



## Breakthroughs

# Making Plastic From Sugar

Kerry A. Dolan, 09.16.08, 11:00 AM ET

BURLINGAME, CALIF. -Making plastic just got a whole lot sweeter.

Nudged in large part by higher oil prices, a wave of innovation is sweeping the petrochemicals industry. A handful of companies large and small have been working on replacing petroleum-based ingredients in chemicals with renewable ingredients. In the latest development, Genomatica, a small, private sustainable-chemicals company in San Diego, says it can now make thousands of tons of a foundational chemical in plastics using sugar instead of a petroleum-based ingredient.

Genomatica Chief Executive Christopher Gann says the process uses sugar to make 1,4 butanediol, a chemical building block known as BDO. Although he's coy about citing figures, he says the process will eventually be cheaper than conventional techniques even if the price of oil drops to \$50 a barrel. The annual global market for BDO is about 3 billion pounds, or \$4 billion; it's used in plastics, solvents, pharmaceuticals, automotive components and apparel fibers.

"We can also make this at a much lower temperature and without using pressure," says Gann, a veteran of Dow Chemical who joined Genomatica in March.

Scientists at Genomatica genetically engineered *E. coli* bacteria to consume sugar and produce BDO. Developing the process has been swift. Gann boasts that Genomatica went from a computer model of the process to a genetically-engineered bacteria able to produce the chemical building block in about a year. It took another year to ramp up production to industrial scale.

By contrast, Gann points out, it took chemicals giant DuPont working with industrial enzyme company Genencor (now a unit of Denmark's Danisco) more than a decade, beginning in 1995, to engineer *E. coli* bacteria to eat corn glucose and spit out a chemical building block called 1,3 propanediol, known as PDO.

To be sure, Genomatica doesn't have any customers yet and still needs to lower production costs. Gann says the company aims to announce its first customer next year. DuPont, meanwhile, partnered with U.K. sugar company Tate & Lyle to make PDO and began marketing it in late 2006.

Gann plans to license Genomatica's technology to a range of chemical producers. "This will help them lower their costs and improve their environmental footprint," he asserts.

Genomatica is also studying how much greenhouse gas emissions can be reduced with its process. In addition to using less energy than the standard petrochemical process, Genomatica's biology-based BDO production requires less capital equipment. The *E. coli* eat the sugar and then ferment for two to three days before Genomatica adds the material to a traditional chemical production line.

Genomatica, which was founded in 2000 by two biology professors from the University of California, San Diego, raised \$20 million earlier this year from venture capital firms Mohr Davidow, Draper Fisher Jurvetson and Alloy Ventures. Gann says the company has seven more sustainable chemicals in its pipeline.

Others pushing forward in the green chemicals space include Novomer of Ithaca, N.Y., which is using chemical processes to make renewable chemicals such as binders for making fuel cells. Another is Elevance Renewable Sciences of Lisle, Ill., which in early September announced a partnership with Dow Corning to market naturally-derived ingredients including a soy wax for cosmetics and personal care products.

In perhaps the biggest undertaking, Dow Chemical is constructing a plant in Brazil to make polyethylene out of sugar cane. Dow will take sugar-cane ethanol and turn it into ethylene and then polyethylene. The plant is scheduled to start producing in 2011.

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