Nano World: Nano replacement for petroleum

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The petroleum used to make adhesives, coatings and in the future, inks and even plastics, could get replaced with nanoparticles of sugar and starch, experts told UPI's Nano World.

The starch in the nanoparticles comes from crops, a renewable resource, unlike petroleum, said John van Leeuwen, chairman and chief executive officer of biomaterials company Ecosynthetix in Lansing, Mich.

"Every $10 increase in a barrel of oil leads to an $80 billion a year impact on the national economy," van Leeuwen added. "Our technology became interesting once oil went above $25 a barrel."

Cardboard manufacturers alone currently use roughly four billion pounds of starchy adhesive a year across 1,700 plants worldwide to glue together the paper layers that make up corrugated containers, van Leeuwen explained. This market alone represented $3 billion in 2005.

Natural starch particles are roughly 30 microns or millionths of a meter wide. Ecosynthetix bases its technology on converting these granules into ones just 50 to 150 nanometers or billionths of a meter large. At that size, the nanoparticles have 400 times more surface area than natural starch granules. This means they require less water when in use for adhesives and thus less time and energy to dry. Instead of running at 350 degrees F, drying can take place at room temperature instead, saving $1 million in natural gas per year, van Leeuwen said.

"You get higher output due to reducing the cooling time needed, and there's also less warping of the paper due to lack of heat, which leads to higher paper strength," van Leeuwen added. Ecosynthetix is now converting two plants to run on their adhesives.

The nanoparticle adhesives could also help replace the polyvinyl acetate, PVA, and polyvinyl alcohol, PVOH, used to help laminate graphics onto cardboard. The market for PVA and PVOH in lamination was $1.3 billion in 2005, van Leeuwen said. The company's first customer in this application is a large Ohio producer of McDonald's clamshells, he added.

The nanoparticles could also find use as the first biosynthetic waterborne starch latex, to replace up to 75 percent of the petroleum-based latex known as SBR, used nowadays as a binder in paper coatings, which constituted a $2 billion market in 2005. "The price of SBR latex keeps rising, up 100 percent in the last three years, with another 10 to 20 percent rise expected in 2006. We could price 20 to 25 percent below PVA and SBR to gain entry and market share," van Leeuwen said.

"What they're offering is quite impressive -- if it's accepted by the market," said Neil Gordon, president of the Canadian NanoBusiness Alliance and nanotechnology industry analyst with Montreal-based technology analyst firm Sygertech. "Their biggest challenge, as it is for any nanomaterials company is securing the first major account."

"We hope in the next couple of months for our first large customer to sign up to use this new binder," van Leeuwen said.

A large number of resins used in the multibillion-dollar ink and toner industry also mostly are based on petroleum. "Our technology looks good for that space. We've gotten good initial results there, although we haven't launched products for that industry yet," van Leeuwen said.

Ecosynthetix could in the future also help create biopolyesters as construction blocks for plastics. DuPont has already demonstrated a biopolyester, van Leeuwen noted, "but our technology would create a biopolyester that is the other commonly used building block."