Lubricants from vegetable oil

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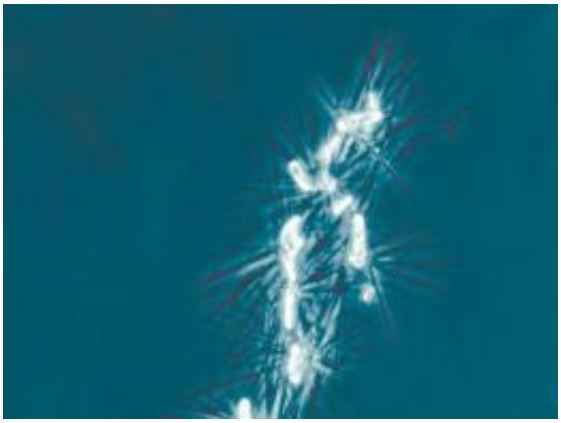

This shows tensides as needle-shaped crystals: Extracted from epoxies of domestic plants. Credit: © Fraunhofer

Epoxides are highly reactive organic compounds comprised of a triple ring with two carbon atoms and one oxygen atom. Among other things, the chemicals industry uses them for the production of lubricants for vehicles and engines, as well as surfactants and emulsifiers for detergents and cleansers. Until now, epoxides have been based primarily on source materials procured from petroleum. Researchers at the Fraunhofer Institute for Interfacial Engineering and Biotechnology IGB have engineered a chemical-enzymatic process that now enables vegetable oil-based production, at lower temperatures and under more environmentally-friendly conditions.

The Fraunhofer Center for Chemical-Biotechnological Processes CBP in

Leuna has made this technology ready for industrial application. Starting October 2012, the findings obtained in the laboratory will be scaled up to an even larger volume. Quantities of up to 100 liters will be possible at the new center. That corresponds to a 70 kilogram-batch of epoxides. In the laboratory this reaction yielded batches only in the grams range. The 14 partners in the "Integrated BioProduction" project will be working until April 2014 on engineering a process for procuring epoxides, made from domestic vegetable oils, for industry use.

Using by-products from the food industry

The foods that are suitable for epoxides production include, for example, the oils of mustard, elder seed, crambe (Abyssinian cabbage) and dragonhead. To some extent, these oils emerge from food production as by-products, but are not themselves used as food. The epoxide is procured in Leuna from fluid oils, or fatty acids as well, with the aid of chemical-enzymatic epoxidation. In contrast to the established, pure chemical variety, the enzyme lipase here catalyzes peracid, the epoxidation medium. The main benefits are that the enzyme is easier and more efficient to handle. In comparison to many other chemical reactions, they operate at moderate temperatures, at neutral pH values and under normal pressure. At the same time, the enzymes conduct the epoxidation only on the designated sites in the molecule, and without side reactions.

"Even if the petrochemical process can never be completely replaced – the potential for sustainable raw materials in the chemicals industry is immense. In 2009, roughly 14 million tons of vegetable oil was used for chemical-technical products, compared to about 400 million tons of mineral oil in the same year. To reduce the dependence on petroleum and carve out potential savings in CO2 equivalents, the industry needs ultramodern biorefineries. In Leuna, we are creating just the right processes for this," explains Dr. Katja Patzsch, group manager for

biotechnological processes at CBP.

The "Integrated BioProduction" project

The project "Integrated BioProduction" is sponsored by the German Federal Ministry of Food, Agriculture and Consumer Protection BMELV. The spotlight of the research activities is on increasing the use of sustainable raw materials – primarily domestic plant-based oils – for production of synthetic components for the chemical industry. In the first phase, which ends April 2012, the researchers selected and evaluated relevant plant oils, developed and tested chemical and biotechnological conversion processes on the laboratory scale, and identified suitable catalysts. In the second phase, scheduled until 2014, the focus shifts to optimization and the adjusting selected processes to a scale that is relevant to industry; here, the Fraunhofer Center CBP acts as the interface. Starting October 2012, the large-scale facilities and processes will be tested in conjunction with project partners Addinol Lube Oil GmbH, Dracosa AG, DHW Deutsche Hydrierwerke GmbH Rodleben, Taminco GmbH, Umicore AG & Co. KG, Linde Engineering Dresden GmbH, Eucodis Bioscience GmbH, Thüringer Landesanstalt für Landwirtschaft (Agricultural Institute for the State of Thüringen), InfraLeuna GmbH, Martin Luther University Halle-Wittenberg, the Fraunhofer Institute for Interfacial Engineering and Biotechnology IGB, the Fraunhofer Institute for Chemical Technology ICT and the Karlsruhe Institute of Technology KIT.

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