



PROCESS TECHNOLOGY

Sugar Replaces Petroleum in Major Chemical Process

Genomatica Inc, a San Diego-based sustainable chemical company, has proven a novel bio-manufacturing process capable of producing thousands of tons of a commodity chemical in a single facility. The process is expected to offer substantial cost savings to chemical producers compared with petrochemical-based processes, as well as providing a 100% renewable pathway by using sugar instead of petroleum as the main input.

The foundational chemical, 1,4-butanediol (BDO), is a key raw material in the manufacturing of hundreds of plastic, rubber and fiber products. BDO has a worldwide annual production value estimated at more than \$4 billion across the automotive, textile and consumer goods industries.

“What has us very excited is having been able to effectively produce a valuable chemical, BDO, inside a microorganism. This was first achieved in February 2008 and we were not only able to increase the output out of the microorganism by a thousandfold, but we also made sure the microorganism could withstand industrial concentrations needed to produce large volumes of BDO at reduced cost,” says Christopher Gann, chief executive officer.

Genomatica scientists altered *E. coli* bacteria to produce BDO through traditional genetic modification, which is guided by detailed designs created with proprietary computational modeling techniques. With these models, the company explored ways to make the targeted chemical and then zeroed in on the optimal designs, providing the precise ‘blueprints’ for further development.

Because of rising oil and natural gas prices, the search for new processes to produce existing high-

volume chemicals from alternative feedstocks in a cost-competitive manner has intensified. Genomatica is using biotechnology to meet demand for greater feedstock flexibility and sustainability. BDO is the first product the company has disclosed in its rapidly maturing pipeline, which targets several other commodity chemicals to be produced using microorganism-based fermentation.

“We believe that this technology has the ability to change the face of chemical manufacturing. Chemical manufacturing takes lots of molecules and changes them in one fell swoop,” explains Gann. “We are taking sugar and having lots of micro-organisms each produce a little bit, which adds up.”

Renewable feedstocks provide significant economic as well as environmental advantages. With a fermentation-based process, it is not necessary to transport hydrocarbons, which are not as safe or easy to transport as water and sugar. In addition, the fermentation process does not need the high temperatures and high pressures of current chemical manufacturing.

“The things associated with the amount of capital to build a plant, the amount of energy to run a process, or the safety surrounding the process end up being the things that support a biological-based process. Now, you can also build smaller units that no longer need to be hooked up to a refinery and you can set up your facility independently or much closer to where you need the molecule to be consumed,” says Gann.

Genomatica is currently working to improve the yield and productivity of its BDO process while scaling manufacturing output to meet the demands of large bioreactors. The company estimates that within a year its BDO process will cost less than

non-renewable hydrocarbon-based processes, even if oil prices drop to \$50 per barrel.

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