

# **Biomaterials have a great leap to make**

There is a large and growing interest in using renewable feedstocks to make chemicals and polymers. But there are many obstacles along the path to commercialization



### JOHN BAKER AMSTERDAM

io-based materials, renewable feedstocks, green chemistry.... Today these terms are an established part of political and industrial agendas. Indeed, it is increasingly hard to avoid the topic of alternative feedstocks for the chemical industry in company announcements, in the news, at conferences and in official pronouncements.

Bio-based material is a rapidly-developing sector with a number of key drivers, emerging technologies and lead protagonists. However, there are also a number of key issues that need to be addressed which, if not tackled, could slow the movement to a greener, more sustainable base for tomorrow's chemical industry.

Last month ICIS, in association with the Investment and Development Agency for the Northern Netherlands (NOM), assembled a panel of experts from across Northwest Europe to discuss these issues. The Roundtable was held on March 18 in Schiphol, the Netherlands.

Two main areas of discussion emerged during the session: how companies should best approach introducing bio-products into the market and whether there was access to suitable and sufficient feedstocks in Europe.

Other issues raised included technology development, the drivers for bio-based materials, the similarities, differences and conflicts between the bioenergy and biomaterials sectors and the extent to which bio-products might replace oil-based chemicals – and on what timescale.

The two major producers in the room – AkzoNobel and DSM, both Netherlands-based – have confirmed their resolve to take the bioroute. Rob Kirschbaum, DSM vice president of open innovation, explained that the company is aiming to generate \$1bn (€690m) of sales within the next 10 years from its biobased materials and biomedical activities. It is already producing polyamides and polyester resins with bio-based content, and is involved in the development of succinic acid and derivatives through a joint venture with French ingredients producer Roquette.

## **GREEN CREDENTIALS**

Peter Nieuwenhuizen, director of future-proof supply chains for AkzoNobel, explained his company is looking to "future-proof" its supply chain by means of bio-based materials.

"While price and quality remain important, we also want to take our responsibility where new and better materials are slowly becoming available. We want to help this industry develop if it presents solutions to the world's long-term challenges." This is part of AkzoNobel's drive to increase sustainability and widen its raw material supply base away from crude oil-based feedstocks.

The company is looking at what it can achieve in sourcing bio-based binders for its coatings activities, focusing on acrylics and polyesters for example. Such moves are being driven by chemical companies' needs to achieve – and be seen to achieve – sustainable operations by encompassing renewable feedstocks and offering products that are more environmentally friendly.

There is also the element of diversifying feedstock base away from petrochemicals, which look set to become more costly and volatile in years to come. Some customers are beginning to ask for – and indeed pay a premium for – products with green credentials – a market pull that is best not ignored.

The stimulus to develop bio-based materials also comes from EU and national governments' drive to shift their economies away from fossil fuels to renewables, as part of the initiative to address issues of global warning and feedstock diversity. Of course, there is also the technology aspect. As major players, venture capital start-ups and the agri-industry are looking to capitalize on the growing demand for green chemicals.

Participants at the Roundtable agreed that appropriate technologies are being developed and will continue to be developed, both for basic building-block chemicals and higher value-added chemicals derived from biobased raw materials. But there was plenty of debate as to the best ways to address the market and maneuver products into existing supply chains.

# The situation does not look attractive for the rapid development of a bio-based materials sector in Europe

This is not an easy process, as the developers of bio-based polymers such as polylactic acid (PLA) have discovered. Introducing a niche product into an already crowded market without cost advantages is a slow process, reliant on customers looking for an environmental message for their products.

On the one hand, participants argued, it is relatively easy to insert bio-derived petrochemical-identical materials into the production chain, thus enabling sellers of the final product to claim some element of renewable content.

Leading examples here include, at the very basic level, ethylene produced from sugarcane via ethanol, and similarly, propylene.

Slightly further along the chain, technologies are being developed for isobutanol (IBA), 1,4-butanediol (BDO), adipic acid, acrylic acid and others.

However, it was also argued that although this is a feasible route and producers may be able to demand a premium for such products in the marketplace, there are two drawbacks: first, in terms of greening production, volumes are insignificant when compared with the hundreds of millions of tonnes of commodity petrochemicals produced, and second, availability of raw materials.

Europe just does not have the feedstocks to engage in high-volume bio-based production. Neither does it really make sense to base an industry in Europe only on imported sugar, molasses or ethanol from, say, Brazil.

Bulk chemical manufacturing provides a great opportunity for European agribusiness if it can produce more biomass and become more efficient to compete on the world market. European agribusiness will then have a great opportunity to supply the bulk chemical sector with the raw materials it needs, at globally competitive prices. But, until Europe achieves

such a position, the bulk chemical sector will need import duty exemptions.

The alternative – one espoused by several participants at the meeting – is to "reap the complexity" of biomaterials to produce fine and specialty chemicals that can be used to make higher value-added products that can be marketed into niche areas.

This involves more complex technology and processing, but ultimately could lead to the development of sophisticated bio-refineries with a multitude of complex building

# The EU stance on the CAP, import duties and tariffs is hampering the development of renewable feedstocks

blocks produced from biomaterial inputs.

One question posed by this approach is how to move early-stage technologies forward when the financial rewards are not on the large-scale characteristic of bulk intermediates. Perhaps, it was argued, companies ought to enter the market with relatively simple products in niches where a green premium is attainable, then expand outwards with more specialized offerings. As volumes increase and costs are driven down, the market would expand.

However, it was also argued that just being green is not enough. Producers need to show the value added of the raw material and have a total view of the logistics and supply chain.

Often, energy content and transport are much bigger factors than the feedstock in determining a product's environmental credentials. Developing green energy is also a vital part of greening the chemical supply chain.

The issue of scale is evidently a problem, and in this respect the chemical side of biomaterials is disadvantaged when compared to the bioenergy side. Bioenergy, one participant pointed out, is a relatively homogeneous sector – mainly bioethanol and biodiesel – with large volume production, easy access to market via fuels blending and with very visible national and EU regulatory targets for use.

On the other hand, bio-based chemicals are much more heterogeneous, have lower volumes of production – by some orders of magnitude – and are less directly mandated by legislation. In the food versus fuel versus chemicals debate, chemicals are always going to come last, given current legislation and subsidy schemes, said one participant. From a sustainability point of view, however, this is not always the case, depending on which feedstock you use and how the fuel or chemical is produced.

With a strong regulatory framework and financial incentives, biofuel projects have been built and the large volumes of required feedstocks sourced, albeit sometimes through imports of vegetable oils into Europe. The situation for chemicals looks less attractive.

To maintain a viable chemical base, Europe needs to compete against global competition from the Middle East, Asia and now even Latin America. Some argue that Europe could find feedstock advantage in bio-based production, given that the region has a highly productive agricultural industry and plenty of land set aside.

There is no doubt that the EU supports the goal of a bio-based economy and has made biomaterials key components, for instance, of its Lead Market Initiative and its new 2020 Innovation Union agenda. The increased use of renewables was also favored in the recent report of the EU's High Level Group on the Competitiveness of the European Chemical industry.

However, it is evident that the EU stance on the Common Agricultural Policy (CAP), on import duties and tariffs and even on the classification of biowastes are all hampering the development of cost-effective renewable feedstocks. So, too, is the distortion introduced into the market by the desire to earmark feedstock to produce biofuels.

For instance, sugar and ethanol attract high import duties, and hence make them uneconomic for use in Europe as a raw material. Rendered animal fats are attracted away from chemical use because of incentives to use them in biodiesel, and even domestic biowaste is classified so as to make it less attractive for use as a bioresource for the chemical industry.

### **CAUTION EXPRESSED ON TIMESCALE**

All in all, the situation does not look attractive for rapid development of a bio-based materials sector in Europe. Even those developing the necessary technologies often look outside the region to establish demonstration or commercial-scale production units because of a lack of access to raw materials.

Given these obstacles, the participants were inevitably cautious about the extent and timescale for development of a significant biobased economy. Several expect it to be decades before any significant shift is seen and, even then, a figure of 10% bio-based materials is the maximum that can be expected.

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**ROUNDTABLE PARTICIPANTS** 

- Janneke Bik, investment manager, Dutch Greentech Fund, Rabobank
- Prof. Dr. Alle Bruggink, technology and sustainability consultant
- Dr. Neil Checker, vice president, CRA
- Dr. Ricardo Gent, executive director, German Association of Biotechnology Industries (DIB), VCI
- Dr. Adrian Higson, head of biorefining, UK National Centre for Biorenewable Energy, Fuels and Materials (NNFCC)
- Dr. Lois Hobson, business manager, Centre for Process Innovation (CPI)
- Rob Kirschbaum, vice president, Open Innovation, DSM
- Dr. Avtar Matharu, deputy director, Green Chemistry Centre for Excellence, University of York, UK
- Peter Nieuwenhuizen, director, futureproof supply chains, AkzoNobel
- **Ton Runneboom**, chairman, Biorenewable Resources Platform
- Rene van Sloten, executive director, industrial policy, Cefic
- John Baker, global editor, custom publishing, ICIS
- Sietse Wiersma, project manager, investment promotion – chemistry, NOM

As one participant pointed out, most growth in global chemical industry capacity will still be crude-oil based and, as another added, there are also other alternative technologies for energy and feedstocks to take into account, such as coal and hydrogen. Biomass is just one issue, but access to raw materials is very important.

Few saw penetration of renewable feedstocks into commodity chemicals of more than 1–2%, while the widely-reported level of bio-based activity in the chemical sector of 8– 10% of total output was firmly challenged on the basis of definition.

This is not to say concrete progress is not being made. Besides green polymers, producers are looking for green ingredients in a range of chemical products, including surfactants, solvents, plasticizers, coatings, lubricants and elastomers. To do this, a whole range of feeds are being investigated

But the message from the Roundtable is that most chemicals will not be bio-based any time soon, and that until the regulatory framework is revamped, especially the CAP and import regimes, Europe might just miss out on the development of the bio-based economy.

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