

# Bio-materials make inroads

Chemicals derived from renewable, bio-based feedstocks are winning a growing place in the market. But how important a part will they play in future? A recent ICIS Roundtable, in association with NOM, brought together leading industry experts to discuss the potential and the issues surrounding wider uptake

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**T**he drive to develop and commercialize bio-based chemicals produced from renewable feedstocks or residue streams continues to accelerate. There is growing optimism that replacing petrochemical-based materials will expand as technology develops and market requirements intensify.

However, it is still far from clear what penetration bio-based chemicals can achieve, or when the sector will be able to sustain large-volume commercial production. To ramp up adoption, proponents of the technology will have to overcome challenges posed by feedstock availability, government policies and regulations, competition from the energy sector and the costs of scale-up and market access.

At the second ICIS Roundtable on Bio-based Chemicals, organized in association with the Investment and Development Agency for the Northern Netherlands (NOM), experts from a range of companies, associations and institutes discussed the main issues. This year's participants were more confident than those at the first Roundtable, held in March last year, that bio-based materials have a promising future and may well make a significant contribution to the chemical sector.

Recent progress on a range of developments is no doubt spurring this optimism, but so too is the growing pull from the market as major brand owners seek, and the public demands, products with greater renewables content, lower environmental impact and enhanced green credentials. The lower CO<sub>2</sub> footprint of renewable materials is a significant benefit and one that will become more apparent to customers as labeling of products begins to include such data. However, use of bio-based materials is not recognized in sustainability index calculations. If it were, this too might spur some greater interest in their use.

There is also a feeling that in Europe, the bureaucrats and policy-makers are beginning to listen more to the needs of the bio-based

materials sector, and are exploring ways of stimulating the business, much as they have done already for the energy and most notably the fuels sector.

However, although generally positive, participants emphasized the point that market development of bio-based chemicals is not a straightforward process by any means. Use of bio-materials in large-volume commodity products is unlikely to be cheaper than the incumbent petrochemical products, so market success will depend on the value they offer to the user in terms of green image and sustainability arguments, supported by quantified lower carbon footprint and real environmental impacts. The perceived value-added is crucial, as end-customers are, on the whole, not prepared to pay the cost of renewable technology in their purchases.

## COCA-COLA SHOWS THE WAY

A leading example here is Coca-Cola's well-publicized intention to use a proportion of bio-polyethylene terephthalate (bio-PET) in its bottles. With such a move, it hopes to win more customers and increase its market share because of its adoption of renewable materials.

The same argument, the participants noted, can be applied to users of bio-based polyethylene and polypropylene, produced from sugar cane via ethanol, who are willing to pay a premium for the packaging resin, in return for end-customer recognition of their environmental performance and sustainability initiatives.

These premiums, commented one participant, are likely to remain in place for a considerable period as the market moves to bio-based materials and competitors seek to adopt the same strategies as leading-edge adopters once the market effects have been gauged and proved positive. And once a particular product or market sector has started to go down this route, it will be hard for other companies not to get involved, and impossible to go back to.

On the other hand, argued the participants, bio-based chemicals going into niche, specialty

uses will be able to compete much more effectively on performance and added functionality, while at the same time also trading on their green credentials. Several commented that at present the market pull is strongest where the end product is "close to the skin," in for example, cosmetics, cleaning products and the like.

As the bio-materials here are used as a small proportion of the whole, in formulations and as additives, the cost issue is not so critical, as long as the technical properties and performance are equal or superior to existing oil-based chemicals.

In this area, chemical companies themselves are looking for more renewable raw materials and sustainable products, but there is also a very strong market pull, not only from the public but also often from state procurement programs, for example in the US institutional cleaning sector. Companies want alternatives and these will have to compete somehow, commented one participant.

AkzoNobel, for instance, is looking closely at more sustainable materials with enhanced performance and functionality, as well as considering price and environmental footprint, in its choice of raw materials. But it is taking a focused approach, not just a broad brush one, and is making sure it does the right thing for the right reasons.

DSM too is focusing closely on sustainability of its operations, and is developing bio-based building blocks which it believes can replace petrochemicals and add additional performance and functionality. It has set business targets for bio-based products and services for 2020. It is currently building a 10,000 tonne/year facility in Italy with France's Roquette for bio-succinic acid.

Of course, as several participants pointed out, bio-based materials are already making a significant contribution in some areas and will continue to do so. However, there are some products that will always be petrochemical-based. There are growing opportunities to exploit the value added of bio-based materials in



the market place, added another participant, though agreeing that you can't replace everything.

The one area where bio-based materials can compete directly on price, most participants agreed, is in the production of acids, alcohols and aldehydes from sugars and starches, where the economics are favorable and the products can be used as intermediates in further steps to the final product. Here, said one, there are clear-cut advantages. Bio-adipic acid and bio-acrylic acid are just two examples being developed and which are showing attractive economics.

#### **NITROGEN POTENTIAL**

Another potentially promising area for bio-based materials arises from the fact that chemicals containing nitrogen can be more easily produced than via petrochemical routes. Along with carbon, hydrogen and oxygen content in the molecule, this can give dual functionality to chemicals that might thus be able to compete well on performance terms.

Several factors will influence the speed and extent of bio-based chemical uptake. On the economic side the price of crude oil is an obvious factor, but the distortions introduced into the market by subsidies for renewable energies and by agricultural policies will also have a major impact.

In the longer term, the increasing tightness of oil supply is likely to push oil prices >>

**Bio-based materials can command greater premiums when they are used in products close to the skin**

» higher, but also prompt chemical producers to seek alternative feedstocks. Renewable resources are just one route here, and will have to compete alongside natural gas and coal-based C1 technologies in chemical production, as well as hydrogen in the energy sector.

Another major factor is access to economically viable amounts of renewable feedstocks. For high-volume, commodity bio-based materials, where hundreds of thousands of tonnes will be required, large acreages of sugar, corn and vegetable oil crops will be essential, whereas for specialty chemicals the scale can be a factor of 10 lower, enabling more diverse streams to be used more locally.

**AGRICULTURAL POLICY ISSUES**

In Europe, the participants argued, agriculture is more fragmented than in say Brazil or the US, and it is harder to see how producers in the region can compete on bio-commodities without basing their operations on imported sugar or ethanol, both of which are currently subject to trade tariffs and quotas. One potential way forward would be through changes to the EU sugar regime, to make it more attractive for EU farmers to grow sugar beet specifically for chemical feedstock use. This would not only increase acreage under cultivation but also provide improved crop rotation opportunities in Europe, where sugar beet yields are high.

Any such moves are tied up with Europe's Common Agricultural Policy (CAP) and multi-lateral trade talks with the likes of Mercosur,

the South American free trade grouping. The chemical industry has had poor or even zero visibility in the CAP deliberations over the years, with the effect policy is geared purely to food issues and environmental opportunities.

But chemical bodies are increasingly lobbying into the Brussels bureaucracy with the aim of ensuring the chemical industry stands a chance of accessing the bio-feedstocks it needs. It will however be some time before any concrete progress can be expected, certainly not before 2015 and more likely 2020.

Given the more diverse nature of European agricultural production, it seems inevitable that production here will use a broader range of biomass and be more focused on specialty chemicals, augmented by imported materials where larger volumes are required.

Current energy and waste policies in the EU and member states also militate against the chemical use of bio-based materials and waste, as biofuel production and energy recycling take precedence over use as a chemical feedstock. Until such discriminatory treatment is revised, potential sources of bio-feedstocks will not be available for European producers.

Also posing a significant challenge to development and commercialization of bio-based materials in Europe are the complicated public funding mechanisms and lack of venture funding for research and development. Over the last decade, the US has proved itself very adept at developing technology platforms for bio-materials, using readily availa-

**Current energy and waste policies in the EU... militate against the chemical use of bio-based materials**

ble venture funding and central state grants. In Europe, in contrast, where venture capital is much harder to come by, the emphasis has been much more on smaller-scale developments and process improvements.

EU funding for R&D is by and large more fragmented and smaller scale than in the US so it is hard to win backing for major projects without breaking them down into parcels to win funding. An associated issue is the lack of available loan guarantees in Europe for funding for scale up to demonstration scale and beyond.

This is not to say that Europe is not innovative in this sector – there is a lot of quality work being done, noted participants, with strength in diversity but also a developing network of innovation clusters across Europe. And, there may be improvements on the way as the European Commission introduces public private partnerships to support large-scale projects with funding that extends further downstream the innovation value chain than just research.

Several points really sum up the consensus feeling of the Roundtable: first, that bio-based materials will make a growing contribution, that they are doing so in terms of value at the moment and will in future also compete in price; second, that there is still a lot that needs to be improved on the policy and regulatory front, and finally that there is also plenty of progress needed in terms of logistics and infrastructure to enable significant volumes to be produced commercially on a sustainable basis.

In the medium term, it may well be, commented one participant, that public demand for bio-materials will outpace supply. However, no-one seemed to argue that there is anything here to prevent steady progress in the bio-based chemical sector.

The big question, though, is how much petrochemical replacement is feasible. In the short term, uptake of bio-based materials is unlikely even to cover the anticipated growth in chemical demand. But taking the long view, oil supply will inevitably peak and decline, so ultimately, alternative feedstocks will be increasingly essential. Perhaps we need to be thinking over a 10–15 year time frame to judge the success of bio. ■

**TAKING PART IN THE ROUNDTABLE**

- **Marcel van Berkel** director business discovery, DSM Bio-based Products & Services, the Netherlands
- **Dr. Ir Bert Jan Lommerts** managing director, Latexfalt, the Netherlands
- **Alistair Reid** project leader, white biotechnology, AkzoNobel RD&I, UK
- **Esben Taarning** project manager, Bio2Chem, research & development division, Haldor Topsøe, Denmark
- **Ricardo Gent** executive director, German Association of Biotechnology Industries, VCI, Germany
- **Jose Mosquera** director industrial policy, Cefic, Belgium
- **Ton Runneboom** chairman, Biorenewables Business Platform, the Netherlands

- **Yvonne Armitage** IB sector expert & knowledge transfer manager, Biosciences KTN, UK
- **Adrian Higson** head of biorefining, NNFC – The Bioeconomy Consultants, UK
- **Lois Hobson** business manager, Centre for Process Innovation, UK
- **Alle Bruggink** technology and sustainability consultant, the Netherlands
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- From NOM: **Sietse Wiersma** project manager, investment promotion - chemistry, energy, recycling, NOM



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