A novel enzymatic catalyst for biodiesel production

July 4 2011

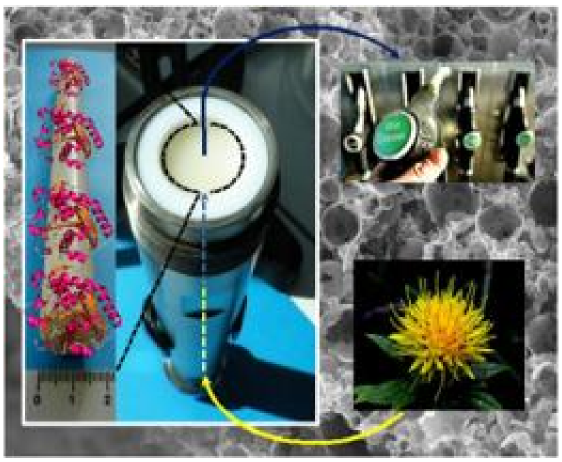

Diagram showing the enzyme biocatalytic reactor and its unidirectional continuous flow operation that uses enzymatic catalysis to turn triesters into biodiesel. © CNRS

Continuous production of biodiesel can now be envisaged thanks to a novel catalyst developed by a French team at CNRS's Centre de Recherches Paul Pascal (CRPP). The results, which have been patented, have just been published in the journal *Energy & Environmental Science.*

Biofuel production provides an alternative to fossil fuels. Biodiesels, for instance, are processed products based on oils from oleaginous plants such as oilseed rape, palm, sunflower and soybeans. They result from a chemical reaction, catalyzed in either an acidic or preferably a basic medium, between a vegetable oil (90%) and an alcohol (10%). This reaction, known as transesterification, converts the mixture into a methyl ester (the main constituent of biodiesel) and glycerol. A saponification side reaction (methyl ester conversion into the corresponding acid salt) reduces methyl ester yield. To increase the yield, it was therefore necessary to develop alternative catalysts.

For this type of reaction, certain enzymatic catalysts such as those belonging to the family of lipases (triglyceride hydrolases) are particularly efficient and selective. However, their high cost and low conformational stability restrict their industrial use, unless they can be irreversibly confined in porous matrices, allowing good accessibility and enhanced mass transport. This has now been achieved by the team led by Professor Renal Backov.

In an initial study, they had already demonstrated the possibility of efficient catalysis, by developing modified silica-based cellular matrices that make it possible to confine lipases in order to obtain exceptional yields for hydrolysis, esterification and transesterification reactions. Their work had also shown that unpurified enzymes could be used in the matrices. The fact that they were unpurified was a first step to significantly reducing the cost of biocatalysts. However, the methodology did not allow continuous biodiesel production. This obstacle has now been overcome.

Researchers have developed a new method that generates the cellular hybrid biocatalyst in situ inside a chromotography column. This novel approach makes it possible to carry out continuous, unidirectional flow synthesis over long periods, since catalytic activity and ethyl ester production are maintained at high, practically steady levels during a two-month period of time. These results are amongst the best ever obtained in this field.

Research is continuing into solvent-free conversion of triesters, aimed at minimizing waste production and curbing the use of solvents and metals in chemical transformation processes. This work, which meets current energy and environmental requirements, shows how much chemists are working in the public interest, and confirms the importance of integrative chemistry.

More information: References:

-- “Enzyme-Based Biohybrid Foams Designed for Continuous Flow Heterogeneous Catalysis and Biodiesel Production”, N.Brun, A.Babeau-Garcia, M.-F.Achard, C.Sanchez, F.Durand, L.Guillaume, M.Birot, H.Deleuze and R.Backov - *Energy & Environmental Science*, 2011 DOI:10.1039/C1EE01295A

-- Catalyseur enzymatique hétérogène, procédé de préparation et utilisation pour la catalyse enzymatique en flux continu. N.Brun, H.Deleuze, C.Sanchez and R.Backov. French patent 2010. File number FR10-56099.

Provided by CNRS