Cheaper second-generation biofuel for cars

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Producing second-generation biofuel from dead plant tissue is environmetally friendly - but it is also expensive because the process as used today needs expensive enzymes, and large companies dominate this market. Now a Danish/Iraqi collaboration presents a new technique that avoids the expensive enzymes. The production of second generation biofuels thus becomes cheaper, probably attracting many more producers and competition, and this may finally bring the price down.

The world's need for fuel will persist, also when the Earth's deposits of fossil fuels run out. Bioethanol, which is made from the remains of plants after other parts have been used as food or other agricultural products, and therefore termed "second generation", is seen as a strong potential substitute candidate, and countries like the United States and Brazil are far ahead when it comes to producing bioethanol from plant parts like corn or sugar canes. Corn cubs and sugar canes are in fact plant parts that can also be used directly as food, so there is a great public resistance to accept producing this kind of bioethanol. A big challenge is therefore to become able to produce bioethanol from plant parts, which cannot be used for food.

"The goal is to produce bioethanol from cellulose. Cellulose is very difficult to break down, and therefore cannot directly be used as a food source. Cellulose is found everywhere in nature in rich quantities, for example in the stems of the corn plant. If we can produce bioethanol from the corn stems and keep the corn cubs for food, we have come a long way", says Per Morgen, professor at the Institute of Physics, Chemistry and Pharmacy, University of Southern Denmark.

Cellulose is organized in long chains in the plant's cell walls, and they are hard to break down. However, it is not impossible: There are on the market various patented enzymes that can do the job and break down cellulose into sugar, which then is used to produce bioethanol.

"But the patented enzymes are expensive to buy. We are proud to now introduce a completely enzyme-free technique that is not patented and not expensive. The technique can be used by everybody ", explains Per Morgen.

Together with colleagues from the University of Baghdad and Al-Muthanna University in Iraq, he explains that it is not an enzyme, but an acid that plays the main role in the new technique. The acid is called RHSO3H, and it is made on the basis of rice husks.

"My Iraqi colleagues have made the acid from treated rice husk. The worldwide production of rice generates enormous amounts of rice husk and ashes from burning the husk, so this material is cheap and easy to get hold of", he says.

It's all about the acid

The ashes from burnt rice husks have a high content of silicate, and this is the important compound in the production of the new acid. The scientists paired silicate particles with chlorosulfonic acid and this made the acid molecules attach themselves to the silicate compounds.

"The result was an entirely new molecule - the acid RHSO3H - which can replace the enzymes in the work of breaking down cellulose to sugar", explains Per Morgen.

He is particularly proud that all levels in this new way of producing bioethanol are environmentally friendly and accessible for all: The

catalyst acid is made from readily available plant left overs, and it can be reused many times. The recipe cannot be patented and the bioethanol is produced from cellulosic plants that cannot otherwise be used for anything else."Cellulose is the most common biological material in the world, so there is plenty of it", he adds.

Since 2010 it has been mandatory in Denmark to add five per cent ethanol to all gasoline sold in the country. You can add up to 85 per cent bioethanol to gasoline, and this is common in several South American countries. Danish research institutions and DONG Energy (denmark) have great focus on how to produce bioethanol from otherwise useless crop residues such as straw.

The use of bioethanol instead of gasoline reduces the CO2 emissions from cars and fossil fuel consumption.

How did the scientists make the new acid?

3 grams of ash from burned rice husk were mixed with 100 ml of caustic soda (NaOH) in a plastic container. The solution was stirred for 30 minutes at room temperature so that the ash content of the silicate was converted to sodium silicate. To the solution was added nitric acid to control its concentration, and then chlorosulfonic acid was added. When the pH approached 10, a white gel began to form. The addition of nitric acid was continued until the pH reached 3, where after the gel rested for 24 hours at room temperature. Then it was centrifuged six times with distilled water and finally the product was purified with acetone. The product was then dried at 110 degrees Celsius for 24 hours and grounded into a fine powder weighing 6.4 grams. This powder was RHSO3H.

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