AGRO & CHEMISTRY

ABOUT **BIOBASED BUSINESS** IN A **CIRCULAR WORLD**

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PATRICK SCHIFFERS (SYNVINA): PEF FASTER THAN PET

WET SPINNING FOR BIOMEDICAL POLYMERS

SMART CITIES: GET READY FOR THE FUTURE

CATCHBIO: CATALYSIS FOR BIOCHEMICALS

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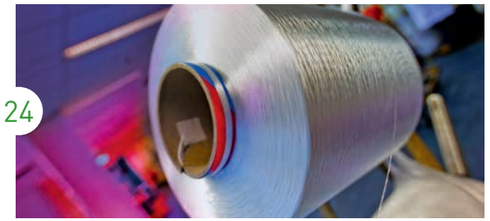
CONTENTS

20

10



24

28

IN THIS ISSUE

EDITORIAL

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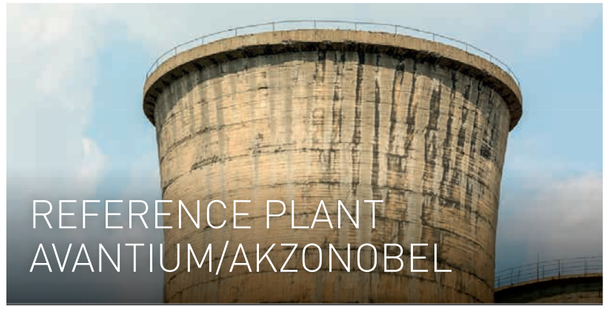
CIRCULAR THE WAY TO GO

The Netherlands wants to be a world leader with its circular economy. The aim is to reduce the use of primary raw materials like minerals, metals and fossil raw materials by 50 percent in 2030. And twenty years later, in 2050, the circular economy should be standing on its own two feet.
It is an ambitious objective with clear urgency, in both ecological and economic aspects. Because raw materials are becoming increasingly scarce, residual and/or waste streams are entering the picture more emphatically. Apart from the scarcity and price fluctuations, the extraction of these raw materials also impacts the environment in ways we can no longer afford.
The transition to a circular economy is also an economic blessing, going by the research the Ellen MacArthur Foundation. This economy can expand into a branch worth billions, providing employment for tens of thousands of people in the Netherlands alone.
Before it reaches that stage, a great deal of work will have to be done. The above transition will undoubtedly have consequences for companies which grew big in the old, linear economy. These players will not give up their position without a struggle.
The business community will also have to 'embrace' it. It must become increasingly possible for businesses to see perspective in circular concepts which are in line with their organisation. And to see that, they have to be well informed of the existence of those concepts. There is still a whole world to conquer in this respect.
There are companies which have taken the lead in the meanwhile. A good example is LEDsEnable, which finances the purchase, installation and maintenance of LED lighting. The company guarantees the users sufficient light during the entire term of the contract.
LEDsEnable claims that the concept has caught on particularly in the private sector. 'Businesses can switch faster and are quicker to react to financial and sustainable incentives,' according to director Reinoud Lyppens. In brief, the government has to put this on the agenda and indicate its urgency. But it would also be good if the government could already support these concepts in practical ways.
Agro&Chemistry is also anticipating this development by highlighting the biobased economy more often from the perspective of the circular economy. That is why the subtitle on the (digital) cover will be 'about bio-based business in a circular economy' from now on.



REFERENCE PLANT AVANTIUM/AKZONOBEL

Avantium, AkzoNobel, Chemport Europe, RWE and Staatsbosbeheer (Nature Reserves Association) have announced they will build a reference plant at the industrial site Chemie Park in Delfzijl, in the Northeast of the Netherlands.

The new reference plant in Delfzijl will be based on a new technology that has been developed by Avantium. The so-called Zambezi process aims to produce high-purity glucose and lignin from forestry residues, pulp or agricultural by-products. The high purity glucose is suitable for both catalytic and fermentation processes for the production of a new and growing generation of sustainable materials. The lignin is an excellent feedstock for renewable bioenergy applications, as its energy content is significantly higher than that of woody biomass.

Chemport Europe

The planned reference plant builds on the strong synergies of the infrastructure, utilities and expertise of the AkzoNobel-site in Delfzijl. RWE will supply feedstock and use lignin residues from the Zambezi process for the generation of renewable energy. Chemport Europe brings strategic support from the Northern Netherlands Region working via a range of initiatives to facilitate the project. Further synergistic partnerships and collaborations are currently under development.

Lux research: break through advanced biofuels

New facilities based on non-food feedstocks and producing novel fuels account for over half of new capacity deployment for the first time in the biofuel industry's history, according to Lux Research.

Lux Research analysts quantified the commercial deployment of new technologies in the global biofuels industry using a database of nearly 2,000 facilities from 1,461 companies in 90 countries with nameplate capacity data through 2022. They found that the global biofuels industry will grow at a slower 2.2 percent annual rate to 67 BGY of nameplate capacity by 2022. First-generation biofuels, which hold a 91.5 per cent market share, will continue to dominate but will lose nearly 6 per cent of market share, as advanced biofuels see rapid growth, nearly doubling their capacity to 9.6 BGY.

Nestlé and Danone: 100 percent bio-bottles

Nestlé and Danone have announced they have joined forces with Origin Materials, an American startup, to form the NaturALL Bottle Alliance. In 2020, the first 100 percent plastic PET-bottle should be available.

Together, the three partners aim to develop and launch at commercial scale a PET-bottle made from a 100 per cent sustainable and renewable resources, such as previously used cardboard and sawdust, so it does not divert resources or land from food production for human or animal consumption.
'Our goal is to establish a circular economy for packaging by sourcing sustainable materials and creating a second life for all plastics', declared Frederic Jouin, head of R&D for plastic materials at Danone.

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VAN DER WIELEN DIRECTOR BERNAL INSTITUTE

Prof. dr. ir. Luuk van der Wielen, chairman of the Executive Board of BE-Basic Foundation, has been appointed as Director of the Bernal Institute at the University of Limerick, Ireland.

The Bernal Institute was launched on November 21 2016 by An Taoiseach, Mr. Enda Kenny, T.D. The Institute represents a €86 million investment in research infrastructure and houses over 260 researchers who work in and across research themes in advanced materials, manufacturing and process engineering and fluid mechanics. The Institute is a major research priority for the University and has plans to grow significantly in impact and scale.
The focus of BE-Basic is implementing sustainable (biobased) solutions in society that balance and optimise economic value and climate impact for non-energetic (chemicals, materials, food&feed) and energetic (transportation fuels, power/heat) uses.

Shell: advanced biofuels production in EU

Shell aims to produce advanced biofuels at a (semi-)industrial scale at the beginning of the next decennium. These facilities are most likely to be planned in Europe and Canada, as it stands now.

Andrew Murfin (general manager Advanced Biofuels, Shell) stated this at the World Bio Markets conference which was held in Amsterdam from the 27th until the 29th of March. 'At the moment, we are between TRL5 and TRL 7. Not where we want to be, but the next three to four years we aim to be at TRL9.'
As for the location of the advanced biofuel plants, Murfin said: 'Both the EU and Canada have policies in place which create room for advanced biofuels (via mandates, ed.). However, mandates do not guarantee price levels.'

AGENDA

MAY 10th
International conference on bio-based materials, Cologne

The 10th International Conference on Bio-based Materials features ten representatives of worldwide leading companies in bio-based building blocks and platform chemicals as speakers. 'A unique opportunity for the participants to meet the pioneers in the field in one place', says Michael Carus, Managing Director of organizer nova-Institute. In addition, the latest market data and policy trends will be presented at the conference by international experts.

MAY 12th
Applied Biobased Materials (ABC Conference), Geleen, The Netherlands

The Aachen-Maastricht Institute for Biobased Materials (AMIBM) will host its second international conference at the Brightlands Chemelot Campus. AMIBM is combining the forces of Maastricht University, RWTH Aachen University and Fraunhofer IME.

MAY 31st
Chemspec Europe 2017, Munich

Chemspec Europe 2017 is the key platform for manufacturers, suppliers and distributors of fine and speciality chemicals to showcase their products and services to a dedicated audience of professionals in the industry sector. The product portfolio of this international exhibition covers a maximum range of fine and speciality chemicals for various industries. Excellent networking opportunities and top conferences presenting the latest results of ongoing R&D projects.

JUNE 12th - 15th
EUBCE 2017, Stockholm

As one of the world's leading R&D conferences, combined with an international exhibition, it serves as the international meeting point for biomass experts from research, development and from industry, with presentations dedicated to biomass, addressing the latest technologies, the policy framework, and the medium and long-term strategies and potentials. The EUBCE is the interface between science, industry and policy makers.

NEWS

Growth forecast for biobased polymers

The worldwide production capacity for biobased polymers grew by 4 per cent to 6.6 million tonnes from 2015 to 2016. This despite a difficult market environment, according to the Nova Institute.

The growth of biobased polymers represents a share of 2 percent of the global polymer market. The biobased polymer turnover was about €13 billion worldwide in 2016 compared to €11 billion in 2014. Production capacity of biobased polymers is forecasted to increase from 6.6 million tonnes in 2016 to 8.5 million tonnes by 2021.
Nova Institute states that the growth rate of biobased polymers is being limited by low oil prices, poor political support and a slower than expected growth of the capacity utilization rate. Strong political support can only be found in Italy and France for biodegradable solutions in the packaging sector. In this sector, the global demand for biodegradable packaging still shows a double digit growth. Additional demand could come from the increasing microplastic problem (marine littering), but so far biodegradable plastics have not benefitted from this debate.

Finland probably has the most sustainable forest bioeconomy in the world top ten, according to the blog of Lauri Sikanen, head scientist at Luke Natural Resources Institute Finland.

Finland has three major companies in world top ten producing pulp and paper. According to Sikanen, only few people know that these companies are also responsible for making textile fibers, biodiesel or bioethanol. And that they're responsible for developing dozens of other bioproducts and green industrial symbioses based on forests and trees. 'Today, one fifth of our export is coming from the forest-based bioeconomy. Sustainability in bioeconomy as you know is the balanced combination of ecological, economic, social, and cultural sustainability.' Despite the large proportion of forestry in the Finnish economy and the heavy use of wood, the country has more trees and forests than ever before. There are about 80 million trees and that number continues to grow, according to Sikanen. 'Even if the next few years the current use of wood will increase further.'

BIO-BASED INDUSTRIES CONSORTIUM

‘MARKETS GET A LEADING ROLE’

Nelo Emerencia: ‘End markets are coming nearer. Therefore, our new SIRA will clearly include the market perspective.’

‘The Bio-based Industries Consortium (BIC) participates with a clear vision in a comprehensive programme with the European Commission in the Bio-based Industries Initiative. Nevertheless, there should always be some degree of flexibility. That's why our strategic innovation and research agenda (SIRA) will get an update. Most importantly, market demand will also get a leading role.’

Text Lucien Joppen **Image** Bio-based Industries Consortium

According to Nelo Emerencia, responsible for programming within BIC (72 industry-members; 169 non-industry members; contributing with € 2.7 billion to BBI’s total budget of € 3.7 billion) we live in an era of perpetual change. As it stands, forecasts - even for the mid-term - are hard to make. ‘In 2012, when BIC was formed, we had to work very hard to get the necessary number of private companies on-board to gain critical mass. We succeeded in bringing together companies from various industry sectors willing to invest in the development and deployment of sustainable value chains, converting biomass feedstock into marketable value-added products for a wide variety of market applications. Our starting membership was relatively heterogenic, with representatives from the chemical, forestry, agrofood, waste and energy sectors. The SIRA at the outset of BIC, had to appeal to all parties involved. They needed to see their core business reflected in this long-term R&D&I-agenda. It made perfect sense.’

NO OCEAN LINER

The original SIRA focussed on five value chains, mirroring the strategies of the above sectors: the mobilisation and conversion of lignocellulosic feedstock into advanced biofuels, biochemicals and biomaterials; to increase the number of value-added products derived from forestry biomass; the development of new agro-based value chains by improving agricultural production and generating new value-added products and markets; the conversion of currently unused waste streams into valuable products and, finally, to integrate energy, pulp and chemicals biorefineries through sustainable bio-energy production in operations aiming at higher added value components production.

‘Along the way, we have incorporated actors in other industrial sectors, such as the food processing, the aquatic/marine and CO_2-utilisation sectors’, Emerencia says. ‘It shows that BIC is not an ocean liner or an ultra large crude carrier with a relatively fixed ‘cargo’ that needs quite some time to adjust direction if needed. We can act flexibly and quickly enough to take these and other parties aboard to sharpen our vision while staying the course.’

INVEST IN EUROPE

Since the start of the BBI programme, the emphasis has been on technology development and upscaling that would facilitate ‘building’ business cases within the above value chains. Using and upscaling proven technologies in demonstration and flagship projects will start realising bio-based value chains from feedstock to market. These large projects, already representing significant investments, will lead the way to further investments in a competitive, innovative and sustainable Europe.

Now there are four BBI grant-funded flagship projects. BBI’s first flagship is First2Run, demonstrating the technology, lower ecological footprint and economic feasibility of converting underutilized oil crops, such as cardoon from marginal lands into chemicals, materials and fuels.

FLAGSHIPS

‘Originally, we had foreseen five flagships by 2020, producing new products that have proven to become cost-competitive with fossil-based products. Through the 2016 call we will already have six’, Emerencia says. ‘In fact, we could have had more flagship projects if it wasn’t for the funding. To expand financing opportunities for excellent projects, we are increasing cooperation with regions throughout Europe. In this respect, we have signed MoUs with ERRIN and the Vanguard Initiative and are partnering with a.o. the six Model Demonstrator Regions and bio-based regional clusters in Poland and Finland. Teaming up with regions will help us establish bio-based industries across Europe.’

MARKET ACCESS

‘While we are making good progress with biomass feedstock integration and technology development and scaling up, we must ensure market access for bio-based products’, Emerencia says. Therefore, aside from recruiting actors from other/more industrial sectors and expanding into central and eastern Europe, BIC is actively seeking brand owners to join. Brand owners can help the bio-based value chains delivering the needed high value bio-based products with specific performance capabilities to meet market demand. Brand owners may also have residual or side streams from their processes that could enjoy significant valorisation versus current disposition, through the bio-based industries.

SUPPLY AND DEMAND DRIVEN

‘For all the above reasons and to reflect recent policy and regulatory developments, we need to adjust the SIRA’, Emerencia says. ‘The original SIRA was more feedstock/supply-oriented, with a strong focus on technology development. This approach also reflected to state of the industry back then. However, several brand owners have set up strategies with ambitious targets in terms of sustainability. Consumers have become more aware of the impact of consumer goods on the ecology. In other words, end markets are coming nearer. Therefore, our new SIRA will clearly include the market perspective: which products and/or functionalities are needed for identified applications. These specs will be ‘back casted’ into the value chains all the way to the biomass feedstock. These feedstocks could be agro-, forest-, aquatic-based, or from bio-waste or gaseous streams such as CO_2.’

OUTPERFORM ON THE BASIS OF LCA

When asked about the most promising business cases for the near future, Emerencia is hesitant naming specific examples. ‘Momentarily, drop-in bio-based chemicals are having a hard time, given the low crude oil price. One needs to perform a life cycle analysis to arrive at comparable costs and impacts. This hasn’t been done consistently yet, but when done, bio-based drop-ins may well be competitive with fossil based counterparts. Bio-based chemicals with more and better functionalities that can outperform fossil-based chemicals are marketable. For example FDCA (2.5 Furandicarboxylic acid for making polyesters like PEF (polyethylenefuranoate)), is well-placed in the market, not in the least because of the involvement of fast moving consumer goods (FMCG)-companies and large chemical companies for the production and marketing/sales/distribution on a global scale.’ ●

REALITY CHECK FOR BIOPLASTICS

‘Brand owners tend to set deadlines which are hardly feasible. As for bioplastics, some companies have indicated that in 2020 a significant amount of their packaging materials would be based on renewable feedstock. It is safe to say that it will take a little bit longer before industrial volumes of bio-based polymers will be available.’

Text Lucien Joppen **Images** Synvina

Patrick Schiffers knows his metier. The CEO of the recently-formed joint-venture Synvina, between Avantium and BASF, has an extensive track record in the international monomer and polymer business, mostly with BASF. His educational background, however, is more in business management, marketing and psychology.

Mr. Schiffers, you were trained to be in general management or consulting. How did you wind up in the world of chemistry and material sciences?

‘Well, when I was graduating at the University of Mannheim in Germany, I already had the drive to go abroad, especially to Asia. The continent fascinated me. From a personal view, a career with a consultancy firm was an option. However, my mentor, a top manager at BASF, advised me not to choose consultancy as these jobs are typically local. A career with a multinational company would open doors abroad that otherwise would be closed. I ended up at Henkel, a renowned company that produces detergents among other products. I joined the operation in Thailand for a year. Then Henkel decided to carve out its chemical activities as it wanted to focus exclusively on consumer markets. In the newly-formed Cognis, I worked for another year in a performance management project until BASF asked me to join them. As BASF could offer opportunities in terms of professional development that Cognis couldn’t, the choice was easily made.’

Within BASF, you went into the intermediates business. For eight years, you were first marketing manager and later marketing director at BASF’s intermediates division in Asia (Hong Kong). Did this job more or less set you up to become CEO of Synvina?

‘Partly yes. From the viewpoint of general management, I have built up experience in setting up and managing both, specialty and commodity business in fast-growing and volatile markets. Also, I have had ample experience in establishing joint-ventures and, of course, had an international working background. It is important that you are able to acclimatize in unfamiliar cultures, not everyone is able to do so. Furthermore, my personal profile fits the job. From my time in Asia, I really enjoyed the entrepreneurial spirit and the market dynamics in an emerging economy. It is in my nature to create and build up new business. So this package may have helped me to get the job at Synvina. Mind you, I was already involved in the contract negotiations with Avantium, so the appointment didn’t come as a complete surprise!’

So you are the perfect fit for this position. What is the fit between Avantium and BASF within Synvina?

‘Avantium has developed a very promising technology based upon which furandicarboxylic acid (FDCA) can be produced and subsequent polymers such as polyethylenefuranoate (PEF). They have developed a strong patent portfolio and patent applications in this field and thus established a strong and leading position in this field. BASF has the expertise, the know-how and the experience to scale up technologies from the pilot stage into commercial production. Furthermore, the company has a global presence which makes it easier to roll out new products on the world stage. These competencies are needed to convince large brand owners we are the right partners to produce FDCA and PEF in industrial quantities.’

In terms of company culture, which culture will be dominant within Synvina?

‘None, if it is up to me. True, BASF has a history of 152 years and Avantium is relatively young. But Synvina’s head office is in Amsterdam, the planned factory is intended to be located in Antwerp and we’re aiming to further cooperate with an increasingly multinational workforce. Ideally, we can forge both cultures - the creative spirit of Avantium and the German Gruendlichkeit (thoroughness, ed.) of BASF - into one Synvina-culture. In fact, the name Synvina has been derived from the words ‘synergy’, ‘vitality’ and ‘nature’. We didn’t hire a PR company for the name finding, but organized internal brainstorm sessions. With 120 (!) possible names, we decided to step back and look at our key strengths. This is when we chose Synvina. That exercise also had a bonding effect: if the colleagues collectively establish the company name, they ‘own’ it and don’t just use it.’

Will larger chemical multinationals increasingly become dependent on smal(ler) companies or start-up’s to make major strides into renewable chemistry?

‘Definitely. BASF is also active in renewable chemistry, both in drop-ins, for example with butanediol based on renewable feedstock, and completely new platform molecules. However, a considerable part of BASF is and will be geared towards fossil-based products for years to come. The short to mid-term decision making for biobased R&D-routes is often influenced by the crude oil price, as you can imagine. I believe the era has passed where companies solely could run on internal R&D. The world has become too complex for this. Therefore, multinationals are increasingly scouting technologies that have the potential to create large-volume markets.’

Talking about volumes, what is your outlook on the FDCA/PEF-market?

Initially, Synvina intends to build a reference plant for developing the FDCA and PEF markets with an annual capacity of up to 50,000 tons. We also target to license our technology and thus enable investments in industrial-scale production plants. Surely, one can look at the PET market and make a prediction of the market potential. The point is, however, that PEF offers better functionalities and barrier properties than PET. Therefore, PEF has the potential to be the product of choice not only in the PET but in the overall packaging market. In many segments, PEF can capitalize on its superior barrier properties. As the high-barrier segment within the packaging market is growing faster than the market as a whole, PEF in particular will benefit from this demand development. On the longer term, PEF’s market share will most likely expand at the expense of PET and other packaging materials as brand owners will increasingly opt for renewable and recyclable materials. Another aspect is that PET has suffered image-wise, as the material has been linked heavily with plastic waste, for example in our oceans. Globally, less than 10 per cent of all fossil-based plastics is being recycled. Ultimately, the target must be to increase recycling rates. Summing up, PEF is superior to any other packaging material: it is based on renewable feedstock, it has significantly better pro- >>

COLUMN

FORESIGHT IS THE ESSENCE OF GOVERNMENT

Recent years we have witnessed many breakthroughs worldwide in the use of renewable raw materials for energy and materials. Even more breakthroughs are expected in the future. And that is important for our country, because the Dutch economy and export are determined to a very large extent by products and technologies from the chemical and agrofood sectors.

According to the Volkskrant (national newspaper) of 15 February 2017, 'the Dutch business sector is working far more energetically on sustainability than the government.' There are numerous examples of this: Ahold, KLM and the NS (National Railroads) aim at 100% climate-neutral energy consumption, Philips is working on the circular economy by 'renting' light and Avantium, Corbion and Reverdia are developing biobased chemicals and polymers. This reduces the dependency on fossil raw materials and agrofood thus becomes increasingly important.

These Dutch companies with global leading technology develop new materials and put them on the market. But the large-scale production has to be done outside our country's borders and even outside the European Union, because of the excessively high energy and raw materials costs. This is a missed chance for the Netherlands, because a lot is expected of these developments in the future, while subsidies and legislation in the Netherlands create an uneven playing field for biomaterials compared with bioenergy.

Again, there are numerous examples. Take Reverdia, with its headquarters at Brightlands Chemelot Campus, which has developed the best technology for renewable succinic acid and is focusing explicitly on the US for large-scale production.

Succinic acid, which had a global market of around 35 kt/year in fossil form, is now in its 'bio form' also regarded as a platform chemical with an expected market size of 600 kiloton in 2020 up to around 5,000 kt/year after 2030. This is the result of significantly lower production costs in comparison with the fossil form.

In brief, a little incentive from politics here would be very welcome. Once the current protracted domestic political issues are finally resolved, we might perhaps have time to talk about how, as a country, we can benefit from the strong synergy between agriculture and the chemical sector in, say, 10 years' time.

This will be achieved partly through creating a level playing field in the short term for bio materials and bioenergy with respect to energy and raw material costs.

Jan Ravenstijn
Bioplastics consultant

perties and it can be recycled in existing facilities, possibly in PET-streams.'

What needs to be done before these markets will be established?

'A ton of work (laughs). We need to scale up our production processes which we are currently operating in our pilot plant at Brightlands Chemelot Campus in Geleen (The Netherlands) which has been expanded recently. In short, we need to generate sufficient volumes to feed application development. For this stage, we have been and will be busy setting up value chain partnerships like for example for polymerisation, preforming and blow moulding. Containers or bottles are by far the largest application but we are successfully working on films and thermoforms as well. For example, Synvina will continue to work with companies like Toyobo and Mitsui in Japan. We will build on these relationships that Avantium has established to successfully develop and market PEF for packaging solutions.'

Finally, can you disclose the hurdles you are facing in scaling up?

'I can't get much into details regarding this matter but we are on schedule in terms of the planned scale-up of our production facilities. The expectations of the large brand owners are very ambitious in terms of timing and availability of biobased polymers. We aim at supplying larger volumes of PEF in the future. Most companies engaged with fast moving consumer goods, so-called FMCG-companies, do not realize that it takes a certain time to supply large volumes of biobased polymers to the market. One has to deal with regulations, technology development, applications, product development, marketing and - of course - scaling up. It took PET 50 to 60 years to be what it is now. We are definitely convinced that we will be faster.' ●

BIODEGRADABLE STILL TO CLIMB OUT OF THE NICHE MARKET

The market for biodegradable plastics will grow considerably in the coming years. A significant share of these plastics is used for packaging foods, especially fresh products. The question is whether degradable bio-based plastics will become mainstream in the food sector. The market has been rather unresponsive as yet.

Text Lucien Joppen **Images** Shutterstock

Technology research agency Technavio argues that the market for biodegradable plastics is showing an upward trend. It expects a CAGR of 21 percent between 2016 and 2021. This would put the global sales at some 5.3 billion US dollars in 2021. These plastics are used mainly in applications with a short lifespan, such as (food) packaging, foams, rubbish bags, agricultural plastics and a further range of other products.

Western Europe dominates the world market with a sales share of 41 percent. According to Technavio, market parties and consumers are open to products which are marketed with an 'environmental plus point' (editor's note: more on this later). Consumer awareness is relatively high, partly because various national governments, including the Netherlands and Germany, put an emphasis on the instruction and collection – source separation – of plastic materials and packaging. In the medium term, other regions – the BRIC countries, Asia-Pacific, the rest of Europe and North America – will catch up.

CONTENTS AND PACKAGING

'We see a rise in environmentally friendly packaging materials (editor's note: i.e. packaging with a low CO_2 footprint) which are often used for products, especially foods, with a natural, sustainable and/or healthy positioning,' according to Swapnil Tejveer Sharma, analyst at Technavio. According to Sharma, the packaging and the contents enhance each other, so that certain consumers are more inclined to take a product if its packaging 'is right'.

In the biodegradable plastics field, it is the biobased plastics which dominate the market. Eighty percent of the global volume of degradable plastics is based on biomass: PLA, potato starch plastics, PHA, PCL, PBS and various types of fibrous materials such as paper, cardboard and composite materials. One good example of the last-mentioned form is the egg carton of the Rondeel egg, produced by the Dutch Paperfoam company.

FOOD THE BIG CUSTOMER

Food is by far the largest customer of biodegradable plastics/materials (including paper and cardboard). According to RnRMarketResearch, 70 percent of the turnover of biobased plastics and 40 percent of the paper/cardboard turnover is realised in the foods sector. As explained earlier, there can be a 'natural' fit between the product and its packaging. This sector is characterised moreover by large players, especially in the retail segment (Wal-Mart, Tesco, Ahold Delhaize, Aldi etcetera), but also on the supplier side with multinationals like Unilever, Coca-Cola and Nestlé. These enterprises have the scale and international presence to make the difference. Some enterprises have set up 'coalitions', such as a joint development platform for PEF, whose participants include Danone, Coca-Cola, Avantium and Alpha. PEF is a non-degradable bio-based plastic. Such platforms for degradable biobased plastics have not yet been set up. A few companies have taken concrete steps, however.

UNILEVER AIMS AT CIRCULAR

Unilever, one of the largest FMCG companies in the world, announced in January 2017 that all of its plastic packaging was to be fully reusable, recyclable or compostable by 2025. Paul Polman, CEO of Unilever: 'Our plastic packaging plays a critical role in making our products appealing, safe and enjoyable for our consumers. Yet it is clear that if we want to continue to reap the benefits of this versatile material, we need to do much more as an industry to help ensure it is managed responsibly and efficiently post consumer-use.'

Unilever is aiming in the first instance at the reuse of plastics, either into the same product (bottle to bottle) or cascading, for example into plastics in the automotive industry. 'But this is not always feasible, which is why we are also looking at biodegradable plastics. These streams do have to be separated so they do not contaminate the general recycling streams.'

BILLION PHOTOS / SHUTTERSTOCK, INC.

MARS WRAPPER

A well-known example is Mars, which, together with Rodenburg Biopolymers and Taghleef, has developed a biodegradable wrapper for its candy bars. The wrapper contains Solanyl C, a granulate based on potato starch (as residual product) and recycled PLA. 'We have produced a compound which has properties similar to those of common packaging materials (e.g. PP) and which can be reused in production. That makes a big difference in the material costs,' according to director Thijs Rodenburg. Other factors which interested Mars were the lower CO2 footprint of the material (-35%) and the lower energy costs of the production, namely 30%. 'The fact that the material was biodegradable was more of an added bonus,' according to Rodenburg. 'That was not very important to the company because there was only a small chance that the consumers would understand it.'

WRESTLING WITH COMMUNICATION

The last-named aspect is a major hurdle which both non-degradable and degradable bioplastics must take. Biodegradable does not by any means mean that packaging will decompose automatically. The materials can be degradable (potato starch, PBS or PHA), industrially degradable (PLA, through thermal treatment), or they can degrade in the soil or water (for example, PHA and starch).

'It seems simple, but there are various blends - for example potato starch with PLA – which then result in different end-of-life scenarios,' according to Jan Ravenstijn, consultant in bioplastics. 'That is why producers of consumer products wrestle with the communication about such plastics, apart from the investments which these materials entail.'

But Ravenstijn does see real opportunities for biodegradable, that is, compostable biobased plastics, in the food sector. 'Degradable foils for (refrigerated) fresh products have a good chance of succeeding. After all, they can be thrown in the compost bucket together with the offcuts and food leftovers.'

PHA, THE ULTIMATE DEGRADABLE PLASTIC

According to Ravenstijn, PHA types are the ultimate biodegradable biobased plastics: degradable in the soil and water, and of course industrially degradable at higher temperatures. 'What is more, PHA blends have good film properties so that they can be used as cling films, foils or as bags, for example in the vegeta- >>

COLUMN

BIOBASED ECONOMY IN EUROPE ON THE RIGHT TRACK!

The biobased economy becomes an important industrial sector contributing to the priorities of the current Juncker Commission: stimulating investments and creating growth and jobs, leading to a more sustainable and circular economy … and to a competitive Europe!

There is a growing mobilisation of private investment in Europe, and the industry participates massively in research and innovation. Via the Biobased Industries Initiative (BBI), a public-private partnership between the industry organised within the Biobased Industries Consortium (BIC) and the European Commission, we not only support deployment but also keep investments in innovative production processes within Europe.

Due to BBI-projects, we are now working with partners from sectors that have never collaborated before to set up new and innovative value chains. Examples include the food industry collaborating with the chemical industry, the forestry and pulp & paper sector collaborating with chemical industry etc. New industrial sectors are joining and more and more sectors discover opportunities to create value from waste and side streams, originating from the food processing sector, the aquatic-based sector, and even bio-waste and CO_2.

BIC already has a more diverse, growing membership. Not only are new sectors joining, like the food industry and aquatic/marine sectors, but we also observe a growing interest from brand owners. Collaboration with brand owners is essential as they develop the vision for the future, help to increase acceptance of biobased products in market applications, develop new applications for biobased products, or even create new markets.

BIC has also strengthened its collaboration with the European regions. Regions are playing an important role in the further development of the biobased economy in Europe as they can support the establishment of (regional) innovative value chains. They are also best situated to identify the available feedstocks in their regions which can trigger the biobased economy. And finally, regions can play a crucial role in attracting investments by using the European Structural and Investment Funds (ESIF) or the European Agricultural Fund for Rural Development (EAFRD), creating jobs and growth, and additional opportunities for the primary sector. All of this makes us hopeful for the future!

Dirk Carrez
Executive director Biobased Industries Consortium

ble and fruit sector. The drawback is that PHA films are still too expensive as yet – compared with the PE standard – and are currently used for niche products such as biological fresh products. But it is a fact that certain PHA suppliers have lowered the kilogram price considerably: from around 5 euros per kilo to 2.30 euros. With the current oil price it does remain a difficult business case. Retailers and producers want to work more sustainably, but they take heed of every tenth of a eurocent when they buy packaging materials.'

GREENERY

That is why there is still no huge demand for degradable biobased packaging materials in the food sector. As stated, it is mainly (fresh) products with a short(er) lifespan for which these materials are suitable. A company like The Greenery, a major provider of fruits and vegetables in the Netherlands, uses them for its biological and sustainable products. 'We especially use PLA foil and cardboard dishes from Paperwise. There is also an increasing trend to switch from plastic dishes to cardboard. We have also recently made cardboard boxes and dishes from the residual waste from tomato plants.'

According to The Greenery, consumers of biological products are willing to pay extra for biodegradable packaging. 'The average consumer does not know enough about the material, which sees PLA land more often in the rubbish bag instead of in the recycling container.'

NESTLÉ UNCONVINCED

The last example illustrates how the end of life of biodegradable plastics, compared with non-degradable biobased or fossil-based plastics, is also an issue. Questions about the sustainability level have indeed been raised from the industry.

Thus Sokhna Gueye, Packaging Environmental Sustainability Specialist at Nestlé, argues that the multinational focuses on reuse in order to combat plastic litter. To that aim, Nestlé concentrates on paper, cardboard and plastics. 'We are also looking at renewable materials. Biodegradable plastics do create problems, especially at their end of life. Not every country has the infrastructure to compost these materials. As a globally operating producer, we cannot tell our consumers that these materials will be composted. So we do lose a product benefit.'

According to Gueye, it is questionable whether compostability is all that sustainable. After all, the material decomposes and the energy released goes into the air. Compared with recycling or recovering the energetic value, that is not really a circular business model. ●

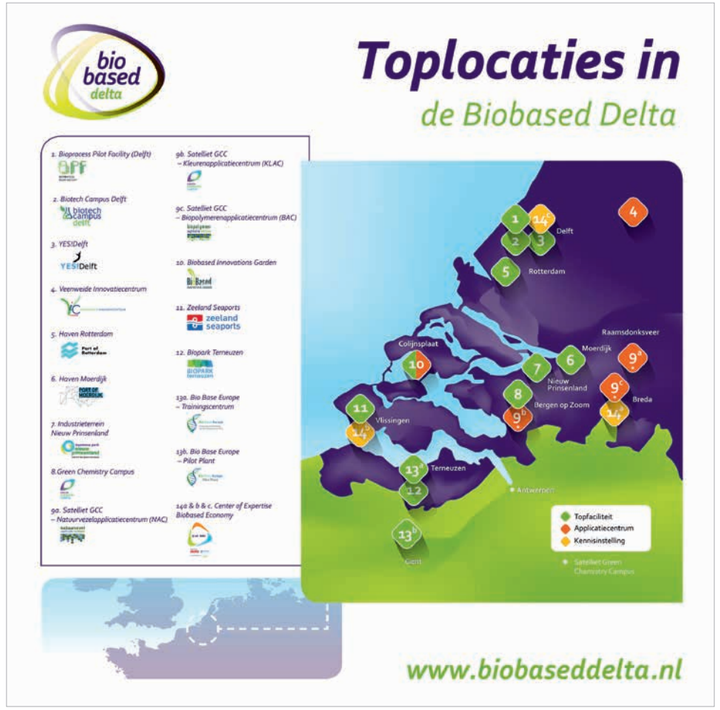
VOLUME WILL TRIPLE

The European market for biodegradable plastics was around 100,000 tonnes in 2015, according to the Nova Institute. As far as volume is concerned, it dominates the compostable (shopping) bag segment. It has acquired this position mainly through laws and legislation ('bagislation') in various EU countries. Packaging accounts for one fifth of the volume. For 2020, the Nova Institute predicts that the total volume will triple to 300,000 tonnes, with the market share of packaging increasing to 31 percent. The research institute does assume that the European Union and the individual member states will develop policies to facilitate this growth, such as unambiguous composting standards and further laws and legislation which promote the use of biodegradable plastics.

‘OUR ECOSYSTEM IS GROWING’

‘The larger programme lines of Biobased Delta are gaining increasingly more traction. We can see that in particular at Biorizon, the longest running research programme in which Biobased Delta participates. The other two programmes, Sugar Delta and Redefinery, are still in their infancy but we are making progress there too.’

Text Lucien Joppen **Images** Biobased Delta



Overview of the main locations in Biobased Delta: the toplocations (in green), application centres (in orange) and knowledge institutes (yellow).

Rop Zoetemeyer, managing director of Biobased Delta since April 2016, says that the major programme lines in the Delta - the biobased/circular cluster in the southwest of the Netherlands - are developing on schedule. Biobased Delta pays attention to SME’s and specific valorisation areas, but is also staking a great deal on green chemistry/biorefinery, with first generation sugars, woody biomass and (household) waste as potential feedstocks.

Delta’s longest-running programme is the development of functionalised bio-aromatics within the Biorizon consortium (which includes VITO, TNO, ECN and companies from the chemical sector).

‘Biorizon, located at the Green Chemistry Campus in the city of Bergen op Zoom, has to break in to the global Top 3 in bio-aromatics within three years. The chance of success is great, all the more so because the consortium is continually expanding with new partners. The announcement by ECN (Energy Research Centre of the Netherlands) that it intended to participate was a big step. That immediately also broadens the technology platform. After all, the thermocatalytic expertise – pyrolysis, for example – is a wonderful complement to the chemical catalysis and biorefinery which other partners contribute.’

‘UNBELIEVABLE PROGRESS’

The progress in the Biorizon consortium is also recognised by the partners. At the annual Biorizon event, held at the Green Chemistry Campus, Niklas Meine, Strategic Technology Manager of Covestro (note from the editor: former Bayer MaterialSciences), spoke of ‘unbelievable progress in the past few years.’

Despite the unfavourable oil price of the past few years, the consortium sank its teeth into the development of bio-based routes to concrete applications, according to Meine. ‘The chemical sector is heavily dependent on the petrochemical industry. If the importance of the petrochemical industry declines, bio-based alternatives automatically enter the picture.’

Jan Harm Urbanus (TNO, renowned Dutch research institute) added: ‘The budget for the research keeps growing, up to a total of EUR 30 million. We have now produced the first samples of functional bio-aromatics. Not surprisingly, interest from the manufacturing industry/chemical sector is growing. The necessary patent applications have also been submitted. The next step is scaling up. The first skids are now being built and will start producing on a multiple-kilogram scale.’

INTERNATIONAL SCOPE

Biobased Delta is also expressly seeking international connections. At the start of this year, the Delta signed an agreement with the German Spitzencluster BioEconomy (Saxony-Anhalt), under which the two clusters will strengthen their cooperation. Both initiatives already cooperate in 3BI (with BioVale and IAR).

The two clusters will focus on the themes of biorefinery of lignocellulose, raising the economic value of sugars, increasing the value of lignin to chemistry/materials and design of biocomposites with renewable raw materials.

Willem Sederel (Biobased Delta, Biorenewables Business Platform) signed the agreement for Biobased Delta. ‘The two parties have much to offer to each other. A large chemical cluster has been established in Saxony-Anhalt (editor’s note: Leuna) with larger parties like Arkema and BASF, but also with interesting SME companies. The knowledge within the cluster of the organosolv pretreatment of biomass can be highly useful, because it can lead to milder process steps and thus to better quality lignin alongside cellulose (sugars). Conversely, the necessary expertise has been built up in the Delta on themes such as biocatalysis, bioplastics and biorefinery. Both clusters also have interesting companies which might want to develop technology together, or simply do business.’

Sederel states that the Spitzencluster looks mainly to the west for (technological) cooperation. The German government also supports this development. ‘This region relied traditionally heavily on brown coal. Currently it is oil and gas, but in the long term biomass will acquire a greater role. We are pleased to be able to contribute to this transition.’

SUGAR CHEMISTRY

Sugar Delta was established in 2016 and is still at a very early stage. ‘Sugar is all about green chemistry, based on first generation sugar, glucose and – not least – fructose’, according to Zoetemeyer. ‘The area of Southwest Netherlands and Flanders harvests and processes around 6 million tonnes of sugar beet – the equivalent of 2 million tonnes of sugars. This volume will only increase with the revocation of the sugar quota and further yield improvements. Non-food applications will then also come into play more emphatically.’

Biobased Delta wants to develop Sugar Delta along two pathways. ‘First of all we want to attract existing business: companies which produce products like citric acid or lactic acid and do not compete directly with fossil products. We are in discussion with several foreign companies to get them heading towards the Delta.

For the medium term we want to attract businesses which develop products for which there is no fossil alternative. Fructose chemistry in particular is an interesting path to follow, for example in the direction of furans and further to materials. Drop-ins enter the picture in the longer term. Currently they cannot compete with the present oil and sugar prices.’

LARGE-SCALE BIOREFINERY GETTING CLOSER

Redefinery saw the light of day at the end of 2014 and is increasingly taking shape, according to Zoetemeyer. ‘Redefinery is intended to ultimately result in biorefinery on an industrial scale, based on woody biomass. This is then converted into cellulose, C5 sugars and lignin. Lignin can also be used as an energy carrier in the production process and – at a later stage – be directed towards chemistry (including bunker oil, biokerosene or bio-aromatics).

According to the original calculation made by Biobased Delta, this factory would have to run at a capacity of 4 million tonnes per year and a feedstock price (pellets) of between EUR 100 and 160 per tonne (editor’s note: 100 percent dry matter). ‘We are now two years further down the road and it turns out that production based on second generation sugars is also possible at lower wood volumes - say between 500,000 and 700,000 tonnes per year - as demonstrated by the factory of Beta Renewables in Crescentino, Italy. And that is the great thing about the bio-based/circular economy: every day we become wiser thanks to the experiences of other companies and/or projects. With Redefinery, the CAPEX standard for industrial biorefinery is now considerably lower, which increases the chance of a lead investor. We are currently in talks with a French company which wants to build and operate this biorefinery. You need a party like this to create actual activity. Otherwise you get no further than planning.’ ●

This article has been written in cooperation with Biobased Delta

TOPELL RESTART WITH BLACKWOOD

‘NOW WE ARE FINANCED BY TURNOVER’

The promising torrefaction technology of Topell Energy, which was put ‘on hold’ due to a subsidy freeze, has now been put on the market successfully by ‘restarter’ Blackwood Technology. Money is being earned in the down-sized form, through the development and licensing of a proven process for the production of high calorific wood pellets from biomass.

Text Vincent Hentzepeter **Images** Blackwood

Torrefaction is a thermal process which converts woody biomass and agricultural residual flows into high-grade, solid biofuels. When the biomass is heated to temperatures between 250 and 300 degrees, the moisture evaporates and low-calorific components are gasified. The hemi-cellulose decomposes and a compact product is created with a high calorific value.

Topell had perfected this process so that the wood pellets produced had optimum combustion characteristics for co-firing in coal-fired power stations. These so-called ‘black pellets’ were produced in large quantities in a modern factory in the town of Duiven (in the east of the Netherlands) and delivered to the Amer power plant of RWE. As a backup, a purchasing contract was signed with the energy company Vattenfall’s Willem-Alexander power plant in the town of Buggenum. A subsidy scheme of the Dutch Ministry of Economic Affairs enabled the co-firing with biomass. This dependence on the government policy also turned out to be the Achilles heel of the company. When ‘Buggenum’ closed on 1 April 2013 and then the co-firing subsidy of the Amer power plant also

finished, the curtain fell for the Topell factory. The entire market behind the successful technology collapsed in a single action, to the bewilderment of the company’s management. Liquidation of Topell’s factory was unavoidable.

MORE FLEXIBLE ORGANISATION

Maarten Herrebrugh (see picture above), managing director at Blackwood and former COO of Topell, remembers that black day all too well. But the founders of Topell did not give up. ‘The old Topell consisted of a technology group of more than ten people and a factory with 25 operators. Our torrefaction technology is the only one in the world which has been proven on an industrial scale and whose application as large-scale replacement of coal has also actually been demonstrated. Very likely to succeed, therefore. Unfortunately, we couldn’t keep the old structure going. We did try to keep running as a demonstration plant for ten months, but couldn’t meet the costs. That is when we set up Blackwood, a straight technology company which develops and licenses technology in the torrefaction field.’

The business model of Blackwood is different to that of Topell. The new organisation is more flexible and is also spreading its wings internationally through partnerships. The knowledge component has remained, but the high-risk torrefaction production is a thing of the past. ‘What we have is a core team which is supported by freelancers who used to work for Topell in the past. This flexible model has helped us build a financially healthy foundation with projects well beyond our country’s borders. We are now financed by turnover and not by capital injections from investment companies. That is a ‘subtle’ difference with the past.’

DIFFERENT MARKET FOCUS

For the Dutch market, the focus was shifted to small-scale applications of torrefaction for local energy generation in businesses and households. ‘To supply coal-fired power stations with black pellets you come up against a shortage of biomass here and the costs go sky-high. That makes it extremely difficult for a large factory to make a profit. One option is to upgrade local biomass in order to serve the local market. With the support of the Province of Gelderland, we did initial testing with our pellets in local, wood-fired heaters. These heaters use a great deal of wet woodchips. The quality fluctuates greatly with the seasons, making the efficiency drop. The poor combustion increases the emissions greatly and you are left with incompletely incinerated ash residue. If you co-fire torrefied chips, they operate more stably, cleaner and with higher efficiency.’

SWIMMING POOL HEATING

The results of this market exploration were so positive that a course of action was set out together with partner Boonstoppel Engineering to develop this market further. The applications range from wood-fired heaters in households to biomass-fired combined heat and power plants. The capacity concerned ranges from a few dozen kilowatts to several megawatts. Herrebrugh gives the example of the efficiency improvement with wood chip incineration in systems for the heating of a swimming pool. These systems are around 2 megawatts. Municipalities currently often use local wood waste to feed them. ‘Those kinds of wood chips contain 40 to 55 percent water which first has to evaporate in the boiler. It would be much better for the stability of the boiler if the moisture was first removed via a torrefaction process. That delivers a high-grade fuel with fixed efficiency for the end user side. Logistically it also offers huge benefits. You aren’t transporting water any more.’

SOUTH AFRICA

Blackwood still targets the ‘coal replacement market’, but outside of the Netherlands. ‘We have entered into discussions for this with parties which are interested in building factories like in Duiven in countries with large amounts of biomass. We are still in the negotiation stage. What I can reveal, is our South African cooperation with electricity provider Eskom which operates fourteen coal-fired power stations there. Large plantation forests are used in South Africa. That provides enough biomass to make the torrefaction process cost-effective.’

Of course there are other rivals, but Blackwood can rely on a technological head start. ‘That is the heart of the system. The biggest difference between our technology and that of the competition is that they still rely heavily on existing technology for drying the biomass, while torrefaction goes further than drying alone. Our technology is tailored much more specifically for the torrefaction process itself. That allows us to perform the process much faster and with greater control. Actually it is really good that there is competition. If we as a technological company were the only ones in torrefaction, there might not be a market for us either.’ ●

AMIBM SPINS 'YARNS' FROM A NATURAL SOURCE

At the start of December, AMIBM opened the doors of its renovated premises to the public. One of AMIBM's showpieces is the Wet Spinning Line, used to manufacture biobased fibres for biomedical applications. For Professor Stefan Jockenhövel, Scientific Director at AMIBM, it is a dream come true.

Text Kelly van Bragt **Images** AMIBM

WET SPINNING LINE

'You will not find another Wet Spinning Line anywhere, the way it has been set up here,' says Jockenhövel. A narrow, long laboratory houses a 17-metre long succession of stainless steel water baths, driver rollers, pumps and discharge pipes. That is where the polymer fibres are made, rinsed and stretched. Unlike Melt Spinning, a method in which the polymer is heated above melting point, Wet Spinning or 'solution spinning' works with solvents and at room temperature. At the end of the system, the fibre is wound like a yarn on to a large spool, ready for processing into an end product. Although the system looks large and cumbersome, each component can be adjusted very precisely. This means that even the thinnest and most fragile polymer fibres can be spun. The system can produce kilometres of polymer fibre a day, which is usually sufficient for the manufacture of biomedical products on an industrial scale.

AMIBM (Aachen-Maastricht Institute for Biobased Materials), the cross-border cooperation between Maastricht University, RWTH Aachen University and Frauenhofer IME, focuses on the transition from fossil materials to the manufacture of polymers and products from natural raw materials.

Research at AMIBM is organised along five lines of research, which run almost parallel with the value chain from biobased raw material to application. Naturally, sustainability plays a major role in the entire chain. Although the institute is still very young, it is experiencing strong growth. 'We started two years ago and now employ 58 people. I believe the secret is the enthusiasm and the way we are able to integrate and communicate the research and the developments. Thanks to very close cooperation along the entire value chain, truly valuable new or optimised polymers and applications are being created.'

INSPIRED BY NATURE

Jockenhövel is extremely pleased with the Wet Spinning Line (see box) which has obtained a place in the new facility at the Brightlands Chemelot Campus. The polymers to be spun with the Wet Spinning Line are intended in particular for biomedical applications. This entails close cooperation with the biomedical industry and doctors, from organisations such as the University Hospital in Aachen, the Maastricht University Medical Centre and the Heart Centre in Bad Oeynhausen, the world's largest heart centre. Examples include heart valves, stents, materials for wound healing and regenerative medicine.

Although Jockenhövel has a medical background, he has always been interested in materials research. 'Many innovations in biomaterials research stem from important medical innovations. Classic examples are soluble sutures and the discovery of titanium for artificial knees and hip prostheses.'

Jockenhövel's inspiration for innovative biomaterials comes from nature. 'Did you know that our bodies, just like textiles, are composed of polymer fibres? Collagen which makes our skin firm, or elastin which makes the skin supple: just a few examples of natural polymer fibres whose biomechanical properties we can copy. I try to imitate that.'

SPINNING AT ROOM TEMPERATURE

The system at the Chemelot Campus complements the equipment which was already present in the facilities in Maastricht and Aachen. Two different polymers can be processed here into a single fibre, a bi-component fibre. Depending on the spinning head used, the structure of the bi-component fibre can be specified very precisely so it has the required properties.

However, bi-component fibres can also be manufactured with the Melt Spinning technique, for example. What makes this system unique, as opposed to a Melt Spinning system, is that the spinning process takes place entirely at room temperature. This makes it possible to make polymer fibres from temperature-sensitive (bio) polymers to which, for example, medicines, peptides or growth factors can be added. 'Proteins will denature above a certain temperature and, just like a boiled egg, lose their biological function. Spinning at room temperature is essential for the (bio) functional applications we want to make with these polymer fibres,' explains Jockenhövel.

BIOMEDICAL PRODUCTS IN THE SHORT TERM

For AMIBM, research into polymer fibres is its daily business. But the Wet Spinning Line is more than just a tool for making polymer fibres. It is also a (research) project in itself. 'In order to get the best out of it, we will need at least a year to get to know and improve the machine and the technology. It is not something you can learn from a textbook. Fortunately we are in excellent contact with the supplier of the system. That allows us to make any adjustments which might be required.'

Jockenhövel expects that the first biomedical products made from AMIBM's polymer fibres will be ready for clinical testing within two years.

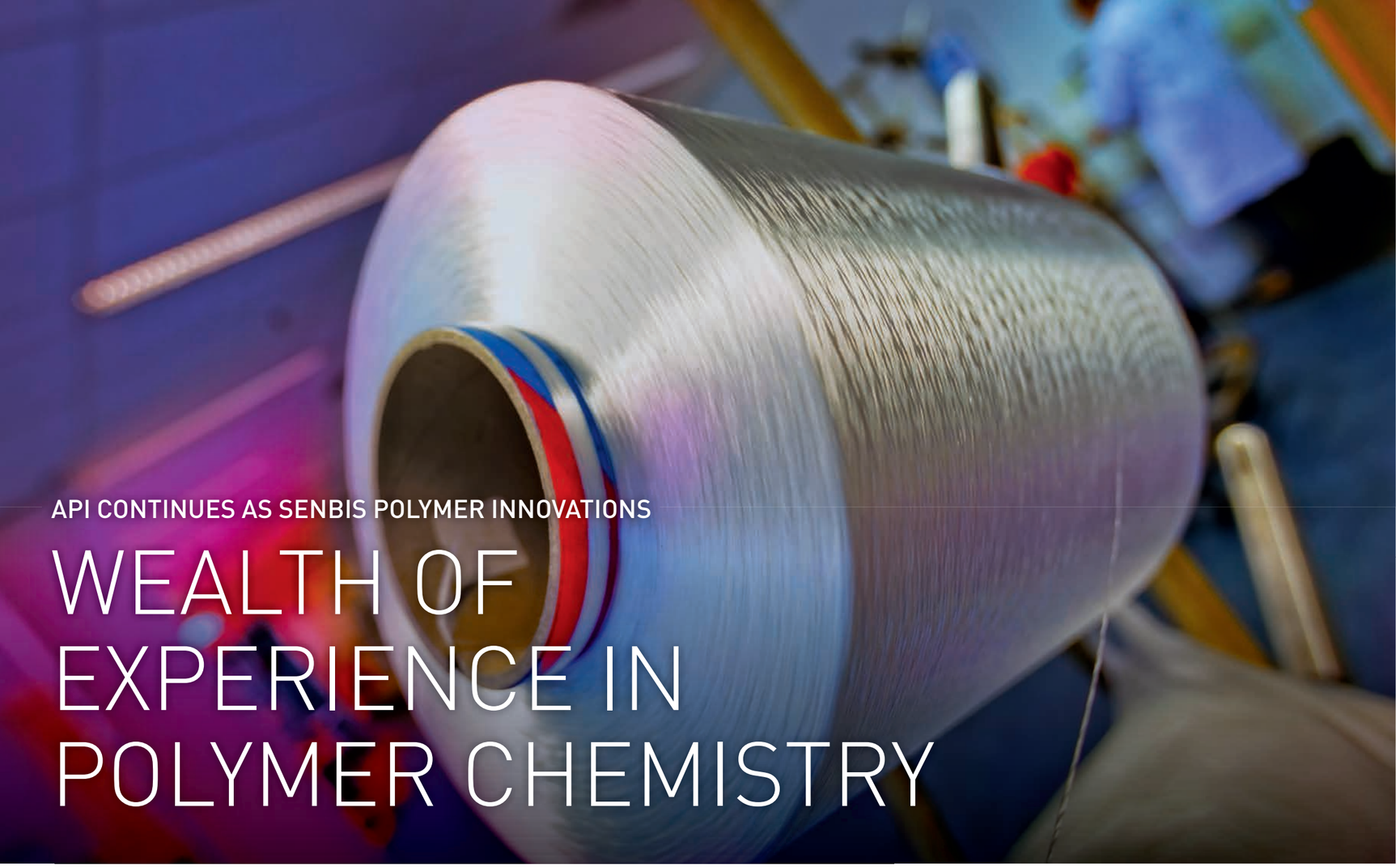
What still needs to be done?

'Currently we have no ceiling above the system. The reason is simple. We want to build a clean room around the Wet Spinning Line in the future. A clean room is a room in which polymer fibres can be manufactured under strictly regulated conditions. Only then will they be suitable for use in biomedical applications.'

BIOBASED FIBRE FOR THE TEXTILE INDUSTRY

'Third parties are very welcome to use the Wet Spinning Line for polymer research or production,' according to Jockenhövel. 'Indeed, we seek cooperation with third parties. In principle the Wet Spinning Line can also be used for non-biomedical applications, as long as this does not interfere with the strict requirements for the biomedical applications. Thus strong biobased polymer fibres with anti-allergenic properties can for instance be put to good use in the carpet or textile industry. But you always have to keep in mind whether wet spinning is the most efficient way for producing the required polymer fibres. Depending on the properties of the fibres, existing technology applicable on an industrial scale may prove more feasible.' ●

Stefan Jockenhövel: inspiration from nature.



API CONTINUES AS SENBIS POLYMER INNOVATIONS

WEALTH OF EXPERIENCE IN POLYMER CHEMISTRY

As of 1 January 2017, Applied Polymer Innovations (API) in Emmen is continuing its activities under the name Senbis Polymer Innovations. Co-owner Gerard Nijhoving sees a multitude of opportunities for the company. 'Our team of eight specialists share a wealth of experience in polymer chemistry. We also have an extensive polymer laboratory and pilot plant facilities.'

Text Adriaan van Hooijdonk **Image** Senbis Polymer Innovations

The API Institute emerged in 2009 from the former research and development department of Diolen Industrial Fibers in Emmen. The producer of industrial yarns, among other things, had various owners, including Enka, AkzoNobel and investment company CVC Capital Partners, before it went into liquidation in 2008.

'However, the R&D department of Diolen Industrial Fibers saw opportunities for continuing independently,' says Gerard Nijhoving, who runs the new company together with technical director Bas Krins. 'This specialist background meant there was a lot of demand for research and laboratory facilities in the field of industrial yarns, but also in polymerisation. We have received more and more enquiries about biopolymers over the past few years.'

The API Institute was able to attract various investors and likewise created the successful spin-off Innofil3D. The production of monofilaments for 3D printers started two years ago in a separate building on the premises in Emmen. Innofil3D has since grown into a leading producer in a market segment with huge potential.

FIT FOR USE

Nijhoving, as a freelance business developer, investigated how the API Institute could improve its business operations. He also examined the opportunities for setting up other successful spin-offs, and concluded that more money was required to invest in this. 'The shareholders, however, were already fully involved with Innofil3D. So it was obvious that we should split the two companies and continue independently as Senbis Polymer Innovations.'

The above company will continue to focus on polymer research and related services. Nijhoving: 'Clients engage our specialists to solve production problems or test samples. Lately we have been receiving an increasing number of enquiries from polymer producers to make their products suitable for 3D printing. These companies have often already developed grades for all kinds of applications such as injection moulding and blow film extrusion, but want to expand their range for this new market. This making 'fit for use' work suits us well, since we also do it regularly for yarns.'

TOP REGION

Senbis Polymer Innovations has an extensive polymer laboratory. It contains analysis equipment for rheological and mechanical measurements, among other things. A wide range of processing equipment for polymers is also available, such as three spinning machines for the development of new yarn products. There are also various extruders for making compounds and monofilaments for R&D purposes in quantities of a few kilograms per hour. Senbis Polymer Innovations also has an autoclave for producing new polymers. 'Moreover, we can call on an extensive network so that large-scale tests can be performed elsewhere if we cannot provide for that here ourselves. Our location here at the Emmtec industrial estate also puts us with big players, such as DSM and Teijin Aramid', emphasises Nijhoving.

The industrial profile with Emmen as the largest cluster of synthetic fibre companies gives the bio-based economy in the region good growth potential. There is good reason why the government designated Southeast Drenthe as the top region in the Netherlands for vegetable raw material-based green chemistry. In Nijhoving's view, the team of eight employees share a wealth of experience in polymer chemistry. 'They are not only scientists, since we also have operators who have gained extensive experience in spinning yarns at Diolen Industrial Fibers and AkzoNobel.'

COMPOSTABLE HORTICULTURAL TWINE

The new co-owner realises that a pilot plant and laboratory facilities are often too expensive for SME companies. 'In offering our facilities, we reduce the R&D costs of our customers. Should an SME company need equipment which we do not have, we can always look around in our network. And if we can also serve other customers with specific facilities, I can imagine that we invest in them together.' For that matter, Senbis works with a number of parties, such as universities, in various research projects.

The company is now very busy working out a number of promising projects in more detail. This includes the development of a compostable horticultural twine and an alternative for dolly rope which hangs beneath fishing nets.

Growers of crops such as tomatoes, capsicums and cucumbers currently mainly use twine which is based on fossil raw materials to guide their products to grow upwards in the greenhouses. 'At the end of the season they need to get rid of the plants. But that is a difficult job because the twine has become entangled in them,' explains Nijhoving. 'This means that growers have a large waste stream for which they incur large costs to dispose of it. Moreover, it is not a sustainable solution.'

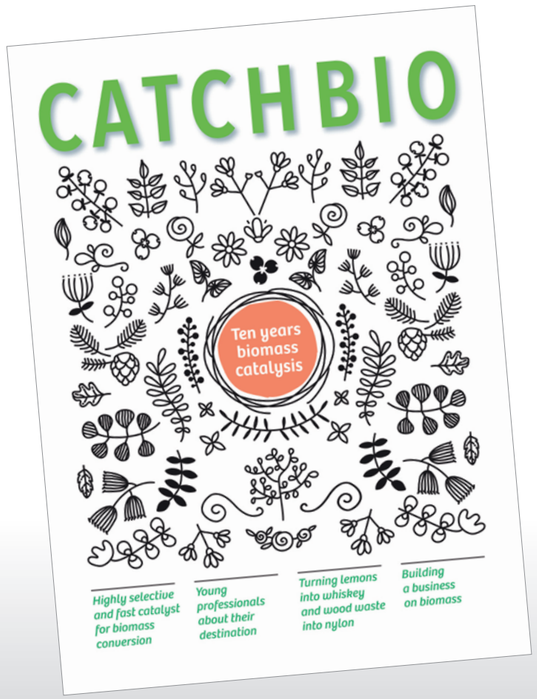
STARTING PRODUCTION

Senbis Polymer Innovations developed a compostable twine based on polymer lactic acid, which has since undergone various field tests. 'It is a technically challenging project because the mechanical properties have to ensure that the plants in the greenhouses do not fall down,' says Nijhoving, who has high expectations of the new product. 'Our twine is now hanging in greenhouses in different countries to test how it works.' If these tests go off successfully, we will start production at the end of the year.'

The company is also participating in a pilot project of VisPluisVrij to find an alternative to the fossil raw material-based dolly ropes. Dolly ropes are hung in clumps under the fishing nets of fishing boats, mainly beam trawlers. These nets drag over the sea floor. To prevent the nets from wearing out too fast, the fishermen use dolly ropes. During the fishing, the plastic wires come loose and end up in the sea. Dolly ropes are made from polypropylene and are therefore not biodegradable. As a result, birds become caught in them, plastic particles end up in the food chain and the beaches are polluted. 'We are working with VisPluisVrij to develop a biodegradable alternative, to reduce the plastic soup in the oceans.' ●

For further information: www.senbis.com

CATCHBIO: FOCUS ON CHEMISTRY



CatchBio was rounded off at the end of 2016. Biomass catalysis was the central focus of the ten-year research programme. The focus initially aimed more at biofuels, and gradually shifted towards chemicals.

Text Lucien Joppen **Image** CatchBio

CatchBio hit the headlines several times over the past years with its research projects. A prime example is the development of a new catalyst based on rhodium. This catalyst can convert pentenamides into caprolactam, opening up the road to nylon production. Of course, a great deal of work still needs to be done. For the time being the catalyst works well with 4-pentenamide, while the conversion of 3-pentenamide is proving more difficult. Scaling up will also require the necessary research and time. Currently the rhodium catalyst can be used approximately 100 times. This has to get to the 100,000 mark for industrial production. An alternative for the expensive rhodium is palladium, which has already been tested.

You can download the CatchBio report from http://www.catchbio.com/downloads/

Bert Weckhuysen (professor at Utrecht University) was there at the start of the programme which was launched in 2006. In 2005 it was announced that considerable funding would be released for public-private partnership programmes in chemistry. The idea of taking the catalytic conversion of biomass as research theme quickly emerged in the Dutch 'catalysis community'.
'Apparently our proposal hit the mark,' says Weckhuysen. 'An added advantage was that the academic field and the chemical industry already worked together closely. The infrastructure was already there. What's more, research in this area was already being done here and there, although it was fragmented. That is why a combination – in CatchBio – would give this research a push.'

DIFFERENT FOCUS

But it still involved a lot of time and effort before the CatchBio consortium was formed. The catalysis community had to be convinced and new 'less customary' partners for chemistry were recruited, such as Wageningen University and Avantium, a company which was still small at the time.

When CatchBio started, three domains were specified: energy, bulk chemicals and fine chemicals/pharmaceuticals. The focus initially included biofuels, which seemed to be a promising market at the time. At a later stage attention shifted to chemicals, bulk chemicals in particular.
'Biofuels were turning more and more into a negative item in the news,' according to Weckhuysen. 'You can talk about whether this is right or wrong, but it did have an impact on our research agenda. When we hauled in the results after 10 years, we can say that the research results in the CatchBio programme are found mainly in bulk chemicals and to a lesser degree in fine chemicals and materials.'
One example mentioned by Weckhuysen is the catalytic conversion of levulinic acid into the intermediary gamma valerolactone for the production of materials. A new catalyst based on ruthenium and palladium was developed in CatchBio. It ensures faster and more efficient conversion.

VARIABLE INPUT

One of the major hurdles facing the CatchBio researchers is the biomass itself. Its heterogeneous character provides the necessary challenges in the development of catalysts which can convert this variable input into the desired intermediary product. 'Catalysis research used to be done mainly in the petrochemical sector, a domain in which the feedstock had high heterogeneity when compared with biomass. Now we had to develop catalysts which could 'deal with' the complex character of biomass and which could be scaled up. In practice it often comes down to a combination of different types of catalysts. We now have a list which specifies different catalysis options (bio, (thermo) chemical, heterogeneous and homogeneous) for specific product routes. The guiding principle is: how can you make the catalytic process take place in the most sustainable way possible?'

> 'BIOFUELS WERE TURNING MORE AND MORE INTO A NEGATIVE ITEM IN THE NEWS. YOU CAN TALK ABOUT WHETHER THIS IS RIGHT OR WRONG, BUT IT DID HAVE AN IMPACT ON OUR RESEARCH AGENDA.'

NEW GENERATION

As stated, CatchBio has been officially shut down. Will there be a follow-up to the programme? The consortium is being closed, according to Weckhuysen. 'But there are very many separate research lines which are being continued.'
Thus a number of projects in the reliable analysis of the outcomes of biomass conversion will continue for a time. Research into the use of biomass-based building blocks for coatings will most likely be continued under the colours of the ARC CBBC (Advanced Research Center Chemical Building Blocks Consortium) in Utrecht.
'In addition, a new generation of engineers and chemists has been trained through CatchBio, and green chemistry can reap the benefits of this for years to come. So I am positive about the future and the importance of this sector for the Dutch economy and society.' ●

COLUMN

DOING BUSINESS IN THE BIO-BASED ECONOMY: YOU'VE GOT TO BE CRAZY!

Whether I was crazy? That's what people asked me when I enthusiastically told them I was giving up my permanent job to start my own technology-oriented start-up in the bio-based economy. Their question is understandable: after all, it is a difficult market. But I am convinced that I have to do this, that I can make a contribution and that there are huge opportunities.
Luuk van der Wielen (BE-Basic) has a great way to make the seriousness of climate change more tangible: 'If we become 2 degrees hotter (so 40 °C), we have a very serious fever and at 4 degrees hotter we end up in a coma.' We cannot let it get that far! Besides renewable energy, the use of renewable raw materials is crucial for the patient. So that is where I am going to do my bit, with my company Viride SuStra!
Viride SuStra is working on innovative biomass treatment to provide the chemical industry with raw materials. The aim is to make the chain more cost-effective and improve the logistics and handling of biomass. The start has been good and I am very confident!
For me, everything starts with people. I have talked a great deal with top people and a number of them even want to help with (and invest in!) my start-up. They can also give an honest opinion on whether your idea has any potential. This is very important because you naturally think it is very good. And then you have the importance of innovative ecosystems, such as BE-Basic (Delft University of Technology), Biobased Delta with the Green Chemistry Campus and Bioprocess Pilot Facility (BPF). Young talent, grey hair, unique facilities: if you know what you need, there is a lot to be found. And last but not least: which problem are you going to solve and how will you earn money? The bio-based transition is a marathon, definitely not a sprint! The world we work in is one of endurance, long-term vision, setbacks and perseverance, which brings us back to the question 'do you have to be crazy to do business in the bio-based economy?' My answer is 'no'. Definitely not, but it does help ... especially with the first jump. I wish everyone much perseverance and let's bring down the fever!

Joop Groen
Founder Viride Sustra

CITY OF THE FUTURE

SMARTER AND MORE SUSTAINABLE

The city is a big hit. Urbanisation is set to increase around the world in the coming decades. But if cities do not want to fall victim to their own success, they will have to deal with raw materials, energy, waste and mobility in smarter ways, according to a recent report by the ABN AMRO-bank.

Text Lucien Joppen **Image** Shutterstock

Urbanisation rose during the industrial revolution, when rural inhabitants moved in massive numbers to the cities in search of work. During the 20th century, the appeal of the cities gradually increased. While 12 to 15 percent of the world population lived in cities in 1900, by 1950 that percentage had grown to 30 percent and in 2000 it was already 50 percent. The United Nations expects that 5 billion people, around 60 percent of the world population, will live in urbanised areas in 2030.

An important driver of this migration is work, as mentioned above, better pay and a higher standard of living. Other factors include infrastructure, i.e. culture, sport, recreation and care, etcetera. In a city these things are all within reach, which is not the case in the country.

UNINHABITABLE

The popularity of the city should not lead to its downfall, however. Cities face the danger of eventually becoming uninhabitable due to population pressure, with symptoms like traffic jams, crime, air pollution and accumulating waste streams.

In itself, this phenomenon is not new. Early in the 14th century, King Edward I temporarily forbade the use of coal in London after complaints about air pollution. In the year 2017 these problems are still current, witness Beijing or Mexico City, with the difference being that modern cities are able to tackle these issues.

And that is where the Smart City comes into the picture. In rough terms this concept means that cities handle issues like mobility, energy, raw materials/residual flows and living/working in a smart way.

The 'smart' part is a matter of IT/Internet of Things (linking objects (cars, buildings, electricity, etc.) to IT systems) and human aspects, that is, organisation. Data, for example on energy consumption or traffic flows, supplies insights which can help reduce these phenomena. Apart from the technological aspect, the smart city also has a clear human side. You have to cooperate intensively. Governments, education, businesses and citizens will all have to supervise the city.

2, 50, 75, 70

The Italian architect Carlo Ratti sums up the impact of the city with a series of numbers. Cities occupy only 2 percent of the earth's surface, they house 50 percent of the world population, account for 75 percent of energy consumption and 70 percent of CO_2 emissions.

GROWTH MARKET

The Smart City is not a woolly concept: it is already an existing market. According to research agency ASDReports, a good 213 billion dollars is involved in this worldwide, a turn over which will reach more than 750 billion dollars in 2020. This turn over will be realised mainly in energy, construction and transport/mobility.

The ABN AMRO report reviews the opportunities and challenges in these subsectors.

In construction, the demand for sustainable buildings is one of the issues. Buildings have to be sustainable energy-wise, but their raw materials, such as biocomposites, are also expected to impact the environment less. The building methods will also change. By preparing better and coordinating building projects through so-called Cross Channel Control Centres, building companies can achieve considerable savings in their logistics processes and reduce the (traffic) nuisance to a minimum at the same time. ABN AMRO expects the impact to be substantial, considering that 30 percent of all freight traffic in the Netherlands is related to the building sector.

SELLING LIGHT

Cities are also energy guzzlers, as Ratti's number series shows. Lighting in buildings and public spaces is part of this. Public lighting is responsible for only a minor share. According to the Dutch government, it makes up 1.5 percent of the total energy consumption in the Netherlands. The government does encourage economising in this area.

That is grist to the mill of LEDsEnable. This company from Amsterdam, financed partly by ABN AMRO, supplies light as a service. The customer rents light via an operational lease structure and no longer has to worry about that issue, according to director Reinoud Lyppens. 'There is a fundamental difference between operational lease and financial lease and hire purchase, where the customer buys the light in combination with a loan. We finance the purchase, installation and maintenance of the LED lighting and guarantee the customer sufficient light during the entire term of the contract.'

OPTIMAL LIGHTING

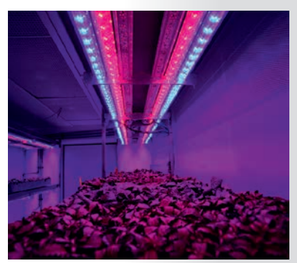
The potential of LEDsEnable for Smart Cities is obvious. And yet private parties seem to be more receptive than (local) governments, according to Lyppens. 'Businesses can switch faster and they react earlier to financial and sustainable incentives. I believe this is because governments are often tied to tendering processes and decision-making is more complicated.'

A good example is Sitech, a service provider at Brightlands Chemelot Campus, a large chemical site in the south of the Netherlands. LEDsEnable has replaced the conventional lighting of seventeen factories at this site by state-of-the-art LED lighting.

'We guarantee optimal lighting for the next fifteen years. We only install lighting where it is needed. This enables us to achieve a maximum reduction of light pollution and reduce CO_2 emissions by 80 to 90 percent.'

The fittings have remote control, individual and per group. Because those fittings also react automatically to daylight, no lights are ever on unnecessarily, according to Lyppens. 'The lease and power costs are lower than the total cost of ownership of the conventional lighting, which means businesses can start saving from day one. We can also prove this by reading out the LED lamps. It's there in black and white!' ●

ABN AMRO recently has published three reports on Smart Cities. Downloads can be found on: https://insights.abnamro.nl/sector/industrie



LED technology and the Smart City come together in urban farming. The cultivation of vegetables in former office buildings is 'driven' by special LED lamps with the specific light spectrum that plants use in their photosynthesis. Lyppens: 'We have facilitated a pilot project with LEDsEnable. I am a financial specialist, so I want an answer to the question: can the customer cultivate enough products to pay the 'light rent'? That question has not been properly answered as yet. This concept may be interesting for the owners of empty offices, because you will probably attract several parties which can do commercially interesting things with the property.'

'CORBION'S POSSIBLE ADVANTAGE IN PRODUCING FDCA'

Corbion possibly has an advantage compared with other processes when it comes to the FDCA production process. Jan Wery, technical programme manager at Corbion, argued this at the Be-Basic Symposium 2017, held on 14 and 15 February.

Text Lucien Joppen **Image** Corbion lab

In his presentation Wery examined Corbion's research of the past three years in more detail. The route developed by the company is based on C6 sugars (fructose) which are taken via HMF to FDCA. The FDCA is then purified so it can be used for bioplastics such as PEF.
According to Wery, the first step especially was challenging. 'HMF is unstable. All kinds of undesirable by-products can arise during the process, like humins. That in turn leads to a tarry end product. In the end we were able to 'tweak' the process to produce a crude HMF with a purity level which is sufficient for FDCA.'

Corbion's labfacilities in Gorinchem, the Netherlands.

HIGH SELECTIVITY

In Corbion's process, the HMF can remain relatively crude because of the next step, in which it is converted to FDCA via biocatalysis with specially developed microorganisms. The selectivity in this case is extremely high: 99+% is converted into FDCA.
Wery stated that the process was scaled up in the past years to pilot level. A toll manufacturer has since produced several tonnes of HMF via the process developed at Corbion. At the Bioprocess Facility in Delft, hundreds of kilograms of FDCA have since been produced based on this HMF. 'We performed application research at the same time, focusing on bottles and foils.'

ADVANTAGES OF A 'BIO ROUTE'

Apart from the end products, Corbion still has to do the necessary work to optimise the process further. The design of a process on a commercial scale is already receiving attention as well, in which aspects such as heat transfer (especially in the conversion of HMF to FDCA), oxygen transfer during the fermentation and fluid dynamics are also examined.
'We are working very well on this level together with Delft University of Technology, and the lights are still green,' according to Wery. 'We are getting closer to a commercially viable process. For example, we have lowered the overall sugar input and raised the titers. Further process optimisation measures, as explained, are required.'
As is known, other parties, such as Synvina and ADM/Dupont, are also working on FDCA and bioplastics based on FDCA. Wery stated that there is space for several providers, although probably the best technology will win. 'We specifically see advantages in the bio route from HMF to FDCA. As explained, it is a highly selective process under relatively mild conditions, which gives us high yields and fewer unwanted by-products. And furthermore, it is enough to use crude HMF, which keeps the process costs down.'

FOCUS ON SMEs

In the Biobased Delta, authorities from the provinces of Zeeland, North Brabant and South Holland work together with small and medium-sized enterprises (SME), multinationals and knowledge institutions on expediting a biobased economy. The programmes and activities are definitely not aimed solely at large enterprises. 'We also have a great deal to offer to small and medium-sized enterprises,' asserts Rop Zoetemeyer, managing director of Biobased Delta.

Text Adriaan van Hooijdonk **Images** Fruvo, Lubo International, Shutterstock

He has been at the helm of Biobased Delta since April 2016, succeeding Willem Sederel, who now covers international affairs on the board. Zoetemeyer was Chief Technology Officer at Corbion for many years and also works as advisor for Cosun. The people on the board and the supervisory board of Biobased Delta are an enthusiastic and motivated group of experienced persons, in his opinion. Their good contacts with authorities, the business community, knowledge institutes and other relevant parties open doors right up to the highest level. 'A good example is the construction of a large-scale biorefinery for wood chips in the port of Rotterdam. We have now found a party for it which is seriously interested in investing.'

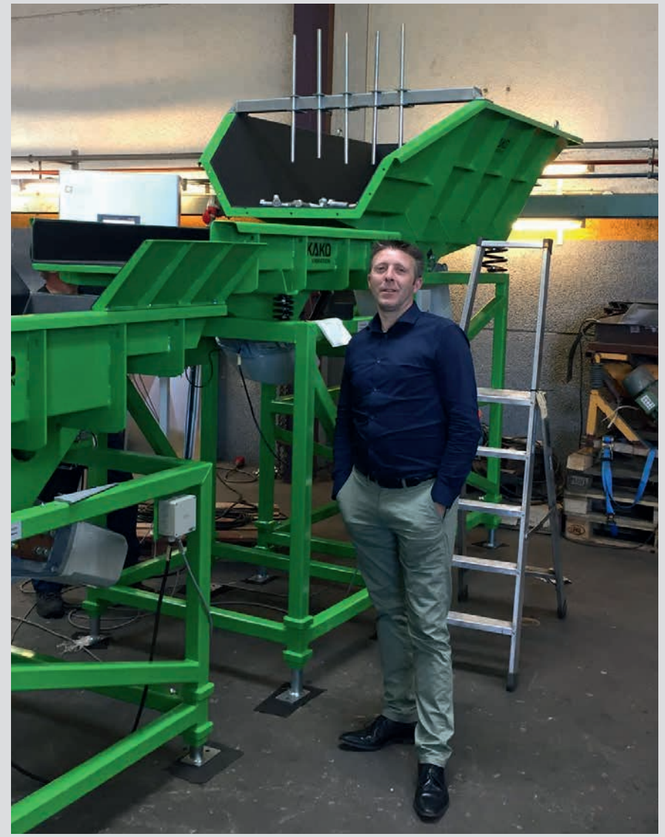
AVANTIUM

With the larger programmes of Sugar Delta, Redefinery and Biorizon (directed at biobased aromatic compounds), Biobased Delta certainly does not concentrate solely on large enterprises. 'Smaller businesses can also take advantage of the developments in these programmes,' Zoetemeyer emphasises. 'Take companies like Avantium and Progression Industry, which are actively involved in Biorizon.'

According to Zoetemeyer, the regional development companies REWIN West-Brabant, InnovationQuarter and Impuls Zeeland play an important part in implementing the SME agenda of the Biobased Delta. Thus they chair the valorisation teams which provide support to SMEs in extracting value from their innovations. These teams have a good overview of the facilities, such as pilot plants, which can help SMEs to get their innovations closer to the market. Together with the regional development companies, Biobased Delta also organises annual business development days focusing on SME.

NATURAL FIBRES

Zoetemeyer and his colleagues of Biobased Delta concentrate particularly on creating synergy between the different provinces. 'If I identify an interesting development in Zeeland which looks relevant for Brabant or South Holland, I arrange for the right contacts to be made.' The managing director and his team also ensure that large and small companies connect. 'Recently I brought Cargill into contact with Millvision, for possible cooperation on the development of biobased products based on natural fibres.' >>



LUBO INTERNATIONAL PLEASED WITH FINANCIAL SUPPORT

'All my products come from Mother Nature,' says Peter de Bruine, director of Lubo International from Kortgene in the province of Zeeland. He developed a smart, dry biobased lubricant based on natural raw materials and minerals, for use with stainless steel screw threads. The lubricant prevents the stainless steel from 'seizing together'. Thanks to the lubricant, cold welding, which is two similar materials adhering to each other due to high pressure, is a thing of the past.

De Bruine received funding in 2014 from the Zeeland InnoGo! programme so he could work his idea out in more detail. In 2015, the Zeeuws Participatie Fonds (Zeeland Participation Fund) acquired a 20% stake in Lubo International. De Bruine received generous funding from InnoGo! again to get the processing line into order. He recently entered into an agreement with WASI, one of the largest wholesalers of stainless steel fasteners in the world. 'They have presented our product to the world at an international show in March,' says De Bruine. 'That is why we are working very hard now to satisfy the expected customer demand. Part of the reason I was able to take these steps is the financial support from the Zeeland innovation programmes.'

The regional development companies also play a significant part in attracting the necessary funding for SMEs. After all, unlike Biobased Delta, the development companies have funds at their disposal for supporting the smaller enterprises so they can take the essential follow-up steps in their business operations.

PYROLYSIS CLUSTER IN MOERDIJK

One of the most tangible examples is Zeeland province's voucher scheme, reopened last year and implemented by Impuls Zeeland. 'SMEs can apply for a maximum of ten thousand euros,' explains Peter Bijkerk, Biobased economy project manager at Impuls Zeeland. 'Eight companies have made use of this, but the current scheme allows for a maximum of fifteen companies.'

'We do keep track of which subsidies are applied for with the regional development companies,' says Zoetemeyer. 'We also try to provide direction by focusing on themes. At the end of last year for instance, with the support of Biobased Delta, REWIN attracted the necessary European funding for the pyrolysis cluster in Moerdijk.'

Pyrolysis can be used to give disposable pallets and used plastic foil a second life, but also things like walnut shells, sewage sludge and other non-recyclable streams. Thermal recycling of these kinds of waste prevents them from disappearing into the incinerator, but valuable chemical building blocks can also be extracted from them.

PILOT PLANTS

Partly thanks to Biobased Delta and the regional development companies, SMEs are gaining access increasingly often to locations where they can test their innovative ideas and produce on a semi-industrial scale, if necessary with the assistance of research institutes. Zoetemeyer presents a list of examples. 'SMEs can use the facilities at PlantOne in Rotterdam, the Bioprocess Pilot Facility in Delft and the Bio Base Europe Pilot Plant in Ghent. These are mainly demonstration facilities on a larger scale. For smaller projects, SMEs can find help at application centres, such as the natural fibre and biopolymer application centres.'

SEAWEED FARMS

According to Bijkerk, the SMEs which target the biobased economy in Zeeland are especially interested in practical applications, for example how to add biobased fibres to plastic. One place they can turn to is the "biobased garden" of the Rusthoeve in Colijnsplaat. There several parties are growing numerous crops which will be put to use in the biobased economy in due course. Regular inspiration sessions are organised especially for SMEs. In addition to sugar beet, Bijkerk sees many opportunities for seaweeds as raw material for biobased applications. Indeed, he sees increasingly more 'seaweed farms' being established, which aim in particular at the high-grade and valuable components.

STEP TO THE MARKET

There is no shortage of SMEs in South Holland with good ideas concerning the biobased economy either, according to business developer Henk Vooijs of InnovationQuarter. 'But taking that step to the market sometimes needs specific support. For example through incentive schemes, such as the Mkb-innovatiestimulering topsectoren Zuid-Holland (SME Innovation stimulation Top Sectors), to examine the feasibility of an innovation,' he explains. A maximum of 25 thousand euros (40 percent of the costs eligible for a subsidy) is available for a feasibility study. Projects can be submitted from 11 April onwards. There is also the UNIIQ fund for helping entrepreneurs in South Holland to get their innovation on the market faster. It concentrates on bridging the risky 'valley of death' from start-up to fully-fledged business.

BIOBASED FOR SME

InnovationQuarter cooperates in projects together with businesses and regional organisations which are already working on them, such as municipalities, province and the Port of Rotterdam Authority.

The regional development company REWIN and the Brabant development company BOM likewise support SMEs in various ways. 'In the Biobased for SME-project, with partners from England, Belgium, France and Germany we cooperate with the SME on several projects,' tells business developer Dennis van der Pas of REWIN. 'We stimulate the use of vouchers which SMEs can use in application centres.'

REWIN has vouchers available for amounts ranging from 4,000 to 100,000 euros. Last year, four companies made use of six vouchers. In addition to this, REWIN brings groups of entrepreneurs together so they can form a value chain. 'In the six clusters, varying from packaging, pyrolysis, building and infrastructure to horticulture, coatings and pigments, we try to arrive at a business case with the entrepreneurs, so they can market their innovation successfully.' ●

FRUVO: MONO DIGESTION OF FRUIT RESIDUE

FruVo bv from Krabbendijke was presented with a Biobased Voucher by Ben de Reu, member of the Zeeland Provincial Executive, on 27 January 2017. The 10,000 euro voucher will allow FruVo to carry out a feasibility study into the possibility of mono digestion of fruit residue for energy generation and soil improvement. 'Every year, FruVo processes 12 million kilograms of fruit,' says Martijn Vogelaar, director of FruVo. 'After processing we are left with unusable pears, which we currently dispose of as waste. We want to investigate whether we can close the cycle with a small-scale mono digester. The digester will supply biogas, and thus energy, which we can use in the business. And the residual product can be used as a fertilizer in the orchard.'

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