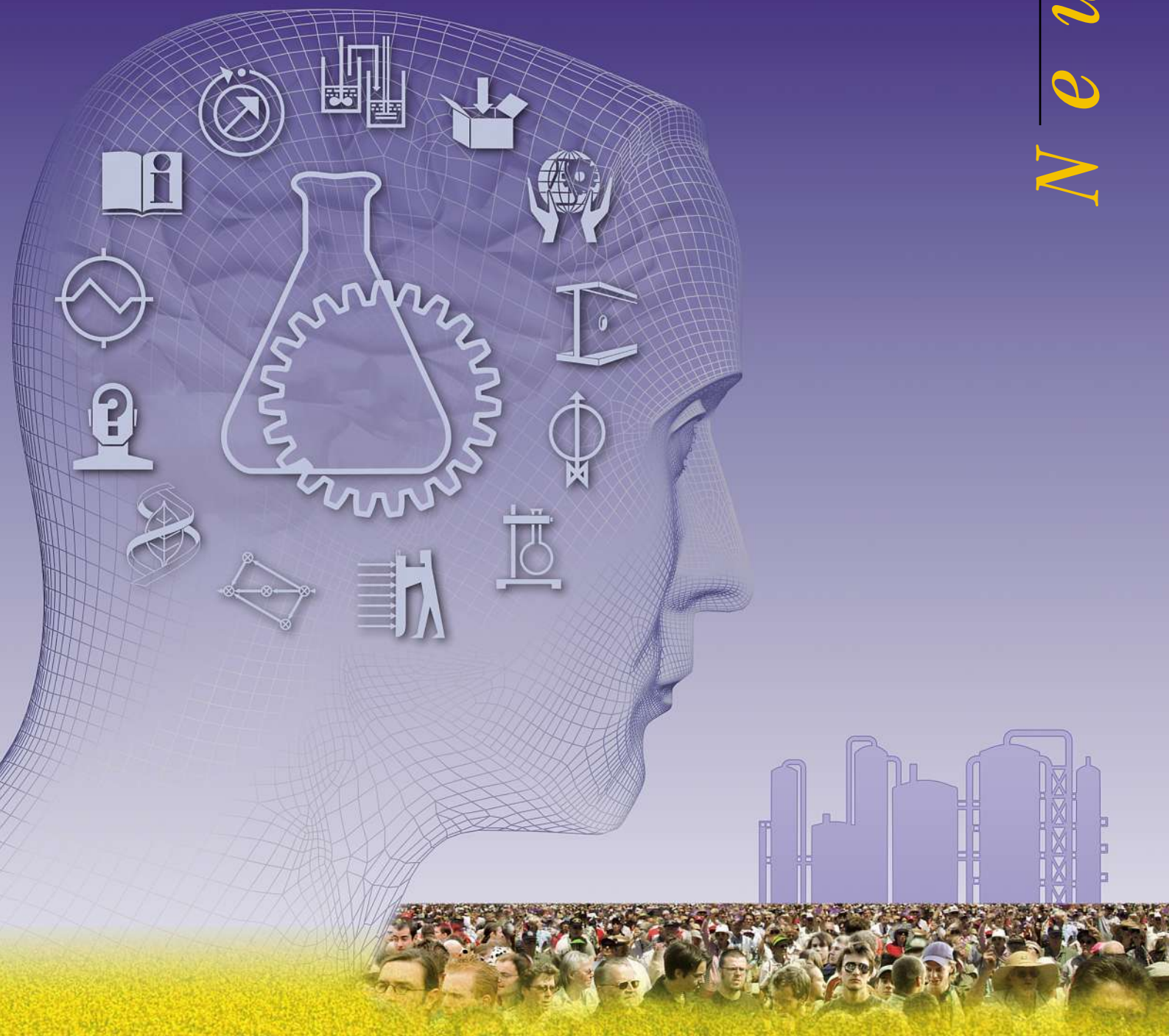
2/2007

ACHEMA WORLDWIDE News



Preparations for ACHEMA 2009 are already in full swing

A special edition from PROCESS

ProcessNet – *Welcome News from Germany*

At the end of last year DECHEMA (Society for Chemical Engineering and Biotechnology) and VDI-GVC (The Association of German Engineers – Society for Chemical and Process Engineering) merged their working party and section activities into one organization to be known as ProcessNet. This umbrella organization now covers all aspects of chemical and process engineering. This implies chemical reaction technologies, particle technologies and product design, fluid dynamics and separation technologies, safety engineering, materials, process and plant design as well as environmental technologies. This facilitates cross-fertilization among the chemical disciplines. Even more important: it gives us the competence and expertise to address topics ranging far beyond a discussion of specific process units. Such topics are closely related to the great needs of mankind in the future:

■ Energy: Energy supply in the future will be even more dependent on chemistry. Examples include conversion technologies for solar energy like photovoltaics, electricity storage, high-temperature-resistant materials for enhanced efficiency of combustion engines, improved energy efficiency of processes in the chemical and related industries.

■ Use of renewables: Of course the use of renewables is closely related to fuel production. Here, there is a strong need for input from chemical engineering. Present first-generation plants producing biodiesel are still far from being process-intensified. Realizing the 2nd generation, based on gasification or intelligent pulping processes of lignocellulosic sources such as wood and straw, will be no trivial matter, especially if we aim to integrate the production of chemicals on a large scale.

■ Solids handling and continuous separation processes, i.e. based on extruders or using the unique properties of ionic liquids, are opportunities which have to be integrated right from the outset into the innovation processes, not forgetting life-cycle analysis and logistics in order to implement the concept of biorefineries.

■ Climate change: A great deal has to be done to maintain the average rise in global temperature at 2 °C (the expected maximum our ecological systems may be able to handle) in this century. Well-known examples of useful technologies are thermal isolation materials for lower heating requirements and CO_2 sequestration technologies. On the other hand such a temperature increase will also require innovative efforts in terms of adaptation: efficient solar-driven cooling systems, water supply for industry and agriculture, flood prevention as well as the development of temperature and drought-resistant plants will be the key topics.

ProcessNet – the initiative of DECHEMA and VDI-GVC – is now in a unique position to address such tremendously important challenges. And we look forward to discuss all this topics with the worldwide chemical engineering community at the next ACHEMA in May 2009 in Frankfurt.

Dr. Kurt Wagemann
Managing Director of ProcessNet

Contents

Cover Photo: DECHEMA

Top marks for *AchemAsia 2007*

22% more exhibitors, 37% larger exhibition area, highly professional visitors – these are top marks for AchemAsia 2007.

Picture: DECHEMA

VIP-Tour through the exhibitions halls with Prof. Cao Xianghong, President of CIESC and Dr. Alfred Oberholz, Chairman of DECHEMA (right)

The hallmarks of this year's AchemAsia – International Exhibition Congress on Chemical Engineering and Biotechnology, which took place in Beijing/PR China from 14 to 18 May, were a tangible air of optimism, high professionalism and excellent contacts. The figures reached an all-time high: 505 exhibitors from 27 different countries on 8,800 m² net exhibition area.
The exhibition profile targets the priorities of the Chinese economy. Target groups are all branches that supply or apply equipment, technologies, complete problem solutions and know-how for the chemical and petrochemical industries, the pharma and food industries, biotechnology, the environmental protection industry and related sectors of the process industries.

Many 'firsts'

There were many 'firsts' at AchemAsia 2007. For the first time the number of exhibitors passed the 500 mark, representing an increase of 22% (2004: 414 exhibitors). The countries with the largest contingents of exhibitors were China (239 exhibitors); followed by Germany (131), Great Britain (20), the USA (20), France (18) and Italy (12). A further 'first' was the exhibitors representing the Russian Federation and Slovakia. Of the Chinese exhibitors around one third were international companies that are meanwhile based in China with joint ventures or their fully foreign-owned companies. This highlights the scale of international companies' involvement in the Chinese economy.
Although the hall area was extended to five halls with 8,800 m² net exhibition area (+37% over 2004) it was not possible to fulfil all exhibitors' requests for stand space. For AchemAsia 2010, therefore, hall capacity will again be increased. Gratifyingly, the trend towards larger exhibition areas ran counter to the international trend. The renewed increase in quality of the Chinese presentations demonstrates that China's process industries are focusing on international competition.
With 13,305 visitors at the exhibition, AchemAsia 2007 topped the previous event (comparable figures for 2004: 10,964). The total number of all visitors, including congress participants and participants of the exhibitors, was around 16,048. Due to a new electronic counting system, the figures are not quite compatible with those of earlier events as the system does not allow for multiple entries by visitors and congress participants.
In the main the visitors were decision-makers and highly qualified professionals. Numerous CEOs and managers made use of the opportunity for networking and initiating business deals. The range of visitors was clearly more international than at previous events; significant numbers of visitors from other Asian countries were recorded. High-ranking business delegations came from Germany, India, South Korea, Japan and Indonesia, among other countries. From India alone there were over 150 participants. This time, too, Chinese visitors were not only from Greater Beijing, but far more were from the region of Shanghai and other Chinese industrial centres.

www.achemasia.de

AchemAsia's importance for the Chinese economy

"China is on the way to becoming a high-tech country and thus depends on cutting-edge technologies, economic efficiency and environmental protection. This requires a dialogue and close cooperation with international companies", stated Prof. Cao Xianghong, President of CIESC (Chemical Industry and Engineering Society of China) on the occasion of the opening

ceremony of AchemAsia which was held in the presence of high-ranking representatives from politics and industry.

"AchemAsia is the biggest international exhibition for the process industries in China and as such provides a suitable platform for the exchange of ideas and experience," Dr. Alfred Oberholz, Chairman of DECHEMA (Society for Chemical Engineering and Biotechnology), stated in his opening speech. The high number of exhibitors from 27 countries illustrated how positively the process industries in China and Asia are developing. In his talks with Madame Gu Xiulian, Vice-Chairman of the Standing Committee of the National People's Congress of PR China and former Minister for the Chemical Industry, it was very apparent that in Asia, too, the greatest challenges were a sustainable economy and a considerable reduction of greenhouse impacts. Oberholz emphasized that AchemAsia provided abundant solutions from a scientific and technological point of view.

According to Mme. Gu, chemistry plays a vital role in all industrial sectors of China; as one of the basic technologies of the country its development is a priority. In the case of new projects China attributes the utmost importance to innovative technologies, resource savings and environmental protection. Cooperation with the companies and countries represented at AchemAsia is of paramount interest. ■

Why are you here? Visitors' comments at AchemAsia

"I am coming here to get some new information about advanced technology and new products – especially technology from Germany. And I'll be here next time."

Mr. Liu, Hamilton-Sundstrand Pump Manufacturer (Nanjing)

"This is the first time I come to AchemaAsia. I hope to find a lot of suppliers and manufacturers here. My main focus is on pharmaceutical technology."

Mr. Arabinda Dey, Printemps International (India)

"On this show, firstly, I want to have a look at new technologies, industry news and development trends; secondly, I want to get some information on new equipment to be brought in; thirdly, I am seeking new projects for cooperation."

Mr. LuoFutian, Equipment Research Institute of Qilu Branch, SINOPEC

Demands for reduced processing times and costs along with maximum safety, product consistency and compliance have resulted in increasing use of disposable products in biotechnological processes, and especially in cell culture-based bioprocessing, over the last ten years. Besides disposable filters, tubing, bags, mixing systems and aseptic connectors, numerous disposable bioreactors are already available.

Today, disposable bioreactor applications range from cell line screening via inoculum production (picture) to glycoprotein production and, although more seldom, secondary metabolite production processes, which are most commonly realized at small- and middle-volume scale.

Disposable bioreactors for cell culture-based bioprocessing

Regine Eibl and Dieter Eibl

A typical disposable bioreactor consists of a sterile cultivation chamber or bag which is made of polymeric materials. After sterile filling with culture medium and subsequent inoculation with the production organism (normally animal cells or plant cells), the desired bioreaction starts. When harvesting the product (e.g. cells, recombinant proteins, secondary metabolites) has finished, the plastic cultivation device is discarded. Compared with their glass or stainless steel counterparts, disposable bioreactors possess many advantages such as short set-up times, no sterilization and cleaning, reduced cross-contamination, high simplicity and flexibility, and shorter production turnaround times. However, there are still limitations in respect of scalability, availability of efficient single-use process monitoring as well as control technology. Other potential difficulties are the possible secretion of leachables and extractables from plastic layers and regulatory unfamiliarity this day. The disposable cell culture bioreactors presented below can be categorized into traditional small-scale culture systems and their modifications, hollow fiber bioreactors, and bag bioreactors.

Traditional small-scale culture systems and their modifications

Petri dishes, flasks and roller bottles, which have the longest tradition in disposable small-scale cell culture, are characterized by simple design as well as by a low level of instrumentation and control. For this reason, they usually require external equipment such as incubators or shakers to ensure an appropriate physical and chemical environment for the cells. They represent typical cell production systems for suspended and anchorage-dependent growing animal cells.

Modifications of these traditional, simple disposable bioreactors exist in terms of either static (e.g. CELLine from Integra Biosciences) or rotating membrane flask bioreactors (miniPerm from Greiner Bio-One), and multi-tray bioreactors (e.g. Nunc Cell Factory, HYPERFlask from Corning). Because of the high cell densities (>10^7 cells/ml) and product titers in mg-range, as partly guaranteed by these modified bioreactors, they are the systems of choice for screening experiments and clinical sample production. Moreover, even today static multi-tray cell culture systems are used by several animal as well as human vaccine manufacturers, as are the familiar roller-bottles. However, the tendency to automatize processes in order to reduce laborious manual work by skilled operators or robotic processors has become apparent over the years.

Additional developments incorporate disposable plastic bottles operating with FibraCel disks (FibraStage from New Brunswick Scientific), disposable spinners as well as their adaptations (e.g. SuperSpinner from Sartorius Stedim Biotech and cellfermPro from DASGIP), and shaking bioreactors equipped with disposable tubes (TubeSpin from ExcellGene) or multiwell plates (µ-24 Bioreactor from Applikon). Disposable shaking bioreactors are preferred in high-throughput scale down systems with high equivalency to large-scale cell suspension. A similar approach is based on 20 l and 50 l cylindrical vessels on a shaking machine that assure growth of insect, CHO, hybridoma and tobacco suspension cells (RWTH Aachen University).

Hollow fibre bioreactors

Hollow fiber reactors (e.g. FiberCell, AutovaxID from BioVest), which were introduced in the 1980s, belong to the group of hydraulically driven high cell density systems, where the energy input is provided by special double-phase pumps. Normally, the cells are grown and the product is secreted outside the fibers (extracapillary space), which have been potted into a horizontally fixed, cylindrical cultivation module. By the fibers' molecular weight cutoff the passage of macromolecules through the fiber wall is affected as oxygen enriched medium flows continuously through the fibers (intracapillary space). Oxygen enrichment is accomplished by the oxygenator, a separate module made of silicone tubes or membranes. The small culture volume (2.5 to 1,000 ml per module) of hollow fiber bioreactors limits their application to small-scale production of antibodies for diagnostic and research purposes.

For glycoprotein production, an adapted hollow fiber bioreactor system

R.Eibl, D. Eibl, Zurich University of Applied Sciences, School of Life Sciences and Facility Management, Institute of Biotechnology, Wädenswil, Switzerland
Email contact: regine.eibl@zhaw.ch

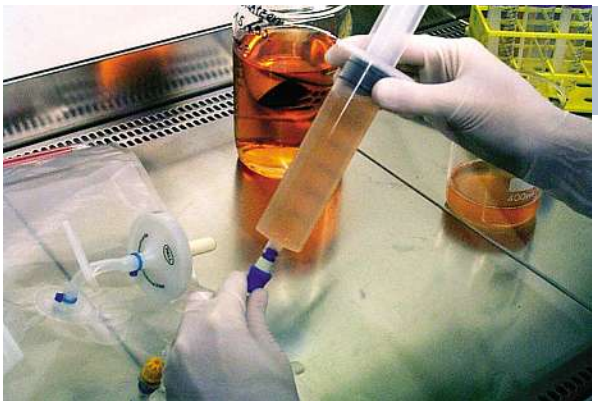
(MBB) operating with rotating, cylindrical cultivation vessel has recently been presented by Probiogen. Multiple hollow fiber modules can be integrated into one single cultivation vessel. The cells which grow in the fibers – an unusual phenomenon – are periodically supplied with medium from the extracapillary space. Test results encouraged the company to contemplate a 400 l vessel volume. However, due to increasing use of animal suspension cells and the availability of membrane flask bioreactors (mentioned above), hollow fiber bioreactors have lost their importance in animal cell-based bioprocessing in most instances. Exceptions are cell production for cell therapies, the generation of functional 2D or 3D tissue and constructs, and the development of organ modules (extracorporeal organoids/bioartificial organs).

Bag bioreactors

For cell cultures, Osmotek's Life Reactor (based on the airlift principle) was the first disposable bag bioreactor referred to in the literature in 1995. In the Life Reactor, which has been exclusively developed for plant cell propagations and secondary metabolite productions, energy input is achieved solely by gas sparging. In the late 1990s, the Plastic-lined Bioreactor, a second pneumatically driven plant cell cultivation bioreactor, was introduced and the early small-scale version of the Wave Bioreactor came onto the market. It is an indisputable fact that the Wave reactor and its success story promoted the development of mechanically driven bag bioreactors, such as stirred systems, a tumbling system, the Artelis-ATMI Life-Sciences' Pad-Drive disposable bioreactor, and a system with Vibromixer, the bio-t bag, in addition to the variations of bioreactors based on wave-induced motion (WIM). While wave-mixed bioreactors with rocking or shaking platform (e.g. Tsunami Bioreactor, AppliFlex, CELL-tainer, Optima and OrbiCell systems) have mainly been designed to grow animal suspension cells, Nestlé's WUB, where energy input is accomplished by raising a platform, is also suitable to propagate less sensitive plant suspension cells.

Interestingly, the two dimensional rocking movement of the CELL-tainer results in very high mass-transfer capacities (KL*a's up to 300 hr^{-1}), which are able to support the oxygen demand of high density cell cultures and even most microbial applications.

Among disposable bag bioreactors with WIM, BioWave and its successor, the fully controlled BIOSTAT CultiBag RM, and the Wave Bioreactor have a leading position due to wide usage, maximum scale, the availability of scale-up criteria, the hydrodynamic expertise and the convincing results of oxygen transport efficiency studies. Different publications confirm their capabilities as well as their superiority for the production of seed inoculum, cells for cell therapies, secondary metabolites, recombinant proteins, monoclonal antibodies and viruses in cases where production organisms with low oxygen demands (e.g. plant suspension cells, hairy roots, macro algae suspension cells, mammalian suspension as well as adherent cells, and insect cells) are grown.



After sterile filling with culture medium and subsequent inoculation with the production organism, the desired bioreaction starts.

Finally, novel types of pneumatically driven, disposable bioreactors have been available on the market since 2006. The SBB, a bubble column that allows a straightforward increase in size by using multiple units, was successfully used for plant cell suspension cultures. Focusing on the culture bag and its shape, a novel approach was implemented in the CellMaker systems, which can be operated as airlift or combined airlift/stirred bioreactor systems. Hence, CellMaker systems are recommended for production organisms with both high and low oxygen demands.

Supporters of stirred bioreactor technology, which dominates in cell culture-based R&D and manufacturing processes, prefer the disposable stirred versions Single-Use Bioreactor and XDR – Disposable Stirred Tank Bioreactor with maximum culture volumes of 1,000 l. Along with the increasing product titers that are mainly a result of the improvements in cell-line engineering and culture medium adaptation over the last 20 years, these fully controlled stirred bag bioreactors will pave the way for completely disposable production trains in the future. Because of their safety (static seals), it is also assumed that disposable bag bioreactors with eccentric (tumbling) motion and in particular bag bioreactors with a Vibromixer will increase in importance. ■

Bag bioreactor overview

Categorization			Bioreactor	Max. culture volume	Developed or manufactured by
Mechanically driven	Stirred bioreactor		Single-Use Bioreactor (S.U.B.)	1,000 l	www.hyclone.com www.thermofisher.com
			XDR – Disposable Stirred Tank Bioreactor	1,000 l	www.xcellerex.com
	Bioreactor with eccentric motion stirrer		Artelis-ATMI LifeSciences' Pad-Drive disposable bioreactor	200 l 1,000 l*	www.atmi-lifesciences.com www.artelis.be
	Bioreactor with Vibromixer		bio-t bag	75 l 1,875 l*	www.zeta.com
	Bioreactors with WIM	Rocking or shaking platform	BioWave BIOSTAT CultiBag RM	300 l	www.wavebiotech.net www.sartorius.com
			Wave Bioreactor	500 l 1,000 l*	www.wavebiotech.com www.wave-europe.com
			Tsunami Bioreactor	960 l	www.megainternational.com.hk
			AppliFlex	50 l	www.applikon-bio.com www.singleusebioreactor.com
			CELL-tainer	15 l	www.cellutionbiotech.com
			Optima and OrbiCell Sterile Cell Culture Bag for orbital shakers	10 l	www.metabios.com www.bellcoglass.com
		Raising platform	Wave and Undertow Bioreactor (WUB)	100 l	www.nestle.com benedicte.terrier@rdto.nestle.com
Pneumatically driven	Bubble column		Slug Bubble Bioreactor (SBB)	100 l	www.nestle.com benedicte.terrier@rdto.nestle.com
			Plastic-lined Bioreactor	100 l	www.personal.psu.edu/wrc2 waynecurtis@psu.edu
	Airlift reactor		LifeReactor	5 l	www.osmotek.com
			CellMaker Lite2	50 l	www.cellexusbiosystems.com
Hybrid system: combination of stirred bioreactor and airlift bioreactor			CellMaker Plus with HybridBag	8 l	www.cellexusbiosystems.com

*announced

The role of chemistry and chemical engineering in future energy systems

Meeting the *challenges*

Ferdi Schüth

With dwindling oil reserves and the problem of global warming, we are facing severe challenges for our future energy supply. Meeting these is a great task for our society, but also for chemistry, since any new energy system will have to rely heavily on advances in the fields of chemistry and chemical engineering. At the same time, substantial opportunities are opened as well, as the societal needs will provide a strong driving force for further development of the chemical disciplines.

An analysis of the historical development of the energy supply reveals that chemistry has gained steadily increasing importance and is now one of the key disciplines in energy technology. Let us take the example of the oil industry: in the early days the petroleum was used – after only rudimentary processing – directly for lighting and heating purposes. Subsequently, refining was introduced to separate the oil in different fractions, but nowadays, an oil refinery is as much a chemical plant as an assembly of distillation units. Catalytic conversions are indispensable in the petroleum and the petrochemical industry. Moreover, recovery of oil from wells nowadays relies heavily on the use of different oil field chemicals which facilitate production of the crude oil.

Future energy systems will be much more diversified and use various different sources of energy. Moreover, we will probably have to replace hydrocarbons as the major storage and transport form for energy with a different medium. This will require major changes and adaptations in almost any aspect of our energy system, with strong needs for novel technologies. In the following, the demands on chemistry and chemical engineering shall be highlighted by some examples. This list is by far not complete, and technologies such as fuel cells, supercapacitors, thermoelectrics, superinsulators, superconductors, light-weight materials or high performance LED based lighting also will need crucial developments in chemistry before they are practically applicable.

Energy production

Conventional energy sources. Although the supply of energy from conventional sources, such as oil, gas and coal, is limited, these will remain the pillars of our energy infrastructure for several more decades. However, in order to extend the reach of these resources further into the future and to reduce the CO_2 emissions associated with their conversion, novel technologies are needed. A special challenge will be the development of economical methods for tapping into the hydrocarbon reserves in oil sand and oil shales. This will require adapted extraction methods and novel catalysts for processing these very heavy hydrocarbons. Natural gas can directly be used for energy generation. However, in order to facilitate transport from remote areas (so called "stranded natural gas"), conversion to liquids such as methanol or higher hydrocarbons would be very beneficial. Units based on current technology strictly follow the economy of scale, and thus smaller gas fields economically do not justify the implementation of conventional gas-to-liquids technology. Thus alternative, smaller scale GTL pathways have to be explored. Coal, finally, is the most abundant fossil fuel, but also has the highest CO_2 emissions during combustion, in addition, as a solid fuel coal is not suitable for transportation purposes. Therefore both technologies to reduce CO_2 emissions and methods for converting coal to liquid fuels (for instance, advanced Fischer Tropsch units) are needed in the future.

Biomass. One of the most intensively investigated fields of energy production is the synthesis of transportation fuels from biomass. While the first generation of biofuels were basically unprocessed vegetable oil,

F. Schüth, MPI für Kohlenforschung, Mülheim/Germany

Nowadays, an oil refinery is as much a chemical plant as an assembly of distillation units.

Picture: obs/Deutsche BP AG

Picture: Schott

While biomass can meet only a fraction of our energy needs due to the limited availability and the competition with food and feed, the sun supplies the earth with energy which is almost 10.000 times higher than the total world consumption. The picture shows solar receivers, the key components of solar thermal parabolic trough power plants.

current biodiesel is produced by transesterifcation of oils with methanol, resulting in so-called FAME (fatty acid methyl ester). The catalyst is sodium methanolate, but replacing this by a solid base catalyst appears to be highly attractive. Other opportunities are the conversion of biomass to synthesis gas and its subsequent conversion to Diesel fuel by Fischer-Tropsch catalysis. The major advantage of this technology is the possibility to also use waste biomass, such as straw, wood, and others for fuel production. Here various different engineering solutions are possible, with advantages and disadvantages associated often with the nature of the biomass and the local supply structure.

Even more attractive appear solutions, in which lignocellulose as the most abundant biomass can directly be converted to fuel without gasification. This will probably require an intensive integration of biotechnological, chemical and engineering solutions, since lignocellulose is very difficult to process. Promising in this connection appears the recent discovery, that wood can be solubilized in ionic liquids which will certainly make it more amenable for further processing.

Solar energy conversion. While biomass can meet only a fraction of our energy needs due to the limited availability and the competition with food and feed, the sun supplies the earth with energy which is almost 10.000 times higher than the total world consumption. Economical methods to tap into this resource could thus solve the energy problem. Unfortunately, present day technology for photovoltaic electricity generation is much too expensive to compete with fossil fuels. Thus advanced solar cells are needed which substantially reduce the cost of photovoltaic electricity. One of the most promising routes are organic solar cells, in which suitable polymers can be used instead of the currently employed silicon. However, the efficiencies are too low, and long term stability is insufficient, so that major progress in the development of polymeric semiconductors is necessary. Alternatively, direct photocatalytic water splitting could also be used to convert solar radiation. Although some photocatalysts are known which allow this process, their efficiency is much too low to provide a competitive solution. Novel catalytic systems are needed which are efficient, cheap and durable.

Energy Storage

Since hydrocarbons are not only an energy source, but also our major storage and transport form of energy, there is a need to find alternatives which fulfill these functions.

Batteries. Advanced batteries are in all cases complex chemical systems where high performance materials are used. In order to increase the storage density and capacities further, novel materials with higher charge/discharge capacities, or redox couples with higher cell voltage need to be developed. Increasing the energy storage density also requires improved safety measures, and the replacement of the liquid electrolytes by novel polymeric electrolytes could be a step in this direction.

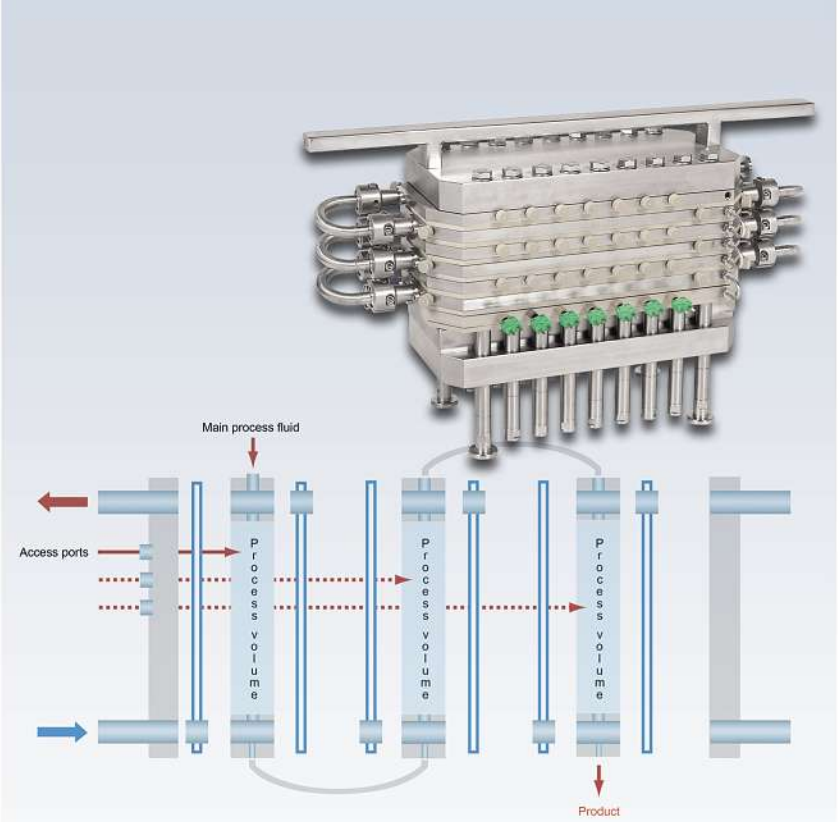
Storage materials. For long-term storage and transportation, compounds with high energy densities are the best solution (nowadays, these are hydrocarbons). Hydrogen is often discussed as the preferred option, because it has many advantages, the most important one being that it is a clean fuel at the point of use. However, it poses severe storage problems especially in transportation applications. Liquifaction and pressure storage of hydrogen both have severe disadvantages, such as energy consumption of liquification or compression, storage density limitations, and boil-off (for liquid hydrogen storage). Chemical solutions, in the form of hydrides, high-porosity adsorbents, or liquids which would be reformed to produce hydrogen when needed, could provide better alternatives. However, none of these chemical systems is presently developed to a state that it could be used in practice, and therefore, intensive research efforts are needed to provide a novel energy infrastructure based on hydrogen.

Conclusions

Although the list is not exhaustive, the examples demonstrate that chemistry and chemical engineering are key disciplines – if not the key disciplines – to meet the challenges we are facing with respect to the transformation of our energy systems. Efforts ranging from fundamental research to product development, and involving players from politics over industry to academia are needed in order to adapt to the changes lying before us. ■

Competitive pressures and environmental legislation forces the chemical industry, Europe's third largest manufacturing sector, to scrutinize its own business and processing techniques. Finding safer, cleaner and more energy-efficient means of manufacturing is a prime concern and a constant challenge for the industry.

Reactions of the desired *kind*



Pictures: Alfa Laval

The ART reactor is a continuous reactor. Process volumes are created when flow-directing inserts are sandwiched between heat exchanger plates. Multiple access ports into the reaction channel enable measurement, sampling and injection of reactants.

BIRGITTA LUNDBLAD

The reactor is the vital part of the chemical process. This is where the reactants are transformed into more valuable products. The traditional way of producing chemicals is to slowly mix the reactants in batches in stirred tank reactors. This is still the prevailing production method for the large majority of fine and specialty chemicals. But the method has serious drawbacks.

The standard tank reactor is seldom perfectly suited to the chemical reaction undertaken. Slow response to temperature changes and uneven mixing of reactants are some of the drawbacks that too often result in poor product quality, inefficient energy use and the formation of undesired by-products.

"Batch reactors have a simple design and are easy to operate," says Oleg Pajalic, Technical Specialist at Perstorp Specialty Chemicals. "However, there are problems in scaling up the process from laboratory and pilot scale to full processing scale due to difficulties in replicating mixing from small to large scale. Another problem with batch reactors is that the temperature control often is unsatisfactory. Both these problems can be avoided with a plate reactor solution."

Cooperation in development

Alfa Laval has developed a new reactor technology based on the plate concept. The new Alfa Laval Plate Reactor with trademark ART is a continuous reactor. It results in major benefits when it comes to economy, production safety and environmental concern.

"We were aware of the problems with batch reactors and wanted to be able to meet growing demands for safer, cleaner and more energy-efficient processes," says Carina Resare, Manager of Alfa Laval Plate Reactor Technology. "We have worked in close collaboration with leading universities in developing the solution. The cooperation with customers and the possibilities they have given us to test the equipment in authentic processes have also been of vital importance. The successful results would not have been possible without the support and commitment from these partners."

The new type of plate reactor greatly facilitates scale-up from laboratory to full production capacity. Therefore the development process and the time to market can be reduced dramatically. "Possible extra earnings of one million EUR a day for a pharmaceutical company, for instance, are fully realistic," Resare calculates.

Positive results

The new plate reactor is highly energy-efficient. Since it offers excellent control, it can operate with highly concentrated reactants and thereby reduce energy consumption by up to 70%.

Safety is of great importance in chemical applications. Certain reactants are sensitive to heat and pressure and it is vital to reduce the risks of explosion to a minimum. The plate reactor minimizes the risks since it reduces the volume of reactants by up to 99% compared to a batch reactor. Besides, the decreased waste volumes and large energy savings mean important environmental benefits.

Barry Johnson, Ph.D. in Chemistry and Process Development Manager of Alfa Laval Plate Reactor Technology leads the development and test work in the company's laboratory. "Within a few hours of operation of a particular reaction we have been able to survey a wide range of operating conditions, explore different reactor configurations and thereby reach product yields at or above values for the conventional batch process," he states proudly. "The equipment provides an ideal environment to bring laboratory chemists, development engineers and production engineers together to share information and objectives at an early stage in the development of a reaction, thereby enabling creation of a robust process in reduced time."

Astra Zeneca is one of the world's leading pharmaceutical companies. Astra Zeneca came in contact with the new reactor technology for the first time in 2001. Björn Gregertsen is the Process Engineering Section Manager at the company's Process R&D Department in Södertälje, Sweden. "The technical solution was there already and we found it interesting. But we needed to be able to handle extremely small volumes to evaluate the new technology at reasonable costs. So I think we supported Alfa Laval's development of its small lab reactor," he says.

Gregertsen sees the poor heat transfer and the insufficient cooling possi-

B.Lundblad, Alfa Laval, Lund/Sweden

bilities as the main problems with batch reactors. "The Alfa Laval Plate Reactor enables us to handle reactions that the traditional technology cannot cope with," he says. "The new technology makes it possible to handle particularly energetic reactions in a controlled and safe manner. It opens up new opportunities for us."

In 2006 Astra Zeneca finalized the first test phase with the new reactor. They have tested it on a number of reactions, measured and quantified the heat transfer and mixing properties and made a technical evaluation. "The tests have fulfilled our expectations. The heat transfer performance was very satisfactory and the system was reasonably easy and convenient to operate," says Gregertsen. "We have identified some potential areas that Alfa Laval can develop further. One big challenge, for example, is how to cope with slurries, i.e. fluids with a certain amount of solid particles."

As Astra Zeneca completed the technical evaluation, they also started to look into the economical aspects and to investigate the commercial viability of the new technology.

Björn Gregertsen, Astra Zeneca

"The new technology makes it possible to handle particularly energetic reactions in a controlled and safe manner."

Promising tests at Perstorp

Alfa Laval has an established relationship with Perstorp, a world leader in several sectors of the specialty chemicals market. "Together we have developed a pilot scale, plate reactor alternative that suits our needs," says Perstorp's Oleg Pajalic. "Alfa Laval's new technology is mainly intended for process intensification. It means equipment of reduced size, better utilization of energy, possibilities to change the process and decreased waste volumes due to better reaction selectivity. These are all factors that we take into consideration in the choice of technology."

Recently Perstorp conducted tests with the new plate reactor. According to Pajalic the results are promising. He points out that it takes a long time and a lot of effort to change technology in an industrial process and that such a change requires patience. He also stresses the importance of thorough development of each and every scaling-up step in order to avoid problems and unpleasant surprises.

"We will continue to consider the new technology and compare it to traditional batch reactors when choosing new equipment. It means that we will test the plate reactor for suitable applications and use it when it proves beneficial for our operations and business. We count on a close cooperation with Alfa Laval and a firm support from them in up-scaling procedures and in the design of equipment and tests that suit our requirements," Oleg Pajalic concludes.

Since the development stage and on site tests Alfa Laval has completed its first two standard models for commercial use – ART plate reactor models 37 and 49. These will make their debut at a press event held at the DECHEMA headquarters in Frankfurt am Main, Germany in November. ■

Since its first presentation on a group stand at ACHEMA 2000, micro process engineering has seen a bright development.

International terminology of *micro process engineering*

Alexis Bazzanella and Burkhard Winter

Microstructured devices, i.e. reactors, heat exchangers, static mixers, pumps and other components, embedded with micrometer-sized pores or channels have found their way into process development labs and have nowadays started to emerge into industrial production scale. Thanks to larger relative surface areas and the small characteristic dimensions, these devices are more efficient for mass and heat transfer. This results in advanced process control and greater selectivity and higher yield for chemical reactions.

After ACHEMA 2000 an industrial panel has been established at DECHEMA (see www.microchemtec.de) aiming to promote the technology and to initiate co-operation between industry and science for development and application of micro process engineering. From 2001 to 2005, this industrial panel was steering a strategic research project for modular micro chemical engineering including the coordination of many smaller research projects highlighting individual aspects of the technology. Standardization issues already played an important role in this research project. Users and manufacturers of microstructured devices discussed manufacturer-independent technical solutions for the fluidic connection of different components, as the lack of compatibility of devices from different suppliers proved to become a limiting factor in the set-up of multi-step processes based on microstructured equipment.

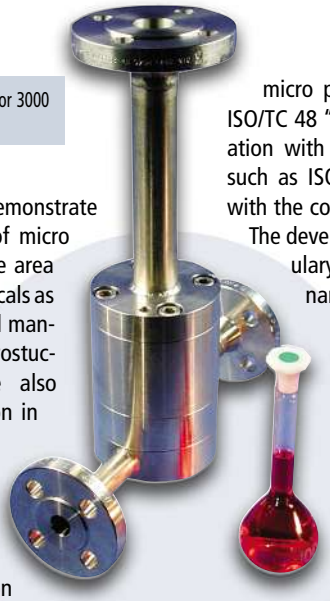
From the demonstration project…

At ACHEMA 2003, a growing number of exhibitors in micro process engineering was present and the first commercial suppliers introduced modular systems which allowed different unit operations as building blocks to be coupled to different processes. At that time, the demonstration project DEMiS (Demonstration project for the Evaluation of Microreaction technology in industrial Systems) was running, which has been a mile-stone towards the use of microstructures in industrial scale chemical production. In this project, Degussa and Uhde with several academic partners erected a pilot reactor for the large scale production of propylene oxide in the gas phase from propylene with gaseous hydrogen peroxide. Since then, many companies have looked into micro process engineering, and it is safe to say that most large chemical and pharmaceutical companies have started at least some own activities in this area. Equipment manufacturers have followed the increasing industrial demand by developing and offering micro-structured components with higher throughput, which today are capable of flow rates well above 1000 l/h.

…to pilot and production applications

Today the existence of approximately 40 pilot or production applications has been reported with a probably even larger number of not published applications. For instance, Xi'an Huan Chemical in China erected a pilot plant in 2005, in collaboration with the Institute of Microtechnology Mainz (IMM), Germany, for the production of nitroglycerine in pharma quality for the treatment of acute cardiac infarctions. In this plant, nitroglycerine is produced safely and efficiently at a rate of 15 kg/h. Again in 2005, DSM Fine Chemicals in Linz Austria and Karlsruhe Research Centre in Germany have developed and implemented a microreactor for the production of a monomer for a polymerization with 1700 kg/h throughput. 300 t of product have been synthesized in a ten weeks production campaign. Several campaigns have followed since. On a smaller scale, Lonza flexibly produces pharmaceuticals for pre-clinical and phase I studies in amounts of 70 kg/week.

A. Bazzanella, DECHEMA e.V., Frankfurt on Main/Germany; Burkhard Winter, ISO International Organization for Standardization, Geneva/Switzerland
Correspondence: Dr. Burkhard Winter, ISO/TC 48, c/o DECHEMA e.V., Theodor-Heuss-Allee 25, 60486 Frankfurt/Germany, Email: din@dechema.de



StarLam 3000 micromixer (IMM) for 3000 l/h throughput and higher

These selected examples demonstrate the industrial relevance of micro process engineering in the area of fine and specialty chemicals as well as for pharmaceutical manufacturing. Moreover, microstuctured components have also started to attract attention in the high tonnage commodity and bulk chemical sectors. Not surprisingly, with increasing industrial take-up of the technology, standardization issues in micro process engineering gain more and more importance. This starts with questions of terminology to ensure the common use of clearly defined, unambiguous technical terms in this area and will exceed to cover technical standards for e.g. connectivity and flow distribution.

A first step in standardization

Since the beginning of 2007, an European and International Standard is developed supporting mutual understanding and international communication in the fast growing field of micro process engineering. This has to be regarded as a first step in standardization of this rapidly emerging technology. International standardization is done by Technical Committees of the "International Organization for Standardization" ISO headquartered in Geneva/Switzerland. The project of an ISO terminology standard for micro process engineering will be run by ISO/TC 48 "Laboratory equipment" in co-operation with related ISO Technical committees, such as ISO/TC 229 "Nanotechnologies" and with the correspondent European CEN/TC 332.

The development of this international vocabulary for micro process engineering is financially supported by the Federal Ministry for Economics and Technology in Germany and by DECHEMA. The future International and European standard will cover terms and definitions which delimit micro process engineering from closely related fields of activity such as micro fluidics and micro reaction engineering (which are parts of micro process engineering) and micro system engineering (which is a more generic term for the combination of different micro technologies, e. g. micro electronics and micro fluidics). Furthermore, the future standard will define most important micro process components such as micro reactors, mixers and separators and their interfacing with each other as well as with the macro-technical environment of a micro process plant. An excerpt of some definitions is given in the box below.

The ISO Technical Committee 48 responsible for the development of this standard would welcome any contribution and an active collaboration from experts around the world. Correspondence can be addressed to the authors. At ACHEMA 2009, we like to present at least a draft international standard for terminology of microprocess engineering together with reports, exhibits and lectures about the latest advances and proceedings. ■

Some definitions

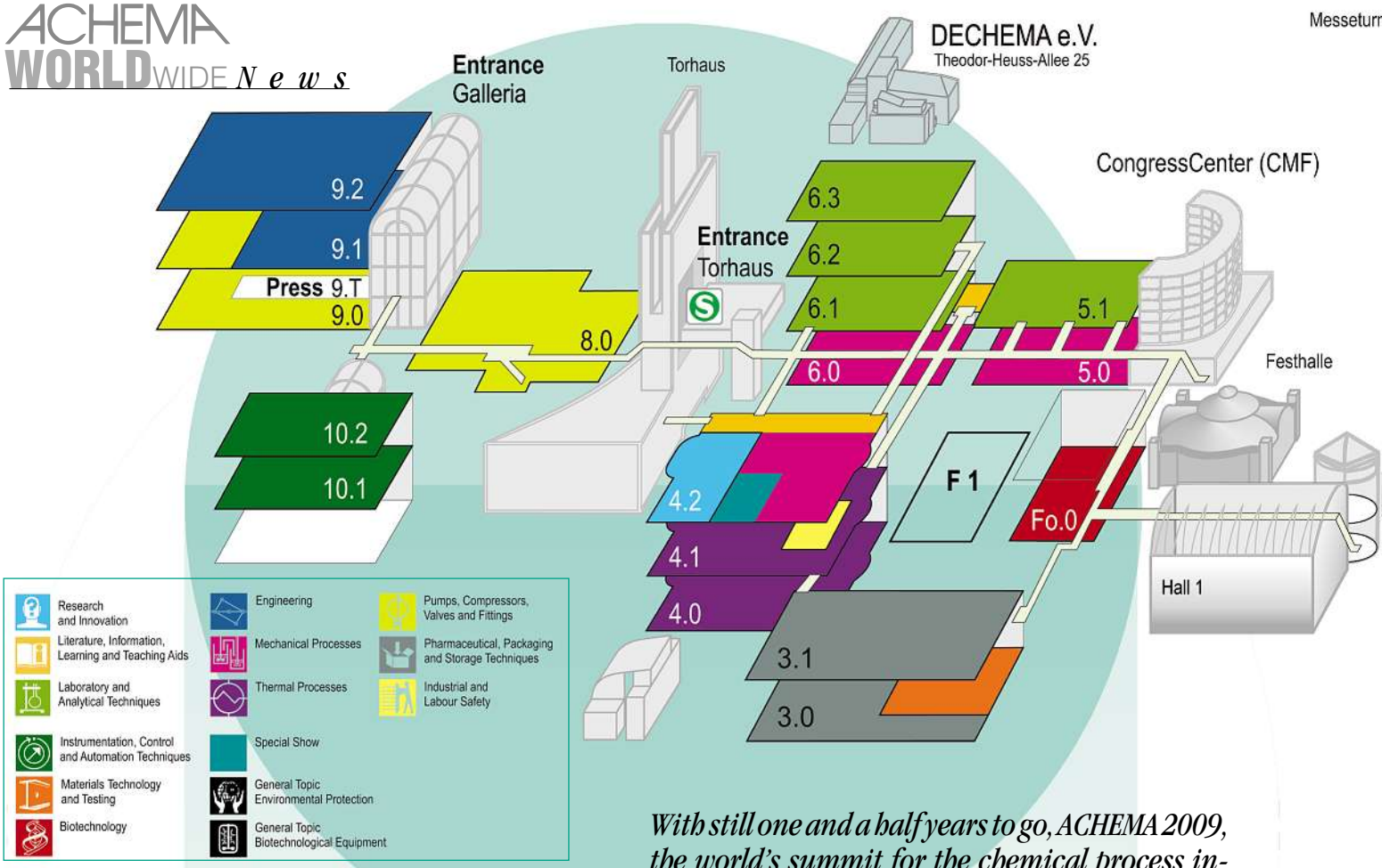
micro process engineering: carrying out of physical, chemical and biological processes inside technical apparatus with inner geometries which have dimensions in the range of micrometers up to a few millimeters

process intensification: unsteady increase of the economic or ecologic efficiency of physical, biotechnological and especially chemical processes and generation of new products or product qualities by measures of process engineering (note: micro process engineering is an important tool of process intensification).

micro process component: micro structured apparatus for continuous processes with inner geometries which have dimensions in the range of micrometers up to a few millimeters and which can be combined with additional micro process components to an micro process plant by using component interfaces

micro reactor: micro process component with the primary function to perform chemical reactions

lab on a chip: highly integrated microfluidic system mainly for analytical purposes providing functions of a laboratory within a plastics card sized apparatus



With still one and a half years to go, ACHEMA 2009, the world's summit for the chemical process industries, seems to be quite far behind the horizon. So plenty of time and no reason to hurry? Not really!

Promotion campaign for *ACHEMA 2009* launched

Thomas Scheuring

In fact, an event of such complexity like ACHEMA can only be organized smoothly when organizational matters get started well in advance. So by now, preparations for ACHEMA 2009, from 11–15 May 2009 in Frankfurt am Main/Germany, are already in full swing. With the recent dispatch of the updated application documents marking the official starting signal for exhibitors, the available exhibition area is getting booked pretty quickly, with currently dozens of applications arriving per week.

Does this mean all attractive exhibition booths are gone already? Definitely not, but it does mean it is advisable for exhibitors to make up their mind as we expect quite a lively demand for this upcoming ACHEMA. The positive economic situation of the global chemical industry, combined with the promising outlook for the foreseeable future, will certainly boost the demand on the part of the exhibitors. So let's briefly unroll what can be expected from the upcoming event. Once again, ACHEMA 2009 will be:

- the unrivaled world forum for the process industries with global impact and visibility which hosts 4,000 exhibitors from 50 countries on a projected net exhibition area of 140,000 sqm.
- a meeting point for 180,000 attendees from all over the world.
- the most significant innovation platform which at the same time is the take-off point for investment decisions in our industries.
- a technology summit with 30,000 decision makers from all over the world who meet experts, likewise from all over the world, to exchange ideas, discuss experiences, and pave the way for future investments.
- a display of technological progress and product innovations some of which will have the potential to redefine whole branches of our industry.

What is new for 2009?

A more compact format of the exhibition, due to some marginal rearrangement of exhibition groups, will enable us to accommodate the exhibition group "Research and Innovation" in hall 4.2 instead of hall 1. Omitting hall 1 from the exhibition layout means the walking distance for the average visitor will be considerably shorter as this hall had turned out to be somewhat off the regular walking pattern.

ACHEMA's Special Show regularly highlights an innovative topic within the general ACHEMA spectrum. For the upcoming ACHEMA this "show inside the show" is dedicated to renewable resources and energy, with an even focus on contributions both from chemistry as well as from biotechnology. This covers the whole field from industrial ("white") biotechnology to chemical and thermal processes, from biorefineries, plants for the production of biofuels or biogas, to the processing of biogenous products. It furthermore includes high-performance crops, photovoltaics and solar chemical processes, chemical energy storage, biocomposites and biopolymers.

Dr. T. Scheuring, Head of Exhibition Congresses, DECHEMA e.V., Frankfurt am Main/Germany

The Special Show brings together quite diverse technological approaches aiming jointly at a sustainable use of energy and resources, and will give proof of the decisive role our industry plays in this field.

Modified handling of day-ticket vouchers

To structure ACHEMA's visitors' campaign with the best possible results, we have modified the handling of our traditional day-ticket vouchers. Motivating visitors to attend ACHEMA represents a joint effort on the part of DECHEMA as organizer and of the exhibitors as well. As a matter of experience, a large share of the visitors shows up with complimentary day-ticket vouchers which they received from exhibitors. Hitherto the respective exhibitor was charged 12.- EUR per voucher actually used. At the last ACHEMA, 59% of the exhibitors took part in this form of visitors' promotion; by implication, 41% of the exhibitors profited from the efforts of the other exhibitors without making any contribution of their own. Moreover, it was difficult for exhibitors who actively participated to budget since the number of used vouchers varied strongly.

In consultation with the ACHEMA committee as the body representing the exhibitors' interests, the charging system for vouchers has now been adapted with a view to avoiding this inequity, and at the same time enabling exhibitors to plan more precisely. Accordingly, every exhibitor will now have access to an unlimited number of guest day tickets, charged at a graduated visitor flat rate depending on booth size. This new system will make it easier for each exhibitor to actively participate in dispatching tickets with full cost control.

Needless to say that DECHEMA will maintain – actually rather increase – their efforts in PR in general, with a particular emphasis on visitors' promotion. The trend of an increasing international share on the part of the visitors, which was to be observed in the recent past, will certainly continue for the foreseeable future. So as a logical consequence there must be a sizeable additional visitor potential to be mobilized abroad, probably more than on our home turf. Considering the fact that ACHEMA 2006 for the first time registered more foreign than domestic exhibitors, it seems quite a realistic goal to gradually attract more foreign visitors as well.

Stay tuned – the next issue of ACHEMA worldwide News will unveil the new focal topics of the conference program for 2009. ■

Contact
Tel. +49 69-7564-336
Email: scheuring@dechema.de
www.achema.de

ACHEMA's face abroad

The launching of the promotion campaign for ACHEMA 2009 is the perfect opportunity to once again introduce DECHEMA's global team – which is your connection to ACHEMA if located in one of the listed countries.

PR CHINA
Mr Wu Hong (Paul Woo)
Jingguang Centre, Office Building
Room 1410, Mail Box 8806
Hujialou, Chaoyang District
100020 Beijing
Tel.: +86 10 65974621/-622
Fax: +86 10 65974623
e-mail: paulwoo@achemasia.net
http://www.achemasia.net

KOREA/MALAYSIA/SINGAPORE
Mr Tae-Jik Chae
Kong Myong E & T
908 A, I-Want Office
890-54 Daechi-dong
Kangnam-gu, Seoul 135-839
Tel.: +82 2 7786792
Fax: +82 2 7786794
e-mail: tradefairs@hanmail.net

FRANCE/BELGIUM
Ms Vickie Nikolaou
25 rue Charles Ferdinand Dreyfus
91640 Fontenay les Briis, France
Tel.: +33 1 64922429
Fax: +33 1 64922429
e-mail: vnikolaou@wanadoo.fr

UK/IRELAND
Mr Mike Day
55 Old Kempshott Lane
Basingstoke RG22 5ER, UK
Tel.: +44 1256 329743
Fax: +44 1256 329743
e-mail: mdayatachemauk@aol.com

ITALY
Mr Ferruccio Silvera
SILVERA MEDIAREP
Viale Monza, 24
20127 Milano
Tel.: +39 02 2846716
Fax: +39 02 2893849
e-mail: ferruccio@silvera.it

USA/CANADA
Mr Alan R. Morris
Morris Marketing, Inc.
22 Bayview Avenue
NY 11030 Manhasset, USA
Tel.: +1 516 8690220
Fax: +1 516 8690325
e-mail: amorris77@optonline.net

EU 2007 DE

Bright future for biotechnology

The *Cologne* Paper

What impact will biotechnology have on the economy and society and where will it be in twenty years' time? Fifty-one European experts from science and industry discussed these questions recently and drafted visions, forecasts and recommendations to assist policy-makers in identifying priorities and adopting measures. The resulting report, dubbed the "Cologne Paper", was published in May 2007 in Cologne at the conference "En Route to the Knowledge-Based Bio-Economy", hosted by the German Presidency of the Council of the European Union. Initiated by the Presidency, it presents the findings from six workshops on the following topics: 1) Framework, 2) Food, 3) Biomaterials and Bioprocesses, 4) Bioenergy, 5) Biomedicine and 6) New Concepts and Emerging Technologies. The paper, which Christian Patermann of Directorate General Research of the European Commission referred to as "the most modern strategy paper in biotechnology", concludes that biotechnology has excellent prospects. For instance, the authors predict that industrial biotechnology products will have a one-third share of industrial production in 2030, worth 300 billion EUR. They are convinced that the impact of biotechnology will continue to increase, particularly in the industrial sector – a "knowledge-based bio-economy" already emerging on the horizon.

Biotechnology is expected to help meet the most urgent global challenges, i.a. limited resources of raw materials, energy and water. Advanced bioprocess technologies will enable more efficient processes in many diverse areas of industrial production, including processing, pharmaceuticals and agriculture, making a valuable contribution to sustainable economic growth. The key to this is novel "high-tech crops" which will serve as factories for enzymes, amino acids, pharmaceuticals, polymers and fibers, and will be used as renewable industrial feedstock for producing biofuels, biopolymers and chemicals. The experts believe that the production of many new products will rely on specifically developed, genetically modified microorganisms. They also agree that plant research is indispensable to industry since traditionally bred crops will no longer be able to satisfy the growing demand for biomass, for example for the production of biofuels. Moreover, genetically modified plants are regarded as indispensable if the potential conflict resulting from limited arable land for food versus non-food production is to be resolved.

The Cologne Paper is available online at **www.bioperspectives.org/Cologne_Paper.html**

Biotechnology is expected to mature from a discovery science into an engineering science, the coming years will see the construction of synthetic cells, capable of selectively producing defined products.

The authors forecast that ageing societies, technological advancements and growing knowledge will continue to drive biomedical research and that the coming years will see the advent of tailor-made, personalized medicine. Thanks to novel biotech drugs and regenerative medicine a number of serious diseases will be treatable by 2030, many severe chronic diseases by transplanting industrially produced stem cells. Organ replacement is expected to be a therapeutic option and future medicine will have succeeded in generating fully functional organs, including teeth. Novel vaccines will also prevent and combat diseases like cancer, multiple sclerosis and Alzheimer's disease.

The Cologne Paper also addresses some of the obstacles that might prevent the rather optimistic perspectives from becoming reality: the paper emphasizes the fact that the number of qualified people will not keep up with demand and that early measures should be taken, in particular to increase young people's interest in science and research. Moreover, the experts fear that European research institutions will not be able to offer attractive positions to top class scientists. The experts suggest building a pan-European network of excellence centers (pan-European Institute of Technology). They also call for improved financial conditions in order to attract private capital to Europe. Public-private cooperation in industrial biotechnology should serve to validate pilot and demonstration projects such as "zero-waste biorefineries".

The Cologne Paper considers public acceptance indispensable, emphasizing that a well-informed public, aware of the opportunities and risks of biotechnology, gives a competitive edge. The authors foresee that public acceptance of genetic engineering and biotechnology in agriculture will increase throughout Europe. ■

LabAutomation 2008

Where Science, Technology and Industry Come Together

DECHEMA and the Geneva/Illinois based ALA Association for Laboratory Automation have agreed on a cooperation in the field of laboratory automation which opens up special opportunities for selected start-up companies.

Face-to-face *with innovation*

As both societies' main activities are related to the exhibition and conference sector, the partnership between DECHEMA and ALA will cover a mutual support regarding their most significant events, i.e. ALA's annual LabAutomation Exhibition and ACHEMA. The ALA LabAutomation Exhibition is the leading event for the laboratory automation sector, with the next exhibition and conference being scheduled from January 26–30, 2008 in Palm Springs, California. The organizer is expecting more than 5,000 scientists, engineers and other professionals from more than 40 countries. The exhibition hall will be filled with more than 300 booths, representing the diversity of the field. So, LabAutomation2008 delivers the educational and informational solutions for the multi-disciplinary global community of scientists, engineers and related professionals involved in research and discovery of a diversity of industries including:

- Drug Discovery & Development
- Clinical Diagnostics
- Agricultural & Food Sciences
- Forensics & Security
- Energy, Commodity Chemicals and Polymers

Key educational tracks are:

- Detection & Separation
- Micro- and Nano-Technologies
- High-Throughput Technologies
- Informatics
- New Frontiers for LabAutomation2008: Agricultural & Food Sciences

DECHEMA will contribute to the ALA Innovation Award Program – which recognizes outstanding oral presentations at ALA's annual LabAutomation Conference – by supporting award finalists to present their work at ACHEMA 2009. Award finalists will receive travel grants provided in equal shares by ALA and DECHEMA to attend ACHEMA 2009.

DECHEMA will furthermore take part in the Innovation AveNEW – ALA's program for start-up companies to showcase their products within the LabAutomation Exhibition – by nominating one especially promising European start-up company to participate in the Innovation AveNEW. Travel expenses for the person to represent this company will be taken over by ALA. Applications from interested companies are welcome and should be directed to DECHEMA's Dept. of Exhibition Congresses. ■

Contact: DECHEMA e.V.
– Dept. Exhibition Congresses –
Theodor-Heuss-Allee 25
60486 Frankfurt am Main/Germany

Phone +49 69-7564-336
E-Mail: scheuring@dechema.de

Contact: ALA

ALA is a non-profit association with 7,000 global members committed to driving progress in laboratory technologies through high-quality education that benefits the global scientific community, including its membership of scientists, academicians, and industry thought leaders.
www.labautomation.org; Phone +1 888 7331ALA (1252)

LabAutomation 2008:
www.labautomation.org/LA08/index.cfm

Special no-cost exhibit opportunities for start-up companies:
www.labautomation.org/LA08/avenew_details.cfm

Submit an abstract or poster:
www.labautomation.org/journal/winasegway.cfm

NANOapplied – nanotechnology abstracts selected for process engineers

NANOapplied is the latest product of the DECHEMA database & information systems family – a unique CD-ROM comprising abstracts of nanotechnology publications of special interest to chemical and process engineers.

The bibliographic NANOapplied database focusses on industrially important applications of nanotechnology. Abstracts of more than 12,000 relevant articles selected from international scientific journals cover about 25 years of research. Main topics include nanomaterials like nanocomposites, nanotubes, nanofibers, and nanoparticles, production and application of nanoscale catalysts, nanosensors, nanofiltration and nanoporous membranes, as well as sol-gel processes. The CD-ROM offers search options ranging from "easy" to "professional" and tools for quick and easy full-text access.

NANOapplied originates from the well-known bibliographic CEABA-VtB (Chemical Engineering and Biotechnology Abstracts – Verfahrenstechnische Berichte) database. The CEABA-VtB information system focusses on industrially important advances in chemical and bioprocess engineering. To reflect the diverse research needs of process engineers, CEABA-VtB covers a broad range of topics and offers a variety of products.

Contact:
Dr. Karin Tiemann, DECHEMA e.V.
nanoapplied@dechema.de
www.dechema.de/nanoapplied
www.dechema.de/ceaba_vtb

Product Life live – the know-how event on product lifecycle management

The Product Life live conference is an annual event on one of the most important management initiatives of the industry. It showcases with a concept outstanding from other PLM-conferences. Multisupplier field reports are the focus of the event. These are presented by PLM-experts of application companies from different industries – directly from experience. The conference contains offers for beginners as well as for experienced PLM-experts. It addresses specialists and managers from large and also particularly from small and medium-sized businesses.

The concept is based on three main parts – the conference program composed of presentations, keynotes and workshops from PLM-users, the networking sessions with Round Tables and the Partner Area where suppliers of PDM-/PLM system solutions, corresponding providers of infrastructure and consulting companies present themselves as competent dialogue partners and solution providers. Rounded off by an attractive evening event the Product Life live provides the ideal platform for communication and exchange of experiences between all participants. This year's event takes place from 6–7 November 2007 in Mainz. Key aspects of the conference are: development of holistic PLM-approaches; global collaborative engineering; PLM – state, trends and visions; PDM/PLM-integration; PDM/PLM-infrastructure; PDM/PLM introduction experiences; intercultural management in the PLM-environment.

Contact:
Christina Katz,
Mesago Messe Frankfurt GmbH
christina.katz@mesago.
messefrankfurt.com
www.productlife.de

ACHEMA WORLDWIDE News

is a special issue of PROCESS

Editorial Staff

Editor-in-Chief:	Gerd Kielburger ☎ (+49-9 31) 4 18-25 36, gerd_kielburger@process.de
Editor:	Dr. Jörg Kempf ☎ (+49-9 31) 4 18-21 73, joerg_kempf@process.de
Editorial assistant:	Gabriele Ilg ☎ (+49-9 31) 4 18-21 07, gabriele_ilg@process.de
Editorial office:	Vogel Industrial Media Max-Planck-Str. 7/9, 97082 Wuerzburg,Germany Fax (+49-9 31) 4 18-27 50, redaktion@process.de, www.process.de, www.process-worldwide.com
Layout:	Dieter Kansog
Production:	Karin Weißenberger ☎ (+49-9 31) 4 18-22 57

Publisher

Publisher's address:	Vogel Industrie Medien GmbH & Co. KG, Max-Planck-Str. 7/9, 97082 Wuerzburg, Germany ☎(+49-931) 418-0, Fax (+49-9 31) 4 18-27 50 A Company of Vogel Business Media
General Manager:	Gerrit Klein
Advertising Manager:	Reiner Öttinger ☎ (+49-9 31) 4 18-26 13 (responsible for the advertising section) reiner_oettinger@process.de

VOGEL Industrial Media

INTERNATIONAL CONFERENCES ORGANIZED BY DECHEMA

November 19–21, 2007: 3rd European Conference on Natural Attenuation and In-Situ Remediation, Frankfurt am Main, Germany
November 19–22, 2007: Formula V – 5th Conference on Formulation Technology, Potsdam, Germany
November 20–21, 2007: Chemical Nanotechnology Talks VIII, Frankfurt am Main, Germany
November 21–22, 2007: 9. Symposium Natural Attenuation, Frankfurt am Main, Germany
November 26–27, 2007: 4th Status Seminar Chemical Biology, Frankfurt am Main, Germany
January 21–22,2008: Workshop CO_2-Capture, -Utilization and -Sequestration, Frankfurt am Main, Germany
February 21–22, 2008: 2th International Symposium on Biothermodynamics, Frankfurt am Main, Germany
April 2–4, 2008: 11th Annual Conference of the European Biosafety Association, Florence, Italy
April 22–25, 2008: EuroPACT – 1st European Conference on Process Analytics and Control Technology, Frankfurt am Main, Germany
September 7–11, 2008: EUROCORR – European Corrosion Conference, Edinburgh, UK
September 7–11, 2008: ESBES 7 – 7th European Symposium on Biochemical Engineering Science, Ljubljana, SLOV

Further Information:
DECHEMA e.V., Congress Office
Theodor-Heuss-Allee 25, 60486 Frankfurt am Main, Germany
Tel. +49 (0) 69 75 64-1 29/-3 33/-2 49
E-mail tagungen@dechema.de
Internet www.dechema.de