

ACHEMA2018

JUNE 2018

Focal Topic Supplement

in partnership with **INNOVATORS**
MAGAZINE

Think
#BioForChem



WELCOME

Biotechnology or chemistry?

For the longest time this was a question of principle when it came to producing fine chemicals, polymers or fuel. In the bioeconomy the best of both worlds is used – anything goes if it is technically feasible. To bring a process from feasibility to reality takes a lot of technical equipment and at ACHEMA 2018 you can find it all. From laboratory furnishings to huge stainless steel tanks to engineering companies who assemble the parts, ACHEMA brings technology into bio-technology. To visit every one of the 150+ companies who have assigned themselves to the focal topic would mean a tour through almost every hall. Just follow the 'Biotech for Chemistry' icon on the hall floor, which marks the stand of every associated exhibitor. If you accept this challenge, I salute you.

Give your feet a break every now and then, too and lend an ear to the extensive congress programme. Room 'Harmonie 3' in CMF is the place to be on Tuesday and Wednesday to listen to talks that go with the focal topic.

This magazine is your guide to ACHEMA 2018 focal topic 'Biotech for Chemistry' so make good use of it and enjoy the trade show.

Dr. Thomas Scheuring
CEO DECHEMA Ausstellungs-GmbH

Follow the focal topic: [#BioForChem](#)



Keep an eye out for this icon



Dr. Thomas Scheuring,
© DECHEMA

Editor's note



Welcome to ACHEMA's official Biotech for Chemistry focal topic supplement.

Dr Marlene Etschmann, ACHEMA communications, labelled us the 'perfect match' to produce it.

"Always on the forefront of technology and covering a broad range of topics, the magazine is just like our trade show," she said.

And the feeling is mutual. The organisers have been great to work with - it is easy to see why they are behind one of the biggest and most impactful trade shows on the planet.

The triennial exhibition for the process industries will provide a great platform for the best of the global biotechnology industry this week – something Innovators Magazine is passionate about.

Enjoy your time in [Frankfurt](#).

**Iain
Robertson
Editor**

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What's the **new** normal?

» Looking for the bio-based 'holy grail' – will the result in Europe be the same as in the US?

Petroleum is a limited resource and if we keep using it global warming will accelerate. Since this realization has filtered in the quest for alternatives has begun. Shale gas and natural gas are only pseudo solutions as those supplies are finite and fossil, too. The only way out are fossil-free resources, bio-based ones that is. Industry and academia are developing bio-based processes fervently and with the prerequisite that the products must not be more expensive than conventional ones. However, in late 2014 the price for crude oil dropped below \$70 per barrel and has not recovered as of early 2018. The prices for the chemical building blocks ethylene and propylene have roughly halved from 2014 to 2016. The dismal prospects have made big players such as Braskem and Dow Chemical shelve their bio-based propylene development. Thyssen Krupp Industrial Solutions sent its multipurpose plant for organic acid fermentation in Leuna, Germany into hibernation in 2015 until better times,

selling it subsequently to EW Biotech.

All around the world times are hard for bio-based chemicals as they can rarely compete with their fossil counterparts pricewise and cannot even play a trump card in the matter of climate change. Of the total energy demand worldwide the chemical industry uses 30% and it is responsible for 20% of the industrial greenhouse gas emissions. In comparison, the amount of 'C' that ends up as part of products is marginal. Consequently energy consumption is the main area to target if CO₂ emissions shall be significantly reduced. Nonetheless, support for bio-based products is firmly anchored in the policies of many governments and the targets they have set are ambitious.

Bio-based policies in Europe and the US

There is consensus in Europe and the US that guidelines on how to switch over to a bio-based economy need to be stipulated;

the approaches to implement the change are quite different regarding the strategies of the different governments and the legislative conditions.

The European Union has agreed upon

- a 40% greenhouse gas reduction by 2030 (compared to 1990 levels)
- at least a 27% share of renewable energy consumption
- at least 27% energy savings.

More explicitly 20% of the chemicals and materials in the European Union will be bio-based by 2020, rising to a quarter in 2030. In the United States the Biomass R&D board envisions a billion ton bioeconomy. By 2030 one billion tons of biomass is projected to be sustainably produced. It is supposed to be the base for emerging bioproducts industries, but mainly to target "a potential 30% penetration of biomass carbon into US transportation market by 2030". Plainly spoken this means biofuel in the forms of biodiesel or the addition of ethanol to gasoline.



Which is the most promising bio-based chemical?

When new processes and products enter the market it's human nature to ask who does best in the competition. For the uninvolved observer it may be simple curiosity, for investors it's a matter of money – and lots of it – to decide whether to jump on the bio-based bandwagon and which car to take.

In 2004 the US National Renewable Energy Laboratory (NREL) defined 12 top value added chemicals from biomass. These products seemed to be the most promising at that time but a lot has happened in the last decade. In the follow-up report of 2016 there is again a list of 12 promising chemicals. The overlap between the two lists is moderate and consists of glycerol, succinic acid and para-xylene.

The European Union, too, strives to identify the chemicals that are predestined to be made from biomass. RoadToBio is an EU-funded project set up in mid-2017 to deliver a roadmap by 2019 illustrating the 'sweet spots' for Europe's chemical industry. In a first step, a long list with 120 chemicals at technology readiness level (TRL) of 6 or higher was compiled that show potential for the chemicals market. In parallel, the value chains of 500 petrochemicals were analyzed from a purely technical point of view. 85% of the value chains offer entry points where a petrochemical could be replaced by a bio-based one. The chemicals that were cited most often as replaceable are ethylene, propylene and methanol.

RoadToBio analyzes the interface between bio-based and petro-chemical

The NREL report and RoadToBio project have in common that they both examine products with a TRL 6 or higher meaning

that the production process has reached pilot scale. Furthermore the studies so far both work along the value chain of petrochemical products. A typical product tree starts from a low value feedstock like ethylene and branches into many higher value intermediates like polyethylene, ethylene oxide and vinyl acetate. The intermediates again have multiple uses; vinyl acetate can end up in an adhesive as well as in paint.

Whenever a chemical can in theory be replaced by a bio-based one this is called an entry point in RoadToBio. Overall, of the 120 chemicals identified in the long list for further analysis, only 49 have entry points into existing petrochemical value chains, while the other 71 are dedicated chemicals. Dedicated chemicals are those which have no fossil-based counterpart and thus offer unique production routes. Lactic acid as base for the bioplastic polylactic acid is a prominent example for a dedicated chemical. In contrast, drop-in chemicals are bio-based versions of existing chemicals. A third group, smart drop-in chemicals, are also chemically identical to their fossil counterparts but provide an additional advantage compared to ordinary drop-ins. This can be a faster and simpler production pathway or less energy use.

In the NREL analysis some products such as ethylene and methanol were consciously excluded as they would compete with chemicals derived from natural gas, which is not realistic. It remains to be seen if RoadToBio researchers take a similar route in the next step, in which they will analyze drop-ins and dedicated chemicals for their market potential.

Four chemicals that appear on both the top 12 NREL list and among the 49 RoadToBio chemicals with potential entry points are succinic acid, para-xylene, 1,2-propanediol and glycerol.

And the winner is...cooperation

If predicting the success of a bio-based product were easy governments worldwide would not employ legions of scientists and commission studies to do so. Only time will tell which of the cited bio-based chemicals will become a blockbuster and whether RoadToBio will come to the same conclusions as the NREL study. The petroleum price and governmental interventions are only two of the more unpredictable factors in the multi-parameter matrix which determines the economic success of a bio-based product. One of the commonalities of the four chemicals discussed above is that they are drop-in chemicals. They are chemically identical to their fossil counterparts and for further processing it doesn't play a role whether they are made from petroleum or from biomass.

On closer inspection the production processes of promising drop-in chemicals are an eclectic mix of chemical and biotechnological. Fermentation steps are followed by chemical transformations; whether a metal catalyst or an enzyme is used is just a matter of what works best. Anything goes as long it is technically feasible. A process is no longer either chemical or biotechnological, cooperation is the new normal. Winners in the quest for the holy grail of bio-based chemicals are definitely the scientists from all the different disciplines involved. They have learned to look past the boundaries of their own sector and gained a whole new perspective.

ACHEMA 2018 focal topic "Biotech for Chemistry" puts the spotlight on the fact that biotechnology and chemistry are growing together. The congress program features presentations about novel processes and products while the exhibition shows equipment of every scale for both biotechnological and chemical techniques.



Focal topic presentations

Room: CMF - Harmonie 3

» Your guide to when and where it's all happening



A High-Throughput Single Cell Screening for Expression and Secretion of Recombinant Proteins in E. coli

J. Eichmann, University of Applied Sciences Mittelhessen (THM), Giessen, Germany

**11:00
11:30**

Use of a *Aspergillus terreus* fructosyltransferase expressed within *Kluyveromyces lactis* for the production of short-chain fructooligosaccharides

J. Burghardt, University of Applied Sciences Mittelhessen, Giessen, Germany

**12:00
12:30**

Tuesday

**12.06.2018,
10:30 – 13:00**

Biotech for chemistry - Organisms

**10:30
11:00**

Production of the microbial glycolipid mannosylerythritol lipid from renewable resources

A. Beck, University of Stuttgart c/o Fraunhofer IGB, Germany

**11:30
12:00**

Evaluation of *Streptomyces sanyensis* and *Micromonospora chalybeata* as biological control agents against *Collaria scenica*

J. Parra Melo, Universidad Nacional de Colombia, Bogota, Columbia



Tuesday

**12.06.2018,
15:00 – 17:30**

Biotech for chemistry - Developing processes

**15:00
16:00**



Lipase catalyzed solvent free esterification

Y. Satyawali, Vito NV, Belgium



**16:30
17:00**

Enhanced production of rhamnolipid biosurfactant by *Pseudomonas aeruginosa* microorganism in fed batch cultivation

B. Mokhtarani, Chemistry and Chemical Engineering Research Center of Iran, Teheran, Iran

**12:30
13:00**

Photobiocatalytic whole-cell biotransformations

R. Kourist, Technical University Graz, Austria

**16:00
16:30**

Process optimization for the production of cellobiose lipids from lignocellulose hydrolysates

A. Oraby, University of Stuttgart, Germany

Design of experiment (DoE) supported upstream optimization and column-free downstream strategy enables automation of recombinant production process for an antimicrobial peptide in *Escherichia coli*

M. Joachim, University of Applied Sciences Mittelhessen, Giessen, Germany

Wednesday

13.06.2018,

10:30 – 13:00

Biotech for chemistry - Developing processes II

10:30
11:00

(-)-Menthol-based DES as substrate and solvent for the lipase-catalysed esterification of (-)-menthol
M. Hümmer, DECHEMA-Forschungsinstitut, Frankfurt am Main, Germany



11:30
12:00

17:00
17:30

Extraction of Bioactive Solutes with Non-Ionic Deep Eutectic Solvents

Y. Marcus, Hebrew University of Jerusalem, Israel

11:00
11:30

Xylonic acid from hemicellulose hydrolysates

T. Hahn, Fraunhofer IGB, Stuttgart, Germany



15:30
16:00

Process development and process intensification for the production of polyketides and non-ribosomal peptides via multifunctional mega-syntheses

A. Oestreich, University of Applied Sciences Mittelhessen, Giessen, Germany

12:30
13:00

Biological Metal Recovery from Ores and Wastes

W. Keller, EKATO Rühr- und Mischtechnik GmbH, Schopfheim, Germany

12:00
12:30

Influence of different process parameters on microbial synthesis of Cellobiose- and Mannosylerythritolipids with *Ustilago maydis*

F. Haitz, Fraunhofer Institute for Interfacial Engineering and Biotechnology, Stuttgart, Germany

Wednesday

13.06.2018,

15:00 – 17:30

Biotech for chemistry - Methane, metals and metabolites

15:00
15:30

Development and simulation of bioreactors for the conversion of methane into value added products

M. Stier, Universität Stuttgart, IGVP / Fraunhofer IGB, Stuttgart, Germany



Process development for cultivation of planctomycetes as new bioresource

O. Kruppa, University of Applied Sciences Mittelhessen, Giessen, Germany

16:30
17:00

Bioprocess Platform Design for Kefiran Production: From Tibet to Tablet

H. Elenshasy, Universiti Teknologi Malaysia



16:00
16:30

Nursery supplementation with Narigenin-Chalcone affects long term wood formation, gene expression and metabolite composition of full grown *Eucalyptus* trees

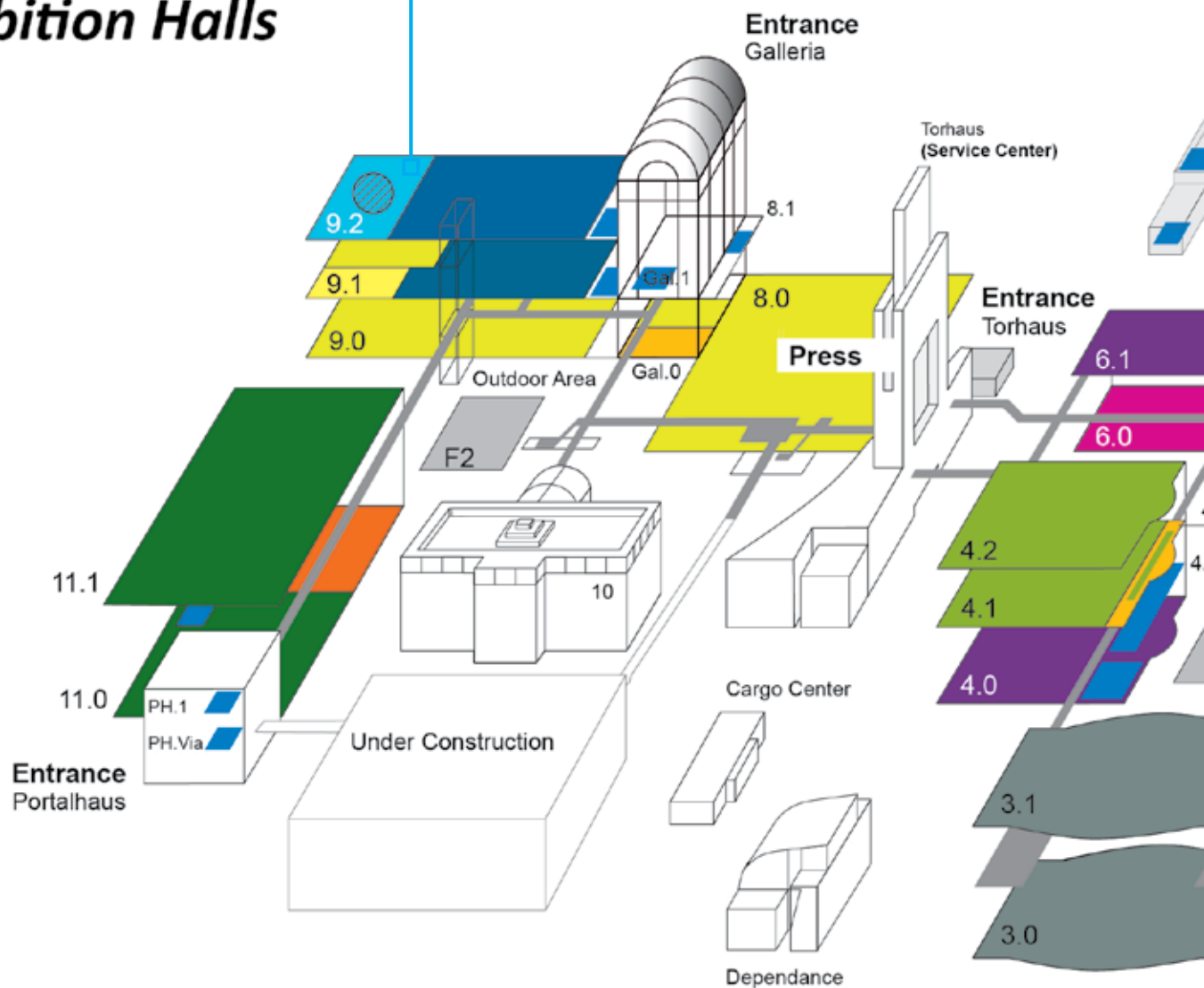
J. Lepikson-Neto, Instituto Senai de Inovação em Biomassa, Três Lagoas, Brasil

17:00
17:30



ACHEMA2018

Exhibition Halls



Engineering



Research and Innovation



Laboratory and Analytical Techniques



Literature, Information, Learning and Teaching Aids



Mechanical Processes



Instrumentation, Control and Automation Techniques



Pharmaceutical, Packaging and Storage Techniques



Pumps, Compressors, Valves and Fittings



Industrial and Labour Safety



Thermal Processes



Materials Technology and Testing



Lecture Rooms



Congress Office



Discussion Corner



Logistics Hotspot


SUGIMAT

Company

SUGIMAT

Location

Hall 5.1 D73

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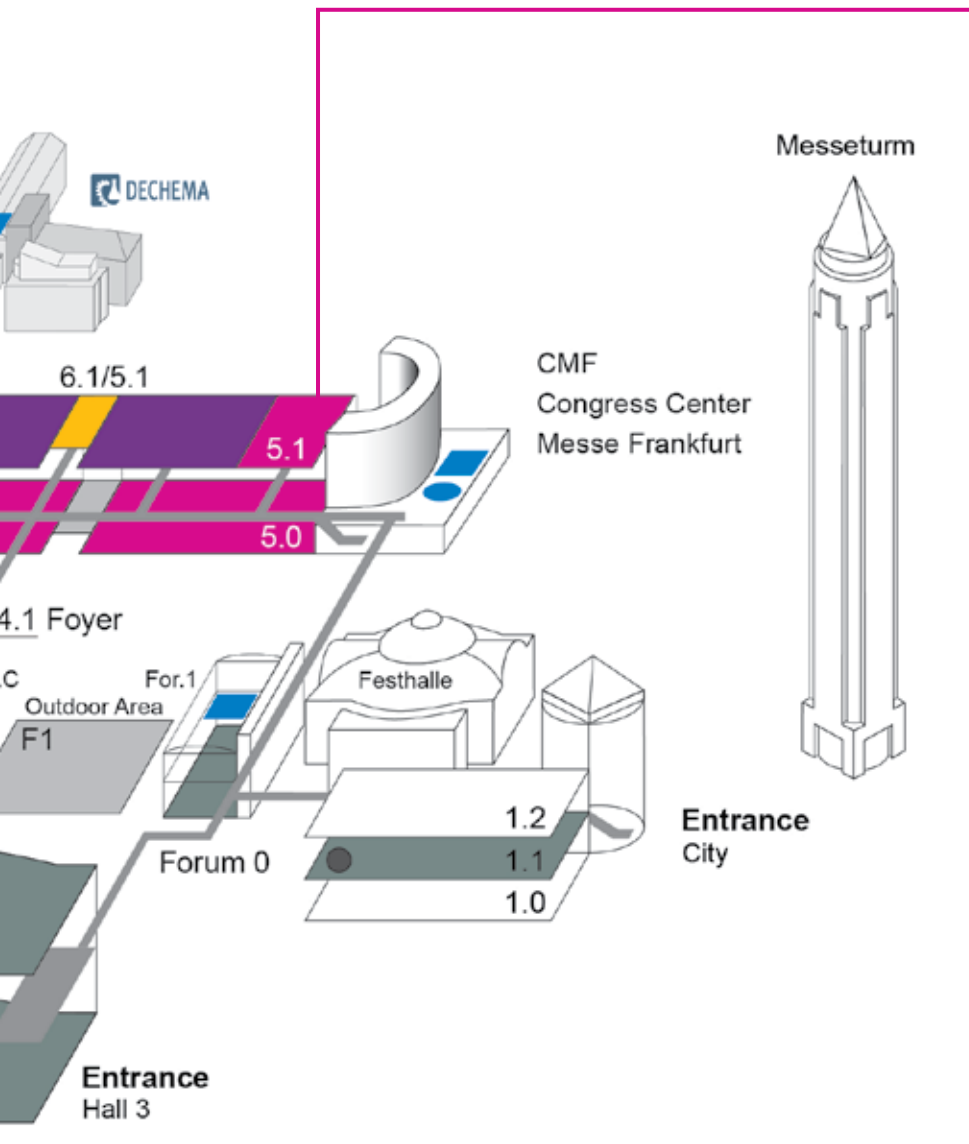
Biocommodities

Company

VOGELBUSCH Biocommodities GmbH

Location

Hall 9.2 D9



Lecture Rooms:

CMF

Harmonie 1 - 5
Spektrum
Conclusio 1 + 2
Fantasie 1 + 2
Illusion 1 - 3

DECHEMA House

Franz Patat Auditorium
Max Buchner Auditorium

Forum 1

Panorama 3

Hall 4.0

Europa

Hall 4.C

Alliance
Concorde
Consens
Entente

Hall 8.1

Symmetrie 2 + 3

Hall 9.1

Esprit
Genius
Logos

Hall 9.2

Dialog

Hall 11.0

Korall

Portalhaus Via

Frequenz

Portalhaus 1

Transparenz

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Vitamin B2: better the biotech way

» Did you plunge an effervescent multivitamin in a glass of water this morning?

If yes, some milligrams of vitamin B2 or riboflavin were fizzing in it to make your skin soft and your hair shiny. Furthermore, the vitamin makes for the sunny yellow of the healthy water.

The riboflavin example illustrates how industrial biotechnology changes production processes in the chemical industry. For the sake of the environment, but for the sake of the manufacturers as well - 'green' processes only have a chance if they are economically competitive.

Isolated for the first time in the 1920s, the vitamin was produced by an eight-step chemical synthesis well into the 1980s. The rising environmental consciousness of the 1970s led to attempts in reducing waste, avoiding toxic substances and cleaning wastewater. A really clean production of riboflavin was only possibly with the microbial production process with the filamentous



Ashbya gossypii © BASF

fungus. The process is so efficient that part of the product starts crystallizing in the bioreactor in high purity. Thus, the ecobalance is non-ambiguous: The microbiological process beats the chemical one in every criterion, starting with 30% savings in CO₂ emissions up to 95% for the amount of waste generated. Consequently, the market leader, BASF, discontinued chemical production in 1996 and has been focusing on biotechnology ever since. Competitor, DSM, uses a microbial process too, albeit based on the bacterium *Bacillus subtilis*.

Silent heroes of biotechnology

Vitamin production on an industrial scale means that bioreactors can reach a size of 100 m³ but who is building these giants? The silent heroes of biotechnology can be found atACHEMA, the trade show that puts the technology into bio-technology.

Even bioprocesses that end up in the multi-cubic-meter magnitude start small on laboratory scale, usually as a shake flask culture.



microbial cultures © DECHEMA

The next step is a bench-top fermenter that can range from 100 milliliters to 5 liters.



bench-top fermenter © DECHEMA

These and the whole lab infrastructure can be found in the laboratory and analytical techniques exhibition group in hall 4. Upscaling a process to pilot and then production size is the task of the companies



fermenter © Sanofi Pasteur

in the engineering exhibition group in hall 9. Their service starts long before stainless steel sheets are bent into cylindrical vessels. Is it more economic to use wheat starch as a substrate for the process or glucose syrup? In the pre-engineering, raw materials and capacities are compared, which are the basis for the decision-making of investors. These numbers are also important for regulatory approval. The detailed planning gets down to the nitty-gritty. No tube may be overlooked, no welding seam neglected. Also, precise process control is a must for



process control © DECHEMA

biotechnological processes and can be found in the instrumentation, control and automation techniques group in Hall 11. If temperature and pH value are only slightly off the optimum, *Ashbya*, *Bacillus* and colleagues quickly fail to perform.

As soon as the microorganisms have accomplished their mission, it's on to

A large industrial centrifuge machine, likely a decanter, is shown in a factory setting. The machine has a large, rounded, stainless steel body with a smaller cylindrical section at the bottom. It is surrounded by various pipes, valves, and structural supports. The background shows other industrial equipment and a bright, possibly outdoor or well-lit indoor area. A red banner at the bottom of the image contains the text "centrifuge © 3DI Equipment".

V



A process demonstration facility



A semi-industrial scale photobioreactor

Q&A

with Adeel Aslam, Head of Consulting

» Bouygues Energies & Services is increasingly the partner of choice for industrial process stakeholders. We spoke to Adeel Aslam, Head of Consulting, to find out why.



Q How does Bouygues Energies & Services support industrial process projects?

A Bouygues Energies & Services supports industrial process projects by working with our clients around early stage business engagement and strategic business consulting. By understanding client and investors' needs, objectives and expectations from an early stage, we are able to provide sustainable scale-up strategies which are supported by our in-house, design and build solution capabilities for pilot plant, demonstrator and full scale manufacturing facilities.

With our unique approach, we can develop solutions from an early feasibility stage. This streamlines the assessment and selection of suitable technologies for the process; both existing and emerging. During the further design development, we maintain a key focus on lean manufacturing and asset lifecycle modelling, whilst considering future business needs. The result is investment programmes which deliver the highest return on investment from day one.

Q How would you kick-start a new project using a FEED study approach?

A Before kick-starting a new project, we need to clearly understand the client's / investor's objectives, targets and expectations. By working in this way we are able to offer a bespoke solution to fit their requirements. We do not believe in a 'one size fits all' approach. All of our FEED studies are tailored specifically for our client's needs to ensure that the project critical success factors are delivered. Whether or not a project brief exists, the studies are aimed at reviewing, questioning and implementing all the project / design requirements in a structured format.

To understand our client and deliver their expectations, Bouygues Energies & Services build the FEED study around a set of client / design team interactive data gathering workshops. During these workshops, all key project stakeholders are presented and given the opportunity for critical input into the development and understanding of project requirements.

Workshops are aligned to suit the type of project being undertaken but will normally begin with a Process / Architectural review where the project brief will be developed and the main facility process flows will be drawn out from first principles.

Q What are the key benefits of engaging with Bouygues Energies & Services in this way?

A When we are engaged from the early stage of a project's development, we can help transform our client's science, ideas and vision into commercial reality. We do so in an accelerated and collaborative manner, whilst de-risking technology investments. This is supported by our unique consultancy "in-house" offer and approach, with single point accountability.

We are involved in a wide range of sectors, including Industrial Manufacturing, Pharmaceuticals, Life Sciences, Biotechnology, Energy, Power and Renewables, so we are able to interchange ideas and innovations. In a highly collaborative way, we share, transfer and connect knowledge utilising open innovation models.

Q How do you keep your methods agile and innovative in a changing landscape?

A We regularly review our offer / approach and complement it with the latest tools and technologies. We utilise the latest design software and also introduce technologies that can enhance our customers' experience.

We also have an approach of continuous learning and open innovation; we keep informed of changing regulatory and statutory requirements by regularly attending a wide range of forums and play an active role in a number of industry networks.

We strive to keep up-to-date with the ever changing landscape of industrial processes and technologies by continuing to build strong relationships with our key value chain partners.



How can interested companies and organisations connect with you?

We can be contacted via our website - www.bouygues-es.co.uk/contact or by email - adeel.aslam@bouygues-es.co.uk. Alternatively, visit our blog - our-blog.bouygues-es.co.uk/ or connect with us on LinkedIn - www.linkedin.com/company/68332/



Efficient heat generation

» How to improve the fuel economy in the production processes

By Miguel Martínez, M. Sc. in Chemical Engineering

In recent years, energy efficiency is becoming a crucial issue in all large industries which consume heat in their production process. The chemical industry is, of course, one of them.

The heat generation is a key topic in many chemical processes, whether as a heat input necessary for the initiation of a reaction, the maintenance of process conditions or the modification of the properties of the fluids involved.

In Sugimat, using the experience acquired in CSP plants up to 125 MW, where the HTF works at 393°C and efficiency is fundamental for the viability of the process, we have extrapolated to the chemical processes, where high temperature is required, the technology which makes possible to increase the efficiency of heat generation in the plant by up to 10% with investment costs that, in most cases, have a return of less than a year. The system consists of preheating the combustion air, before it is directed to the burner,

by means of a combustion gas air exchanger.

The paper will discuss the details of the integration of this system in ordinary heaters as well as the way in which it is controlled that the maximum emissions of nitrogen oxides established in the recent European directive for boilers of medium power is not exceeded.

For Sugimat, Germany is an important market. For this reason, the company wants to improve its visibility attending different exhibitions in the coming years. Next stop is Achema from 11st to 15th June. Precisely during this exhibition and under the name "Efficient heat generation" Miguel Martínez, Key Account Manager at Sugimat, will give a presentation focused on the demands of the industry and its peculiarities in the new business model. Martínez is M. Sc. in Chemical Engineering and he has more than 5 years of experience in the thermal energy arena.



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Background

Sugimat is a company dedicated to the design and manufacture of facilities for the generation and use of energy for about 40 years. Its extensive experience in the sector and its commitment to innovation, quality, and internationalization has allowed the implementation of more than 3,000 installations in up to 27 different countries to generate energy through the use of renewable energies and fossil fuels. The headquarters are located in Valencia although it has seven offices spread across Germany, United Kingdom, France, Portugal, Italy, Poland and the USA.



Say hello

Visit the Stand at Achema trade fair and our specialised staff will show you how successful this family business has developed turn-key projects adapted to each client's needs. Sugimat, Efficient Engineering Solutions.

Visit us at Booth **5.1 - D73**
www.sugimat.com

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We are specialists in the design, manufacture, and commissioning of energy saving and generation solutions with boilers using fossil fuels, biomass, and waste. The deep know-how of the energy sector since 1978 and the commitment to **innovation** has enabled us to design, construct and assemble more than 3,000 solutions/power plants installed in up to 27 different countries around the globe **with unbeatable durability and reliability**. Prestigious clients such as Repsol, Evonik, & IFF already trust us. Do you?

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