

CO₂ as raw material for green chemistry



Dimethyl carbonate - the sustainable alternative: AkzoNobel is making giant inroads in its pursuit of one of the chemical industry's holy grails: using carbon dioxide (CO₂) as a raw material for sustainable products. And that is precisely what we at AkzoNobel Industrial Chemicals (ANIC) have achieved.

We've developed a new process using CO₂ to deliver a green product. The product in question is DMC, or in technical terms dimethyl carbonate. Used in special chemical applications and as a solvent, DMC is also suitable as a green ingredient for petrol and diesel because it's less toxic and reactive than comparable traditional products. Together with our partners, we've designed our own patented process route.

"Technologically, the primary goal of this project is to develop innovative process routes to make DMC from CO₂," explains project leader, Marcus van Schilt. "The processes must be both profitable as well as sustainable. And they must provide us with the flexibility to build up a portfolio of patent rights. We want to make a sizable contribution to AkzoNobel's ambition to achieve sustainable growth. In that respect, DMC is an excellent strategic expansion of our product range."

Sustainable and safe to use

A comparatively young chemical, DMC is still only produced on a relatively small scale. While global output is currently estimated at 400 Ktons a year - of which half is located in China - demand for DMC has grown strongly in recent times because of its green properties. It is used increasingly as a substitute for toxic products such as phosgene as well as traditional methylation agents. Other applications include as a solvent for coatings, an octane booster in petrol, and as a component of diesel.

"DMC is a highly versatile, ecofriendly product," says Van Schilt. "It's a product that exemplifies the modern chemical industry because it's sustainable and safe to use. It can be used as a substitute for existing toxic products, which pose a potential high risk for workers and communities around chemical sites. DMC has made an entire chemical production chain

more energy efficient and therefore contributes strongly to the sustainable development of the chemical industry."

Thanks to an attractive combination of competitive price and ecofriendly chemical properties, demand for DMC has grown strongly in the last 10 years. However, existing license providers historically have a strong patent position and until now have pursued a restrictive licensing policy primarily aimed at serving the polycarbonate industry where DMC is increasingly used instead of phosgene. As a result, no DMC produced in Europe is sold on the market. It is precisely for this reason that we see excellent prospects for an alternative. Since May 2011, we have had a full time business development manager working on premarketing. Initially, the focus will be within AkzoNobel, but later this will switch to the outside market."



More efficient process

DMC offers yet another bonus. The AkzoNobel technologists have succeeded in developing a production route using CO₂ as raw material. As a result, one of the chemical industry's key sustainability targets has been achieved, notably using the greenhouse gas CO₂ as the basis for green products. The conversion process is simple. First, you combine CO₂ with hydrogen to produce

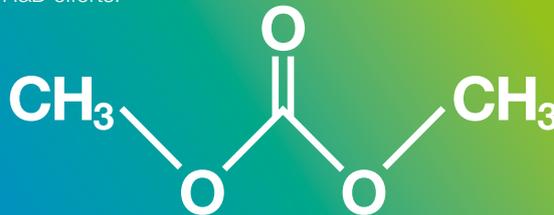
methanol. This is then converted into DMC using CO₂. Alternatively, you can begin immediately with biomethanol or buy in methanol and convert it into DMC. Both options require state-of-the-art catalytic process technology. Says Van Schilt: "We have a head start because CO₂ is widely available and we also have access to hydrogen released during the production of chlorine."

The development of this route opens the door to producing our own DMC. At present pilot studies are being prepared, while the processes and details of the design will be finalized this year. This knowledge will be used to build a pilot plant with an initial capacity of around 100 tons. Eventually, the design will be scaled up resulting in a facility capable of producing between 50 and 100 Ktons a year.

DMC - success thanks to open innovation

The DMC process consists of a combination of new catalysts and new reactor technology. Our technologists and researchers have developed the new technology together with external partners. Inside AkzoNobel, besides our own technologists, we've drawn on expertise from the laboratory in Deventer (NL); Engineering & Operational Solutions (NL); the Sustainable Development Group (Sweden); and AkzoNobel Intellectual Property (NL).

Externally, the collaboration with two research institutes, VITO in Flanders and SINTEF in Norway, in particular has been highly successful. SINTEF has the high throughput screening facilities needed to test the large numbers of catalysts and this quickly led to 240 unique catalysts, 40 of which are now being tested in depth. Without SINTEF, this process would have taken much longer. Besides these two institutes, there are also partnerships with other European knowledge institutes. Both the European Union and the Dutch government are also contributing financially to our R&D efforts.



Van Schilt is extremely proud that the door is now open to using CO₂ as a chemical building block. "We're exploiting our position as leading chemical company and market leader, in partnership with universities and industrial partners, to deliver on our ambition to achieve sustainable growth. As part of this process we're taking a new direction and that is producing high grade sustainable chemical products using CO₂. This fits into our aim to be one of the top three sustainable chemical companies in the world. In doing so, we're doing justice to our slogan to deliver 'Tomorrows Answers Today'."

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Marcus van Schilt, project leader



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AkzoNobel is a leading global paints and coatings company and a major producer of specialty chemicals. Calling on centuries of expertise, we supply industries and consumers worldwide with innovative products and sustainable technologies designed to meet the growing demands of our fast-changing planet. Headquartered in Amsterdam, the Netherlands, we have approximately 48,000 people in around 80 countries, while our portfolio includes well-known brands such as Dulux, Sikkens, International and Eka. Consistently ranked as one of the leaders in the area of sustainability, we are committed to making life more liveable and our cities more human.

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