

ACHEMA

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A special edition from

PROCESS
Chemie · Pharma · Verfahrenstechnik

4
2014

BREAKING THE SILENCE

You couldn't miss the reports about the first test flights with biobased jet fuel. Amyris and Total pulled out all the stops of public relations to make sure their technological break-through was recognized worldwide. From a consumer's perspective, however, the shift from fossil fuels towards a biobased economy is a silent revolution.

The nylon socks you are wearing could very well be made of plant-based succinic acid. Did you check? Do you care? Probably not, as long as your socks are as soft and durable as you are used to from fossil-based nylon socks and they are in the same price range. Performance is key, regardless how a product is made and what kind of raw material was used. Manufacturers know that and they also know that green credentials alone will not suffice to survive in the market.

The biobased economy is far beyond your grandma's scratchy handknit sweater. Do you remember? The ugly brown one that you only wore because grandma had put her heart and soul in it. Oh, if grandma had only lived to see what biotechnology can make of her scratchy wool yarn: add the appropriate enzyme and it shaves off the small ends of the fiber that cause the itch. The result is a silky smooth surface which also makes the garment shrink-resistant when you put it in the washing machine. Using biotechnology has made the scratchy sweater into a cozy high-tech product that you love to wear because it performs. Looking at your sweater's label, however, you will be none the wiser because it doesn't say "biotechnology at work" or "proud member of the biobased economy". What a pity. Give credit, where credit is due.

At Achema 2015 we give credit to those involved with BiobasedWorld. You will have the opportunity to experience what the end-user will rarely see: biobased economy in the making. Here, you can meet them all, the technology providers, the equipment manufacturers, the project developers, the investors and many more.

Need a separator for algal biomass? Have a look at mechanical processes in hall 5. Wondering about the best distilling method to produce bioethanol? Ask the thermal processes experts in hall 6. Want to acquire a license for an innovative bioprocess? Go to the research and innovations hall 9.2. Like to build a biorefinery? Achema offers one-stop shopping for technical equipment and know-how. Interested in the latest developments? Listen to the talks of the congress program. In need for an expert? Try our partnering service.



■ DR. MARLENE ETSCHMANN

Project Manager BiobasedWorld,
DECHEMA Exhibitions ■

"The biobased economy is far beyond your grandma's scratchy handknit sweater."

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PROCESS ANALYTICS AND INDUSTRY 4.0

Addressing topics with particular impact for the future of our industry has always been one of Achema's key targets—and process analytics is a perfect example.

DR. RENATA KÖRFER AND DR. THOMAS SCHEURING

The triumphant advance of automation in all sectors of the process industries requires an increasingly continuous monitoring of process parameters. This is only possible through substantial improvements in online analytical technology. Cost pressure, globalization, and quality assurance will additionally stimulate the demand for automation in the future across all other industries.

R. Körfer is Project Manager at DECHEMA e.V.; T. Scheuring is CEO of DECHEMA Exhibitions.

In this context it is Achema's aim to provide you with first-hand, compact yet comprehensive, and real-life information on all aspects of PAT process control and engineering.

So What Is "PAT"—Process Analytical Technology—All About?

PAT is definitely much more than just one sensor integrated into a process. Process Analytical Technology is a risk-based strategy for designing, analyzing and controlling manufacturing processes. The Critical Process Parameters (CPPs) are identified in line with the definition of the

Critical Quality Attributes (CQAs) of intermediates or final products. Process Analytical Technology offers a number of tools for measuring and controlling these CPPs.

Process analysis is a holistic approach that separates a whole system into its components, and the analytics is the method of logical analysis. A step-by-step breakdown of the process is then used to convey the inputs, outputs, and operations that take place during each phase. A process analysis can be used to improve the understanding of how the process operates, and to determine tar-



On the fast track to production: Process analysis will certainly play a more important role in the future of the process industries than it has in the past.

gets for process improvement by removing waste and increasing efficiency.

Spectroscopic Techniques on the Rise

To an increasing extent, spectroscopic techniques are replacing conventional sensors. Spectroscopic sensors are, in that sense, complex systems providing detailed information on the molecular structure of components. As spectroscopic techniques can simultaneously detect all morphological and chemical features, the complete fundamental functionality is inherent in every spectrum.

However, redundant and unnecessary information must be excluded and sensitivity and selectivity increased. The necessary prerequisites and objectives for advanced instrumental sensors are:

- increase intelligence on the sensor platform that also includes calibration procedures;
- integrate first principles into the data analysis, increasing selectivity;
- increase sensitivity by means of higher photon fluxes and better detector principles;
- use multimodality as the sensor principle, thus obtain complex spectral trajectories.

Another buzz word in the media of today is Industry 4.0.—or shall we rather say Chemistry 4.0?

The specific terms don't really matter—but process analysis will certainly play a more important role in the future of the process industries than it has in the past. Let's briefly look back:

After the first industrial revolution with the mechanization of industrial manufacturing and the second industrial revolution with the introduction of the assembly line and electrical power came the third revolution at the end of the last century, introducing information technology into mass production.

Today we are very likely at the verge of the fourth industrial revolution—which will be the smart factory. The future of industrial automation will be arbitrarily modifiable and expandable (flexible), and connect arbitrary components of a network of multiple producers. It will thus enable its components to perform tasks related to its context independently and on a self-organizational basis, with the emphasis on the ease of use.

In short, smart materials are processed in smart factories with smart sensors to produce smart products. This enables the

production of small batches of goods that can be customized for any customer. You don't need to be a visionary to understand that this is an industrial environment which, for the process industries, is fully dependent on a truly advanced real-time process analysis and monitoring.

Sounds complicated? Get a better understanding of what's going on in our industry and visit us at www.achema.de and—definitely a must!—in Frankfurt am Main/Germany next year (June 15–19, 2015). ■

DON'T MISS THIS CHANCE

Biobased processes use a lot of the hardware their oil-based counterparts need and much more. ACHEMA is well versed in the BiobasedWorld, as it has been the meeting point for biotechnology and chemical engineering alike for a long time, so what better place to be if you want to probe the booming market.

DR. MARLENE ETSCHMANN

Ignacy Łukasiewicz looks mildly frustrated in his portrait that shows him sitting at his desk, a massive textbook in front of him and a distillation apparatus in the background. Perhaps he looks frustrated in the 1880s because he already has a foreboding that only 150 years later, his lifelong passion would be doomed. A trained pharmacist Łukasiewicz investi-

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gated mineral oil in his native Poland for medicinal applications when he realized its potential for illumination. At that time whale blubber was the fuel of choice for oil lamps but the light was miserable, smelled awful and burned with a lot of soot. Łukasiewicz distilled mineral oil to kerosene but could not make it work in the traditional oil lamp therefore he invented the kerosene lamp. Thus he contributed to the first oil boom and is one of the pioneers of the oil based chemical industry. Nowadays, mineral oil is on the downgrade and even if there's still quite

a bit left in the natural reservoirs, we have to face the fact that we are using a finite resource. Shale gas may come to the rescue temporarily, but aside from environmental concerns it also comes with the clock ticking—mild frustration included.

Microbial Solvent Production: Back to Weizmann's Roots

Bioeconomy can't be attributed as easily to a single person, it cannot even be easily attributed to a certain period. Is Louis Pasteur the rightful hero as he produced butanol for the first time by biological means in 1861? Or is credit due to Charles Weizmann, who filed the patent for "production of acetone and alcohol by bacterial processes" in 1916? After all, the ABE (acetone, butanol, ethanol) fermentation was applied on a large scale during the first world war. At that time acetone was needed to produce the state-of-the-art smokeless explosive cordite. The process remained industrial standard well into the 1960s, when petrochemical methods for solvent production took over. Now history repeats itself and fermentative solvent production is one of the focal technologies for the production of biobased fuels.

Perhaps it's the microorganisms that are the true and timeless heroes of the bioeconomy. Many of today's biorefineries are home to *Clostridium* species—the same bacteria Weizmann used for acetone production 100 years ago—or to baker's and brewer's yeasts. Granted, today's biorefinery yeasts have only little in common with those you find in your daily bread and beer. Fine-tuning metabolic pathways by genetic engineering has turned the humble microorganisms into biological high-tech machinery with yields that Weizmann could only have dreamed of.

Solvents and biofuels, especially ethanol, are the most prominent products of the biobased economy and probably also the most controversial.



Ignacy Łukasiewicz,
pioneer of the
oil-based world

→ BiobasedWorld at ACHEMA 2015

As an ACHEMA exhibitor, you will soon have the chance to become part of BiobasedWorld by signing up for our special publication. A visit to the BiobasedWorld section of the congress program will bring you up to date on what's simmering in the think tanks around the world concerning biorefinery platforms, novel bioprocesses from the idea for the biocatalyst to the downstream processing of the product, development and processing of biobased products from bulk chemicals to specialties and much more.



The German chemical industry association (VCI) objects to disrupting the mechanisms of the free market with political interventions such as quotas or subsidies. Customers buy products according to performance, not out of political motivation, is the VCI's rationale. However, political intervention is something you can't ignore while discussing the biobased economy. Brazil was among the first countries to implement a national ethanol program in 1975 in response to the first oil crisis and today every gasoline pump dispenses fuel that contains between 20 and 25% ethanol. The US established their National Renewable Fuel Standard program in 2005 and now have ethanol admixture in two thirds of the national gasoline supply. When oil companies launched E10 gasoline with 10% ethanol in Germany in 2011, however, they banged their heads against a brick wall. Generally known as law-abiding, the general public did nothing to fulfill the quota demanded by the European Union's renewable energy policy. Drivers simply refused to buy the bio-enhanced fuel and preferred to pay a premium for unadulterated gasoline. They still do so today and E10 never got a foothold in the German fuel market. Much of the doubt about E10 is rooted in the belief that it could damage the engine and this is due to a communication disaster. Upon introduction of the new fuel car manufacturers and motor clubs announced that E10 may not be suitable for some cars. Thereupon drivers feared for the safety of their beloved cars and sought refuge in the well-known, risk-free, ethanol-free standard gasoline. While it is true that the ethanol content can damage the piping of older cars, this affects only 1% of the vehicles rolling on the streets of Germany. The biofuels market could look quite different, had the facts been phrased in a positive way, that is with 99% of all cars you probably wouldn't notice a difference if they ran on E10.

Lesson learned: the old adage “perception is reality” still holds true, regardless of the facts. What the consumer thinks about your product is what you should focus on, marketing-wise and all those involved need to act in concert.

Study Bioeconomy

Brick-and-Mortar or Online

The biobased economy sings its own praises to be knowledge-based and new master studies are emerging worldwide. Germany's E10 phenomenon shows that the marketing of biobased products has its peculiarities and that even the best technology is prone to misunderstandings if not communicated properly. Obviously it is not enough to teach the students the “bio”-part, but the “economy”-part also needs to be addressed thoroughly and this shows in the curricula. At Hohenheim University (Germany) for example, there is a module “markets, innovation and social acceptance of biobased products”. Other options to study bioeconomy are Edinburgh University (UK), the University of Eastern Finland in cooperation with the Graduate School of Forestry Research Institute of Ghana and Iowa State University (US). Even if your undergraduate days are long gone, you can join the massive open online course “Technology for Biobased Products” at www.edx.org, the non-profit online initiative created by Harvard and MIT. The course is a joint initiative of TU Delft, the international BE-Basic consortium and University of Campinas. Within seven weeks you can learn the basics of process design for biobased products from feedstock to biomaterials, chemicals and biofuels.

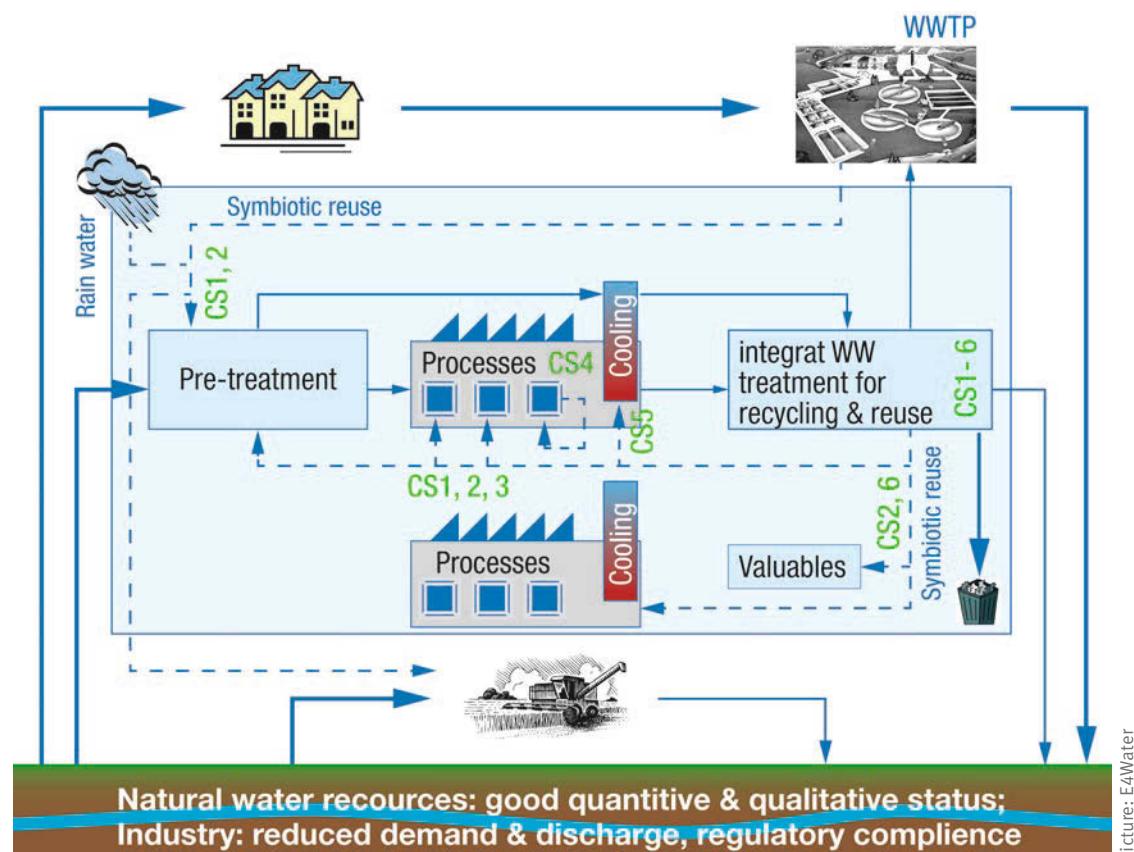
BiobasedWorld at ACHEMA offers you the chance of five days of real life continuing education without an exam. Whether it is concepts for the design of new bioprocesses or the equipment to make them a reality, both in the exhibition and congress program you can experience the biobased economy at work. ■

NEW WAYS TO IMPROVE WATER EFFICIENCY

The FP7 EU project E4Water – “Economically and ecologically efficient water management in the European Chemical Industry” – deals with water reuse, wastewater production, energy use, and economic growth to achieve an integrated industrial water management approach.

DR. CHRISTINA JUNGFER

The E4Water concept, following an integrated, multi-disciplinary and holistic approach in different industrial scales and across sectors. The dashed lines indicate the impact by E4Water, CS (= case study) indicate where on site industrial pilot testing and demonstration are focused on, the number allows their identification.



In view of the requirements of water related policies, the eco-efficient and sustainable industrial water management is considered to be one of the main strategies for environmental protection in many European countries. The chemical industry is a cornerstone of the European economy. It converts raw materials into thousands of different products and is both a major water user and a solution provider for the key strategic European process industry sectors such as mining, industrial biotechnology, health, food, electronic, pulp and paper and energy.

C. Jungfer is Project Manager at DECHEMA e.V.

The chemical industry offers significant potential for increasing eco-efficiency in industrial water management also for other industrial sectors.

Primary contributions of the E4Water project include a paradigm shift in the chemical industry to create a breakthrough in industrial water treatment and management. The project addresses crucial process industry needs, to overcome bottlenecks and barriers for an integrated and energy efficient water management. International partners, namely industry stakeholders, research partners and end users, deal with reduction of water use, wastewater production and energy use in

the chemical industry with the objective of increased eco-efficiency and sustainability. Particularly the societal, environmental and economic challenges are in focus where innovative solutions are needed to uncouple growth from water use.

E4Water builds on state-of-the-art and new basic R&D concepts. Their realization, improvement, utilization and validation, with the compromise of early industrial adaptors, are clearly innovative. E4Water realizes this by (1) developing and testing innovative materials, process technologies, tools and methodologies for an integrated water management, (2)

...❖ Industrial Water Management at ACHEMA 2015

Want to learn more about industrial water management? It is one of the focus topics at ACHEMA 2015 — visit www.achema.de to learn more.

providing an open innovation approach for testing E4Water developments with respect to other industries, (3) implementing and validating the developments in six industrial case studies, representing critical problems for the chemical industry and other process industries, (4) implementing improved tools for process efficiency optimization, linking water processes with production processes- and eco-efficiency assessment.

The figure shows the E4Water concept following an integrated, multi-disciplinary and holistic approach in different industrial scales and across sectors. The six case studies (CS) are designed to ensure and demonstrate the relevance of the E4Water approach to the chemical industry:

- The chemical site of CS1 is located in the coastal area of the Netherlands. Due to shortage of fresh water the partners are working on facilitating the use of reclaimed water in industrial water management process.
- CS2 is located in the Port of Antwerp (Belgium), a multi-company site. Due to pressure on fresh water resources and regulatory demands for waste water, water reuse and identification of synergies are of interest.
- The coastal area of northern Spain with small river basin facing periodical water shortages. CS3 focuses on ensuring process continuation by closing the water loop and minimizing fresh water use.
- CS4 deals with recycling of wash water streams that occur in the production process of household chemicals. Inno-

vative ways to enhance in-process water loop closure by integrating biocidal with wastewater treatment technologies are in focus.

- CS5 is looking for integrated waste water management on a petrochemical site in Northern France.
- CS6 is located at an industrial symbiosis site in Denmark. The focus is to develop innovative symbiotic treatment concepts for high-loaded organic waste water streams coming from industrial fermentation processes by creating added value.

The case studies were chosen as prototypical examples for generic challenges in order to show the generality and broad impact of the E4Water concept. The implementation of E4Water developments helps to decouple the increase of industrial production from the use of water, natural resources and energy. The outcome of E4Water strengthens both the leadership of the European Water Technology Industry and of European Process Industries in the global competition.

Further information: www.e4water.eu. ■

CAUGHT IN THE FOSSIL TRAP?

The US chemical industry thrives on shale gas, coal chemistry is celebrating a comeback in China. Where does this leave visions of a bio-based chemical industry on a broad range?

PROF. DR. KURT WAGEMANN AND DR. KATHRIN RÜBBERDT

For the first time in the history of the chemical industry, the raw material base is not changing globally, but becoming differentiated according to region. As BASF Vice Chairman Martin Brudermüller pointed out at the biannual DECHEMA and ProcessNet conference, while shale gas acts as a game changer in the U.S., China focuses on coal, South America aims to make use of its renewable resources, while traditional oil and gas remain a major raw material source in Europe. Global companies adapt to these regional developments by broadening the range of their technologies, making use of whatever is available on the regional market.

For apologists of a completely bio-based future, this must appear as a severe drawback. Why should companies invest in technologies to produce bulk chemicals such as ethylene or propylene from biomass when they are available cheaply and in abundance from ethane crackers and via propane dehydrogenation? Why develop bio-based pathways to commodities when the well-established and optimized highways from petrochemicals remain open?

On closer analysis, however, there is no need to ring bioeconomy's death bell even before its proper birth. On the contrary, the shift in the raw material base may result in new opportunities for bio-based processes. Bio-based ethylene and propylene will not be competitive in the foreseeable future, but the production of functionalized molecules such as lactic acid or propane diols from biomass is very attractive. The increasing use of shale gas leads to a shortage of C4 and higher hydrocarbons as well as aromatics. The effects are already visible: Over the last months, massive investments in plants for the bio-based production of butanediols and succinic acid have been announced, and research efforts in this



Picture: Fotolia - Brian Jackson

area seem to have increased significantly.

While access to the "simple" aromatics xylene and phenol still remains a largely unsolved challenge for bio-based routes, there exists in principle an attractive route to terephthalic acid from carbohydrates via 5-hydroxy-methyl-furfural.

Overall, however, while the debate and the competition go on, it becomes even more obvious that the best opportunity for a bioeconomy in the short and mid-term lies not in providing drop-ins for well-established and cheap products from the petrochemical age. Its biggest chance is to develop products and solutions that are new, better and cheaper than their fossil ancestors. Instead of de-functionalizing complex molecules to mimic the bottom-up building of traditional chemistry, new products should

make use of the functionalities provided—an effect we see already today in pharmaceuticals or cosmetics, where the chemical total synthesis of active ingredients has been replaced by biotechnological processes on a broad range. The same applies for vitamins, enzymes, but also more "technical" products such as surfactants or bioplastics.

Is the bioeconomy caught in the fossil trap? No. The way out, however, is not along the well-trod synthetic pathways of the past, but along new, innovative routes that lead to improved products. Convincing consumers by performance rather than relying on their ecological conscience is the key to establishing bio-based products on a large scale. Bioeconomy will not come as a revolution. But we are already in the middle of the bioeconomy evolution. ■

... Panel Discussion at Achema 2015

A panel discussion at Achema 2015 will draw the spotlight on the effects of shale gas on the bioeconomy on Tuesday, June 16. Find more information at www.chema.de in spring 2015.

PRODUCTS2COME

Doing business means finding the right partners. products2come (p2c)—The 1st online technology transfer and partnering event for the life sciences—is a highly innovative format for innovation providers and technology seekers. The

combination from online conference and online partnering is an “innovation exchange” and a partnering platform serving academia, SMEs and large companies. Whether you wish to learn about exciting inventions or if you are seeking R&D

cooperations and wish to present your projects, p2c connects you to the right people from the global life sciences community. Submission of abstracts is open until December 12; all submissions will be evaluated by experts from top global companies. On March 24 and 25, selected technology offers will be presented in online ses-



sions, accompanied by a two-day online partnering.

...⇒ **More information you will find at:**
www.products2come.org

1ST DEchema PRAXISFORUM

Enzymes are considered to be little miracle substances for innovation, process advantages and cost reductions. The application areas in which enzymes can be used sensibly and profitably are diverse and nowhere near exhausted. The 1st DEchema PRAXISforum “Enzymes for Industrial Applications” on February 4–5, 2015 brings together industry professionals, solution providers and key customers in the field of enzyme technology from all over the world. It is your chance to attend and become informed about the latest developments and new products, services and process and production technologies. The key topics are:

- new industrial enzymes — where is the future?
- Best practice examples and lessons learned: successful enzyme applications
- Lead-time-reduction: efficient scale up from lab to production
- Technologies in enzyme production: engineering solutions and platform technologies

The PRAXISforum addresses industry professionals along the value chain who are looking for innovations meeting their practical needs. It offers presentations, an exhibition and extensive room for discussions.

...⇒ **More information you will find at:**
events.dechema.de/en/Enzymes+for+Industrial+Applications.html

THE ACHEMA STUDY COURSE

Maybe all that glitters is not gold in Germany's education system – but the dual approach of combining practice-oriented elements with theoretical learning modules certainly is a great asset. DECHEMA is supporting this approach in many ways through various activities, and ACHEMA's Study Course is just one of them.

DR. THOMAS SCHEURING

The idea behind our study course at ACHEMA is quite simple: We offer future chemists and engineers hands-on experience through exhibits they can touch on the world's most comprehensive display of process technology. "Experience the whole world of process engineering" is the slogan during the ACHEMA week, and appropriately it is also the headline of the little information brochure we have compiled for students.

Students, as well as pupils, have the chance to experience the full scale of process technology, get information on job profiles, even make first contacts with potential employers. From small laboratory devices or the most advanced automation concepts to complete pharmaceutical packaging lines: With thousands of exhibits ACHEMA is showcasing state-of-the-art technology in a comprehensiveness which cannot be found elsewhere. So the whole world of process technology is literally at their hands – an opportunity for the young generation which only comes every three years. At DECHEMA we consider this a chance not to be missed, and we feel it is our obligation to make this wealth of information accessible for the young generation: Eventually they are the experts, customers, and decision makers of tomorrow!

So how does it work: Students register beforehand, together with their academic tutor who is supposed to accompany his or her group. DECHEMA is then sponsoring travel costs as well as giving support with some basic logistics. Plus, there

is no entrance fee for students' groups. The study course program is being complemented by additional lectures particularly for tutors and teachers, and of course these groups have access not only to the exhibition but the conference as well, with all the lectures, plenary events and panel discussions for additional inspiration.

Special Career Day

That means ACHEMA is an invaluable chance for the young attendees to get detailed and comprehensive insight into an industry which is versatile and future-orientated like few others. At each ACHEMA regularly more than 10,000 students make use of this offer. There is one particular day – the "career day" on Thursday, organized in cooperation with the German web portal "job vector" – which is especially dedicated to this clientele, and young professionals can get guidance and advice for their first steps towards the job market.

One final word: We are aware that groups of students entering an exhibition booth are not necessarily always welcome, particularly if the stand staff is already busy talking to some regular attendees. Nevertheless we would like to ask you, our valuable exhibitor, for your understanding and patience once a student group enters your booth during the event.

ACHEMA's student program is important not only for us and the young academics, but for you as well: These young people will be your customers or co-workers of tomorrow, and they deserve your attention. ■

T. Scheuring is CEO of DECHEMA Exhibitions.

◆◆ International Events Organized by DECHEMA

- **November 27 – 28, 2014:** Solid-State Batteries from Fundamentals to Application, Frankfurt am Main/Germany
- **January 20 – 21, 2015:** 10th Status Seminar Chemical Biology, Frankfurt am Main/Germany
- **January 26, 2015:** Infoday "Synthetic Pathways and Synthetic Enzyme Cascades", Frankfurt am Main/Germany
- **February 10, 2015:** Non-canonical amino acids in proteins: structural investigations and biocatalysis, Frankfurt am Main/Germany
- **March 19 – 20, 2015:** Jahrestreffen der Fachgruppen Computational Fluid Dynamics und Mehrphasenströmungen, Lüneburg/Germany
- **March 23 – 24, 2015:** International Workshop "Molecular Modeling and Simulation: Science, Engineering, and Industrial Applications", Frankfurt am Main/Germany
- **April 21 – 24, 2015:** Annual EBSA Conference 2015 – 18th Annual Meeting of the European Biosafety Association: Orchestrating a (bio)safe world, Vienna/Austria
- **April 21 – 22, 2015:** 3rd Workshop: The new Paradigm – IgM from bench to clinic, Frankfurt am Main/Germany
- **May 11 – 13, 2015:** Scale-up and scale-down of bioprocesses, Hamburg-Bergedorf/Germany
- **May 20 – 22, 2015:** ENERGY, SCIENCE & TECHNOLOGY – International Conference and Exhibition – EST 2015, Karlsruhe/Germany
- **June 15 – 19, 2015:** ACHEMA 2015, Frankfurt am Main/Germany
- **September 6 – 9, 2015:** 2nd European Conference on Natural Products, Frankfurt am Main/Germany
- **September 9 – 11, 2015:** Bioflavour 2015, Frankfurt am Main/Germany
- **September 27 – 30, 2015:** 54th Tutzing Symposium: Sustainable Phyto Extracts – Trends, Perspectives and Visions

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