ADIPIC ACID **DORIS DE GUZMAN** NEW YORK

Bio-adipic acid prepares for entry

Rennovia and Verdezyne plan to commercialize renewable-based adipic acid by 2014

Amid tightening supply and rising prices for global adipic acid (ADA), US start-up firms Rennovia and Verdezyne see a good chance to enter the sector with their renewable-based ADA versions.

Menlo Park, California-based Rennovia, US, which was founded in 2009, intends to start up its pilot scale bio-ADA production in December, a year after it initiated research and development (R&D) for the glucose-derived chemical.

Unlike ADA produced from cyclohexane feedstock, Rennovia's product uses glucose, which is converted into glucaric acid as an intermediate via oxidation with a catalyst. The glucaric acid is converted into adipic acid via the hydrogenation process. It produces water as a by-product.

GREEN CHEMICALS IN BRIEF

FORD TO INCREASE WHEAT-STRAW PP USE

US car manufacturer Ford Motor is increasing its use of US plastics compounding firm A. Schulman's wheat straw-based polypropylene (PP) for injection molding materials. Replacing glass fiber, mica and talc as fillers in PP composites could reduce costs by up to 10%, while replacing acrylonitrile-butadiene-styrene (ABS) with wheat straw-based PP could cut costs by 10–15%, according to Ford.

CATHAY BIOTECH PLANS BIOBUTANOL EXPANSION

Chinese biobutanol producer Cathay Industrial Biotech plans to build its second n-butanol facility either in China or the US, with capacity of around 100,000 tonnes/year. The company expects to finalize its plans by the end of the year. Cathay Biotech manufactures corn-based n-butanol for chemicals application, mostly for the domestic market.

Rennovia's preliminary cost estimates for the method is below the cash cost of the cyclohexane process operating when crude oil is at $60/bbl (€46/bbl), said president and CEO Robert Wedinger, who spoke at the Bio-based Chemicals East conference in Boston, Massachusetts, US this month.

The company's strategy is to use chemo-catalytic processing. "Not only can we leverage existing chemical manufacturing assets using catalytic chemical processes, we also have greater efficiency and scalability compared to fermentation processing," said Wedinger. "High space-time yields, temperature and solvent flexibility, high carbon efficiencies and low cost of product isolation make chemo-catalysis preferable to fermentation for many large-volume chemical manufacturing processes."

Using its high-throughput catalyst R&D infrastructure, Rennovia said it could produce gram quantities of ADA from glucose within three months of initiating the project. The firm intends to use existing infrastructure for its feedstock supply, including tapping into the oversupplied high-fructose corn syrup (HFCS) capacity.

US demand for HFCS has fallen by 2.3bn lb (1m tonnes) since 2002, said Wedinger. "We believe there are opportunities to shift corn wet mill capacity from HFCS production to renewable chemicals production without threatening food supply."

"Our big advantage here is eliminating numerous steps"

DAMIEN PERRIMAN
Vice president, business development, Verdezyne

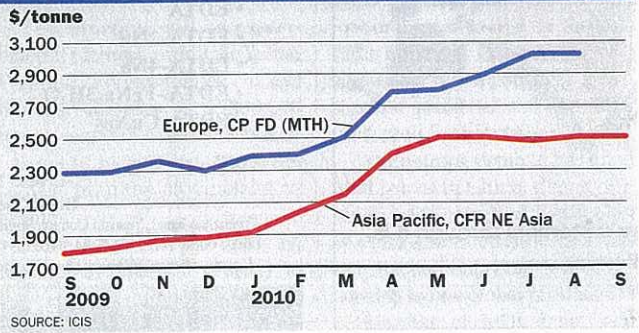
Rennovia plans to diversify to non-food-based raw materials, such as lignocellulosics, as soon as these supply chains mature.

CAPACITIES COMING SOON

Rennovia plans to scale up its bio-ADA manufacturing to a demonstration facility late next year to early 2012, and to commercial production by late-2013 to early-2014.

The capacity of the commercial plant is expected to be between 300m–500m lb/year, which is the typical production capacity of petroleum-based ADA facilities, said Wedinger.

ADA CONTRACT PRICES ARE RISING



SOURCE: ICIS

"We intend to do the semi-work and commercial-scale facilities with a partner. We are already engaged with people from the value chain, coming from both upstream feedstock suppliers and downstream consumer manufacturers," he noted.

Verdezyne, based in Carlsbad, California, US, has also been working with its bio-ADA for a year and aims to scale up from laboratory to pilot production next year. The company produces ADA via fermentation processing using sugar, plant-based oils or paraffin as feedstock.

According to Damien Perriman, Verdezyne's vice president of business development, the company is looking for a partner for the pilot facility. Commercialization is expected in 2014–2015. Perriman also spoke at the Bio-based Chemicals East event.

"Our goal is to license the use of our microorganisms and the processing technology for making [ADA] to interested parties or partners," said Perriman. "[ADA] is such an enormous market and we feel that licensing our process is the best way to reach the entire market in a faster manner."

Depending on feedstock used, Verdezyne estimated its processing to have a 20–30% cost advantage in the long run over petrochemical-based ADA. Its process will be cost-neutral if petroleum oil prices fall as low as $40/bbl, said Perriman.

"Our big advantage here is eliminating numerous steps typically seen in making [ADA] from cyclohexane, where each step has yield losses," he said. "With fermentation processing, you're essentially converting the raw material to [ADA] in a single step."

Another advantage, added Perriman, is to be able to build smaller-scale fermentation plants for a fraction of the volume risk across different regions based on the locally available feedstock that they can use.

European petchems at a disadvantage
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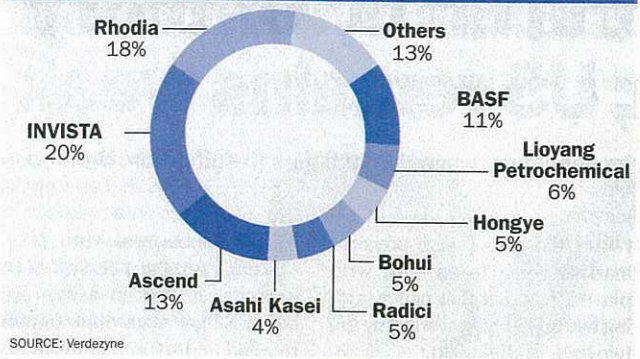
GLOBAL ADA PRODUCERS AT A GLANCE



SOURCE: Verdezyne

"The scenario here is to have a facility making feedstock choices. Smaller-scale facilities provide less capital risks compared to a new large-scale chemical plant," said Perriman.

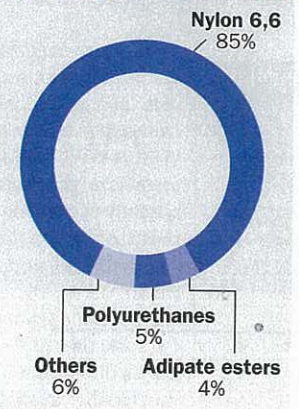
ADA ATTRACTION

Rennovia estimated the global ADA market size at 4.8bn lb, with a growth rate of 3–5%/year. The global operating rate for ADA this year is estimated at 85%, compared with 95% last year, said Wedinger. Verdezyne also estimated the market at 4.8bn lb last year, with a growth rate of 4.3%/year. It chose ADA because of the strong consumer market pull in footwear, automobiles and electronics, said Perriman.

"Engineering plastics is an area where new application developments are especially looking for more sustainability value, such as using renewable-based materials," added Perriman.

The majority of ADA goes into the production of nylon 6,6, accounting for 85% of demand in North America, according to US consulting firm Nexant . Polyurethanes (PUs) account for 5% of demand, followed by ADA esters, at 4%.

DEMAND IN NORTH AMERICA, 2009



SOURCE: Nexant

"There is now the possibility of creating 100% bio-based nylon from ADA"

ROBERT WEDINGER
President and CEO, Rennovia

Wedinger pointed out the possibility of now being able to create 100% bio-based nylon since ADA can also be converted into adiponitrile (ADN), which can then be converted into caprolactam (capro), the precursor to nylon 6.

"[ADA] was once largely used to produce [ADN] by dehydration of the diamide, but cheaper butadiene [BD] has kicked out this route into oblivion. But the price of [BD] has been going up and the market has been volatile," said Wedinger.

ICIS estimated the September contract price for European ADA at $1.36–1.40/lb, FD (free delivered), NWE (northwest Europe). The Asian contract price was at $1.11–1.15/lb, CFR (cost and freight), NE (Northeast) Asia.

Rennovia estimated the US ADA price at $1.25/lb, while Verdezyne noted the spot price had skyrocketed to around $1.75/lb, because of the global shortage of ADA. Reduced operating rates and global capacity reductions last year were the drivers for the tightening market, said Perriman. ■