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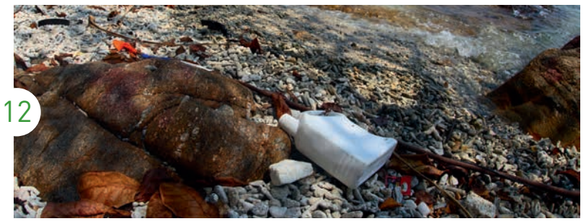

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EDITORIAL

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MICROPLASTICS: SMALL BUT A NUISANCE

The disadvantage of the term biobased economy is that all too often the economic or financial side is being emphasized and that the ecological aspect is being pushed to the background. Replacements of fossil chemicals and/or materials are mainly judged on price and functionalities. There's nothing wrong with that. However, it is not a complete picture. If biobased products are demonstrably more sustainable, for example by having a lower CO2-footprint, then this also should represent a value.
Unfortunately, CO2 is not visible, only its effects on the climate in the shape of global warming, floods and other disasters. Plastics are an entirely different story. Plastic soup, the enormous amount of plastic particles, floating in our seas and oceans, has become a hot topic on the international stage. Countries with long coastal lines, such as Italy, have sprung into action, for example by 'outlawing' single-use plastic bags. Given the amount of single-use plastics, an understandable step. Vast amounts of these plastics - PET-bottles, HDPE-caps, PE-foil et cetera - wind up in the (aquatic) environment. From there on, a slow breakdown process is taking place, 'giving birth' to countless smaller parts: microplastics.
Aside from these so-called secondary plastics, derived from larger parts, there are also primary microplastics. Minuscule beads, usually made from PE, are used in personal and home care because of their abrasiveness.
These microbeads end up in the environment. The problem is how to quantify this stream. The Nova Institute published a report on this matter and it appears that only a rough estimation can be made. Some industry experts state that this volume is relatively low compared to the volume of 'normal-sized' plastics and that the impact on the environment is low. Other sources are less optimistic: some expect these microbeads to end up in marine environment where they can wind up in the food chain and ultimately back to us.
Regardless of its impact, it doesn't mean that primary microplastics can be taken for granted, especially because they are preventable. In the US, there will be a ban on the use of these microplastics in consumer products as from 2018. There are also biobased alternatives on the market. Not bioplastics, but other products such as ground apricot or walnut shells. The question if bioplastics, for example PHA, could play a role. For the answer, please read the feature article of this edition!

Changing consumer views on mobility will have implications for the car industry. As consumers increasingly will share 'vehicle time' with each other, cars will be used more intensively, hence decreasing their life spans. This in turn will foster developments to design cars in a more circular fashion.

This is one of the findings of the ABN AMRO-report 'The circular car' which has been published in August. 'The production of cars with parts that can be re-used for similar or other high-value applications, would have a lower environmental footprint', according to the report. This in turn would be beneficial for producers, especially when cars are not so much owned by individuals but by companies or third parties. 'For example, private lease is a fast growing construction in the Netherlands, expecting to cover 105.000 car users in 2020.'
The shift from private towards corporate ownership implies that corporate owners become responsible for the vehicle's life and end-of-the-life, the authors of the report say. In this scenario, the industry would be forced to rethink car design and the materials that are being used in car production. Aspects such as recycling, upcycling, modular design, biobased materials come into play. ABN AMRO expects that suppliers to the automotive sector can benefit from this development.
'The importance of circular production will push the industry towards its suppliers to jointly develop circular concepts ', David Kemps, sector banker Industry of ABN AMRO, says. 'This in turn offers opportunities for suppliers world wide, especially the Dutch sector which is well-positioned for this transition.'

Third BBI call closed with very good response

The BBI 2016 call has been closed on September 8. A total of 103 proposals were submitted in response to this call.

The 103 proposals were divided as followed: 7 proposals for the 4 CSA topics, 70 proposals for 12 RIA topics, 20 proposals for the 9 demonstration actions and 6 proposals for the 2 flagship topics. This is an average of 3.8 proposals per topic. The evaluation of the proposals will start in September and be finalized in November 2016. Applicants will be informed about the outcome of the evaluations by mid-December 2016. The successful proposals will go through the Grant Agreement Preparation phase and the deadline for the Grant Agreement signature is 8 May 2017.
As part of the panel review for the 2016 call, hearings will be organized for all submitted flagship proposals to clarify the proposals and help the panel establish their final assessment and scores, or to improve the experts' understanding of the proposals.

Bill Gates invests in Renmatix

Bill Gates and Total are investing $14 million in the commercialisation of a technology that may produce cheaper bioplastics and biofuels. Developer of this technology is Renmatix.

The company's proprietary Platrose-technology converts waste biomass to cellulosic sugars, which in turn can be used for chemicals and fuels. The process is based upon the use of supercritical water instead of enzymes, solvents or acids. The company won a 2015 Presidential Green Chemistry Challenge Award for its technology, which the White House says could result in a sizeable increase in the production of plant-based chemicals and fuels.
'To effectively address climate change, we need to develop an energy infrastructure that doesn't emit greenhouse gas and is cost competitive', Gates said in a statement. 'A critical component in this effort must be to decarbonize the industrial sector. Another is the possibility of cost competitive biofuels. Renmatix provides an innovative process that is an exciting pathway to pursue.'


PAOLO BONA / SHUTTERSTOCK.COM

Toyobo and Avantium partner up

Japanese Toyobo and Dutch Avantium have announced their partnership on PEF-polymerization and PEF-films. Both companies have jointly developed thin films made from PEF.

These PEF-films are about 10 micrometer in thickness (one hundredth of a millimeter) and can be applied for food packaging, in electronics applications such as displays or solar panels, industrial and medical packages. Compared to standard PET-films, PEF-films have a 10 times higher oxygen barrier, 2 to 3 times higher water vapor barrier, improved mechanical strength and are fully transparent.
'The performance benefits enable new packaging opportunities, such as transparent pouches for soups, sauces or baby foods', Avantium claims. 'The barrier properties extend the shelf life of oxygen sensitive products like meat, fish, dairy products, or fresh pizzas, or moisture sensitive products such as cereals, cookies, crisps, personal care or medical products, and enhance the aroma barrier for packaged cheeses, fish or detergents.'
The market development of the PEF-films in Asia will be performed in collaboration with Mitsui, with which Avantium announced a partnership in December 2015. The parties expect to offer samples for packaging tests from 2017 onwards.

MARCEL WUBBOLTS NEW CTO OF CORBION

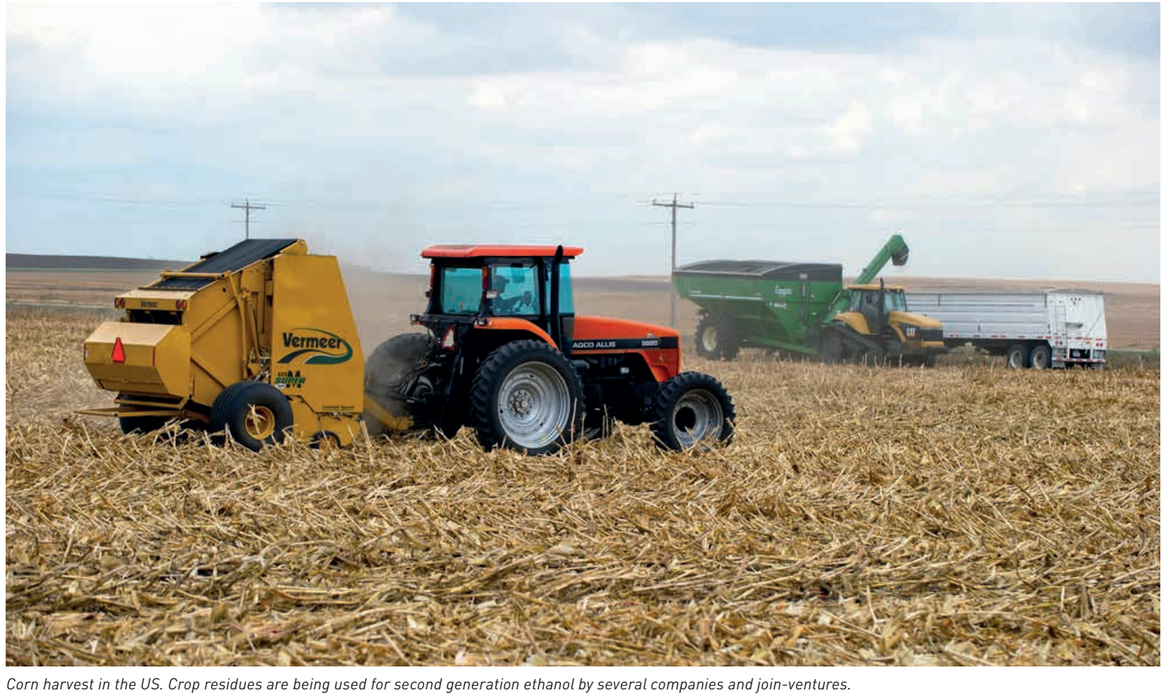
Marcel Wubbolts, momentarily the CTO of DSM, will join Corbion as Chief Technology Officer. Wubbolts will start his new job on the 1st of November 2016.

As Chief Technology Officer, he will be responsible for Corbion's global R&D organization. He will be driving the innovation and technology agenda enabling business development opportunities to support the company's growth journey.
Wubbolts holds a Ph.D. in Mathematics and Natural Sciences from the University of Groningen. Following several positions in academia, he joined DSM, a global science-based company active in health, nutrition and materials based in the Netherlands. Currently, Marcel is CTO and member of the DSM global leadership team. During his 20 years of service at DSM he held several science leadership positions in biochemistry and biotechnology, aiming at developing sustainable production methods for intermediates for pharma, nutritional and materials applications. In addition, he is well connected in the broader biotechnology industry network, amongst others he chairs the Governing Board of the Biobased Industries Joint Undertaking, a Public-Private Partnership between the EU and the Biobased Industries Consortium.

LIGNOCELLULOSE AS FEEDSTOCK OF THE FUTURE

There is already and will be a clear need in the future for chemicals and materials which are derived from second generation feedstocks. Within Bioforever, a consortium will explore and potentially scale up five different value chains, based on lignocellulosic feedstocks.

Text Lucien Joppen **Image** DSM/POET



Corn harvest in the US. Crop residues are being used for second generation ethanol by several companies and join-ventures.

Bioforever, short for biobased products from forestry via economically viable European routes, has been launched in september. The reason why this project has become a reality, is clearly market driven, says Anton Robek, responsible for dissemination and exploitation of the project results.

'In the US, the government has already set a limit to the use of corn ethanol for fuel purposes. Hence the development and construction of several second-generation bio-ethanol plants on this continent are ongoing. Also in Europe, discussions are ongoing about a possible cap on first-generation bio-ethanol and derivatives. Furthermore, the industry in general is more in favor of using non-food feedstocks as it wants to avoid prickly discussions about food versus fuel or food versus materials. It doesn't matter whether the arguments against foodcrops for fuels, materials or chemicals are justified or not, it is the way the industry goes.'

THREE TYPES OF FEEDSTOCKS

So if the Coca-Cola's, Danone's or Lego's of this world are interested in biobased chemicals/plastics, the building blocks ideally should be derived from non-edible biomass, for example lignocellulosic feedstocks. According to Robek, the Bioforever-consortium will focus on woody biomass but will take three types of lignocellulosic biomass in consideration: traditional woodchips/pellets, crop residues and energy crops. 'The best chances for now I see for waste wood, crops residues and energy crops, such as 'energy cane' or fast growing poplar, mainly because its availability and its price per ton. Traditional wood chips/pellets are momentarily too expensive, partly due to energy subsidies. Let me put it like this: if the price per ton dry matter would be 70 euro, it would make a business case. However, current prices of wood chips hover around the 100 euro-mark. In terms of quality however (heterogeneity etc., red.), this feedstock would be ideal as pretreatment steps are in general easier compared to "fluffy" crop residues.'

VITAL STEPS

Robek stresses that biomass selection and pretreatment are the most vital steps in the entire process from biomass to intermediates. If the quality and/or homogeneity of the input are compromised, the output is likely to be of a lesser quality. This could work out for some products, but for example for specialty chemicals and several plastics the quality of the underlying building blocks should be second to none. If not, subsequent purifying steps would add to the total processing costs. Under the Bioforever-umbrella, four pretreatment methods will be explored and/or scaled up: a combination of acid and steam explosion demonstrated in the BPF in Delft, highly concentrated hydrochloric acid (Avantium's Zambezi-process), the proprietary BALI-process (using sulphites, ed.) from Borregaard and AVAP (based on organosolve, ed.), also a proprietary process from API. The first two processes are in a pilot/demo stage, the latter two are already in a more advanced stage. According to Robek, it is not necessarily a race with one winner between the above technologies. 'It depends on the performance of the end product or intermediate, which depends in turn on the end product. For example, Avantium - partner in Bioforever - is interested in deriving FDCA from lignocellulosic feedstocks. For this application, the purity of the C5 and C6-sugars is very important for the conversion towards furanics. Needless to say, cost structures and the robustness of the technologies come into play.'

DSM is one of the 14 private partners in Bioforever. The Dutch life and material sciences company is active in various domains relevant to the biobased economy, such as the development of enzymes and biobased materials. Harry Spuyman: 'DSM is interested in the entire value chain: from biomass selection to end product. As a producer of enzymes, enzymatic hydrolysis has our special attention, this speaks for itself. Within the scope of Bioforever, it would be interesting to see whether the aforementioned process can be fine tuned to correct for irregularities in certain feedstocks. For the time being, it is too premature to go into details. We've only just started.'

BIOFOREVER

Bioforever will run under the umbrella of the **Bio Based Industries Joint Undertaking** (BBI JU) which is a public private partnership between the European Union and the Biobased Industry Consortium. The project consortium consists of 14 European companies. The project will run 3 years from September 2016 - September 2019 with a total investment of 16 million euro.

FIVE VALUE CHAINS

As mentioned before, the Bioforever-consortium will explore five different value chains, based upon varying feedstock-process-combinations: bio-ethanol (fuel, building block), butanol, FDCA, lignin derivatives and C5/C6-sugars for fermentation purposes. Harry Spuyman (DSM), the overall coordinator of Bioforever, explains that at the end of the Bioforever-project, in 2019, there will be a blue print of several blue prints for an industrial-scale plant. In terms of volume, such a facility would mainly produce C5/C6-sugars and lignin. Therefore, the cost-competiveness of these streams should be warranted to make this a viable business case. Based upon current parameters, also lignin should be valorized higher than purely into heat (by co-combustion). 'During the project, most parameters will undoubtedly shift', Robek says. 'We are aiming for a facility with a biomass intake between 1 and 3 million tons of dry matter per year. This band width is similar to existing factories in the paper and pulp sector, that have a long history in processing biomass.'

BUSINESS POTENTIAL

This kind of facility could see the light of day in 2022/2023 at the earliest. In terms of CAPEX, a large scale facility (processing 3 million tons biomass) would cost approximately 750 million euro, Robek says. If this facility would not be able to tap into existing infrastructure for its electricity and heat, costs would go up to 1 billion. 'We also are going to look into various financing options for such a facility, be it in a later stage. There are numerous configurations possible. More important is the interest from around the world in industrial-scale conversion of lignocellulosic biomass, partly because of environmental policies, partly because of the business potential.' ●

BIO-SUCCINIC ACID FULFILS ITS PROMISE

Marcel Lubben: 'Why we would go to the USA and not stay in Europe? Simple: the prices of glucose and energy. Both form a substantial part of the cost price.'

The market for bio-succinic acid is on the rise, although not as swiftly as the industry had initially hoped. The global volume should reach between 400 and 700 kTonnes by 2025. 'With our technology and application capacities, we have chosen the right path to seize a significant part of this market.'

Text Lucien Joppen **Image** Carin Willemsen

Marcel Lubben is CEO of Reverdia, the joint venture between DSM and Roquette. He believes that bio-succinic acid is not only a more sustainable foundation - in comparison with fossil-based chemicals - among the fine chemicals/materials, but it also offers foreseen and sometimes unforeseen functionalities for certain applications. It is not for nothing that the authors of the well-known DoE report 'Top value-added chemicals from biomass' selected bio-succinic acid as one of the top biobased chemicals. This report appeared in 2004. We are now 12 years further down the track. In the meantime bio-succinic acid has gone into industrial production - the Reverdia plant in Cassano set the ball rolling in December 2012 - and there are four suppliers (alongside Reverdia there are Myriant, Bioamber and Succinity) that produce bio-succinic acid based on different technology platforms.

Marcel, you have been at the helm of Reverdia for a good two-and-a-half years now. Has bio-succinic acid already developed into a top biobased chemical as suggested in the Department of Energy report?

'It is too early for that yet. I think that we and our competitors were initially too optimistic about the speed at which the market would eventually take it up. It takes time to process bio-succinic acid in applications and then test them. In itself that is not so surprising: it is not a drop-in that you just slip in somewhere. Its use requires adjustments to the production processes further in the value chain. In the meantime there are numerous products that are being produced on the basis of bio-succinic acid. A good example is PBS, a bio-degradable plastic whose properties are close to those of polypropylene. We see that biobased PBS is used especially in packaging, as agricultural plastic and other applications, for example in combination with PLA. Polyurethanes likewise present an interesting market. This involves products/semi-finished products like soles for running shoes or swivel rollers for roller skates. These products have to link a certain degree of elasticity with hardness/durability. Paints and coatings are also a market with future prospects, in which bio-succinic acid can replace some of the volatile organic compounds and also reinforce certain properties such as the scratch resistance of enamels or greater resistance to weather conditions.'

The industry was too optimistic at the start. Is the forecast 400-700 kTonnes for 2025 likewise too rosy a picture?

'No, when I see which fossil-based chemicals bio-succinic acid can replace, such as oil-based succinic acid or oil-based adipic acid, the contours of the market volume become clearer. This involves considerable volumes, say thousands of kilotonnes of polyurethanes or polyesters, for example. Of course there are uncertainty factors. What will the oil price do? Will a "price on carbon" come and if so, how high will it be? Then there are also macroeconomic factors that are involved. Aside from these factors, bio-succinic acid has the potential to make products better and more sustainable. Then you have a solid business case and you are less dependent on external factors.'

Reverdia in Cassano, Italy, currently uses a 10-kTonne plant for production. In view of your market forecast, this capacity is insufficient to respond adequately to market growth. Is a new plant coming?

'That is our intention. Currently we are engaged in a discussion with an American partner with which we possibly want to build a plant in the United States, in a joint venture. It will be a 50-kTonne facility, five times larger than the current capacity. 'Then you are talking about a CAPEX of between 150 and 200 million euros. Why we would go to the USA and not stay in Europe? Simple: the prices of glucose and energy. Both form a substantial part of the cost price. Even if we produce bio-succinic acid in this volume in the USA and transport it to Europe, it will still be cheaper for us.'

Have you considered establishing the plant in the Netherlands and using sugar based on sugar beet, for example?

'Yes, but in that case too the costs of energy and sugar or glucose are still the most important business location factors, with the liberalisation of the sugar market in Europe still forming an uncertainty factor. The glucose price in the USA is more solid and structurally lower. In other words: we will not be surprised by a volatile glucose price in the coming years. The price is more likely to drop due to an oversupply because the human consumption in the USA will sooner drop, due to soft drinks among other things. Another aspect that distinguishes the USA from Europe is the boldness of regional authorities. They are prepared to contribute, you are directly in discussion with the right partners. As far as that goes, in Europe you really need to do some searching. Of course, our first plant is in Europe, but that also had to do with it fitting perfectly on the site of Roquette.'

The market for bio-succinic acid will grow strongly. How will Reverdia respond to this? Is the focus on application development or will the profit be found in process optimisation?

'We can still improve on both fronts. The process that we have refined over the years has now achieved the goal we had set, but it can still be more efficient. In our fermentation laboratory in Delft, yeast strains are being developed that deliver better yields than their predecessors and can thus keep the kilo price down. The real growth is in the market, of course, and that is what we are now focusing on. In the coming years - this year and 2017 - we will therefore also increase our application capacity. In doing so we will restrict our focus mainly to polyurethanes, PBS and resins and paints. We will not exclude other applications, nor will we give them an extra push.'

We have not talked about price yet. To what extent is bio-succinic acid affected by the persistently low oil prices? Is there price pressure?

'This definitely applies to drop-ins, say bio PE or bio PET. Bio-succinic acid, with which we aim at new products that add value, keeps us a little more protected from price pressure. The low oil price does not help, of course. There are always parties for which this is a reason to delay the jump to sustainable products. Fortunately there are also customers for whom sustai- >>

COLUMN

SECTOR NEEDS TO REINVENT ITSELF

The Dutch chemical sector is a global player in science and industry. Currently, however, its economic position is under pressure, partly due to the lower prices for energy and raw materials elsewhere in the world. The Association of the Dutch Chemical Industry (VNCI) does see a prospect of growth in due course, with increased sustainability playing a decisive part.

The chemical sector will have to reinvent itself. We have mapped out a route up to 2030 that should result in more production growth, partly through higher volume, and partly through more products with greater added value. Considerable challenges will face us in the coming decades, for example in the area of climate or dealing with scarce resources. The chemical sector has a crucial role to play in this because it supplies to all manufacturing industries.

The VNCI has translated this into an ambitious plan to reduce the environmental footprint of the chemical industry – as well as that of the products to which it contributes. We want to achieve this in various areas: CO_2 reduction, efficient handling of raw materials, biomass as feedstock and waste as raw material. The CO_2 reduction must amount to 40 percent by 2030 (including supply chain impacts and compared with emissions in 2005, ed). The use of biomass definitely offers opportunities to the Dutch chemical sector. Our ports process tonnes of biobased raw materials every day. We also have more than enough sugar beet and potatoes in our country that can serve as raw material for the chemical sector and/or materials. Waste as a raw material is likewise a promising pathway, definitely in view of the large volumes and the low feedstock costs involved.

The question is whether the biobased economy is developing fast enough. It is not just a matter of R&D, but also of actual industrial activities. It would be wonderful if a factory or industrial complex, for example a biorefinery with several businesses around it, could see the light of day within the foreseeable future.

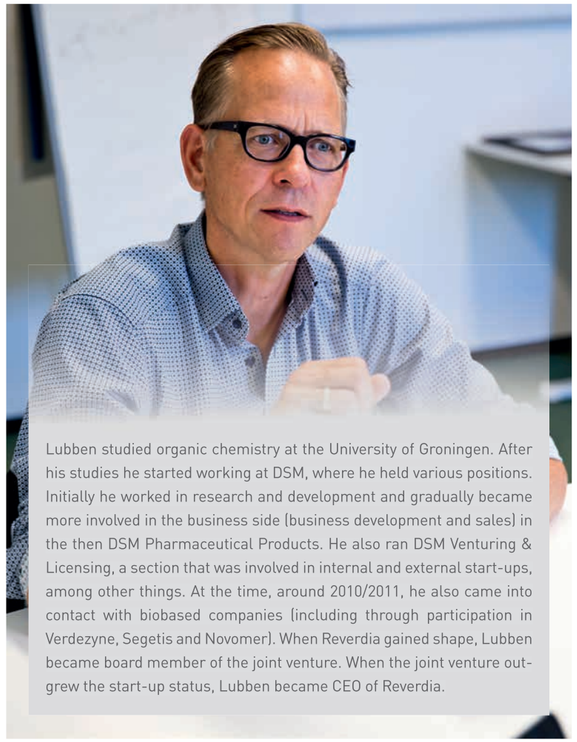
The earning capacity in the long term is important. This is not just a matter of costs of energy and raw materials, but also of added value. Because the chemical sector supplies products and semi-finished products that deliver added value for humans and the environment, it can also achieve an economic added value. This applies to both high volume and low volume products.

Colette Alma
Director of VNCI

nability is inextricably linked with their long-term vision. It is also a question of leadership. Look at the role of Feike Sybesma at DSM and Paul Polman at Unilever. Or of course the chief executive of IKEA (editor's note: Peter Agnefjäll), who has decided that only recycled or renewable materials will be used from 2020. These companies are not doing this for idealistic reasons only, for that matter. They also anticipate the "future costs of carbon", the era in which carbon will be taxed and (partly) internalised in (consumer) prices.'

Finally, how do you view the role of non-quantifiable factors in the development of the biobased economy? Is it only about numbers or does belief also play a part?

'Definitely, in the early stage there are numerous moments when setbacks could make you decide to pull the plug. If you do not feel supported - firstly by your partners and customers in the market and of course also by the joint venture partners - you are sooner inclined to throw in the towel. You need intrinsic motivation to persevere. Nor can you assess everything solely on the basis of the figures. Just look at the uncertainties still facing the market, such as market growth of biobased products or how a possible "price on carbon" will affect them. That is why belief plays an important part: the fossil-based economy will tip slowly but surely towards a circular and biobased economy, and the opportunities for more sustainable and better performing alternatives will grow.' ●



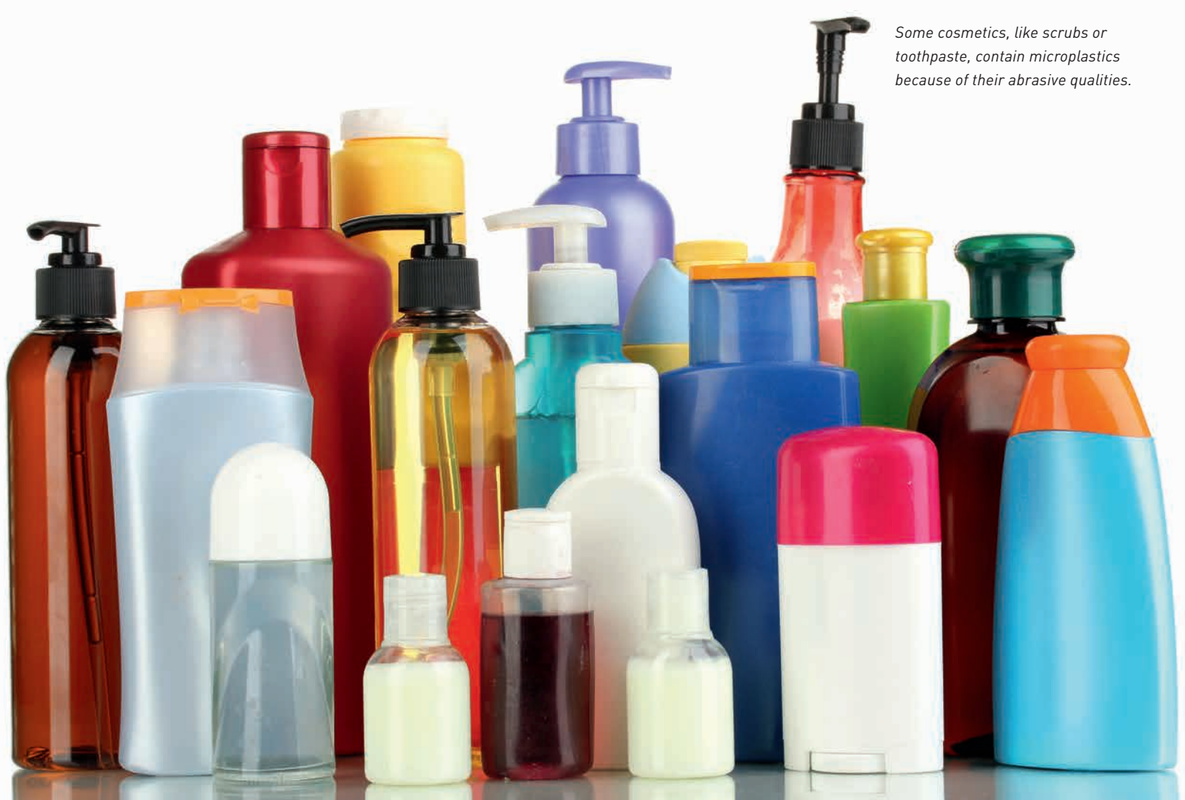
Lubben studied organic chemistry at the University of Groningen. After his studies he started working at DSM, where he held various positions. Initially he worked in research and development and gradually became more involved in the business side (business development and sales) in the then DSM Pharmaceutical Products. He also ran DSM Venturing & Licensing, a section that was involved in internal and external start-ups, among other things. At the time, around 2010/2011, he also came into contact with biobased companies (including through participation in Verdezyne, Segetis and Novomer). When Reverdia gained shape, Lubben became board member of the joint venture. When the joint venture outgrew the start-up status, Lubben became CEO of Reverdia.

MICROPLASTICS IN THE ENVIRONMENT

ARE BIOBASED PLASTICS AN ALTERNATIVE?

Plastics can create huge environmental problems for animals and humans. By now the plastic soup has gained the attention it deserves. Microplastics only form a relatively small part of this 'soup', but they do deserve the necessary attention because they can end up in the food chain.

Text Lucien Joppen **Image** Shutterstock



Some cosmetics, like scrubs or toothpaste, contain microplastics because of their abrasive qualities.

The literature defines microplastics as plastic particles varying in diameter from 1 micrometre to 5 millimetres. A distinction is made between primary and secondary microplastics: primary microplastics are plastics that are produced specifically as small particles, while secondary microplastics originate from larger plastic parts that are broken down, through temperature and UV light among other things.

The primary microplastics are used in various applications. One major market is cosmetics, for which microbeads are worked into shampoos, face creams and toothpaste. The reason? The beads have a scrubbing effect on hair, skin and teeth.

This abrasive effect is why microbeads are also incorporated in both industrial and domestic cleaning products. Beads are also used to a lesser extent as carriers in medicines.

LARGE SHARE FOR PE

These beads are manufactured on the basis of different plastics. PE takes a large share in cosmetics. Apart from its share in microbeads, polyethylene is globally the plastic with the most bulk: by 2018 the worldwide production will reach around 100 million metric tonnes, while double this amount is anticipated for 2050.

Primary microplastics can also have polypropylene, polystyrene, PET, PVC and other polymers as their basis, often with additives such as softening agents or fire retardants. In brief, they are non-degradable plastics that end up in the environment.

It is extremely difficult to estimate the volumes involved with the use of microplastics. The Nova Institute made a rough assessment of the European consumption, based on an American study. The research institute came up with a yearly volume of 3,125 tonnes, but remained very non-committal. It remains a tricky business, because there is no earlier research and data is not always available.

GAP IN KNOWLEDGE

The same applies to the volumes of microplastics that flow through the drains towards waterways and open waters every year. There is a gap in our knowledge in this area, according to the Nova Institute. Do water purification plants filter out a portion, and if so, how much? And what proportion eventually reaches the seas and oceans?

Because primary and secondary plastics in open waters are composed of similar constituents, it is also extremely difficult to specify which proportion is primary and which proportion is secondary.

According to the Ocean Cleanup, the initiative of Boyan Slat, only a comparatively small portion of the microplastics will end up in open waters. 'There is a good chance that they are carried back to the coast, sink on their way or are eaten by marine animals,' according to spokesman Joost Dubois. 'We believe that it is mainly secondary microplastics that accumulate in open waters in the so-called gyres (editor's note: areas of concentration of plastics and microplastics). We expect to be able to use our technology to remove these particles, with diameters measuring from 0.5 millimetres.'

BACK TO THE SOURCE?

As Dubois already stated, a proportion of the microplastics ends up in the food chain. Mainly the so-called filter feeders, such as oysters, mussels and other shellfish, feed themselves by filtering large amounts of water. A study by the French Research Institute for Exploitation of the Sea shows that oysters absorb the microplastics and that this has a negative effect on their reproduction. Because filter feeders also form a source of nourishment for other marine animals, the microplastics can also 'travel' higher up the food chain. These microplastics could eventually return to the 'source': humans. For the time being this does not seem to be the case. This also requires more detailed research.

Whatever the case, the question is whether primary microplastics should enter the environment at all. All the more so because they are produced specifically and do not arise through the breakdown of larger plastic pieces.

OBAMA SIGNS 'ANTI-BEAD ACT'

That is why Barack Obama signed the Microbead-Free Waters Act last year. Manufacturers in the United States are now forbidden as of 1 July 2017 to use microbeads in personal care products. This applies to both fossil-based and biobased plastics. As of 1 July 2018, such products may no longer be sold. 'A very important step in the fight against plastic soup and a strong signal to the rest of the world,' according to the Plastic Soup Foundation, which organised the international campaign Beat the Microbead.

Things are not that far in Europe yet. Cosmetics Europe prefers to promote a voluntary phase-out (until 2020) instead of a strict ban as in the USA. According to the sector organisation, there are enough alternatives for fossil-based microbeads and several of its members have already phased out microbeads.

UNILEVER

Manufacturers and retailers in the Netherlands have also taken these steps. Unilever already made the decision in 2014, while other players such as L'Oréal, P&G, Kruidvat, Etos and De Tuinen have likewise said farewell to the microbeads.

'At the time we took the decision as a reaction to the publicity about the enormous increase of microplastics in the environment,' according to a spokeswoman of Unilever. 'Previously, in a limited number of our personal care products we used microbeads based on PE for their scrubbing effect. For that matter, these microbeads were totally safe for humans and the environment. We have replaced them now by largely organic materials such as ground apricot shells, walnut shells or shell particles, ground pumice and silica.'

POSSIBILITIES FOR BIOPOLYMERS

As Unilever already indicated, there are more than enough substitutes on the market for microbeads based on PE. At the German personal care trade fair In-Cosmetics, dozens of (chemical) companies presented their solutions. For example, Evonik has developed a synthetic variation on natural sand, largely for hygienic reasons. The American company Micropowders sells polyactides based on corn starch while the Swiss Permcos offers body scrubs that are made on the basis of hydrogenated palm oil.

Besides these beads from natural materials, the Nova Institute also sees possibilities for polymers like TPS, PBSA and PHA that are biodegradable in seawater. The research institute does not commit itself, however, because the environmental impact of these biopolymers in a microbead application has not been sufficiently investigated. In any case it does not consider oxo-degradable bioplastics as a solution, because they contribute precisely to the microplastic soup.

PHAS INTERESTING

PHAs (polyhydroxyalkanoates) are an interesting option, according to Jan Ravenstijn (ex-DSM, Dow), bioplastics consultant. 'In principle PHAs are highly suitable because they can be absorbed and digested by the human body, but also because they form part of the metabolism of vegetable and animal organisms. PHAs are already used in medical applications for soft tissue engineering. Now the USA has included bioplastics in its ban on microbeads. PHAs will have no effect on this market now. However, there are countries that do not exclude >>

COLUMN

PROBLEM AREAS

The New Earth New Chemistry action agenda of the top sector chemistry sets ambitions for the long term: one of them is for the Netherlands to be known worldwide as the country of green chemistry in 2050. But there are still various problem areas obstructing these ambitions. Will the Netherlands seize these chances or will all the scaling up go abroad after all?

Firstly, the generally accepted End of Life needs to be secured in the Dutch situation. The Netherlands Institute for Sustainable Packaging (KIDV), together with Holland Bioplastics, the NRK (umbrella organisation for the rubber and plastics industry in the Netherlands) and many other parties, took a major step on 23 June in defining a waste guide, based on the 7P number, to label compostable packaging as exclusively intended for the 'green' rubbish bin. Plastics have to go in the Plastics Hero bag and oxo-degradable plastics go with residual waste because they may not disrupt the recycling. This will hopefully bring an end to the unjustified discussion that bioplastics disrupt the recycling of plastic. After all, every plastic now has its own end-of-life position.

Secondly, a prohibition on oxo-fragmentable additives. In contrast to Belgium and Italy, there is as yet no prohibition in the Netherlands on the use of additives that only make more micro plastics on an accelerated scale.

Thirdly, better communication in the area of bioplastics. The KIDV study has also made this clearer: it is now up to the retail chains and packers to apply this in practice. Clear sustainability criteria are also desired. An approach such as that of packaging specialist Paardekoper van der Windt with a detailed life cycle assessment (LCA) (supported by environmental organisation Natuur & Milieu) should also be applied to bioplastics, but with the cooperation of the manufacturers. Bioplastics still need some encouragement. What about a Green Deal to stimulate them? Identify and list the problem areas and deal with them systematically. Governments play a role in stimulating this development through more sustainable procurement and the realisation of pilot projects. Unfortunately there is not enough progress on this point, because buyers for the governments continue to play with insufficient supply. And there are indeed alternatives: the conventional plastics.

Public funding is likewise a government instrument that is unfortunately not being put to use. We hope to be surprised on Budget Day with reduced VAT rates on bioplastics and recycled plastics.

Finally, I would like to plead, as I have done more often, for a price to be put on CO_2 emissions. As long as this does not happen, progress will lag.

Jan Noordegraaf
Managing director Synbra Technology

bioplastics in advance. So there is a possible market for certain PHA blends with the right properties.'

ALARM SET TOO LATE

Ravenstijn does point out that it will take at least five years to develop these blends for a specific application. The large cosmetics and personal care manufacturers have already been working with the previously mentioned alternatives for several years. 'I have the idea that PHA manufacturers have set the alarm too late. If they had responded to this development earlier, buyers might have still been interested. Unless PHA manufacturers can make a better business case, for example based on price and/or functionality of the end product. To achieve this, we will have to form alliances with players in the value chain so that these PHA beads can be developed and then tested to see what happens to them in fresh water and seawater. To be honest, I am more inclined to see a market for biobased and bio-degradable plastics in other applications, such as packaging film. There is a market demand there too for plastics that break down in a watery environment without causing damage to it.'

The **Nova Institute** estimated that 4,360 tonnes of microbeads from EU countries ended up in the sea in 2012.

Six to ten percent of the global plastics production ends up in the sea. These are mainly secondary plastics that then disintegrate into smaller parts, including microplastics.

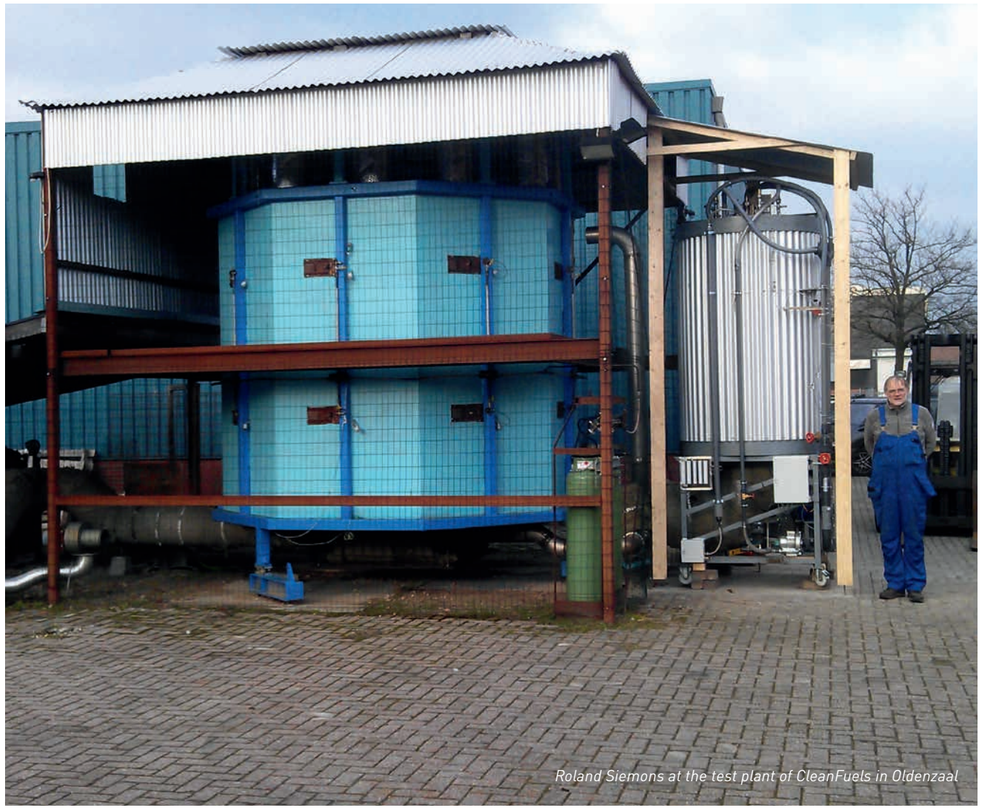
In 2008 an average of **752,100 pieces of plastic per square kilometre** were floating in the Pacific Ocean.

INNOVATIVE, CLEAN TECHNOLOGY

CLEANFUELS MAKES THE PRODUCTION OF CHARCOAL MORE SUSTAINABLE

'We can make a huge environmental profit by converting biomass into charcoal cleanly and efficiently,' claims CleanFuels director Roland Siemons. 'We have already proven this in our test plant in Oldenzaal. Now it is time to launch our knowledge and products on the market.'

Text Edwin van Gastel **Image** CleanFuels



Roland Siemons at the test plant of CleanFuels in Oldenzaal

The Dutch summer has ended and the barbecue season along with it. The quantity of 'kilo killer deals' and wrong fish that finds its way from the shop to the grill and the plate has gradually been dropping for years due to the attention for animal welfare and the depletion of the world's oceans. But the story is different for the charcoal on which the food is cooked. The buyer generally lacks awareness about the production method, partly because of the poor information provision, while the lion's share of the coal comes from heavily polluting industry.

PRIMITIVE, INEFFICIENT PROCESS

'Below the line those businesses have an enormous impact on humans, the environment and nature,' according to Siemons. 'The charcoal burnt on barbecues is just a fraction of the total worldwide consumption. It constitutes the main fuel in large parts of the world, for instance for heaters and cookers or for energy generation for factories. We are talking about a global market of a good fifty million tonnes. The production in non-Western countries is generally a primitive, inefficient process that is scarcely under control. Wood, obtained legally or otherwise, is covered and ignited. It carbonises because the oxygen is withheld. This releases large amounts of the harmful greenhouse gases methane and nitrous oxide, which are 21 and 310 times more harmful respectively than CO_2. At CleanFuels we want to change this by developing sustainable carbonisation technology.'

> 'THE PROCESS HAS NO POLLUTING EMISSIONS, IT IS HIGH-TECH AND IT IS PROTECTED BY VARIOUS PATENTS'

MERGER WITH TNO

Siemons completed his mechanical engineering studies at the University of Twente in 1984. He set to work at the newly established BTG that aimed at technology development and consultancy in the field of energy generation from biomass. Siemons became co-owner, developed into an authority on the production of charcoal and was involved in a large number of projects in countries like Sudan, Egypt and Mozambique. This often involved linking up with development programmes of United Nations Industrial Development Organization, Food and Agricultural Organization of the United Nations and the Directorate-General for International Cooperation. While technological innovation for the generation of energy from biomass was increasingly subsidised by the government, the market for BTG toppled. The company merged with technology partner TNO in 1998, which eventually bought it out. Siemons obtained a doctorate as economist and travelled the world as advisor for the World Bank, but in the end chose the excitement of running a business again. In 2005 he started CleanFuels.

SLOW PYROLYSIS

'Initially we focused on extracting oil from biomass using flash pyrolysis: the swift heating of biomass in the absence of oxygen. What you get is mainly oil, plus some gas and charcoal,' explains Siemons. 'Everywhere in the world a lot of biomass is being burned inefficiently, including in sugar cultivation. By making oil from it you have a great way of extracting its value, for example by producing fuel for other industries. We tried this in a trial project in Uganda. However, the business case turned out not to be sustainable in practice. The price of the pyrolysis oil cannot compete with fossil oil. Charcoal, however, is a high-quality product; on an energy basis it is even two times more expensive than petrol. There is a large market and huge environmental profit to be made. So we shifted our attention to the development of technology and knowledge in the sustainable production of charcoal by means of slow pyrolysis. In our test plant in Oldenzaal we now make coal of exceptional quality. Oil and gas are now by-products, and we use them in commercial systems not only for the process itself, but also to generate a surplus of electricity and heat. The process has no polluting emissions, it is high-tech and it is protected by various patents.'

RETURN

The knowledge and technology of CleanFuels have enormous potential export value. However, marketing this is no simple matter. It is a question of holding out for a long time. This has been underlined by a first large order from South Africa.

Siemons: 'It comes from a landscaping company that collects a tremendous amount of biomass, for example from farmers and along electricity cable routes. Until now it was shredded and exported as a low-value product. Now they are going to use our technology to carbonise the biomass. Soon 65 percent of their biomass will be converted into charcoal and 35 percent into electricity and heat. This increases the economic return greatly. All the same, building and running a pyrolysis plant are far removed from their core business. Moreover, they do not know the coal market. So we support them in all kinds of areas, in the entire process from technology to sales. This kind of broad consultancy is inherent to our product. It makes what we do even more complex, but also especially attractive and valuable.'●

This article has been written in cooperation with BIC-ON.

FERTILISER PELLETS FROM CHARCOAL

Thanks to support through ERDF funds and from the provinces of Gelderland and Overijssel, the CleanFuels test plant was recently expanded with a new plant for carbonising pellets. These pellets can be made from all kinds of biomass, but CleanFuels lays the stress on manure.

'There is still a large manure surplus in the Netherlands and other parts of Europe,' according to Siemons. 'Carbonising that manure can contribute to solving that problem. In our process the minerals are conserved in the coal. This creates a concentrated fertiliser of coal pellets whose mass is a factor five less than the original already diluted raw material. This also reduces the transport costs considerably. What is more, the CO_2 from the manure is secured in the carbon. So it does not get into the atmosphere anymore. In this case, too, our pyrolysis process is energy-neutral, from drying through to carbonising. I see a beautiful future for this technology, all the more because it can be used to extract value from widely varying raw materials like manure, grass and sewage sludge.'

BACK TO BASICS

Biobased building started when the first Homo Sapiens Sapiens appeared. The first industrial revolution caused a major change, but in the year 2016 we have to change tack again. Our work will be cut out with this transition.

Text Gie Steenput* (edit: Lucien Joppen) **Images** Shutterstock

From the very beginning, some 200,000 years ago, humans have been using biobased materials for building. These varied depending on the climate zones: snow, ice and furs have been found at the North Pole, branches, leaves and grass in the subtropics and tropics, and flax, hemp, clay, sand and reeds in moderate climate zones.

Nomadic Inuit at the North Pole still build igloos that are replaced by constructions made from branches and furs in the summer months. Other examples of biobased nomadic building can be found with the Bedouins in the Sahara, the Mongols in Asia and the Native Americans on the North American continent.

Examples of 100 percent sedentary building can be found on a global scale, but they are becoming rare.

The Native North Americans originally lived in caves, sometimes hacked out from rock, which is not biobased, and later in pueblos, built from rammed earth. Until recently the Berbers in North Africa lived in buildings three or four floors high constructed from mud, and in remote villages this is still the case. People in the south of the Arabian peninsula still live in buildings up to nine floors high built from earth and wooden trunks.

TOTAL RECONSTRUCTION

The Shrine in Ise (Japan) is the last Shinto complex that is still demolished completely every twenty years and rebuilt with new materials. This has been happening since the 7th century. 20 years is the approximate time needed to let the materials required for the rebuilding grow to the necessary size in nature. The ridge of the roof is finished with wood, the roof covering is thatch, while the outside walls, floors, beams and posts are made from wood. But the Japanese are also very practical. Not every part is biobased: the foundations are made from rocks. 100 percent biological building is abandoned here in the context of a building requiring less maintenance. The rocks do not absorb any water from the surrounding earth, and thus protect the wooden posts on these rocks from rising moisture and early rotting.

EUROPEAN TIMBER CONSTRUCTION

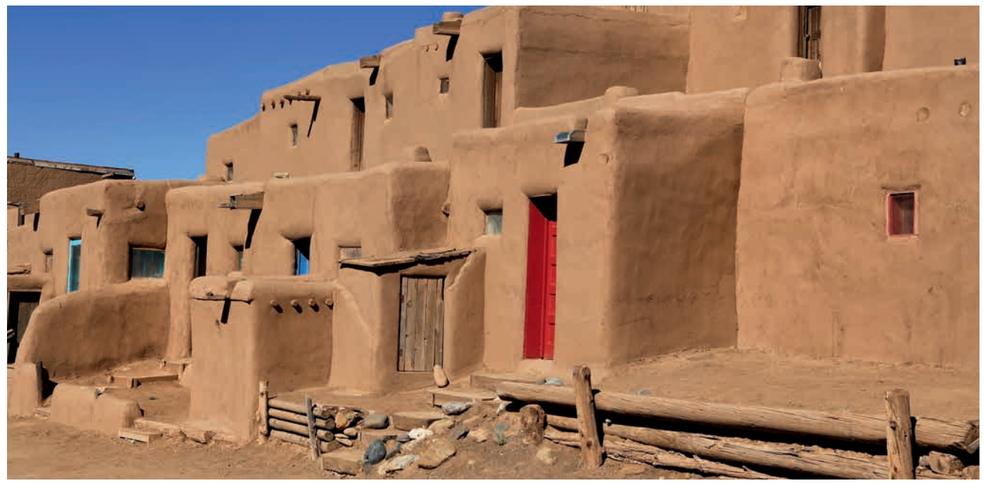
Over the years, wood has developed into a popular biobased raw material, perfect in areas where this raw material is readily available. Numerous old buildings in Europe illustrate how wood can withstand the ravages of time. The Norwegian stave churches date from the 12th century and can still be visited. The >>

Michel Piccaya / Shutterstock.com

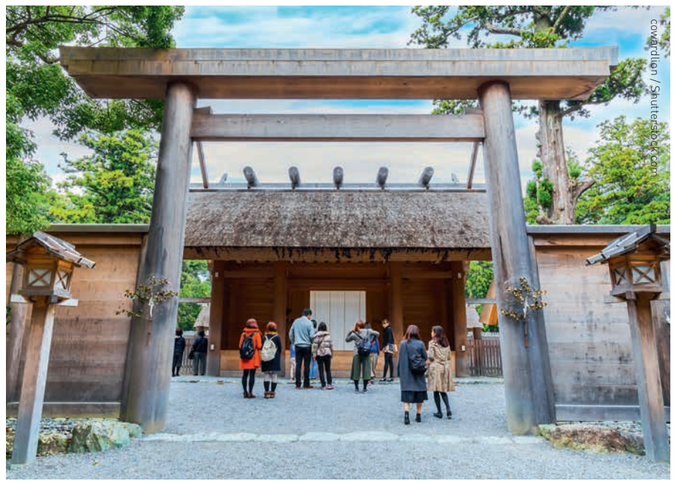
Djenne

HIGH POINT IN MALI

The pinnacle of building with earth can be found in Mali. It is an example of biologically sound building that also shows how a building, or rather the building's maintenance, fosters a strong sense of community. The mosque of Djenné is built entirely of clay and wood. Every year festivities are organised around the repair of damage caused by rain and temperature fluctuations. Everyone joins in. Some people take care of food and music. Women and girls carry water to pits where the plaster is prepared. Boys are in charge of mixing the plaster, while men transport the plaster from the pits to the mosque.



A pueblo, in this case in Taos, in the north of Mexico.



conrad ellon / Shutterstock.com

The shinto-complex in Ise, Japan.

original foundation on wooden piles in the ground was abandoned quite early for a stone foundation on which the wooden frame was placed. Everything above this stone foundation is made from wood: posts, beams, walls and roof. Dovetail, mortise and tenon joints and 'locking' hold the skeleton together and provide for flexibility that can absorb the working of the wood. The wooden shingles on the roof, for example on the stave church of Borgund, have covered it for nine centuries now. A clear indication that wood, when used properly and combined with the right roof shape, can last a very long time, even as roof covering.

THE MACHINE AND FRANK LLOYD WRIGHT

The first industrial revolution took a relatively short time to change the way we build and how we live and increasingly distanced us from biologically sound building. In the 1920s, as an answer to the problems of West European cities that were clogging up, concrete and steel were initially used for the fast and efficient production of houses with minimum comfort for everyone. This made the traditional building methods lose more and more ground in favour of an industrialised construction world.
Frank Lloyd Wright presented some response with his Usonian houses. The Jacobs house from 1936-37 is a wonderful example that illustrates how this famous architect drew on the ties with nature again and again. He designed a house that did not have to last any longer than the lives of its residents. The modest budget of $5,000 (equivalent to €75,000 now) put the value of the life of the house into perspective. The Jacobs house was built primarily from natural materials such as sand, gravel and especially a lot of wood, machine-treated, for window frames, roof truss and outside wall covering.

GOLDEN YEARS AND OPEC

The post-war years of the 1950s and especially the 1960s were the golden years of our culture. Building, construction and rebuilding went on at a cheerful pace. Cavity wall constructions - without insulation - were erected. Roofs became flat, petroleum-based roof coverings overran the market. The coal-fired heater replaced central heating with boilers that needed gas or fuel oil to burn. The middle class used their heating enthusiastically. This stopped abruptly with the organisation of the OPEC countries and the subsequent oil crisis of 1973. The higher oil prices resulted in increased insulation with, cynically enough, insulation materials manufactured chiefly by the petrochemical industry.
There were also pioneers in the 1970s who argued in favour of ecological building. The Orejona house of architect/artist Luc Schuiten from 1976 is one of the first self-supporting houses on Belgian territory. Planned for a wooded hill, with respect for the surroundings, the house was equipped with the first solar panels that were available on the market in Europe. A wind turbine provided power and rainwater was collected. A diamond-shaped sun room facing south caught the heat in the scarce sunny hours of winter. A vegetable garden and an orchard turned the residence into a self-sufficient whole. But the Orejona house cannot be copied directly as a building model just like that. The expected population growth and urbanisation require different solutions.

PAINFUL INVESTMENTS

The current building world is demonstrating initiative in any case. There are more than enough platforms. You can find eco builders everywhere. There is a growing realisation that it can be different and has to change. But the building industry has been left with painful investments from the past. Copper ore still comes from mines; cement, one of the most important raw materials for concrete, originates from lime that in turn comes from limestone quarries, open pits. The steel industry releases tonnes of CO_2 into the air every year. Cement and steel factories cost money that has to be recovered.
Fashion and taste also play a part. Designers and residents are still to a large extent in love with the syntax of Modernism. Flat roofs, large sliding doors, stainless steel kitchens. A house is still a dream, a 'beautiful' picture that is chosen mainly for reasons of aesthetic preference, linked with the desired comfort. Preferences that can be achieved thanks to the non-biobased materials of steel and concrete.

HEADING TOWARDS A BIOBASED BUILDING INDUSTRY

A huge amount of work still has to be done with a view to a planet-friendly or, better, human-friendly building industry. Biobased building seems to indicate the way: in the building process use as many materials as possible that nature can produce again within a reasonable time so that the raw materials on earth do not become limited and the greenhouse gases do not increase.
Who should take care of this? A building is the sum of many elements. You have materials, and you have the production processes that make them. You have the schedule of requirements of a building, the comfort level and the implementation of the building.
Producers of building materials could focus on materials whose production does not send CO_2 into the atmosphere, that do not use finite raw materials and do not leave large open excavation pits in the earth's landscape.
Clients could ask themselves what the balance between initial building costs and running costs and maintenance costs could look like. How comfort can be created with biobased materials and how this can challenge the preconceived syntax.
Designers could settle down to the study of the characteristics of the 'new' biobased materials and see how this can change and improve the syntax of spaces.
Implementers of building works could specialise in working with biobased materials and maybe even with biobased equipment.

There is a long way to go. Not everyone will have changed their minds by today or tomorrow. But the signs are hopeful that building in the near future will be fully biobased. ●

This article has been written in cooperation with Biobased Delta.

Biobased construction has a prominent place in Biobased Delta. For example, Avans Hogeschool (higher education) has established a specific lectorate on this theme. The scope of the lectorate is construction, renovation, foundation, roofs, facades and civil engineering (roads, waterways).
The province of Zeeland is active in the field of public procurement (in building and renovation). REWIN, the provincial investment agency of the western part of the province of Noord-Brabant, has established a specific cluster centred around biobased construction. NovaLignum, a company based on the 'bio-industrial' complex Nieuw-Prinsenland, is going to produce biocomposite facade-panels on a industrial scale. A telling example of biobased business being realized in Biobased Delta.

** knowledge network member lectorate Biobased Bouwen, University lecturer Avans of Applied Sciences Tilburg, architect*

TOP 5 (PLUS 2)

Lists always do well, so it is a good idea to make a list of the Top 5 (partially) biobased buildings and two renovation projects. The order in which they are given is arbitrary. These projects were selected according to widely varying criteria, so it is not possible to compare them one on one. They were chosen on the basis of material use, heating system, ventilation system and spaciousness. They show that really good homes or other spaces can be designed with biobased materials, elevating these materials above the well-meaning DIY practice.

Text Gie Steenput

RENOVATION

1 RENOVATION OF FARM INTO AN ALPINE FARM APARTMENT, BOHINJ, SLOVENIA

This is a textbook example of contemporary rural lifestyle combined with traditional local architecture. The old recycled wooden shed was upgraded to a dwelling, which has a fully wood-lined interior with old and new (wooden) materials alternating playfully.

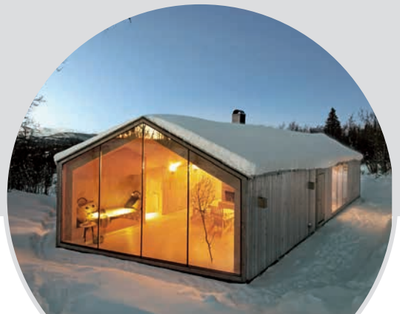
2 RENOVATION OF BUNGALOW INTO A HOUSE, GERAARDSBERGEN, BELGIUM

The house is self-supporting in terms of energy, water and heating needs. The external wall is made of materials including linseed oil, insulating hempcrete, clay and lime plaster. The clay-lime plaster combination provides a moisture buffer. The hempcrete refers to the clayey strata in the surroundings.

NEW CONSTRUCTION

1 V-LODGE, ÅL, NORWAY

The outside, both walls and roof, are fully lined with pre-patinated pinewood. This creates a simple, homogenous skin that blends in with its surroundings. Inside, the walls, ceiling and furniture are made from plywood sheets while the hearth-kitchen combination is concrete.



2 THE STAIR HOUSE, ALMELO, THE NETHERLANDS

The 10 floor levels differ by 75 centimetres each time, creating a sensation of continuous space in which view and functionality are always changing. This stair house is built entirely of wood. The exterior is covered with vertical wooden planks, while the interior is lined with Arauco plywood.

3 TÅKERN VISITOR CENTRE, GLÄNÅS, SWEDEN

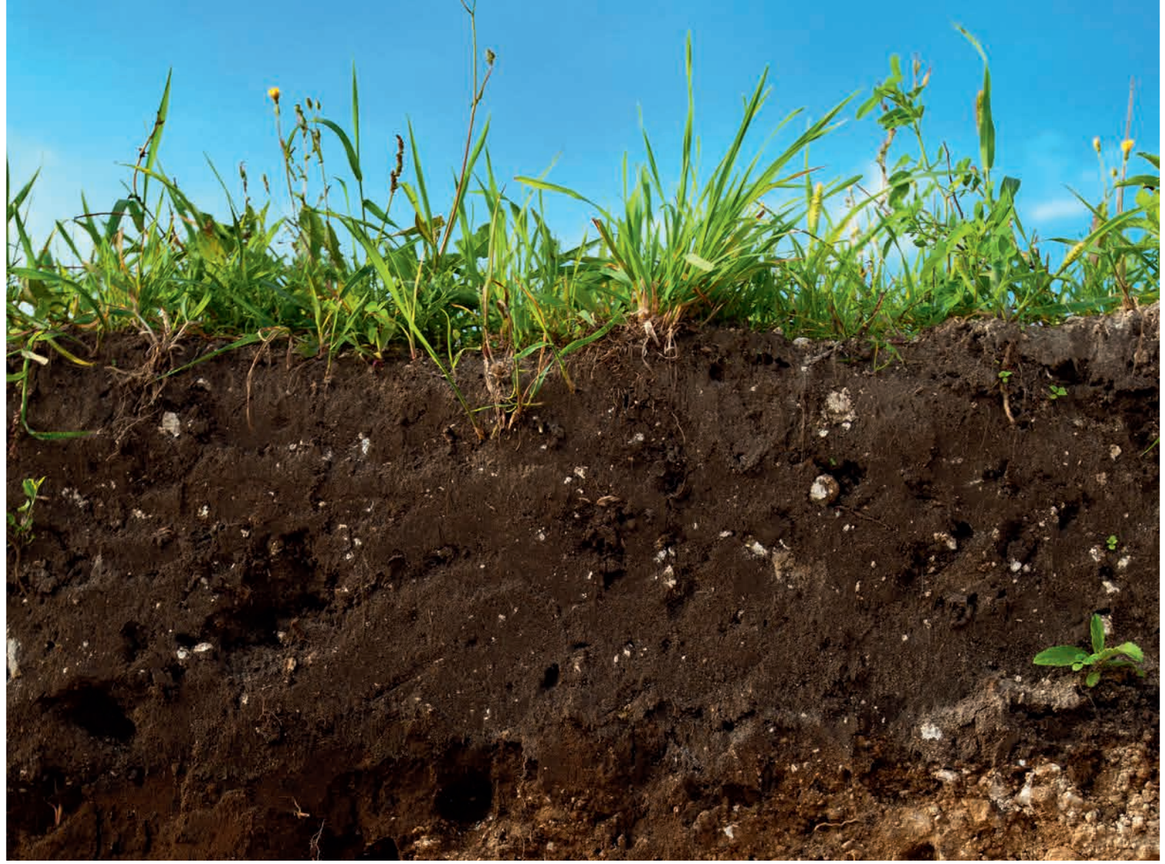
Traditional building techniques were used to cover the wooden walls and roof of the building with 'golden' reed thatching. This will gradually turn grey and integrate better with the bird observation towers in the vicinity. Local materials create a new silent syntax.

4 RAUCH HOUSE, SCHLINS, AUSTRIA

The monolithic structure becomes a sculptural, abstract and artistic block of nature that was seemingly pushed up out of the earth. The technical process of building with rammed earth arose from the desire to build a house exclusively from ecological materials.

5 ANNALISA HOUSE, VALS, SWITZERLAND

A composition of exquisitely reinterpreted traditional wooden volumes, complete with recessed and spacious openings that mark the landscape immediately. The solid wood has a tangible presence - soft and close to the body - and shines softly and silkily in the light.



TOXICOLOGISTS TAKE AN IMPORTANT STEP IN ASSESSMENT OF BIOCHEMICALS

FDCA GETS THE GREEN LIGHT

Recently completed toxicological research throws a new and positive light on the biochemical substance FDCA (2.5-furandicarboxylic acid). Thus FDCA proves to have no endocrine-disrupting effect and similarly does not pose any extra risk to the soil environment. According to Corbion, producer of lactic acid and PLA, this supports the possible applications of FDCA in bioplastics such as PEF.

Text Adriaan van Hooijdonk **Images** BE-Basic, Shutterstock

Environmental toxicologists from the VU University Amsterdam conclude in the May edition of the journal Green Chemistry that the production of the biochemical substance FDCA from plant waste poses no extra risk to the soil environment in comparison with the current production of PET from petroleum.

The BE-Basic Foundation commissioned Chinese doctoral candidate Guang Chen, together with Nico Van Straalen and Dick Roelofs from the VU University Amsterdam, to examine the toxicity of three substances for the soil environment. These were terephthalic acid (TPA), a fossil raw material for the production of polyethylene terephthalate (PET) and the green raw material-based 2.5-furandicarboxylic acid (FDCA). The third chemical they examined was 5-hydroxymethylfurfural (HMF), which is required as an intermediate substance for the synthesis of FDCA.

NOT TOXIC

According to Van Straalen, the results of the soil research show that FDCA and TPA are not toxic in normal soils. The environmental toxicologist believes that the risk for the soil comes mainly from the intermediate 5-hydroxymethylfurfural (HMF), which is formed during the synthesis of FDCA. HMF induces a large number of biotransformation enzymes in the micro organism, an indication of the conversion to a reactive intermediary product. HMF fortunately has a very short half life: the microorganisms break the chemical down within two days. This is shown by the fact that the reactivity of HMF can only be measured in sterilised soils.

A second toxicological investigation carried out by Biodetection Systems (BDS) in Amsterdam concentrated in particular on the possible endocrine-disrupting effect of FDCA. This is a known problem that occurs with many traditional plastic constituents. However, according to Bart van der Burg, innovation director at BDS, research on human cells has revealed no indications of endocrine disruption.

FDCA REGISTERED AT ECHA

FDCA had already been registered earlier with the European Chemicals Agency (ECHA) in Helsinki by Avantium in the framework of the European chemicals regulations REACH. Companies that want to put biochemical substances on the market must provide ECHA with sufficient information to register the chemical, precisely like producers of petroleum-based chemicals. This obligation stems from REACH: Registration, Evaluation and Authorisation of Chemicals. The aim is to protect humans and the environment from the risks involved in the manufacture and use of chemical substances. Manufacturers and importers of chemicals must know and identify the risks of the use and the conditions under which these chemicals can be used safely. They are obliged to register these details with the ECHA, which evaluates them and, if necessary, proposes risk mitigation measures.

SOFTENING AGENT

'Files at ECHA currently do not contain any research into the possible endocrine-disrupting effect of the registered chemical,' explains Van der Burg. 'It has therefore been shown not to be demonstrable for FDCA, in contrast to a chemical like bisphenol A and many phtalates. Companies use these chemicals in the manufacture of different types of plastic. There is a great deal of discussion about this because some toxicologists believe that these chemicals pose a risk due to their endocrine-disrupting effect. The European Court of Justice has even ordered the European Commission, in a legal action brought by Sweden, to also identify and list the possible endocrine-disrupting effect in the evaluation of chemicals that have already been registered at ECHA.'

A spokesperson of Corbion argues that FDCA, also in view of the favourable toxicological properties, forms an important future bio building block for the production of PEF. 'This involves a combination of FDCA with ethylene glycol. Here the terephthalic acid in PET is replaced by FDCA, creating a biobased polymer that can replace PET,' explains the spokesperson.

Research has also shown that PEF scores better than PET on various parameters, according to this spokesperson. 'Products keep for longer in PEF packaging due to the better barrier properties for gases, for example oxygen, in comparison with PET. What is more, products can be pasteurised in PEF packaging.'

ENZYMES

Van Straalen concludes that the production of FDCA from lignocellulose is certainly no simple matter as yet. To be sure, the material can be obtained in large quantities from the residual streams from the production of sugar cane and palm oil, as well as from all kinds of fibre-rich plant material released as waste from agriculture and forestry, such as straw, wood and reeds. At the same time, it is interwoven with lignin molecules. 'The bottleneck of the process is getting this lignocellulose to break down,' explains Van Straalen. 'Currently that is being done in an environmentally unfriendly way using lyes and acids. That is why we are researching the possibility of using enzymes for this purpose.'

However, according to Van Straalen we are still a long way from an industrial application, for example as material for plastic bottles. 'But I can imagine that Corbion wants to get started on a pilot project, just as other companies in the public-private partnership also run pilot projects in various fields.'

The research currently taking place into FDCA contains various links that will build up the entire chain towards 100 percent biobased PEF. Both industry and science play important roles in this endeavour. ●

AGENDA

26TH - 28TH OF OCTOBER
REINEU 2016
Bratislava, Slovakia
Hundreds of representatives from European and international research, innovation communities and the business sector will meet to discuss the latest developments in nanotechnologies, advanced materials, manufacturing and production technologies and biotechnology.

28TH OF OCTOBER
Accenture Innovation Summit
Utrecht, the Netherlands
The Accenture Innovation Awards is a yearly event, directed at innovative services and products in the Netherlands. There are in total eleven 'arenas' in which companies can compete, for example Health & Well-being, Fair Food, Smart Industry and Circular Economy.

16TH OF NOVEMBER
Open symposium CatchBio
Halfweg, the Netherlands
CatchBio (Catalysis for Sustainable Chemicals from Biomass) is a Dutch public-private consortium (nine universities and 12 companies (DSM, BASF, Avantium) which investigates catalytic conversion of biomass, more specific lignin into valuable components (chemicals etc.). After ten years of research CatchBio is looking back at the achievements that have been made over the years. Some of the speakers are: Marcel Wubbolts (DSM), Tom van Aken (Avantium) and Bert Weckhuysen (University Utrecht).

15TH - 16TH OF FEBRUARY 2017
Biobased World 2017
Cologne, Germany
BiobasedWorld is the first genuine trade show in Europe for biobased industries, according to the organizers DECHEMA. BiobasedWorld offers an overview of latest enabling innovations, products, technologies and services, ready to be applied today. The exhibition will bring together experts from all fields to exchange ideas. This encompasses process-focused sectors such as industrial biotechnology and biorefineries as well as products such as biochemicals, biopolymers or building materials and equipment ranging from photobioreactors to filtration units.

NEWS

SuperBIO-project launched to support industrial innovation

SuperBIO, an innovation project supported through the EU Horizon2020 funding programme, has been launched. The € 3.8 million project supports the development of promising industrial value chains in the bioeconomy.

The project provides ten different types of innovation services to third party SMEs that are funded by the project for 75 per cent. As such, it brings these value chains closer to reality. SuperBIO is designed to support cross sectoral and cross border industrial value chain building and provides innovation support services to SMEs. Industrial stakeholders are invited to submit their idea for an innovative value chain to the SuperBIO project. Once a value chain is created, SuperBIO analyzes the gaps to be filled and further requirements to bring this value chain closer to the market. The SuperBIO-consortium includes four industrial cluster organisations (from Belgium, France, Spain and Poland), and six service providers (from the UK, Germany and Belgium).

ANNE GLOVER: 'PEOPLE ARE OUR GREATEST ASSET'

'Our greatest asset is our people. Scotland has a strong educational system, outstanding international universities and a world beating research sector. These are principal components of a circular bioeconomy.'

Professor Dame Anne Glover CBE FRSE (University of Aberdeen and former EU Chief Scientific Officer) stresses the importance of human resources in the Scottisch (and European) circular/bioeconomy in an interview preluding the EFIB-conference which will take place in Glasgow from the 18th until the 20th of Octobre.
According to Mrs. Glover the Scottish and in general the European bio-economy is very strong in R&D, but somehow needs to communicate its strengths more to citizens and politicians. 'Demonstrate the value of what you do through case studies and make it real for citizens and politicians alike. The impact of our research in the EU is enormous but we lag behind others in translating this into the corresponding benefits for citizens and the economy.'

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Agro&Chemistry is the European edition of 'Agro&Chemie', the quarterly magazine about business in the biobased economy in the Netherlands and Flanders. Agro&Chemistry contains a wide selection of articles from 'Agro&Chemie'. Agro&Chemistry aims to visualize the biobased agendas of leading enterprises, governments and research institutions and encourage cross-sectoral meetings and collaboration.

'Agro&Chemie' is published online, on our website and mobile app, and offline, as a quarterly magazine. The content is produced in close collaboration with our partners, whose logos can be seen on the left.

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Agro&Chemistry is published by
Performis B.V.
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www.performis.nl
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