ACHEMA Worldwide News

On page 16 you will find details revealed for ACHEMA 2018 PRAXISforums.

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DIGITIZATION REINFORCES INNOVATION CAPACITY AND COMPETITIVENESS

The world of chemistry is in a state of global upheaval: the main growth centers shift from formerly Europe to Asia and increasingly to the US, not only due to rising demand: emerging economies enhance their investments in research and development and push forward their innovation processes with governmental tailwind to gain market shares.

The chemical and pharmaceutical industries in Germany face greater challenges than ever to assert their top positions in international comparison. To keep up with the global pace of innovation and remain competitive enterprises have to consequently exploit the potential of new technologies and business models. Digitization plays a driving role.

DR. UTZ TILLMANN
Director-general of VCI (Verband der Chemischen Industrie — The German chemical industry association)

Production in German chemical plants is for the most part already automated. Digital process control is widely a standard practice to gain maximum efficiency in raw material and energy use. But, with digitization, the bar is set higher: virtual planning of complete plants in 3D, better programmes for control systems and an intensive use of sensors for the predictive maintenance of large-scale plants are to ensure an increase in productivity. Visitors of ACHEMA 2018 will get an idea of the evolutive path the process industry is embarking.

The provision of digital information beyond company boundaries offers opportunities for new business models for the whole industry through the horizontal networking of value-added chains. To activate this potential, politics have to create the necessary framework. This includes the development of a nationwide efficient IT infrastructure with security infrastructure as well as the consideration of new technological trends in training initiatives. If we lay these foundations, data as raw material for added value could have a career in the chemical industry.

"With digitization, the bar is set higher."

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ACHEMA GRÜNDER PREIS

■ **ACHEMA-GRÜNDERPREIS**
What has become of the ideas and businesses of the finalists of the ACHEMA-Gründerpreis 2015? ■

MODULAR PLANTS – STANDARDIZATION IS KEY

Modular plant concepts are globally on the rise in order to shorten development and product cycles in the chemical and pharmaceutical industries. The proof of concept has been provided; but in order to enable a broad application of modularization in process engineering, both nomenclature and equipment need to be standardized and scalable.

DR. KATHRIN RÜBBERDT,
LINUS SCHULZ*

Source: © industrieblick, © newb1/Fotolia.com; [M] Götzelmann

Individualization does not only apply to cars, clothes or your breakfast cereals. The chemical and pharmaceutical industries are also facing an increasing demand for customized products. The resulting short development and product life cycles are a challenge to conventional plant concepts. Modular plants are globally on the rise in order to meet the changing customer expectations.

Modularization can be applied to the planning phase; reusing engineering information and closed data handling throughout the projects phases can lead to an accelerated engineering phase and shorter time to market. To achieve this goal the utilization of a standardized modular planning workflow is essential prior to physical modularization. Therefore, a process is first virtually divided into equipment groups that belong to the same part of the process. This reduces the complexity of a process and creates reusable building blocks.

All planning documents required for the construction of such modules are merged in functional process units that are called Process Equipment Design modules (PED) which are saved in databases. A PED incorporates at least one main equipment item, providing the desired unit operation together with all needed peripheral components. PEDs should be accompanied by simulation models, which allow for the configuration of modules, starting from a description of the PED functionality. The PEDs are then categorized in functional units, the process and service units.

Physical modularization can take place on the level of apparatus, plants and logistics on site as well as in the production

White Paper "Modular Plants"

The White Paper "Modular Plants", written by the temporary ProcessNet working group of the same name, gives an overview on current developments based on project evaluations. The authors from industry and academia call for a standardization of both nomenclature and equipment in order to enable a broad application of modularization in process engineering. The white paper is currently available in English; a German version will follow. The paper is available for download free of charge:
processnet.org/en/posis.html

* K. Rübberdt is Head of Communications, L. Schulz is Project Manager, DECHEMA e.V.

network. The compatible modules are constructed as adaptable units and assembled to form multi-purpose plants. A single piece of equipment can be defined as modular if it provides one of the following features:

- inherent modular design, providing serial or parallel numbering-up of basic elements or another key feature dedicated for reusing the equipment;
- inherent modular design, providing configurable elements to adapt to various operating conditions;
- or series of equipment providing the same functionality at different operational scales.

Physical modularization is suitable for multiproduct/multi-purpose plants, in which frequent reconfigurations of the process structure are common between product campaigns. Additionally, an integration of small scale continuously operated equipment into pilot or multipurpose batch plants can be realized to enable highly efficient hybrid production concepts. In this case, the plant consists of individual Process Equipment Assemblies (PEAs). A PEA represents the physical implementation of a PED, following additional geometrical and technical design guidelines, to ensure compatibility of independently planned modules. During the following operation, the exchangeability of single modules simplifies maintenance and service and reduces changeover times.

Research projects such as F3 Factory or the ENPRO initiative have proven that the modularization approach is feasible and can be implemented. The vision of the F3 Factory project was a radical modular approach for a rapid process development and the implementation of novel flexible and sustainable processes with an improved CapEx and OpEx. In the successful case studies, the potential of intensification and modularization for the chemical industry was demonstrated. During the project first design guidelines and standards were applied that enhanced the flexibility of a production plant by exchangeable PEAs.

Nonetheless, this is a completely new approach. In order to reach the goal of a completely modular designed and built plant, a lot of effort especially regarding the standardization of equipment and automation technology is still necessary. A key prerequisite for the modular approach will be the development of standard solutions for problems occurring repeatedly and the definition of guidelines for designing new PEDs. Interfaces are required to interconnect PEAs among one another and to local infrastructure. These interfaces have to match the requirements of a large variety of potential processes. This can only be achieved with flexible interfaces suitable for adaption to local boundary conditions. ■

GET DIGITAL — A (R)EVOLUTION

Everybody is talking about digitalization — but what they refer to ranges from the fridge that orders milk automatically to the fully automated assembly line that paints the bumper blue, yellow or green before fixing it to the car. So what does digitalization mean with regard to the chemical industry? Do high-throughput technology, process analytics, flexible production and e-learning mean we are already there, or is the true “digital revolution” still looming ahead?

DR. KATHRIN RÜBBERDT, DR. BJÖRN MATHES*

On the face of it, the chemical industry is already strongly digitalized in many respects. The degree of automation is high as the industry has been focusing for years on process optimization and intensification. But the real change that is enabled by big data, increased computing capacities and new algorithms is yet to come.

The Digital Plant Vision

A completely digitally controlled and integrated chemical industry site is based on a “digital plant”. The basic idea: A digital 3D model of a complete production plant is developed and used along the whole plant life cycle from the planning phase right through to production and maintenance. The objects in the 3D model are associated with topological data and various additional information (e.g. material flows, operating conditions or materials/material classes). Further documentation can be deposited in the system such as operating or service manuals from the OEM or documentation of services performed. In the late planning stages, thanks to virtual reality glasses or domes, the operator can virtually walk through the plant. This improves the planning process and enables early training. Even the bringing into service of the plant can be simulated, allowing for early tests and fixing of bugs.

During operation, the individual objects with their respective sensors communicate online with the digital plant model and add to the available data. From the digital model, the current operational status of a component and the foreseen service date can be obtained. The process model is also part of the digital model. Optimal process states can be calculated based on economic conditions and directly implemented, either in an open loop by the operator or closed loop directly by the process control system.

The Reality of the Digital Plant

Many components of the digital plant have been successfully used for years. Yet, for most operators the digital plant vision remains just that — a vision. The reasons are manifold: In plant design and plant building, the use of 3D models is state of the art. But there is a large variety of software tools that can be used for building, maintenance and use of the 3D model. The data storage formats of these models differ. Whenever there is a switch of tools, data is lost. Recently, the DEXPI initiative has been working on a neutral data exchange format.

The same problem occurs when the 3D model is transferred to the plant operator. And then the model requires continuous care and service if it is to be used further. This includes the required hard- and software as well as the mirroring of changes in the real plant in the virtual model.

Associated problems and cost often result in neglect of model care or the restriction to parts of the model. Besides, many companies are operating older plants without a 3D model. The retroactive building of a model is immensely costly and therefore avoided.

Towards Industrial Symbiosis

The complete data-based integration will not only affect processes in individual plants, but will advance models of industrial symbiosis as well.

1. At process level: Individual processes within plants are already largely interlinked with upstream and downstream production steps. This development is pushed by the growing individualization of the products and the integration of raw and secondary materials and residues. Management and benchmarking systems for energy and resource

* K. Rübberdt is Head of Biotechnology, B. Mathes is Head of PRAXISforums, DECHEMA e.V.

FOR THE CHEMICAL INDUSTRY

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efficiency allow for the analysis of the plant-specific energy and resources consumption over time, the attainable minimum and intermediary losses etc., but they are mostly not coupled to an automatic optimization.

2. At plant level: The "Verbund", the network of plants, is already in place at many sites. The cross-plant optimization of resource and energy streams becomes more important. This trend will be accompanied by a further closer interlinkage of production and other services such as supply chain management.

3. At site level: The integration of global production sites within one company ("virtual super site") or with external industrial or communal structures outside the site ("industrial symbiosis") can be advanced by the digital transformation. Increased flexibility and reaction to regionally diverse customer demands can be obtained beyond the individual site, resulting also in increased efficiency and resource security.

The growing integration of different sites and cross-site systems as well as the development of disruptive product innovation based on data analysis require the coupling of internal and external data such as customer information. But so far, there is a lot of resistance due to data security concerns and critical information issues that hinder cooperation. These hurdles can only be overcome by cooperation and based on clear understandings and, not least, trust.

The Road Ahead: New Business Models

Modular production will gain from the digital transformation as production needs to become more flexible. Modular plants can play to their strengths especially if many different reaction steps are required and only small amounts of valuable products are made — namely in fine and specialty chemistry. But in order to ensure competitiveness, development has to be focused on standardized modules and data interfaces to facilitate easy "plug & play" and allow for the digital communication between the individual modules and plants (see also page 6). This is a precondition for the fast exchange of modules. At the same time, large data volumes ("big data") that are for example generated by real time sensor networks will have to be analyzed. To meet all these requirements, the chemical industry needs not only adequate hardware and algorithms, but also human specialists ("data chemists").

In the production of fine and specialty chemicals, a trend towards modular and continuous production has been perceived for years. This development that is by no means concluded should help the industry to meet increasingly individual customer demands fast and competitively. Innovative digital control elements and software are important to actually deliver customized products in mini batches cost-effectively and profitably.

But apart from all mentioned examples, the by far largest potential for development for the chemical industry can probably be tapped with new digital service-oriented business models. The advancement of agricultural chemistry towards a service-oriented industry that delivers added value by combining data (e.g. weather, pest infestation, soil composition) and chemical products is a striking example for the opportunities to develop existing business models further and create new ones for the fine and special chemicals industry — essential steps in order to ensure the future as a place for innovation and production. ■

SMART SOLUTIONS FOR SMART MINDS

What will the future of the laboratory look like?

DR. KATHRIN RÜBBERDT*

Source: © Paulista/Fotolia.com

The Curie laboratory, in which radium was discovered a short time ago, [...] was a cross between a stable and a potato-cellar, and, if I had not seen the worktable with the chemical apparatus, I would have thought it a practical joke," said catalysis pioneer Wilhelm Ostwald on seeing the Curie's laboratory facilities around 1900.

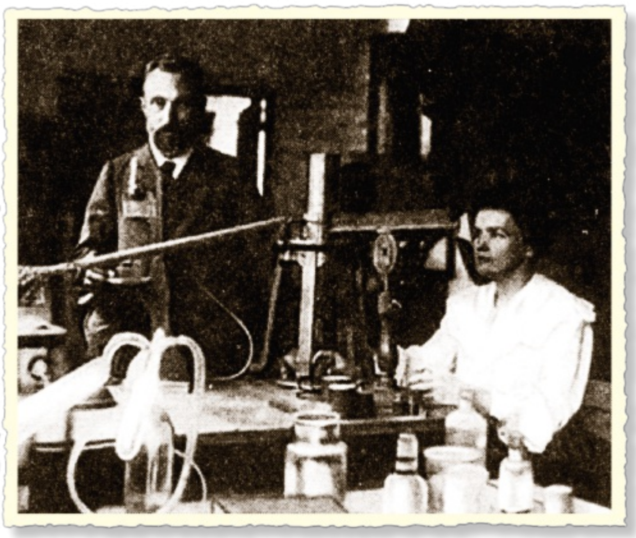
For today's strive for innovation, such an environment is inconceivable. Even the laboratories of 20 years ago with their fixed benches, the division between laboratory and computer room, with endless manual pipetting and paper-and-pen documentation, are deprecated. Where lab robots are performing high-throughput analyses, in vitro and in silico work are converging, and international cooperation means much more than a couple of e-mails a day, adequate R&D facilities are a prerequisite for success.

The Hardware

The modern laboratory environment is shaped by the same trends that affect most areas of today's life: Flexibility, digitalization, communication — combined with the never-changing requirements for a lab such as safety, robustness, and cleanliness.

The differences compared to the lab of old start literally at the foundation: Modern laboratory buildings provide open spaces, bringing in silico and in vitro work close together, and offer facilities for cooperation and communication. In its current report "Lab of the future", CBRE Workspace Solutions, a commercial real estate service firm, forecasts that the need for traditional lab space will fall by half until 2029, while the high-tech development in modeling, artificial intelligence, instrumentation, analysis and collaboration tools will lead to an increase in flex labs of 21%. The layout of the lab depends, however, on the work performed: While for quality assurance test-

* K. Rübberdt is Head of Communications, DECHEMA e.V.



Picture from old times: Pierre Curie and Marie Skłodowska-Curie, pioneers in radioactivity, in their laboratory

ing or routine work, traditional labs may still be the solution of choice, open-concept and flex labs are more appropriate for free-thinking research.

But buildings and rooms can only be used flexibly if the furniture supports this. Compared to the robust laboratory bench of old that was literally carved in stone, modern lab furniture is light, lean and modular. Laboratory desks and benches can be adjusted in height and put to different uses from bureau to work bench. Service installations are not permanently fixed, but decoupled and can be moved depending on changing requirements. Lab furniture provider Waldner offers service modules in form of spines, suspended booms, columns, wings and ceilings fit for every conceivable laboratory layout. Hemling Laborbau has developed a modular concept with standardized measurements, consistent heights and no projecting ends so that the lab can be completely rebuilt according to need.

And the laboratory builders have to think further: A provider who is active in the global market has to prepare for diverse conditions. German supplier Wesemann, for example, developed a mobile chemical laboratory for BASF that can ensure a constant room climate in a surrounding temperature range from -25 to +30 °C.

The Software

The vision of the future lab takes the furniture another step ahead: Smart surfaces will not only be able to heat or stir — goodbye magnetic stirrer and heating plate — with the appropriate diameter, temperature and speed, they will communicate with the lab worker, providing information on experiments and results and documenting the different steps in the process.

The interaction between the lab worker and the lab will be enabled by virtual systems and augmented reality. Protective glasses with virtual reality features project information on experiments such as volumes or amounts of to be weighed, temperature, time etc. right in front of the experimenter's eye. Integrated cameras and sound-recording systems coupled with voice recognition software record every single work step, significantly reducing the potential for mistakes and ensuring the complete and at any time accessible documentation of all work performed. Especially in analytical labs that have to adhere to strict standards, this can mean a tremendous improvement in efficiency and quality management. The virtual devices can also be used for communication: in a video conference, the expert on the other side of the globe can be shown the data from the glasses in order to comment or discuss the phenomena first-hand.

Digitalization in the lab is already far advanced. High-throughput methods and the ever more sophisticated analytical technologies are already now generating immense volumes of data — the term "big data" seems almost too weak for the amount of information handled in the modern lab; "giant" would probably be more adequate. Thus, modern LIMS have to be much more than data storage systems. They can be integrated with electronic laboratory journals as well as with order management systems, turning them into integrated Laboratory Management Systems that cover supply chain, functions, documentation and processes and can also be connected to big data analytical systems.

Another new technology has entered the lab on the quiet over recent years. While the discussion about the opportunities and limits of additive production is still going on, 3D printers have entered research laboratories especially in the life sciences. Scientists are not only printing away on tissues and biological structures; they also use 3D printers to develop and produce their own equipment from the reaction vessel to the mixer and other devices.

Cooperation is Key

But all visions of the smart lab, the movable modules and intelligent instruments depend on a common approach. Without standardized interfaces and data exchange formats, the ideas of flexibility and interaction will not become reality. Therefore, several initiatives have already been founded in order to advance the development of the laboratory of the future and, in particular, establish common standards for furniture and equipment suppliers as well as providers of software and analytical devices. In 2014, in the Federal state of Saarland, the nonprofit society "Labor der Zukunft" has been founded. Centered on a technology initiative of the Fraunhofer IBMT, eleven companies and institutions such as MESSKO or THIEMT have joined forces to promote the standardization of future labs. The initiative also focusses on mobile lab solutions.

Nexygen stands for "The Next Generation Lab" and is a joint initiative of German laboratory equipment and services providers, including Köttermann, Sartorius, Memmert, 2mag and Hirschmann. They follow an interdisciplinary approach based on the holistic view of the analytical process from the preparation of samples right through to documentation and disposal of waste.

But no matter how smart the lab will get in the end — it will always be a tool and supporting system. If there had been a mechanical helper to process huge amounts of uranium ore, the Curies would certainly have welcomed it. They could have used the new-won freedom to explore what really matters in research: The creativity of the human mind. ■

BIOTECH FOR CHEMISTRY

The future has long since begun: By now, the biotechnological production of fine and bulk chemicals as well as biopharmaceuticals by means of enzymes, prokaryotic or eukaryotic cells has found its way in the chemical industry. No surprise, that "Biotech for Chemistry" is one of the focal topics at ACHEMA 2018.

DR. MARLENE ETSCHMANN*

"A chemist who is not a physicist is nothing at all," said Robert Bunsen, German chemist and famous for the invention of the Bunsen burner. Little did he know that his contemporary Louis Pasteur, working only a few hundred kilometers away in France, discovered that fermentation is caused by bacteria. Had Bunsen anticipated how important biotechnology would be for chemistry one day, he probably would have demanded more microbiological expertise in chemists.

Fast forward 160 years and Biotech for Chemistry is one of the focal topics at ACHEMA 2018. From gene to product to process it features the growing number of biotechnological applications that are gaining traction within the chemical industry and either complement chemical reactions or even replace them completely. In the following two examples — of 1,4-butanediol and lactic acid — illustrate the increasing importance of industrial bacterial technologies.

* M. Etschmann, Communications and ACHEMA Focal Topics, DECHEMA Ausstellungs-GmbH.

Biobased Spandex

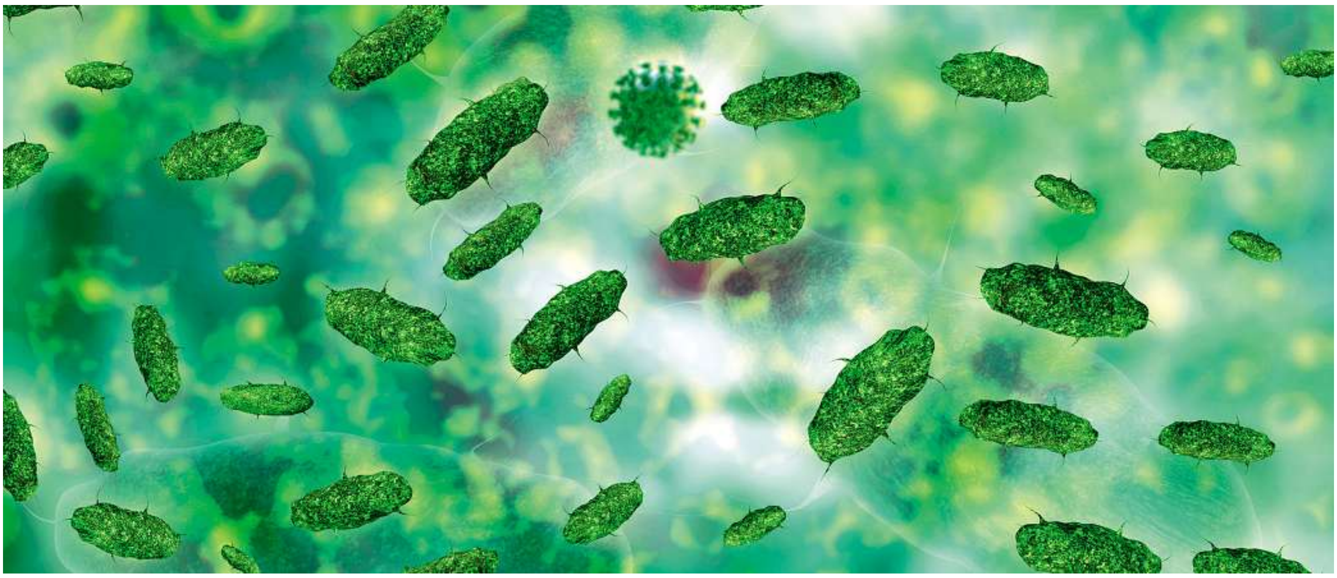
1,4-butanediol (BDO) is an important intermediate and raw material for plastics, solvents and synthetic fibres. Think polyurethane foam cushion you are sitting on or Spandex fibres which make up your sportswear and lots of it. The worldwide production capacity for BDO is about two million tons and market leader BASF covers a quarter of that.

In the most popular chemical synthesis, applied by BASF among others, acetylene reacts with two equivalents of formaldehyde to form 1,4-butynediol which is then hydrogenated to 1,4-butanediol. Apart from being based on fossil feedstock, the process is energy-intensive and causes significant greenhouse gas emissions thus a more sustainable way of production was desired.

California-based Genomatica started out to make BDO production green in 2008 with the help of the most common of bacteria: Escherichia coli. What started with a measly 1.2 g/L BDO in 50 hours in a shake flask was tuned into an industrial process with a titer of >125 g/L running in 600,000 liter fermenters.

As BDO is a chemical that does not exist in nature a completely new biosynthetic pathway consisting of five reactions had to be developed. Hundreds of enzymes were tested and the best ones assembled into a wild-type Escherichia coli. The central metabolism of the bacterium was rewired to channel more of the metabolic intermediate succinyl-CoA into the final product and byproducts were reduced.

The first commercial batch of 2,000 tons BDO was run in 2012 on the premises of Tate & Lyle Bioproducts Company



Source: © fotoliaxrender/Fotolia.com

Chemist's little helpers: bacteria

⋯ Call for Papers

Biotech for Chemistry is also reflected in the extensive presentation program of the ACHEMA congress. If you would like to contribute please **apply for a presentation slot** in the sections

- Biochemical Reaction Technology
- Biorefineries
- Biotransformations/Biocatalysis
- Integrated Production
- Raw Materials and Alternative Feedstocks

at **www.achema.de/congress** until **September 1st, 2017**.

Spandex yarn

and the success story continues. BASF has a license agreement with Genomatica that allows the production of 75,000 tons of BDO and Novamont obtained a license of 30,000 tons for its plant located in Adria, Italy.

Biotech Tops Chemistry

At this growth rate it will be interesting to see when biotechnological BDO production will overtake the chemical process. In lactic acid this has happened a long time ago. There is only one major producer left that relies on the chemical production of the acid: the addition of hydrogen cyanide to acetaldehyde and subsequent hydrolysis to form lactonitrile which is hydrolysed by hydrochloric acid.

The bulk of the acid is nowadays produced by lactic acid bacteria and very efficiently at that. The process has 85–95 % yield and can be controlled to produce racemic mixtures or up to 99.9 % L-lactic acid.

Lactic acid became increasingly popular with the rising demand for bioplastics as it can be condensed to the thermoplastic polymer polylactic acid (PLA). Market leader Nature Works got competition lately when Corbion Purac announced to build a 75,000 t PLA/year plant in Thailand. Both companies will probably have no problem selling their product as the market is fuelled by the trend towards desktop 3D printing where PLA is applied as printing filament. ■

HIGH-TECH HONEY HARVEST

Honey bees are considered the industrious ones in the animal kingdom but how much can honey production be industrialized?

DR. MARLENE ETSCHMANN*

When ACHEMA opens its gates in early summer the hustle and bustle is not unlike the one in a beehive going on at the same time of year. In both cases gatekeepers look out who is allowed on-site and inside an intricate system regulates what type of construction has to go where and who is working on what. But while the exhibits in the trade show business are all glistening stainless steel and high-tech equipment, beekeeping and honey production is an unhurried and homey trade full of ancient craftsmanship. Or isn't it?

The beekeepers in their oldfangled veiled hats may look unhurried, but they are part of a serious industry which is behind the honey jar on your breakfast table.

Source: © smspsy/Fotolia.com

Beekeeper at work

Germans have the sweetest tooth worldwide and consume a whole kilogram of honey per inhabitant and year. Only 30 % are produced locally, the missing 60,000 tons are imported from all over the world. A considerable amount of the imports come from China as world's largest producer with 466,000 tons/year. The European Union follows with 204,000 tons/year and Turkey makes 95,000 tons of honey each year. Although many beekeepers work on the small scale, these production numbers cannot be achieved with mom-and-pop-operations alone. The largest individual beekeeper in the world currently is Adee Honey Farms LP in South Dakota, USA, operating 80,000 hives and producing nearly 2,000 tons of honey per year. At this scale beekeeping isn't homey but as mechanized and automated as possible. However, there are limits to high-tech in the keeping of the winged honey producers.

Source: Carl Fritz

CFM Honey extractor with Siemens control unit

The Internet of Bees

A cattle farmer can monitor feed uptake and milk yield of each of his animals individually by means of an RFID tag. Poultry farmers can at least manage the flock by controlling the composition of the feed mix. Beekeeping in contrast is largely a black box operation. The insects forage in a radius of about three kilometers around their hive and it is at their discretion which plants they visit to collect nectar. However, monitoring devices are having a foot in the hive entrance recently. They measure weather data outside as well as temperature, humidity and acoustics within the hive: relaxed bees sound different than stressed bees. A GPS sensor sets off an alarm if a hive moves away from its location — colony theft is common and a serious problem in the industry. Load cells measure the weight of each hive which is an important indicator for the keeper when to harvest the honey.

Apart from modern monitoring possibilities there hasn't changed a lot in the actual keeping of the bees in the last dec-

* M. Etschmann, Communications and ACHEMA Focal Topics, DECHEMA Ausstellungs-GmbH.

ades. High-tech equipment only is applied when the honey is harvested. In the past the honey-filled frames were uncapped by hand with a special comb before loading them into an extractor. Here at the latest technology comes into play as the times of hand-cranked centrifuges are definitely over.

The cylindrical body holds a wire basket that fits several uncapped frames. When the lid is closed the motor rotates the wire basket and centrifugal force throws the honey to the inner wall of the vessel. It runs down the wall and collects at the bottom. Midway the motor needs to change rotation direction to extract both sides of the honeycomb. It takes experience and intuition of the operator to get an optimal result out of a centrifuge with conventional control: good extraction of the honey without breaking the wax structure of the honeycomb in the wooden frame.

German extractor producer Carl Fritz has teamed up with Harzer Antriebstechnik to make the system more compact, intuitive and easier to handle. They use Siemens controls, frequency converters and operating panels to offer automated extraction programs which can still be modified manually.

Large scale beekeepers naturally work at a different level of mechanization. Honey processing lines such as those manufactured by Italian company Giordan start with an uncapper that cuts off the capping wax of eleven frames per minute. The mixture of cappings wax and honey is separated in a press with a collection hopper. The combs are moved along a conveyor toward the stainless steel extracting tank. While the uncapped combs are pushed from the loading section of the conveyor into the stainless steel extractor reel, the empty combs of the previous load are pushed out of the reel onto the unloading conveyor. While the extractor is processing frames uncapping continues for the next load.

Before filling into jars wax crumbs, bee's legs and other impurities need to be removed from the honey. In Europe the honey is usually strained through a sieve with a mesh size of around 200 µm. In the U.S. honey can be micro-filtered with a mesh size of 0.1 to 10 µm to remove particles that are not visible to the naked eye. These particles act as seed crystals and removing them makes for a very clear honey that stays liquid for a long time. However, microfiltration also removes pollen that bees harvest together with the nectar.

By microscopic analysis of the pollen grains the country and even region of origin of the honey can be determined thus removing the grains opens the floodgates for counterfeiting honey. European Union law prohibits any kind of addition or removal from honey and therefore also microfiltration. ■

DETAILS REVEALED FOR ACHEMA 2018 PRAXISFORUMS

Topics of practical relevance are being presented in compact form by experts affiliated with the ACHEMA exhibitors — this is the mission of the highly attractive ACHEMA PRAXISforums.

DR. THOMAS SCHEURING*

Source: DECHEMA e.V./Helmut Stettin; © sdecoret/Fotolia.com; [M] GötzelDobler

A high-profile, explicitly practice-oriented congress programme is complementing the ACHEMA exhibition and contributes to the event's all-around approach. Various special and guest events, expert round tables, panel discussions and plenary lectures round off classical conference formats and offer a comprehensive overview of current trends in the process industries. A corner stone of this approach are the ACHEMA PRAXISforums: They will be held in close proximity to the respective exhibition group in the midst of the exhibition grounds on the following topics.

Advanced Reactor Design

The reactor is the core of every chemical process; modern processes require sophisticated reactor concepts that combine intensified reaction conditions with improved safety precautions and precise reaction monitoring/control. Advanced concepts also include in-situ product removal, flexible production, multiphase reactions and flow chemistry. This topic also covers unique reactor designs for specific applications such as membrane reactors, microreactors as well as electrochemical and photochemical reactors.

Bioprocessing: Speed, Flexibility, Disposables

Newly developed reaction systems (e.g. single-use technologies), continuous processes, modularisation, process and strain development, advanced process analytics and data-mining tools allow to speed-up the optimisation of bioprocesses. These innovative systems, tools, and technologies can be applied for the production of fine and bulk chemicals as well

* T. Scheuring is CEO of DECHEMA Ausstellungs-GmbH.

as biopharmaceuticals by means of enzymes, prokaryotic or eukaryotic cells.

Chemical & Pharmaceutical Logistics

From service provider to system partner with higher-level solutions — the digitisation of the logistics chain opens new doors in supply chain management and distribution: Nowadays logistics have to meet strict requirements in the chemical and pharmaceutical industries. The flow of goods and information must be further optimised and adapted to the needs of the customers. The monitoring and quality assurance of goods during transport and production are becoming increasingly important. In particular, the advancing automation and digitisation play a decisive role in the development of innovative logistics solutions.

Future Production

Two major production concepts of the chemical industry entail continuous-flow and modularized production which follow the trend to customised specialty and fine chemicals as well as increasing product varieties. The general goal of these activities is to decrease time to market and to produce with a higher quality and in a less wasteful manner. New technologies open up pathways for novel production concepts which have not been practicable before — modular plants (see page 6), self-adaptation and self-surveillance or production on site and demand being only some examples. Future plant concepts also include a smart use of process data coupled with logistics and market information.

Innovative Mixing & Separation Solutions

Mixing and separation technologies have a significant impact on the efficiency and cost of processes in the chemical, biotech, and materials processing industry. New process developments and advanced apparatus solutions provide the basis for a major decrease in operating and capital expenditures.

Lab of the Future

Modern lab equipment today enables researchers to perform literally millions of reactions and analyses in a short time frame. Along with the digital transformation, the working environment in chemical or biotechnological labs will transform dramatically (see page 10). To reach optimal performance laboratories often need to be structured, equipped, operated, and maintained in different ways. The PRAXISforum covers the latest innovation in products and services around laboratory technologies, from basic lab equipment to automated modular systems up to the software and modelling tools needed to convert big data into smart data.

Pharma Meets Production

Innovative equipment, technologies, and services have the potential to facilitate and optimise the complex production processes of (bio)pharmaceuticals. The PRAXISforum covers practical and close-to-the-market aspects of the manufacturing processes including reactor systems, product purification and formulation technologies, fill and finish, labelling and logistics (incl. new facility concepts).

Safety First!

The practical application of safety is the core of this session. Best practices and lessons learned as well as the latest innovative products and services (ready-to-use) for plant and process safety together with occupational safety will be presented and discussed.

Sensor-Based Production Control

For an almost fully automated production including scheduling, dispatching and monitoring of all production steps intelligent and smart sensors are key components. New control systems and concepts, as well as new sensors, enable the process industry to achieve optimum performance in all stages of production. The PRAXISforum will cover newest technologies and solutions in the field of sensors and their implementation in the process industries.

State-of-the-Art Fluid Handling

Movement and storage of liquids, gases, liquid-solid suspensions or other multiphase mixtures are key operations in all fields of the process industries. Fluid handling and transfer equipment as well as pumps and peripheric devices represent ACHEMAs largest exhibition group; they are of key relevance for our industry and remain the subject of continuously progressing innovations. ■

Contact

Dr. Björn Mathes
e-mail: mathes@dechema.de
Phone +49-69-7564-365

The winners and mentors of ACHEMA-Gründerpreis 2015 (f.l.t.r.): Prof. Dr. Rainer Diercks, Dr. Gerhard Baaken (Ionera Technologies), Hans-Peter Ilgner, Heimo Adamski (4Gene), Dr. Michael Brandkamp, Thorsten Seipp (Volterion)

Source: Jose Poblete/DECHEMA

TWO YEARS AFTER ...

Have you ever thought about founding a company? The finalists of the ACHEMA-Gründerpreis 2015 (ACHEMA Founder Award) have taken up the challenge. What has become of their ideas and businesses over the last two years? We followed up.

DR. KATHRIN RÜBBERDT*

hydrogenious TECHNOLOGIES

... develops solutions for storage and transport of hydrogen in Diesel-like Liquids.

• How has your company developed since 2015?
The year 2015 was dominated by the first in-house prototypes. Building on that, we signed a contract with a US hydrogen logistics company on two field systems in 2016; the contract was extended to an additional plant in December 2016. These field systems will be delivered in 2017. Today, after a successful second round financing was closed in November 2016, Hydrogenious has 40 employees.

• What were the biggest hurdles, and how did you overcome them?
Convincing pioneer customers to invest in a new technology was not easy; focusing on smaller, more innovative hydrogen logistics companies proved a viable strategy. The regulatory requirements were also a challenge that was solved by the commitment and effort of our employees and with the intensive support of our suppliers and partners.

• What would be required to have more successful start-ups in the process industry, chemistry and biotechnology in Germany?
These fields are very capital-intensive. Larger investment sums should be more easily accessible, and the German industry could provide more support for engineering start-ups.

4GENE

... develops and produces natural, biotechnologically engineered, activatable Aroma-Glycosides that are marketed as Flavor-on-Demand.

• Over the past two years, what has been easier than expected?
Due to the commitment of our researchers and developers and the laboratory equipment we could finance from funding, the expansion of our product range from 7 to 22 flavour glucosides has been realized much faster than expected. We are today able to offer two products on an industrial scale; the other products are available in smaller volumes.

• How did the ACHEMA-Gründerpreis affect the development of your company?
Winning the ACHEMA-Gründerpreis was a tremendous motivation for our team. The external impact was bigger than we expected. It helped to get public funding to continue the speedy development of our technology. And the numerous industry contacts that resulted from the award had a major effect on focusing and substantiating our business model.

• What would be required to have more successful start-ups in the process industry, chemistry and biotechnology in Germany?

* K. Rübberdt is Head of Communications, DECHEMA e.V.

When developments in biotechnology are discussed, it's almost always from a pharma perspective; the same applies to the term "life science". We would welcome increased efforts to broaden especially media coverage in order to show that biotechnology is so much more and offers innovative solutions for a lot of applications.

sciomics
enabling precision medicine

... supports and speeds up Protein Biomarker Research and Discovery Programmes for Precision Medicine and Companion Diagnostic applications.

• Where does your company stand today?
We have positioned ourselves as an innovative early phase developer of prognostic and diagnostic biomarker signatures. In addition, we have significantly expanded contract research for protein and phosphorylation analyses as the second pillar of our business model, cooperating with renowned research institutions and companies of every size.

• What were the biggest hurdles over the last two years, and how did you overcome them?
The biggest hurdles were the ever increasing bureaucratic effort resulting in significantly growing costs and the unfavourable financial environment with regard to venture capital as well as the cumbersome framework for innovative research projects. These conditions slowed down the company's growth, inhibiting the employment of additional personnel, the implementation of innovation and growth within Germany.

• What are your expectations for the next three years?
We are expecting ongoing growth in our service business and the first commercial successes from our biomarker development projects. With regard to the political framework for growth and innovation in Germany, strongly hoping for a more innovation friendly environment.

bentekk

... develops a fast, portable gas detector (GC-PID) for the on-site analysis of volatile organic compounds (VOC).

• How has your company developed since 2015?
We have entered the market in early 2016 and have acquired a number of renowned large customers such as BASF and Total. Our gas detectors get an ever wider distribution in the oil, gas and chemical industry. Currently, we are preparing the market entry of our second product line. And we are exploring the opportunities for additional services, especially in connection with the web platform that is linked to our gas detectors. Thus you might say we are going with the zeitgeist, using digitalization to expand our sales sources beyond hardware.

• What has been easier than expected?
Refineries and chemicals producers in Germany are better connected than expected. Safety professionals and plant fire departments are in close contact — thus, numerous recommendations and word of mouth have pushed our sales.

• What would be required to have more successful start-ups in the process industry, chemistry and biotechnology in Germany?
CCC — Entrepreneurially educated characters, more capital for technology-oriented start-ups and a more risk-friendly culture that pardons failure.

GLYCONIC

... provides its proprietary glycosylation platform to develop new active cosmetic and pharmaceutical ingredients (ACI, API) that show enhanced activity, compatibility, and stability.

• Where does your company stand today?
Glyconic is funded by the "Gründungsoffensive Biotechnologie" (GO-Bio) of the German Federal Ministry of Education and Research (BMBF). At the end of phase 1, the first ACIs will be validated in terms of efficacy and safety and thus be ready for in vivo studies. In addition, Glyconic prepares to scale-up the current production processes on an industrial scale.

• What have been the largest hurdles?
A challenge is to find investors in time for funding a high-tech company, which offers an excellent IP position, an enthusiastic team of experts, and potentially high returns of investment. A second mission was to convince large companies to consider and integrate Glyconic's novel technology platform into their R&D processes.

• What role has the ACHEMA-Gründerpreis played for the development of your company?
The ACHEMA-Gründerpreis increased the visibility of Glyconic. It helped us to make important contacts for our project. The evaluation of the Glyconic project also helped us to strengthen the business case.

ACHEMA-Gründerpreis 2018

ACHEMA GRÜNDER PREIS

In the run-up to ACHEMA 2018, once again DECHEMA, the Business Angels Frankfurt-RheinMain and the High-Tech Gründerfonds want to pave the road for innovation in chemistry, process engineering and biotechnology. For the second time they call for submissions to the ACHEMA-Gründerpreis.
From the first idea to the concept and business plan phase, the ACHEMA Start-Up Award supports (future) founders by providing what they need most: Advice and help from industry and finance experts, contact to potential customers and investors and a high visibility to the global industry.

Submission of business ideas, concepts and business plans is open as of now:
www.achema.de/gruenderpreis

AWAKENING THE GIANT: PETCHEM-ELDORADO IRAN

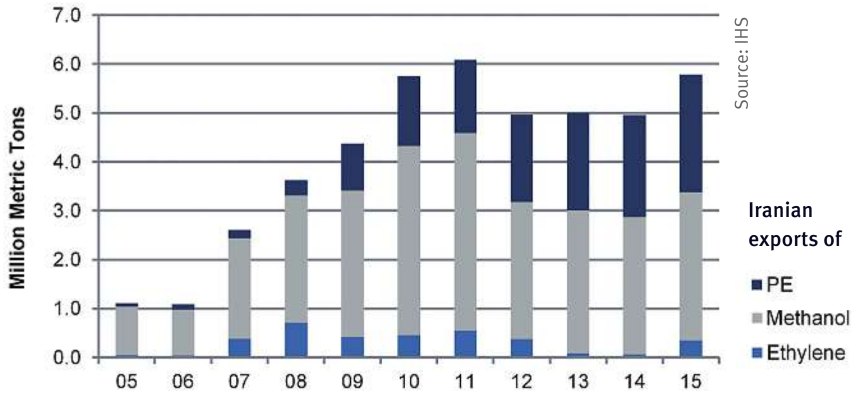
Iran is back in business: The end of the sanctions and trade embargos makes the oil-rich Gulf state a petrochemical hotspot. But possible investors have to be willing to stomach certain risks.

DOMINIK STEPHAN*

The hopes are high: As the sanctions against Iran will be lifted or suspended, the country provides tremendous opportunities for engineering projects — and the enormous oil reserves provide the financial background for the much needed modernization. A new strategy, expressed in the concept "Iran Vision 2025", outlines the target of becoming the largest regional producer of petrochemical products. Thus, the Iranian government encourages international investments with the intend of raising US$ 20 billion in mining and downstream projects. This marks a paradigm shift, as in the past, over 75 % of foreign investment went to upstream sectors.

"Big Oil" has already placed its bets: Shell was among the first to announce a cooperation agreement with Iran's National Petrochemical Company NPC, covering "enhancement" projects for gas-to-liquids (GTL), among others. Competitor Total has since signed a memorandum with NPC to study a jointly owned petrochemical complex in Iran, while Sojitz of Japan studies a methanol-to-propylene plant. Also China invests heavily, with a new US$ 3 billion contract announced earlier this year.

In late 2016, news agency Bloomberg reported that Persian Gulf Petrochemical Industries was in talks with Asian companies to raise US$ 1.1 billion. Further down the road is the Kaveh Methanol Plant which, upon completion, will be the world's biggest methanol production with a nameplate capacity of seven million tons per year.



India is lining up US$ 20 billion for fertilizer projects in the Chahabar special economic zone, Oil Minister Dharmendra Pradhan stated. These could be "either joint ventures between Indian and Iranian public companies or with private sector partners". The minister further expressed India's interest in importing LPG from Iran and proposed to set up an extraction plant in Chahabar.

With new projects and modernisations in the pipeline, Iran's petrochemical industry continues its race to catch up: Today, oil, gas and petrochemicals account for roughly 80 % of the country's industrial production. Nearly half of this output, namely 18.1 million tons, is dedicated towards export markets. In 2016, nearly 19 million tons of petrochemical products worth US$ 10 billion were exported.

This is by no means the final stage of the restructuring of the country's once blooming industry, officials said: Within nine years, production shall reach 160 million tons. "Sustained and planned development of the entire value chain with focused development of downstream markets is expected to bring significant value addition to Iran's economy", Ali Mirmohammad, Business Development Manager at Frost & Sullivan confirms. Iran requires at least US$ 70 billion to achieve its Vision 2025. Such an investment is expected to catalyse growth in exports from less than US$ 12 billion in 2015 to over US$ 40 billion by the end of 2025.

Yet, Iran is no safe bet: According to IHS Chemicals, risks include a high degree of political risk, legal uncertainty and bothersome levels of administrative obstacles. Despite these, Iran has a number of important advantages, including low-cost feedstock and access to major markets. This is significant given that chemical feedstock availability in other countries such as Saudi Arabia, Kuwait and Oman, has become more limited. "If you are a petrochemical producer looking at Iran for its investment and growth opportunity, and you can forget for a minute about the major risks involved, it presents an attractive opportunity," said Michael Smith, vice president EMEA, IHS. ■

* D. Stephan is editor at PROCESS.

Source: © Brian Jackson/Fotolia.com

International Events Organized by DECHEMA

- **May 2–3, 2017:** Systems Biology meets Synthetic Biology — Frankfurt/Germany
- **May 10–12, 2017:** EuroPACT 2017 — 4th European Conference on Process Analytics and Control Technology — Potsdam/Germany
- **June 25–28, 2017:** 6th International Conference on Self-Healing Materials — Friedrichshafen/Germany
- **July 12, 2017:** German-French day — Nancy/France
- **September 24–27, 2017:** 22. International Biohydrometallurgy Symposium — Freiberg/Germany
- **October 23–26, 2017:** CORUSS 2017 — International Exhibition and Conference on technology, equipment and materials for corrosion protection — Moscow/Russia
- **October 29 – November 1, 2017:** EuroMOF 2017 — 2nd European Conference on Metal-Organic Frameworks and Porous Polymers — Delft/Netherlands

Further Information:

DECHEMA e.V., Congress Office
Theodor-Heuss-Allee 25, 60486 Frankfurt am Main/Germany
Phone +49-69-7564-129/-333/-249; Fax +49-69-7564-176
e-mail: tagungen@dechema.de Internet www.dechema.de

THE ULTIMATE MATERIALS REFERENCE NOW ONLINE

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The DECHEMA-Werkstoff-Tabelle (materials charts) is now available online. The renown German-language compendium for engineers, chemical plant designers and process experts offers 24/7 access to 120,000 material-media-combinations. It describes the corrosion and chemical resistance of all technically important metallic, non-metallic inorganic and organic materials in contact with aggressive media. Ways of corrosion protection and prevention are also shown. The information is given in form of a comprehensive text, figures and tables. Thanks to a full text search and extensive index, all information is accessible easily and fast. Both single and multiple user licence models are available.

Further information: **http://dechema.de/DWT_Online.html**

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EDITORIAL STAFF

Editor-in-Chief: Gerd Kielburger, +49-931-418-2536, gerd.kielburger@vogel.com
Editor: Dr. Jörg Kempf, +49-931-418-2173, joerg.kempf@vogel.com
Editorial Assistant: Gabriele Ilg, +49-931-418-2107, gabriele.ilg@vogel.com
Editorial Office: Vogel Business Media GmbH & Co. KG, Max-Planck-Str. 7/9, 97082 Wuerzburg, Germany, Fax +49-931/418-2750, redaktion@process.de www.process.de, www.process-worldwide.com
Layout: Vogel Design Werkstatt
Production: Werner Wolz, +49-931-418-2479

SALES

Sales Director: Reiner Öttinger, +49-931-418-2613, (responsible for the advertising section) reiner.oettinger@vogel.com

MEDIA GROUP

Publisher's Address: Vogel Business Media GmbH & Co. KG, Max-Planck-Str. 7/9, 97082 Wuerzburg, Germany, +49-931-418-0, Fax +49-931-418-2750, A Company of Vogel Business Media
Managing Directors: Matthias Bauer, Florian Fischer, Günter Schürger