Chemicals and biofuel from wood biomass

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A method developed at Aalto University in Finland makes it possible to use microbes to produce butanol suitable for biofuel and other industrial chemicals from wood biomass. Credit: Mikko Raskinen

(PhysOrg.com) -- A method developed at Aalto University in Finland makes it possible to use microbes to produce butanol suitable for biofuel and other industrial chemicals from wood biomass. Butanol is particularly suited as a transport fuel because it is not water soluble and has higher energy content than ethanol.

Most commonly used raw materials in butanol production have so far been starch and cane sugar. In contrast to this, the starting point in the Aalto University study was to use only lignocellulose, otherwise known as wood biomass, which does not compete with food production. Another new breakthrough in the study is to successfully combine modern pulp - and biotechnology. Finland's advanced forest industry

provides particularly good opportunities to develop this type of bioprocesses.

Wood biomass is made up of three primary substances: cellulose, hemicelluloses and lignin. Of these three, cellulose and hemicellulose can be used as a source of nutrition for microbes in bioprocesses. Along with cellulose, the Kraft process that is currently used in pulping produces black liquor, which can already be used as a source of energy. It is not, however, suitable for microbes. In the study, the pulping process was altered so that, in addition to cellulose, the other sugars remain unharmed and can therefore be used as raw material for microbes.

When wood biomass is boiled in a mixture of water, alcohol and sulphur dioxide, all parts of the wood – cellulose, hemicellulose and lignin – are separated into clean fractions. The cellulose can be used to make paper, nanocellulose or other products, while the hemicellulose is efficient microbe raw material for chemical production. Thus, the advantage of this new process is that no parts of the wood sugar are wasted.

In accordance with EU requirements, all fuel must contain 10 per cent biofuel by 2020. A clear benefit of butanol is that a significantly large percentage – more than 20 per cent of butanol, can be added to fuel without having to make any changes to existing combustion engines. The nitrogen and carbon emissions from a fuel mix including more than 20 per cent butanol are significantly lower than with fossil fuels. For example, the incomplete combustion of ethanol in an engine produces volatile compounds that increase odour nuisances in the environment. Estimates indicate that combining a butanol and pulp plant into a modern biorefinery would provide significant synergy benefits in terms of energy use and biofuel production.

The project run by Aalto University is part of the Biorefine technology

programme, which is primarily funded by Tekes, the Finnish Funding Agency for Technology and Innovation.

The Biorefine programme is developing new competence based on national strengths and related to the refining of biomass. The overall aim of the project is to increase the refining value of forest residues that cannot be utilised in, for example, the pulp process. The research has been developed by Professor Aadrian van Heiningen and Tom Granström and a group of researchers at Aalto University. Results of findings have been published in scientific journals such as Bioresource Technology. The developed technology has been patented.

More information: Survase, S.,Sklavounos, E., Jurgens, G., van Heiningen, A., Granström, T., Continuous Acetone-Butanol-Ethanol fermentation using SO2-ethanol-water spent liquor from spruce, *Bioresource Technology* (2011) doi:10.1016/j.biortech.2011.09.034

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