Bioeconomy BW

In order to innovate, we must come down from the ivory tower

"Industrial biotechnology" is gradually coming out of its academic cocoon. Even the term itself is rather bland and it is not always easy to understand what it actually refers to. However, industry has now started to speak out about the need to shift from petrochemically produced materials to biotechnologically produced materials. At talks given at the recent Biotechnology Days in Berlin, representatives of a number of different BMBF-funded clusters showed that numerous strategies to enable the industrial production of biopolymers and biomaterials from resources other than oil are now available. Walter Pytlik from BioRegionUlm talked with Dr. Ralf Kindervater, CEO of BIOPRO Baden-Württemberg GmbH and manager of the Biopolymers/Biomaterials cluster. Dr. Kindervater is also a chemist who specialises in biotechnology and biochemistry.

Does the world actually need biopolymers and biomaterials?

Yes, more so now than ever. Not only have polymers become an integral part of our daily lives, it is believed that oil reserves will come to an end in the not-too-distant future.

We not only require sustainable bioenergies, but also sustainable materials produced from biological resources.

The good news is that it is not just nature that provides biodegradable plastics, as was assumed ten years ago, but we, as human beings, are also able to produce technical and high-performance plastics from biogenic elements and molecules. Moreover, these new bioplastics can be fed into the material cycles without the need for comprehensive alterations.

What is the cluster focusing on? Is it more interested in raw materials, or in the requirements of industry? Have you conducted any surveys to find out what is required?

Dr. Ralf Kindervater, manager of the Biomaterials/Biopolymers cluster focuses more on the latter stages of progress along of the value creation chain
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We are not exclusively focusing on either sustainability or on biotechnology as the 'saviour' of the value creation chain. We are pursuing a multidisciplinary approach and we are involved in all the areas of development: we work with raw materials, with biotechnological processing and with polymer chemistry. But we are also focused on the processing properties of materials, compounding and blending. We maintain a dialogue with the key partners in each field of application and also

ensure that all materials are thoroughly tested for their use in areas such as construction, packaging and automotive.

How do you do this?

We need to move out of the narrow view of our own discipline and take a more general view by talking to people at the end of the value creation chain, for example, car manufacturers who are planning to use plastics and are interested in finding out whether a particular material can be varnished. That is when you leave the biotech area, and move into looking at aspects of the plastics sector.

What were your first steps?

Prototype for nylon-5,10 applications: an anchor bolt that is lighter and more robust than common anchor bolts.

The cluster initially focused on polylactic and poly-butyric acid-like plastics that were known as biodegradable plastics at the time the cluster was established. BASF then discovered biobased polyamides and Tübingen researchers discovered anthocyans and lignins. The range of such materials is immense. 30 project proposals were submitted of which three have been given funding through the BMBF. These three projects focus on succinic acid, polyamides and lignin. We are now focusing on additional projects, which we believe have a good chance of taking up where the first three leave off once BMBF funding comes to an end in a few years' time.

What happens to the funded projects?

One of our next major tasks will be to create a scenario that helps us develop suitable market options. We cannot even imagine developing competitive products without having the necessary market in place.

Are there any markets for these products?

Let me answer with another question, if I may: Where will the markets develop, and who will be capable of delivering which products in which areas? Our challenge now is to show the world what can be done. A minor attitude shift has already taken place regarding the field of bioenergy. But this is far from being the case in terms of biomaterials. Numerous biomaterials are available but nobody is aware of their existence.

What problems do you face in your cluster?

We have realised that the chemical industry is not working on biobased materials as fast as companies like Fischer, Daimler and Bosch would like them to. These kinds of companies require the biobased materials as soon as possible and would be prepared to use them even if they were twice or three times as expensive as petrochemical materials. However, the problem is that there are no big biobased material production plants available. Whenever there are innovations, there are always groups that seek to protect their vested interests. For example, many years ago when the electric locomotive was on the point of replacing steam engines, it had many detractors who were quite often interest groups related to steam engines.

So the most important issue at the moment is moving towards larger scales?

Yes. We need to establish large-scale facilities. Pilot plants have shown that the processes work. We now need to construct 50 to 100 m3 reactors. We need huge quantities, robust production strains, and inexpensive ways to process source materials.

What can the cluster do to help achieve this?

It can bring people together and find more partners in order to solve these problems.

Does this mean that BASF will focus on the large-scale production of these monomers?

I am sure that this facility will not be erected on the Ludwigshafen-based BASF site. The cluster is interested in establishing the facility in Baden-Württemberg or in Germany.

Does industrial biotechnology always require huge factories?

This is a question that I have put a great deal of thought into. Modern biotechnology can be carried out in factories of all sizes, this has been shown to be the case in the past as well. I believe that the debate concerning biorefineries is taking us in a completely different direction.

What direction? Does the concept behind biotechnology production currently resemble production processes in petrochemical refineries too closely?

Yes, I think so. The Bioliq process has shown this very well. In a classical biorefinery concept, the only things required are straw, the withdrawal of water and air using rapid pyrolysis and the transportation of an oil-like intermediary product to refineries where the Fischer-Tropsch process is

used to transform it into synthesis gas. But for me this is only a transition stage. Refineries also have to focus on energy production.

Biotechnological and processing industry processes can be linked, just like a lumber mill, a paper or sugar factory. Integrated substance streams such as those in a biorefinery are not required. The focus is on producing a new product from a 'waste molecule', to create a 'by-process' or to use the remaining biomass to produce energy, once it has been used for the generation of materials.

There won't just be answer A or B; there will not only be detached processes or only biorefineries.

Biorefineries are thus...

an intermediary step. We must be careful to avoid misleading explanations or terms as this could be counter-productive.

It is clear that certain chemical processes need to be carried out on a large-scale, both technically and chemically. But I am sure chemical processes can also be efficiently carried out on the smaller scale. For example, the increasing costs of transport will most likely mean that production will be carried out more on the regional level than is currently assumed. I do not think that new large-scale refineries will be erected solely for the purpose of producing biobased materials. They will be used for additional purposes.

The idea of using the new materials in the automotive industry amongst others seems to be more innovative.

Prototype developed by the Biopolymers/Biomaterials cluster: Engine fan with frame connector, made of biobased polyamide Nylon-5,10.

Yes, let me explain why I believe that this is the most effective approach. Here in Germany it's often the same story: technology fields are compared with one another and a certain technology is taken to be a pseudo-industrial field, which quite simply is not the case. This has happened with biotechnology. Let me put it another way: is biotechnology an end in itself or is it an innovation engine for other industrial sectors? Here in Baden-Württemberg, a lot of money is made in traditional industrial sectors, and a lot of money is invested in biotechnology. The traditional sectors do not understand why so much money is spent on the life sciences. And, putting it bluntly, the life sciences do not really know what to do with their innovations, with the exception of the pharmaceutical and medical device industry. This is not so obvious in the other industries.

What are you doing to prevent biotechnology from getting stuck in the ivory tower?

Let's take a boxing analogy to explain this. We have left the biotech corner temporarily but not permanently. At the moment we are thinking about innovation and we are looking at traditional industrial sectors to find out what the problems are and what biotechnological product scenarios can be put in place to solve these problems, at least partially. This is the new way of thinking: rather than remaining in our corner of expertise, we are seeking to become generalists and innovation partners to companies in traditional industrial sectors, such as automotive, packaging, construction or textile, and find out the sustainability problems involving petrochemical plastics. We collect up these problems and try to find biotechnological solutions.

What kind of solutions are available for the "green car", which you mentioned in your lecture at the German Biotechnology Days?

I am sure the entire automotive industry will shortly focus on constructing totally sustainable cars, both in terms of material and fuel. Here in Baden-Württemberg, and throughout Germany, we are focused on making people aware that the materials for developing such cars exist, though not at the right price. Once there is an increase in demand, prices will fall. What we are trying to do is to bring together the provision of knowledge and information with the state of demand and requirement.

And this leads to projects?

Yes, it does. We are currently working on projects that focus on polyamide 5, 10 and succinic acid. I have found out that shifting from one material to another in the automotive industry is not an easy process. A huge catalogue of criteria has to be taken into account, the materials have to be thoroughly tested, step by step. This is especially the case with materials research. We have to deal with this and accept it.

Your activities are not only focused on moderation...

We are active business developers and business promoters, and in these roles we access different areas and collect information about the status quo of different projects. We are heavily involved in

the whole process, acting, I like to think, as innovation engines. Our role is not just that of scientists discussing possibilities with companies. We need to work to accelerate these processes. Something that previously took ten years to happen, now needs to be done in two to three years. Otherwise, we will be overtaken by other countries.

Does this mean that your cluster is not a standard funding project?

We have some projects that have reached a degree of maturity that enables us to think about spinning out companies. This helps us circumvent a problem: for example, if a partner like BASF has invested in a cooperative project in order to achieve value creation, the company will not limit the use of this material exclusively to project partners such as Fischer, Daimler and Bosch. In order to guarantee some kind of exclusiveness for a certain period of time, the spinning out of a project company is a good move in order to solve problems such as the further development of products, rights, products and profit. This is what we are currently focusing on.

What can the cluster achieve in five years, what should it achieve and what will it realistically not be able to achieve?

We want to show that it is possible to take one or several products from a biotechnologist's shaking flask to a specific field of industrial application. For me, it is important to show that clusters like ours are able to accelerate innovation. There are many people who try to do this in theory. But my aim is to do this practically and efficiently. I want to show German and Baden-Württemberg politicians that mechanisms are available for pursuing one or other of their high-tech strategies. It is possible to accelerate innovation and technology transfer in a way that means it enters industrial application in the right conditions. I am expecting economic growth to be achieved within a few years through the real cooperation of science and industry in a regional structure, rather than through some kind of risk capital scenario.

Are you confident that you will reach the industrial scale you mentioned?

As things are at the moment, I am sure we will succeed with our succinic acid project. We still have more work to do on the polyamide project in order to be able to bridge pilot manufacturing and large-scale industrial production. But the good news is that all the parties involved in the project are very open. BASF is very open to further developing the project and will not hide the project away in a drawer. It is clear that we need to move faster on all the projects in order to be able to meet the demand when the time is ripe. We have to create the demand, show that our plans work, and we have to react. It is not good enough to just say, biotechnology is good.

You talk about innovations being pushed to the back of the drawer, innovations that are about 50% or 75% of the way to being realised. You are looking for potential users. In contrast to other clusters, you focus more on the latter stages of progress along of the value creation chain.

Yes, that's right. Let me give the following example: Imagine that BASF develops a bio-nylon, I will then ask myself as a normal member of the public, not as chemist: where is nylon used? One answer is in anchor bolts. So I get in my car and drive to Fischer in Waldachtal in order to ask the manufacturer whether he is interested in using bio-nylon rather than petrochemical nylon. The fact

that Fischer had actually thought about this alternative itself, was a lucky coincidence.

It was not the same story in the automotive sector. Bosch had been thinking about using biological alternatives. And I think Daimler also, although neither had really made these ideas public. Fischer Automotive was very open to using bio-nylon. For me this was just what the world had been waiting for and we've found it. More valuable projects are needed to attract the interest of other people in other potential plastics molecules. We can then put these companies into contact with users. It is a kind of innovation chain reaction.

What will happen in the automotive sector in terms of opening markets?

We are currently focusing on turning one particular idea into reality. This idea was jointly conceived within the cluster: an automotive design challenge for biopolymers. We plan to launch an international competition calling on manufacturers to produce individual components from all kinds of different plastics. Our intention is to bring materials, design and application together.
During the automotive crisis we grabbed the opportunity to produce ventilator vanes and cases, lids and other things with the new materials using idle manufacturing machines. This means we already have quite a few components. The next step is to assemble a car with as many bioplastics parts as possible.

Article

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Biorefinery concepts are close to implementation