented "improved optical brightening compositions". This technology was developed by Archroma combining magnesium salts with optical brighteners. According to the company, papers treated with this process present enhanced brightness and whiteness levels, offer-

ing consumers a more pleasurable writing and printing experience. The patent covers mixed salts of most of the common paper optical brighteners containing magnesium cations.

The agreement recognizes Archroma as the sole owner of the European patent after it has become final, and grants a license to Blankophor as the first licensee to use the patented process.

Dr. Bernd Hauschel, Head of Technology and Intellectual Property at Blankophor, said: "Even though we have a different view on the decision of the European Patent Office, we do respect their decision after we lost the opposition case against Archroma's patent. For this reason, we decided to enter into a license agreement to avoid any infringement of the Archroma patent." (rk)

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Umicore Calls BASF's Patent Breach Claim "Flawed and Erroneous"

Belgium-based battery materials technology leader Umicore has publicly responded to BASF's allegations that it breached the German chemical giant's patents for nickel-cobalt-manganese (NCM) cathode raw materials used in lithium-ion batteries for electric cars and portable electronic devices.

In its official response to the Wilmington, Delaware, USA, federal court hearing BASF's charges, the company called the complaint "flawed" and "erroneous."

Subsequently, in response to a question about the worst-case scenario outcome of the lawsuit during Umicore's earnings call, the company's CEO, Marc Grynberg, said: "There is no case and there is no worst case scenario to be considered."

"All products in our business do have freedom to operate and are not

infringing on the BASF or any other patents and we can demonstrate that," Grynberg added.

Supported by Chicago-based Argonne National Laboratory, from which it licensed the patents, BASF in April filed suit in the Delaware court as well as with the US Federal Trade Commission (FTC).

The world's largest chemical producer also claims that Umicore has sold the technology to third parties, naming the US arm of Japan's Makita Corporation in the lawsuit.

According to BASF, the patent breach has cost it billions of dollars in potential sales and deprived it of the ability to compete as a supplier for electric car platforms expected to launch in 2016 and 2017. The German group plans to invest up to \$500 million in its battery materials business up to 2020. (dw) ■

BASF Declares FM for EO-Based Care Chemicals

BASF has declared force majeure for ethylene-oxide based products in its Care Chemicals portfolio, due to a captive shortage of the ethylene derivative (EO). The restrictions apply to products of its Home Care and Industrial & Institutional Cleaning, Formulation Technologies, AgChem Additives units and certain EO-based products in its Personal Care portfolio. The German group shut down its 345,000 t/y EO plant at Ludwigshafen on May 19, citing technical problems, and declared force majeure for EO as well as for monoethylene glycol. Its larger Antwerp facility is still on stream but being operated at reduced capacity.

Effects of the outages on customers are currently being evaluated, BASF said. The EO plant is not expected to be back on stream

until the beginning of June, and the group does not expect the impact in downstream production to ease until around the end of June.

BASF is taking steps to limit the consequences for its customers and will "continuously inform" them about any new developments and details regarding supply capability with the affected products.

The EO outage in Ludwigshafen adds to the series of force majeure declarations currently sweeping the European petrochemicals sector, leading to supply shortages and higher prices. Crackers operated by Total at Lavéra, France, and Shell at Wesseling, Germany, are down following fires in mid-May. As a result, several major producers have declared FM for polyethylene and polypropylene as well as PVC. (dw) ■

DSM Dyneema Finalizes Cubic Tech Deal

DSM Dyneema, subsidiary of Dutch chemical producer DSM, has finalized the acquisition of Cubic Tech Corporation, a privately owned company based in Mesa, Arizona in the US.

Cubic Tech specializes in the custom design, development and production of innovative high performance ultra-lightweight flexible laminates and fabrics, most of them based on Dyneema, the ultra high molecular weight polyethylene (UHMWPE) high-tech fiber invented and manufactured by the DSM offshoot.

The Dutch company said the acquisition reinforces the position of Dyneema fiber as one of the leading brands of ultra high performance materials and also broadens

its portfolio, while providing it with complementary downstream processing technology.

Adding Cubic Tech's technology to DSM Dyneema's expertise in application development, operational excellence and marketing competence will accelerate entry into the performance apparel markets and add important new revenue streams as well as creating access to several new applications and strengthening the company's commitment to sustainability, said Jeff Turner, vice president Strategy at DSM Dyneema.

Cubic Tech will be fully integrated into the DSM organization and all employees will be offered transfers. (dw) ■

BASF: First Asian PA Plant Inaugurated at Shanghai

BASF has inaugurated a wholly owned 100,000 t/y plant for PA 6 and PA 6.6, sold under the "Ultramid" trademark, at Shanghai Chemical Industry Park (SCIP).

The new facility, the German group's first investment in polyamide in China, "shows our strong commitment to this market," said CEO Kurt Bock. The "innovative production setup" will allow BASF to supply its customers more quickly and with more flexibility, he added.

Albert Heuser, BASF's chief executive for Greater China, said the investment reflects management's confidence that demand for PA from the region's engineering plastics, fiber and film industries will continue to grow strongly.

Reports say caprolactam feedstock for the Chinese PA 6 plant will be supplied in part from BASF's European production, with additional volumes to be procured locally, probably from an adjacent plant owned by US polyamide specialist Invista.

The US company is also building a PA plant at the site, earmarked for start-up later this year.

BASF is also a partner in an integrated world-scale isocyanates production at SCIP. Together with US polyurethanes specialist Huntsman, other partners in the Lianheng Isocyanate joint venture include several Chinese firms.

The joint venture recently received permission to doubling its MDI capacity to 480,000 t/y. (dw) ■

Dow to Cut up to 1,750 Jobs in Olin Chlor-alkali Merger



Our productivity efforts continue to center on cost-out actions and doing more with the resources we have in place.

Howard Ungerleider, CFO, Dow Chemical

Dow Chemical has announced it will slash around 1,500-1,750 jobs, up to 3% of its global workforce, as part of a plan to reduce costs by \$1 billion over three years. The US chemical giant said the job cuts are part of the \$5 billion deal to separate a significant part of its chlor-alkali and derivatives businesses and sell them with Olin.

Planned to be completed over the next two years, the layoffs will go hand in hand with consolidation or closure of production facilities representing less than 1% of the company's net property value, which Dow called "minor footprint adjustments."

The measures are expected to save \$300 million in operating costs annually.

Dow said it would take charges of about \$330-\$380 million in the second quarter for asset impairments, severance and other costs.

"At our Investor Day last fall, we committed to a new, three-year \$1 billion productivity drive," Dow CFO Howard Ungerleider said. "Our productivity efforts continue to center on cost-out actions and doing more with the resources we have in place, all to enable higher earnings."

The announcement of job cuts and facility closures "illustrates our ongoing commitment to the consistent implementation of our strategy moving forward and proactively addresses any stranded costs from the divestment of Dow Chlorine Products." Ungerleider added. (dw) ■

Merck Millipore Buys Rights to Singulex's SMC Technology

Merck Millipore, the life science business of Germany's Merck KGaA, has signed an exclusive agreement with Singulex, developer and leading provider of Single Molecule Counting (SMC) technology for clinical diagnostics and scientific discovery, to manage the Alameda, California-based US products group's life science research business.

The deal, which expands Merck Millipore's Protein Detection business with the addition of Singulex's ultra-sensitive Erenna immunoassay platform, foresees the German-based company making an upfront payment to the California firm and also includes royalties and additional payments based upon achievement of certain commercial milestones.

Under the terms of the agreement - for which financial terms were not disclosed - Merck Millipore will have exclusive rights to further develop and commercialize the SMC technology for research applications worldwide. Singulex is retaining the rights to the technology for use in

its clinical lab testing and in vitro diagnostics businesses.

"Reliable, ultra-sensitive protein detection is a critical unmet need in life science research," Merck Millipore said. "Current technologies allow detection of only approximately 5% of proteins in the entire proteome due to the very low abundance of many biomarkers, leaving the vast majority of proteins virtually undetectable."

The clinical benefits of the Singulex SMC technology, a patented technology combining signal enhancement and background reduction coupled with low volume sampling to achieve ultra-high sensitivity protein detection, have been "well-established," the German company said.

"This agreement is further evidence of Merck Millipore's commitment to bringing innovative technologies to our global life science customers," said Udit Batra, president and CEO of Merck Millipore. (dw) ■

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Preparing for Serialization

Multi-layer Machine and Software Concept Offers the Highest Safety for Pharmaceutical Packaging

This year is an important year for the serialization of pharmaceutical packaging. Time is pressing, as numerous laws and guidelines are coming into effect all over the world. While some countries are still discussing how to transpose their guidelines into legislation, others are already well on their way to implementation. Pharmaceutical manufacturers are facing the challenge of finding suitable technologies, as well as connecting them with their production and packaging processes. A multi-layer machine and software concept undoubtedly is the safest approach.

Barack Obama's signature of the "Drug Quality and Security Act" (H.R. 3204) in November 2013 set the pharmaceutical industry in motion. The act grants the US Food and Drug Administration (FDA) more authority to advance the long-awaited system for pharmaceutical supply chain integrity. The FDA aspires to apply a standardized code identifier (standard numerical identification, SNI), more precisely a 2D data matrix code to the packaging of all prescription drugs. As of today, complete implementation including nationwide, public databases will presumably be due in 2023/2024.

In parallel, many other countries, for instance Brazil, China and Argentina, are busy developing and implementing new guidelines and laws. The Brazilian national authority for medical assessment ANVISA published a resolution in 2013, which is supposed to be implemented by December 2016. The Turkish serialization program ITS even mandates the serialization of all over-the-counter (OTC) and prescription drugs with a 2D data matrix code from production right through to patient level.

EU Directive with Additional Safety Layer

The European Union's directive 2011/62/EU (Falsified Medicines Directive) was enacted in 2011. It stipulates the adoption of encoded packaging with unique serial numbers for almost all prescription drugs. Similar to many other countries, the serialization feature is a 2D data matrix code. It contains the code of the pharmaceutical manufacturer, a randomized serial number, the batch number and the expiry date, as well as a national number for reimbursement, if applicable. Prescription drugs and some OTC products will presumably be ready for verification in pharmacies by the second half of 2018.



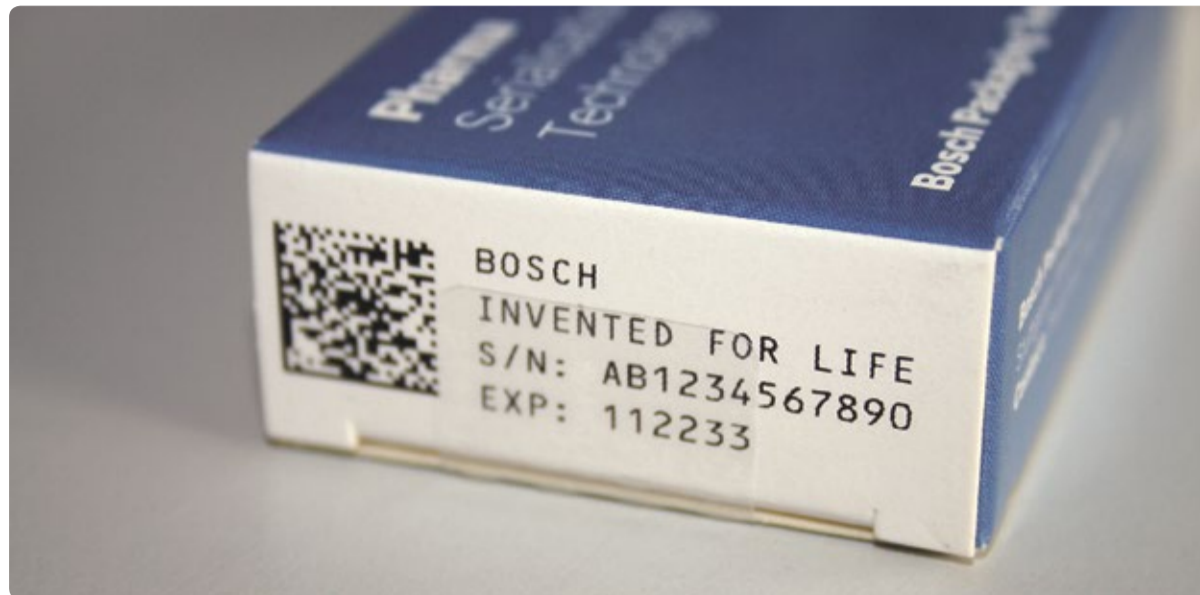
Daniel Sanwald, Bosch Packaging Technology

At the same time, the EU demands a second level of security in form of tamper-proof closures, such as integrity seals or glue safety closures. They clearly indicate whether a package has been previously opened or tampered with. While some countries such as Italy and Belgium already have vignettes on the outer packaging, and France has even been applying a 2D data matrix code for some time, the main goal of directive 2011/62/EU is an EU-wide harmonization of legislation, as well as the applicable codes and seals.

Learning from the Automotive Industry

In the coming years, the pharmaceutical industry will face huge challenges. Drug producers are required to apply the respective guidelines within a given time frame. And this implementation is not going to be an easy task. Most companies will not be able to avoid developing and applying a global strategy for a consistent serial number assignment first. This requires solutions that are compatible with in-house processes, leading to the adaptation of often highly demanding packaging processes. Furthermore, new processes must be established for both management and storage of serial numbers.

Track & Trace systems have been successfully applied in the automotive industry for many years, especially to trace security-related parts such as brakes or steering components. Bosch Packaging Technology has adapted this know-how to suit the demands of the pharmaceuti-



cal industry. The requirements can be subsumed in a single key word: "modular". A Track & Trace system should not only be able to mass-serialize the packed product in the sense of printing a code onto each pack. These codes also need to be verified unambiguously. Moreover, the packs are usually also equipped with a label or integrity seal, before the next packaging layer is added. The entire process needs to be controlled, and the data retrieved at any time. Only this way do producers – and later on the issuing authorities and legislators – have an exact overview of all process steps.

From Application to Enterprise Level

Serialization and aggregation present the IT departments with par-

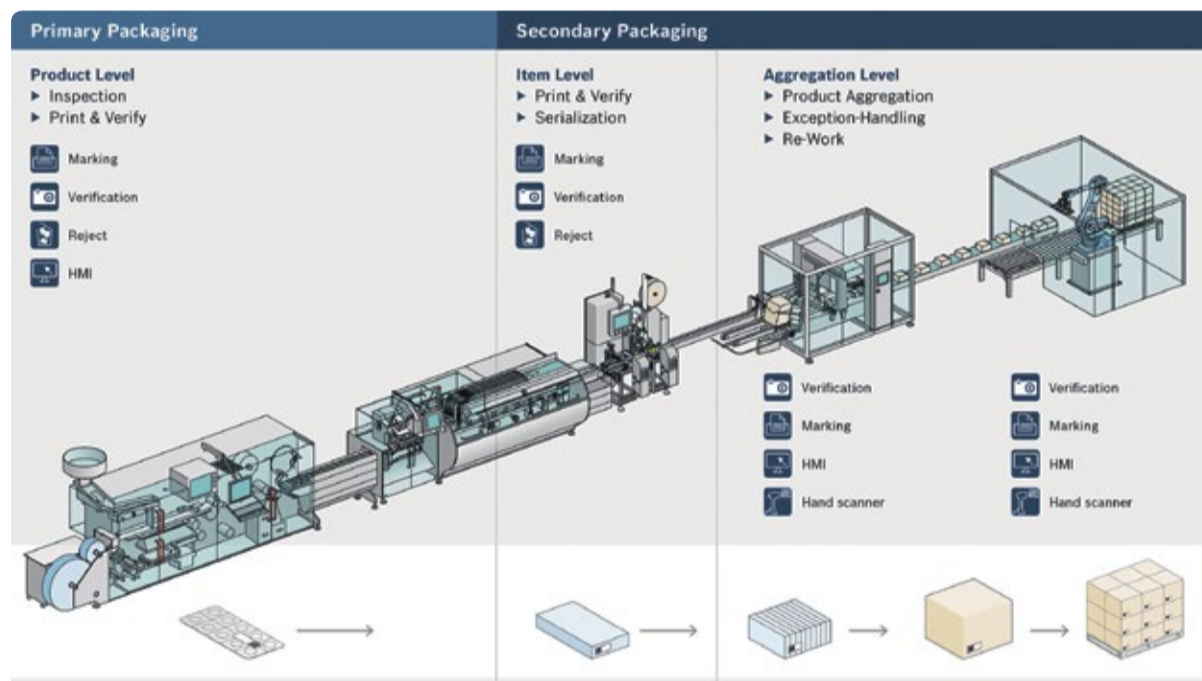
ticularly demanding challenges. Not only must the packaging processes be synchronized with the newly integrated procedures. At the same time, entirely new processes have

the serial numbers at the required integration level – from application level, line process and line management through to production and enterprise level. Individual com-

Serialization and aggregation present the IT departments with particularly demanding challenges.

to be developed for the consistent and safe management and storage of serial numbers. The integration of packaging machines into these new procedures is an essential component of each serialization project. It requires careful planning to unambiguously and permanently store

ponents such as printers and cameras are situated at the application level. The central HMI operates the modules and documents all data. To control both operating condition and data at any time, the connection between the physical machine level and the control software must



Equipped with a central HMI, the CPS transforms into a complete solution that centrally manages and configures all production, printing and layout data.

be integrated across many stages of the company's IT. The MES (Manufacturing Execution System), for instance, can function as a translation platform between the machine and the ERP (Enterprise Resources Planning) system and map the entire production area.

The Track & Trace system should be able to evaluate data in real time and answers the following questions: Where exactly is which product located? Which information is available about this product? This includes information on the code content, the current overall aggregation and production status, as well as quality data such as possible error patterns and weight indications. All results are reported to superordinate ERP systems on the enterprise level.

Facilitating the Implementation

The CPS (Carton Printing System) 1900 with Tamper Evident Labeler, for instance, shows how Bosch Packaging Technology has transferred and expanded the Track & Trace principle from the automotive industry to pharmaceutical applications. The modular system prints up to 300 folded cartons per minute and applies additional safety seals. To protect the packaging and its content from manipulation, both side flaps of the folded carton can be sealed either from the top or bottom and the seal's presence can be checked. Once the tracking data has been printed onto the package, it is automatically verified by a camera system that records every single printed character.

Equipped with a central HMI, the CPS transforms into a complete solution that centrally manages and configures all production, printing and layout data. Based on a generic, object-orientated and result-based software platform, the system can be extended by all requested aggregation levels, including bundling, shipping cartons and pallets. Subsequent upgrades of existing packaging lines are also possible.

Daniel Sanwald, product manager Track & Trace, Bosch Packaging Technology, Stuttgart, Germany

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www.boschpackaging.com

2015 Facility of the Year Awards Category Winners

On June 2, The International Society for Pharmaceutical Engineering (ISPE) formally appreciated its 2015 Facility of the Year Awards (FOYA) category winners at a banquet in Baltimore, Maryland, USA.

Established in 2004, the FOYA program recognizes state-of-the-art pharmaceutical manufacturing projects that utilize new and innovative technologies to enhance the delivery of a superior project, as well as reduce the cost of producing high-quality medicines.

This awards program values innovation and creativity in manufacturing facilities serving the regulated healthcare industry. Projects selected for the awards set the standard for pharmaceutical facilities of the future by demonstrating excellence in various fields.

For the field of project execution the 2015 FOYA winner is AstraZeneca China, the award for equipment innovation goes to Astellas

Pharma, and the facility integration award has been assigned to IDT Biologika. In addition, FOYA's international judging panel has awarded an honorable mention to Pharmeducence Pharmaceuticals.

ISPE President and CEO John E. Bournas, who made the announcement said: "Each of our 2015 category award winners has captured the spark of innovation and transformed it into processes, projects and products that ensure quality medicines reach the people who need it. The facilities honored ... exemplify ... ISPE's dedication to enhancing patient health through advancements in pharmaceutical manufacturing."

2015 FOYA Category Award Winners

AstraZeneca China has won the project execution category for its market supply solid dose facility located in Taizhou, China. AstraZeneca's in-



Category winner for facility integration: IDT Biologika for their multipurpose biologics and vaccines production facility (isolator vaccine filling unit) at Dessau, Germany

country team used a broad range of the company's global engineering, operations and safety practices to complete this 533,000 sq. ft. facility in a record time of 20 months. The facility came in 18% under the sanc-

tioned budget while maintaining an exemplary safety record.

Astellas Pharma is the winner in the equipment innovation category for its tube packaging and labeling equipment project. Astellas Ireland

(Kerry) delivered a technology innovation allowing it to fill product into tubes that are printed with only common information for various markets, and introduced a process to add country-specific label information on the tubes. This innovation dramatically improved plant flexibility, simplified the supply chain, and significantly reduced acceptance testing, product raw materials stock levels and overall delivery lead-time.

IDT Biologika has won the facility integration category for its biologics and vaccines production facility in Dessau, Germany. The highly automated manufacturing facility for filling and freeze-drying is designed to be modular, efficient and expandable. The site's layout was devised to guarantee the shortest supply and disposal routes. Design of the integrated equipment suite represents significant contributions, resulting in efficient product change over and increased efficiency.

Pharmeducence Pharmaceuticals has received an honorable mention for the execution and entrepreneurial spirit demonstrated by the construction of its new aseptic filling facility in Billerica, Massachusetts. Through good planning and prioritization, Pharmeducence met the challenge of balancing investment, appropriate compliance, efficient operations and business viability.

The 2015 FOYA overall winner will be announced during the plenary session at the 2015 ISPE Annual Meeting on November 8–11 in Philadelphia, Pennsylvania, USA. (mr)

[International Society for Pharmaceutical Engineering \(ISPE\), Tampa, Florida, USA,](http://www.ispe.org)
Barbara Peck
bpeck@ispe.org
www.ispe.org

Cleanliness Becomes a Challenge

— From Outsourcing to Industry 4.0: ISPE Discusses the Future of Pharmaceutical Manufacturing —

Requirements for pharmaceutical manufacturing are high. Rules for cleanliness are very strict. In addition, all processes have to be carefully documented and controlled. The International Society for Pharmaceutical Engineering is a not-for-profit organization with 20,000 members globally, connected by the themes of pharma manufacturing, technology, quality standards and regulation. Thorsten Schüller asked Dr. Thomas Zimmer, vice president of European operations, for his views on the current challenges for the production of medical drugs.

CHEManager International: Only a few people have an idea about pharmaceutical manufacturing. Could you please outline some of the current challenges for the production of drugs?

Dr. T. Zimmer: Let me start with the people working in such a factory. I consider it as essential that the function of engineers in pharmaceutical manufacture is seen as a strategic value for a company. For decades we have had a trend to outsource the classical work of engineers in the pharmaceutical industry. As a consequence many engineers do not consider the pharmaceutical industry as a good place to make a professional career. So they often choose other industries.

With this, external services for engineering often cannot be evaluated in-depth by in-house experts. This represents a risk for pharmaceuticals in a highly regulated environment. For example, companies must give evidence that each manufacturing process exactly runs according to specifications and conditions as registered in a pharmaceutical product dossier. This requires a huge amount of work in documentation, which adds pressure on time and budgets and can slow down processes, waiting for closing of documentation first before continuation.

ISPE organizes the exchange of best practices in order to help the industry solve problems like this.



Dr. Thomas Zimmer,
vice president of European operations, ISPE

Each company develops its own approach in order to implement regulatory requirements?

Dr. T. Zimmer: To a certain extent, yes. For example, some drugs have to be manufactured in a way that the final product is sterile. As some products cannot be sterilized at the end of the manufacturing process, they therefore have to be produced aseptically. Every step in the manufacturing process must be under sterile conditions. If, for example, the air in a production site is not exchanged regularly, there might be a risk for microbial contamination. If this process is not covered by excellent environmental monitoring, the contami-

nation will probably be detected in a later stage, which might be too late.

The implementation of an aseptic process is difficult as there are many factors affecting the result, such as layout, machine design, people's behavior, etc. And there is often room for interpretation of regulation, how to do it the best way. At ISPE there is a platform where subject matter experts meet in order to exchange their experience and expertise.

Did regulatory requirements become stricter in the past years?

Dr. T. Zimmer: Absolutely. They are in a continuous development process and have become more demanding. Also the enforcement has become stricter. Health authorities also penalize based on findings within inspections.

What are the consequences for companies of stricter inspections?

Dr. T. Zimmer: The expenditure for training and documentation increases, also the costs. Most pharmaceuticals already have pressure on cost and budgets as margins go down and R&D costs go up.

How do pharma manufacturers react in order to cope with these challenges?

Dr. T. Zimmer: For example, companies more and more check the feasibility to use so-called single-use technologies in order to reduce the costs for cleaning and cleaning validation. Single-use technologies can be parts of machines and reactors but also auxiliary equipment.

Do increased regulations make drugs safer?

Dr. T. Zimmer: It is the overall goal to make drugs safer. All stakeholders strive for it permanently and with

high energy. ISPE is in a continuous dialogue with regulators regarding best ways for implementation of new regulatory and GMP requirements. ISPE as a membership organization is considered "neutral," and therefore ISPE is a well-accepted discussion partner by regulatory authorities. The benefit of this dialogue materializes often in an efficient and effective implementation of new requirements. With regard to this your question can be answered by a clear "yes."

ISPE also addresses the theme "factories of the future." What will they look like?

Dr. T. Zimmer: This depends on the products to be manufactured. A factory for three big-volume products will look different than one for 30 small products. There is a tendency away from big-volume products to small-volume products in general. We will see more modular concepts allowing a shorter change over time and a higher agility of a factory. This is of special importance for biopharmaceutical products and underlines the need for excellent engineering.

At the annual conference of ISPE in Frankfurt at the beginning of May you talked also about the "new paradigm" in quality. What does this mean?

Dr. T. Zimmer: In former times, there were only quality controls at the end of the manufacturing processes. Today there is the new standard that there is evidence and 100% transparency over all steps in all processes. This leads to another challenge — how to evaluate big data volumes and how to create transparency in the complexity of information?

Can you learn from other industries in terms of production, costs and compliance?

Dr. T. Zimmer: Benchmarking is an important topic for pharmaceutical operations.

At our annual conference we had a benchmarking presentation by Porsche Consulting regarding the question of how to manage complexity in the process industry. The automotive industry delivers products where no one is completely equal to the other. In the pharmaceutical industry there is also a high complexity given by global supply chains and many countries of destination. All of them require different package print versions, languages, pack sizes, labels, leaflets, etc., coming out of one or even several bulk products for the same marketed product. As Porsche Consulting found its way to manage complexity, we think that we can learn from them. ■



Nikon and Lonza Cooperate on Regenerative Therapeutics

Swiss fine and specialty chemicals producer Lonza, which claims to be the world's leading developer and manufacturer of cells for regenerative medicine therapeutics, has entered an exclusive cooperation with Japan's Nikon covering cell and gene therapy manufacturing in Japan.

Under the terms, Nikon will have access to Lonza's quality and operating systems, facility design and ongoing consulting services for the establishment of a wholly owned cell and gene therapy contract manufacturing business under the name Nikon CeLL innovation Co

The Tokyo/Yokohama area of Japan is currently under consideration for the location of the new facility.

Nikon will acquire Lonza's technical know-how to differentiate and manufacture cells, including somatic stem cells, as well the Swiss company's quality and safety evaluation standards and operational procedures in the manufacturing process.

Since the adoption of the Revised Pharmaceutical Affairs Act in November 2014, Japan has become an attractive location for the future of regenerative medicine, Lonza notes. According to the legislation,

conditional product approval may be granted at the time when clinical safety and an indication of efficacy of a regenerative medicine product are demonstrated. For this reason, Japan is expected to be a promising location for the expedited clinical application of cell and gene therapy products, the company noted.

"This collaboration will contribute greatly to the growth of the global cell and gene therapy market," said Andreas Weiler, head of Emerging Technologies, Lonza Pharma&Biotech. "We are utilizing our expertise built over the last

decade to work together with Nikon in bringing high-quality, innovative development and manufacturing to Japan."

Nikon's newly created subsidiary plans to actively contribute to the early realization of Japan's regenerative medicine market and over time intends to expand its business domain into adjacent technology areas. Additionally, it will develop equipment and disposables needed to optimize the manufacture of high-quality cells, along with hardware and software from Japan to the international market. (dW) ■



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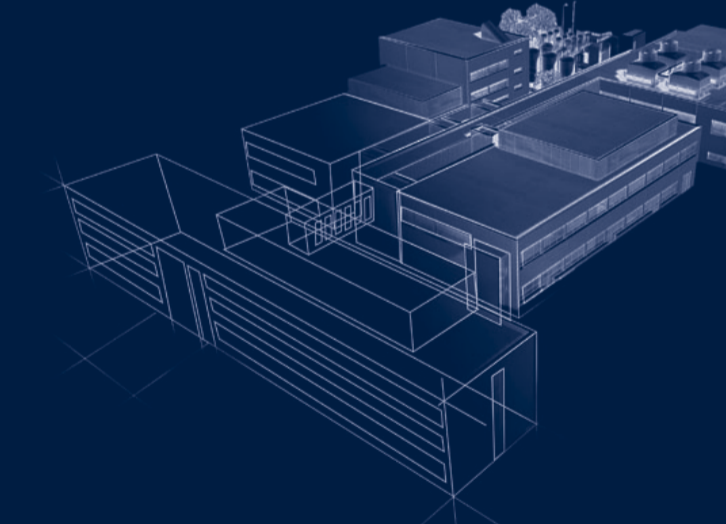
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Seeing Is Believing

Visualization Techniques in Process Engineering

The development of new processes and equipment in the chemical and related industries requires the measurement and visualization of parameters such as composition, temperature, velocity, phase state and distribution, density, and pressure in cross sections or volumetric areas. Their measurement should be nonintrusive.

By conventional local intrusive or nonintrusive measurement techniques, physical properties are measured at certain locations as a function of time. To obtain field visualization by cross section or volume of an apparatus, numerous measurements must be taken by placing the measurement probe at different locations. Because of the rather extended time interval for this kind of measurement, only time-averaged information is gathered, especially from non-stationary flows. To overcome these intrinsic measurement problems, nonintrusive measurement and visualization techniques provide high time and spatial resolution over a complete cross section of an apparatus without interfering with the process itself.

Optical Visualization Techniques

Numerous optical techniques have been used to visualize two- and three-dimensional fields of different parameters such as velocity, density, concentration, temperature, etc. They are nonintrusive and reproduce the measured field parameters with high spatial and time resolution. Their applications require optical accessibility of the measurement object. Video or high-speed camera observations require visible light.

The properties of visible light that are used for measurement and visualization purposes are the intensity, the frequency, and the phase shift of coherent monochromatic light, as well as the velocity of light in media with varying optical density (refractive index).

In Raman spectroscopy, measurements are taken from a plane, which is illuminated by monochromatic light. Electrons hit by a photon are lifted to a higher energy level. When they return to their original energy level, a photon of different energy with a shifted wavelength is emitted. Different types of scattering (e.g., Stokes and anti-Stokes Raman scattering, Rayleigh scattering) are observed depending on this shift. Their analysis leads to the measured temperature or concentration fields.

Infrared light due to thermal radiation is used for measurement and visualization techniques like

thermography and pyrometry. Depending on its temperature, each surface has a certain radiant emittance, which is measured by radiation detectors. For recalculation of the temperature, the surface properties of the examined material, the Kirchhoff radiation laws, and the dependence of the radiation on the emission angle must be known. Several measurement systems are used for the two-dimensional imaging of temperature fields.

Holographic measurement techniques lead to three-dimensional information related to the observed volumetric field. The volume is trans-illuminated by monochromatic light, which is scattered and reflected by the measurement object onto a photographic plate. At the same time, parts of the monochromatic light are led directly from the light source to the photographic plate. The two light beams with passway differences smaller than the coherence length, called the object and reference beams, interfere and form a stable interference pattern on the photographic plate. When the plate is trans-illuminated by the reference beam, the measured object is reconstructed three-dimensionally and can be viewed from different angles.

By taking holograms of an object from two directions, its position can be assessed by cutting the two holograms into slices and comparing them to each other. This kind of technique provides high spatial and temporal information on the process and has been successfully employed for measuring particle sizes and velocities in sprays and bubbly flows. To measure the particle velocity, two holograms are taken at short intervals. By comparing the two holograms, the paths of the particles and their velocity vectors can be measured.

Real-time interferometry is applied for continuous measurements of variations in temperature or concentration profiles.

The hologram of the cross section of a wind tunnel is recorded by the first object beam, which is transmitted through the test section and interferes with the reference beam. The latter is directed past the test section onto a photographic plate. After processing of the photographic plate it must be repositioned. If the reference beam passes the hologram plate, it is diffracted at the microscopic interference pattern, and the first object beam is reconstructed. When the concentration field changes because of injection of carbon dioxide, the refractive index varies. As a result the optical path length of the second object beam differs from that of the first object beam, which is recorded on the hologram plate. Because of the



phase shift, a fringe pattern is deflected, which enables visualization of the concentration field in a cross-sectional area of the wind tunnel.

In a similar manner the temperature profiles caused by dissipative heating in viscous polymer solutions are reconstructed to an accuracy of 0.01 °C near a rotating stirrer.

Particle image velocimetry (PIV) has become a valuable tool for measurement of two-dimensional velocity fields in flow fields of different types. From these measurements further information on vorticity, path lines and Reynolds stresses are derived. For imaging, the measurement volume is illuminated with a laser sheet for a short time. The illuminated sheet is taken by a CCD camera and digitally stored. This procedure is repeated within time intervals to obtain information on the velocity field. By processing the stored images (in the simplest way, by cross-correlation of two images) the velocity field in the illuminated part of the flow field is calculated. For application of PIV in two-phase flow, special algorithms for the detection of gaseous or liquid particles as well as for the calculation of the flow-field are available.

Laser-induced fluorescence (LIF) methods are based on laser excitation of molecules followed by their natural fluorescence. For this purpose the molecule of interest absorbs one photon of the incident laser light and is shifted to an upper energy state. The excited molecule drops back to a stable energy level, and the emitted radiation is characteristic of the concentration and temperature of the observed species of molecule. The exciting photon energy must be selected to be equal to the difference of two energy levels of the molecule. Since the energy

differences are specific for each species of molecule, the frequency of the laser must be chosen in accordance with the molecule of interest.

Two-color laser-induced fluorescence is applied for visualization and measurement of the progress in mixing on macro- and microscale simultaneously. This is done by injecting a mixture of two fluorescent dyes into the mixing vessel. Both are excitable at the same wavelength, and their emission characteristics are distinguishable. For mixing purposes the inert dye serves as a tracer for macromixing. The other dye undergoes a chemical reaction that alters its fluorescence behavior. Since the chemical reaction requires mixing on the molecular scale, the reacting dye visualizes the micro-mixing indirectly. This is quantitative

done by means of the degree of deviation, derived from the ratio of the local concentration of the reacting dye and the concentration of the inert dye. The latter equals the concentration the reacting dye would have locally if the reaction had not taken place.

Tomographic Visualization Techniques

Tomography has become increasingly popular in the chemical and process engineering industry. It is a nonintrusive visualization technique for two- and three-dimensional fields of density, concentration, temperature, velocity or local void fractions in cross sections of different kinds of equipment. Since the measured fields are often of non-stationary or even of transient character, tomographic measurement techniques should provide high spatial and temporal resolution.

The term tomography originates from the Greek tomos (slice) and graph (image). The two-dimensional images visualize the areal or volumetric profiles of a physical property. For medical applications this might be the density or the water

fraction related to the texture of a tissue. In process and chemical engineering the applications of tomographic measurement techniques are, in comparison to the medical sector, still in rapid development for applications in research and production.

Tomographic measurements have two major advantages: First, the measurements are conducted without interfering with the object. Second, the target quantities in the measurement plane are generated by mathematically derived reconstruction techniques from simultaneously taken integral measurements of local values along defined passways.

Dieter Mewes,
Langenhagen, Germany

Read more about this topic in Ullmann's

This article is an excerpt from the Ullmann's Encyclopedia of Industrial Chemistry ([wileyonlinelibrary.com/ref/ullmanns](http://www.wileyonlinelibrary.com/ref/ullmanns)), which celebrated its 100th anniversary in 2014. More about the topic can be found in the encyclopedia article on Visualization Techniques in Process Engineering. More concept articles on general interest topics in industrial chemistry and chemical engineering can be found on the Ullmann's Academy homepage (<http://bit.ly/1G5GYQC>).

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ICL to Close Flame Retardant Line

Israeli chemical group ICL said its ICL Industrial Products segment (ICL IP) will close a manufacturing plant for its FR-1210 flame retardant product.

The closure follows the company's recent start of commercial-scale production of the FR-122P polymeric flame retardant used to fire-proof extruded polystyrene foam (XPS) and expanded polystyrene foam (EPS) under a 2012 licensing agreement with Dow Chemical.

Due to the switch to more sustainable products, ICL said it has stepped up its own R&D efforts to develop state-of-the-art alternatives to FR-1210 recommended by the SAFR (Systematic Assessment

of Flame Retardant) tool it has developed and planned to launch at Chinaplas plastics trade fair in Shanghai in May.

The company said closure of the FR-1210 production line reflects its customers' switch to alternative suppliers in advance of the EU's ban on hexabromocyclododecane (HBCD) flame retardants from August 21, 2015 as well as the competitive market for FR-1210.

Other factors were said to include a move toward more sustainable products and the high cost of re-summing production following a long strike. ICL stressed that it "remains committed" to the flame retardant business. (dw)

PTT, Marubeni Pick US Cracker Site

PTT Global Chemical, Thailand's state-owned chemical company, and Marubeni, a Japanese trading house, have chosen a site in the US state of Ohio, near Wheeling, West Virginia, for a jointly owned world-scale US petrochemicals site that would use natural gas liquids, in particular ethane, from the Marcellus and Utica shale gas fields.

The companies join Shell and Odebrecht in evaluating or finalizing sites for shale gas-fed production. However, none of the petrochemical players has actually committed to building the complexes, and no financial decisions are expected to be made in the current uncertainty over the direction of prices for tradi-

tional petrochemical feedstocks. According to an announcement by the office of Ohio governor John Kasich, PTT Global and Marubeni have committed to planning and engineering over the next 12 to 16 months.

Shell continues to evaluate the Horsehead complex in Pennsylvania as a location for a 1.5 million t/y ethane cracker and plastics production facility. A start-up date of 2018 was envisaged. Odebrecht has been studying a site near Parkersburg, West Virginia, for a cracker to be built in cooperation with subsidiary Braskem, the Brazilian petrochemicals giant. However, the company said it would not build a US cracker to go on stream before 2020. (dw)

Repsol to Build LDPE Plant in Spain

Spanish petrochemicals producer Repsol has licensed the Chevron Phillips Chemical (CPC) process to produce metallocene-based LDPE resin at its complex in Taragona.

The plant, for which neither start-up date nor capacity have been given, will be the first outside the US to use the process.

Repsol said the investment is part of a competitive enhancement scheme to run until 2016. Upgrading capacity, the Madrid-based company said, will allow it to focus on higher value-added products. This in turn, will enable it to better compete with imports from countries in which producers have access to cheap

feedstocks. According to Repsol's estimate, imports of HDPE, for example, accounted for more than 40% of consumption in Spain in 2014.

As the new LDPE facility shares "critical facilities and equipment" with the HDPE plant, thus requiring a temporary shutdown of the latter, and construction is expected to take three months,

Repsol is splitting the construction process into two one-and-a-half month phases. The first will begin in June of this year.

Repsol's Downstream unit increased earnings in Q1 of 2015 by 84.1% to €534 million, mainly due to wider margins in the refining and chemicals businesses. (dw)

PEOPLE



Anja Krusel

Anja Krusel has been appointed as Vice President Group Controlling effective May 1, 2015. She succeeds Executive Board member **Mark Tonkens**, who assumed the position of CFO as of November 1, 2014. Krusel joins Borealis from Munich-based Microsoft Germany, where she has held the position of Senior Director Finance and Administration since 2011. Before joining Microsoft, she spent nearly 15 years at the Philips Group in a variety of roles, including Senior Finance Director at Philips Consumer Electronics. She subsequently spent nearly four years in the US, serving as Senior Director Financial Planning & Analysis at Philips Consumer Electronics in Atlanta, Georgia and Senior Director Finance and Talent Management North America at Philips operations in Andover, Massachusetts. A German native, Anja Krusel studied business administration in Cologne and Giessen.



Huub Moolenaar

Huub Moolenaar has been appointed by Emerald Kalama Chemical as sales manager, EMEA, for K-FLEX plasticizers and coalescents in Europe, the Middle East and Africa. Moolenaar, whose experience includes more than 30 years in various marketing, business development and technical roles in the specialty additives and materials industries, joins Emerald from Eastman Chemical, where he most recently served as manager, marketing and strategy, EMEA. Previously, he also held positions with Linde Gas, Pfizer and Dow. He obtained an M.S. in chemical engineering from Eindhoven University of Technology, Eindhoven, Netherlands.



Dr Stephan Glander

Dr Stephan Glander (46) has been appointed new managing director of BYK-Chemie and worldwide president of BYK Additives & Instruments, one of the divisions of Altana. He will take up these roles as of July 1, 2015, succeeding **Dr Christoph Schlünken**, who became a member of the Altana management board in November 2014. Dr Glander brings many years of international management experience. With a PhD in chemistry and an MBA at Michigan State University, he held various management positions in major chemical companies such as Bayer. In his last role as managing director of the Engineering Plastics Division of Röchling, he had full responsibility for the Composites and Medical Plastics business units. Before that, from 2005 to 2012, he worked for Quadrant EPP in Switzerland as business line manager Advanced Engineering Plastics and was later promoted to global director Marketing & Technology.

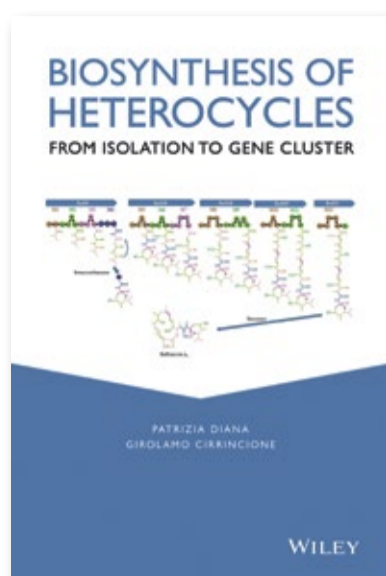
Chad Holzer has been named global business director of Dow Home, Institutional and Personal Care Solutions, a business unit of the Consumer Care division of Dow Chemical. In his new role, Holzer manages a team of 400 employees across 12 manufacturing and R&D centers worldwide. Holzer started with Dow as the strategic marketing manager for Dow Building Solutions. He joins Dow Home, Institutional and Personal Care Solutions after most recently serving as the global business director for the Specialty Monomers, Vinyl Acetate Monomer, and the Acrolein Derivatives business. Holzer holds a Bachelor of Science degree in Civil and Environmental Engineering from Cornell University and a Masters of Business Administration from the Harvard Business School.

Teresa Szelest has been named as BASF's President, Market & Business Development North America, effective May 1, 2015. Szelest is currently Senior Vice President, Global Business Unit Hygiene at the company's site in Ludwigshafen. She will be located in Florham Park, New Jersey. Szelest, who was born in New York and studied Chemical Engineering at Rensselaer Polytechnic Institute, succeeds Dr Beate Ehle who will take a sabbatical until the end of 2015 at her own request.

Sharon Johnson is to head Catalent's newly formed Quality, Product Development & Regulatory Affairs organization. Prior to assuming her new responsibilities, Johnson had served as Catalent's Senior Vice President, Global Quality & Regulatory Affairs since 2009. She has more than thirty years of experience in the pharmaceutical industry. Before joining Catalent, Johnson served as Vice President of Quality for GE Healthcare's Medical Diagnostic Division, having previously worked in roles of increasing responsibility for Baxter Healthcare and Sanofi Aventis. Johnson holds a postgraduate Diploma in Industrial Pharmaceutical Studies with Distinction from Brighton University and a BS Honours degree in Biological Sciences/Microbiology from North East Surrey College of Technology.

Biosynthesis of Heterocycles

This book describes biosynthetic methods to synthesize heterocyclic compounds, offering a guide for the

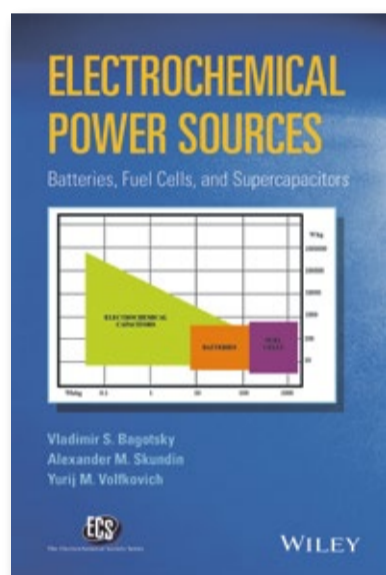


development of new drugs based on these important compounds. After an introduction discussing synthetic pathways to illustrate the basics of biosynthesis, the authors explain natural products in chemistry and their formation along with important analytical methods and techniques for working with heterocycles — including isotopic labelling, enzymes and mutants, and pathway identification. Subsequent chapters describe heterocycle biosynthesis starting from natural products, with particular attention to bioactive molecules.

► **Biosynthesis of Heterocycles**
Patrizia Diana, Girolamo Cirrincione,
John Wiley & Sons
Price: €175,-
ISBN 978-1-118-02867-4

Electrochemical Power Sources: Batteries, Fuel Cells, and Supercapacitors

Electrochemical Power Sources (EPS) provides in a concise way the operational features, major types, and applications of batteries, fuel cells, and supercapacitors.



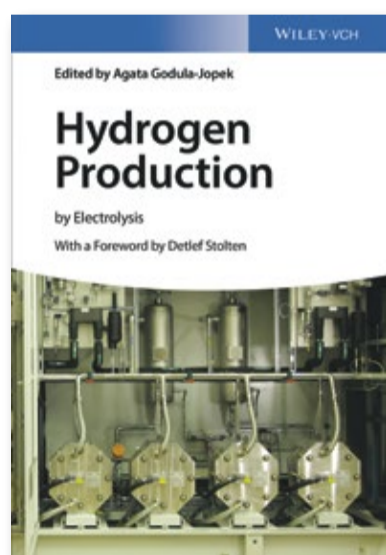
The book presents details on the design, operational features, and applications of batteries, fuel cells, and supercapacitors. It covers improvements of existing EPSs and the development of new kinds of EPS as the results of intense R&D work, provides an outlook for future trends in fuel cells and batteries and shows the most typical battery types, fuel cells and supercapacitors; such as zinc-carbon batteries, alkaline manganese dioxide batteries, mercury-zinc cells, lead-acid batteries, cadmium storage batteries, silver-zinc batteries and modern lithium batteries.

► **Electrochemical Power Sources**
Vladimir S. Bagotsky, Alexander M. Skundin,
Yuriy M. Volkovich
John Wiley & Sons
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ISBN: 978-1-118-46023-8

Hydrogen Production: by Electrolysis

Covering the various aspects of this fast-evolving field, this book includes the fundamentals and a comparison of current applications, while focusing on the latest, novel achievements and future directions.

The introductory chapters explore the thermodynamic and electrochemical processes to better



understand how electrolysis cells work, and how these can be combined to build large electrolysis modules. The book then goes on to discuss the electrolysis process and the characteristics, advantages, drawbacks, and challenges of the main existing electrolysis technologies. Current manufacturers and the main features of commercially available electrolyzers are extensively reviewed. The final chapters then present the possible configurations for integrating water electrolysis units with renewable energy sources in both autonomous and grid-connected systems, and comment on some relevant demonstration projects.

► **Hydrogen Production: by Electrolysis**
Agata Godula-Jopek
Wiley VCH
Price: \$190,00
ISBN-13: 978-3527333424

PEOPLE



Peter Wilkes

Peter Wilkes (54) has been appointed as Managing Director of Biesterfeld Spezialchemie next to Dr Nicole Hamelau with effect of May 1, 2015. Wilkes is responsible for the further strategic development and the operative business of the company and its subsidiaries. He is the successor of **Thomas Arnold**, who assumed the position of CEO of Biesterfeld AG on April 1, 2015. Wilkes holds a degree in economics and earned a Master of Business Administration from the University of Chicago, Illinois, USA. With previous management positions at companies like Dow Chemicals, Air Products and Chemicals, and Kolb, Peter Wilkes has gained over 25 years of international experience in the increasingly globally oriented specialty chemical industry.



Wayne T. Smith

Wayne T. Smith has been appointed chairman and CEO of BASF Corporation, US subsidiary of the Ludwigshafen, Germany-based chemical producer. In the position, he replaces **Hans Engel**, who previously served in the double function of US chief and chief financial officer. Engel will retain the CFO function in addition to other duties within the global group. The new US chief executive, a native of Rochester, New York, began his career at BASF Corporation in 2004 as group vice president for the regional intermediates business unit. He was appointed to the BASF group managing board in 2012. Smith will continue to serve on the BASF board, where he has global responsibility for the catalysts, coatings and performance materials divisions.



Dr Peter Manshausen

Dr Peter Manshausen (55) has been appointed to the Managing Board of Georg Nordmann Holding. He will direct the international business of the Holding together with the board's chairman, Edgar E. Nordmann, and board member Gabriele Henke. He holds a doctorate in chemistry and has more than 20 years of executive experience in the chemical industry. Most recently he was the sole managing director of Caldic Deutschland Chemie, the globally operating chemical trading company based in Düsseldorf.

Russell Hunt has been appointed as new CFO of MDS. A Chartered Accountant with over 20 years of experience in financial roles across a variety of sectors, Hunt joined MDS from Agrivert, a provider of organic waste management solutions, where he was Group Finance Director. Prior to joining Agrivert, he was Group Finance Director at Sorex, a manufacturer of branded chemical and non-chemical products for professional pest management. During his tenure, the group delivered substantial profitable growth before subsequently being acquired by BASF in 2008.

Thomas Beck has taken over the new senior role of vice president quality management (VP QM) at Recipharm with effect from April 1, 2015. Beck is currently Head of Quality Control and Assurance at Recipharm Stockholm, a position that he has held since 2010. In his new role he will lead the quality strategy and policy across the Recipharm Group subsidiaries and assist the group management team in monitoring and evaluating the company's quality efforts. He will also lead the company's audit process and support the sales activities. Beck is chairman of the Quality Assurance section within the Swedish Academy of Pharmaceutical Science.

Dr Rafael Amado has been named as Chief Medical Officer and **Adrian (Ad) Rawcliffe** as Chief Financial Officer of Adaptimmune, both with effect of March 16, 2015. Dr Amado will lead Adaptimmune's clinical strategy and assume responsibility for the company's clinical trials across the US and Europe under its strategic collaboration with GlaxoSmithKline (GSK). Prior to joining Adaptimmune, Dr Amado served as senior vice president and head of oncology R&D at GSK and was previously executive director of therapeutic oncology at Amgen. Ad Rawcliffe joins the company from GSK where he was senior vice president, Finance of its North American Pharmaceuticals business. He joined GSK in 1998 and holds a BSc degree in Natural Sciences from the University of Durham, UK.

Dr Joseph Bedford joined Huntingdon Life Sciences and Harlan Laboratories as Corporate Vice President of Global Strategic Marketing. The creation of this new position strengthens the two firms' international strategic marketing function across its Contract Research Services and Research Models Services business units. Prior to joining Huntingdon and Harlan, Dr Bedford served at Taconic Biosciences. His other experience includes stints with Covance and the Almac Group covering a twelve year period.

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International Trade in Chemical Products

World chemicals sales in 2013 by regions

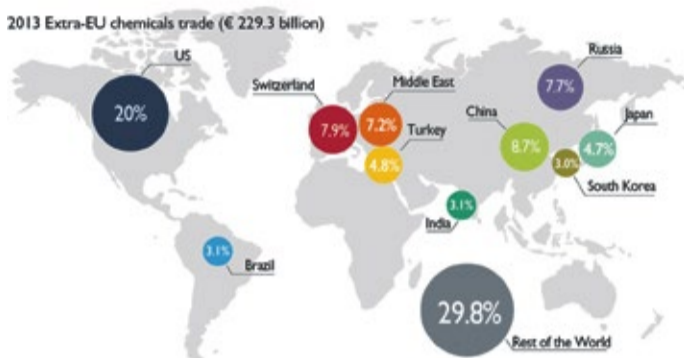


Source: CEFIC Chemdata International (2014)

Global Chemicals Sales

World chemicals turnover was valued at €3,156 billion in 2013. Global sales grew by 2.4% from €3,084 billion in 2012 to €3,156 billion in 2013. World chemicals sales in 2013 grew nearly €73 billion compared with 2012, marking a modest recovery in the world chemical industry. It was largely driven by China, where chemicals sales swelled from €918 billion in 2012 to €1,047 billion in 2013, a 33.2% share of the global total. The EU chemicals industry ranks second, along with the United States in total sales. When including both the European Union and non-EU countries in Europe, total sales reached €630 billion in 2013, or 20% of world chemicals sales in value terms.

Top 10 EU chemicals trade partners

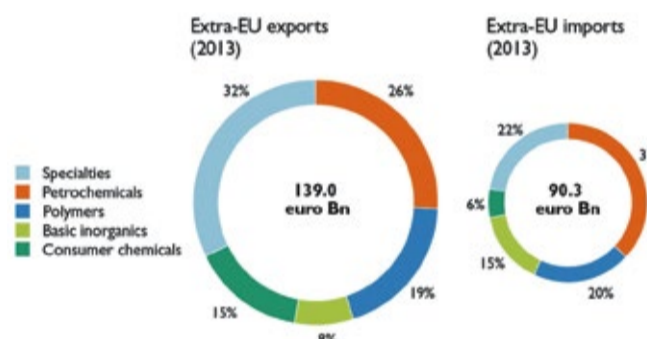


Source: Eurostat (Comext) and CEFIC analysis

EU Chemicals Trade Partners

The top 10 EU chemical trade partners accounted for 70% of exports and imports. The US is by far the EU's biggest trading partner in chemicals. It buys €26 billion of EU exports, nearly 20% of the EU chemicals total every year, whilst providing €20 billion of EU imports. The Gulf Cooperation Council was the fifth largest trade partner of the European chemical industry, with a trade flow of €11 billion. In 2013, €152 billion of chemicals were sold in Japan, making it the world's third-biggest market, but with €11 billion of EU-Japan imports and exports, it ranks on position seven among trading partners for the EU chemical industry. EU-India trade in the chemicals sector accounted for €7.2 billion, a 3.1% share.

EU chemicals trade flows with third countries by sector (% of total)

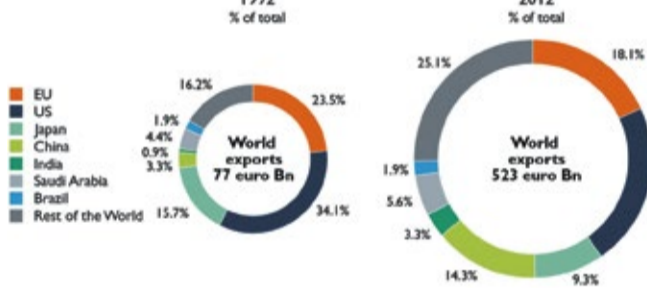


Source: Eurostat (Comext) and CEFIC analysis

EU Chemicals Trade Areas

Output from the EU chemical industry covers three broad product areas: base chemicals, specialty chemicals and consumer chemicals. In 2013, base chemicals – which cover petrochemicals and their polymers along with basic inorganics – represented 61.8% of total EU chemicals sales. Specialty chemicals cover the areas such as paints and inks, crop protection, dyes and pigments and made up 26.5% of total EU chemicals sales in 2013. Consumer chemicals, such as soaps and detergents as well as perfumes and cosmetics, represented 11.7% of total EU chemicals sales in 2013. Petrochemicals and specialty chemicals accounted for the majority, 53.1% of total EU chemicals sales in 2013.

Chemical exports by country of origin (% of total)



Source: Oxford Economics/UN Comtrade, CEFIC

Global Chemical Exports

Over the past 20 years the EU export market share decreased substantially, due to declining competitiveness as opposed to slow-growing destination markets. This means that the EU's export growth did not keep pace with the growth of world export growth. Declines have also been seen in other developed nations at the expense of China and Saudi Arabia, although the magnitude of the European decline is larger than that of the US. The decline has been driven primarily by petrochemicals and polymers. Due to the erosion of competitiveness, the EU has slipped from number three to four out of seven leading global chemical exporters with regard to absolute levels of competitiveness. (rk)

US Senate Vote Could Endanger TTIP Passage Prospects

By a vote of 52 to 45 (a majority of 60 was needed), the US Senate has declined to pass the Trade Promotion Authority bill that would have given President Barack Obama the power to negotiate trade agreements such as the Transatlantic Trade and Investment Partnership (TTIP) and Trans-Pacific Partnership (TPP) with foreign governments in total.

Unless the decision is amended, which looks unlikely in the current climate, all provisions of all such treaties will have to be approved by the US Congress separately. This would deal a severe blow to the European Commission's attempt to finally push the TTIP to a final settlement.

The Senate vote was triggered by demands from Asian countries such as China for a reassurance that Congress stood behind the provisions of TPP. The EU has not asked for such guarantees.

US lawmakers, including many in Obama's own Democratic Party, also had expressed concern about the impact the TPP in particular would have on US jobs. As regards the transatlantic agreement, up to now more opposition has been seen in Europe than in the US, although this may be changing.



The concerns of European consumer and environment advocates as well as same small businesses, among other things, revolve around import and labeling of GMO food. The most controversial talking point, however, is the Investor-State Dispute Settlement (ISDS) mechanism, which would allow foreign investors to challenge national laws in closed international arbitration tribunals rather than in domestic courts.

As reported, in advance of the US vote, EU trade commissioner Cecilia Malmström had presented to the

European Parliament (EP) a set of proposals for rewriting ISDS. The provision had been excluded from the negotiations a year earlier in an effort to expedite its passage.

In particular, Malmström's proposals include hearing investors' appeals in a permanent dedicated court.

The European Parliament is due to vote on the Commission's proposals on June 9. It is not yet clear what impact, if any, the US Senate's decision will have. (dw)



Green ferries – Spanish ferry operator Baleària has enrolled its vessel Martin i Soler into AkzoNobel's carbon credits program. Developed in 2014 the program financially rewards ship owners, who are converting existing vessels from a biocidal antifouling system to a biocide-free advanced hull coating, by enabling them to generate income in the form of carbon credits earned by reducing CO₂ emissions. The Martin i Soler was converted from a silyl biocidal antifouling to AkzoNobel's Intersleek1100SR marine coating. In addition to the positive environmental image of using biocide-free technology, the new dip reduces fuel consumption, and hence CO₂ emissions. Monitored over one year, the vessel's performance showed a 12% improvement in fuel efficiency — which equates to a reduction of 15 tons of CO₂ per day. 100 eligible ships were already converted to the biocide-free technology. (mr)

This issue of CHEManager International contains the insert „30th anniversary of Chemspec Europe“. We kindly ask you to take notice.

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