Biomass pre-treatment for hydrogen fermentation

Steef Lips and Rob Bakker

The project

Hydrogen will be an important energy carrier in the future. The concept of HYVOLUTION is based on the exploitation of bacteria, which freely and efficiently produce pure hydrogen as a by-product during growth on renewable resources.

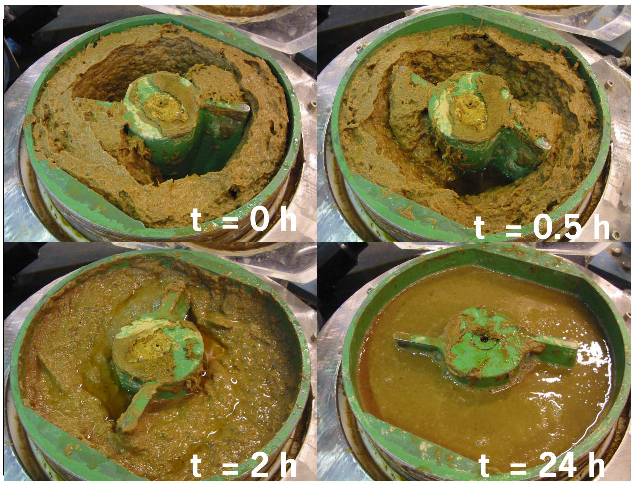
Raw materials

Our partners in the project focus on sugar rich crops like sugar beet and Sweet Sorghum as raw materials. As growing of energy crops is not economic in The Netherlands, we focus on industrial or agricultural by-products such as side-streams from potato- and cereal processing. These raw materials have to be converted into sugars and organic acids to be able to use them as a substrate for hydrogen fermentation. Potato Steam Peels (PSP) are chosen for their high starch content which is easily to hydrolyze. Barley Straw (BS) is chosen as a model for lignocellulosic raw materials for which an alkaline treatment is chosen to make the cellulose accessible for enzymatic hydrolyses. Wheat bran (WB) has a medium starch and (hemi)cellulose content. Experiments are performed on laboratory scale and small technical scale from 2 to 50 litres.

50 litre conical screw reactor

Co-products

PSP: protein rich fibre for feed
BS: lignin as replacement of phenol in resins
WB: proteins for feed



Enzymatic hydrolysis of wheat straw in 2 litre pulp mixer

Chemical composition in %

Based on dry matter	Potato Peels	Barley Straw	Wheat Bran
Dry matter*	13.9	89	85.9
Ash	8.5	11.6	4.9
Protein	23.9	low	17.8
Starch	33.9	low	22.1
Hemicellulose	2.9	17.1	13.5
Cellulose	14.3	29.7	7.0
Lignin	9.5	18.6	5.9
* Based on fresh material			

Results

Each feedstock requires a dedicated pre-treatment route, that is optimized towards BioH2 production. Pre-treatment methods increase in complexity and costs, in the following order of PSP→ BS → WB.

Feedstock	Pre-treatment	Breakdown of Polysaccharides
PSP	alpha-amylase → glucoamylase	95 – 97% (starch)
BS	Alkaline → cellulase	60-70%
WB	alpha-amylase → Alkaline→cellulase +glucoamylase	50 - 80%

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The aim of HYVOLUTION is to develop a blue-print for non-thermal decentral hydrogen production process using local biomass. HYVOLUTION is an integrated project, funded by Framework Programme 6 of the EC.

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