

US Novomer developing process for Acrylic acid from CO₂, ethylene

DATE : 2013-09-20

US renewable chemicals firm Novomer is developing a process that produces acrylic acid (AA), which is typically propylene-based, from ethylene, enabling it to take advantage of the North American shale gas boom.

Novomer's catalytic process uses the sequestration and conversion of waste carbon dioxide (CO₂) and ethane-rich shale gas to produce mass market chemicals such as acrylic acid, butanediol and other commodities used in paints, coatings, textiles and diapers.

Production of the "drop-in" chemicals is expected to reach pilot scale of 2,000 tonnes/year by 2016 and commercial scale by 2017, thanks to a \$5m (€3.7 m) grant from the US Department of Energy (DOE) and a partnership with a global industrial gases producer.

The partner, whose name has not been disclosed, will use a solid oxide electrolysis process to convert waste CO₂ into carbon monoxide (CO). By using CO₂ as a raw material, the carbon footprint could be reduced by 40-110%, depending on the target chemical, Novomer said.

Then, Novomer's catalytic process will convert the CO output from the solid oxide electrolysis, as well as ethylene oxide (EO), into acrylic acid and other chemicals. The company's homogeneous catalysts will make an intermediate called propiolactone, which is then converted into acrylic acid.

"The catalyst used, we feel, is very innovative," said Mike Slowik, director of chemicals at Novomer. "It's 99% selective, which means no raw materials are wasted in the process, and it operates at moderate temperatures of 30-50 degrees Celsius, compared to other catalysts that typically operate at 200-250 degrees Celsius."

The sequestration of waste gases occurring with only moderate temperature requirements, coupled with the savings from using electrolytes to convert raw materials into CO and from taking advantage of cheap ethylene derivatives in shale gas, could lower production costs by 20-40%, he said.

"It's really about the feedstocks, and CO₂ is a low-cost starting material that composes about 50% of the acrylic acid," Slowik said.

"With ethylene, there's been about 30% new ethylene capacity being announced in the US Gulf region because of the shale gas phenomenon," he said.

The advent of shale gas has caused many US crackers to switch to lighter feedstocks such as ethane, which produces a lot of ethylene. However, ethane produces less co-products such as propylene.

Because the advent of shale gas has also led to ample supplies of low-cost propane in the US, several companies have announced plans to build propane dehydrogenation (PDH) plants to bring on more propylene capacity.

Still, Slowik said this should not hinder Novomer's acrylic acid from remaining competitive.

"PDH plants are capital intensive, and the derivatives are low cost, so we're very confident, even if propylene comes online," he said.

If successful, Novomer's technology could lead to the first acrylic acid plant built in the US in more than 10 years, the company said. It also could allow US producers to become global low-cost leaders in chemical intermediates and vastly reduce dependencies on crude oil markets.

"We think it'll happen rather quickly, assuming we can hit the cost-savings target of 20-40%, because we already have significant amount of interest with chemical companies wanting to partner with us," Slowik said. "We have discussed this with chemical companies that either are in the acrylic acid industry today or have a lot of ethylene derivatives, and they are very interested in our technology."

For its existing partner, the process would increase the demand for CO.

"Any new technology for CO that is lower energy is something we have a similar cost interest in," Slowik said.

Additionally, Novomer believes its technology could increase energy productivity of chemical manufacturing by 30-70%, as well as provide energy savings of over 20tr BTUs/year within 10 years.

"This technology platform has the potential to have a transformational impact on the US chemicals industry," said Jim Mahoney, CEO of Novomer. "We are proud of what has been accomplished to date and excited for the future as we continue to commercialize the technology."

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