2G-Ethanol Technology demonstration at 1 TPD scale

New Delhi, Jan 15: A 2G-Ethanol Technology has been demonstrated at 1 TPD scale, with a steam explosion pilot plant at 300 Kg/Day scale. This technology is being taken up for further scale up and demonstration at 12 Tons/day scale by Oil Marketing Company. Indigenous Enzyme development for biomass hydrolysis is being supported in mission mode.

(i) Cellulitic Enzyme Development

Enzymes for lignocellulosic pretreatment, such as beta-glucosidase, cellobiohydrolase, endoglucanase and LPMO have been isolated, characterized and engineered. Several novel enzymes and auxiliary proteins for biomass hydrolysis were identified mostly from fungi by two DBT –Bioenergy Centers. The DBT-ICGEB Centre has genetically engineered a fungus for production of an active enzyme preparation with a specific activity that is comparable to the commercial enzyme, CTec3 from Novozymes. However, the team is working to increase the titer to lower overall enzyme production cost.

The DBT-IOC Centre has developed a fungal mutant that produced about 12 FPU/ml of culture broth at 5 Litre scale. This enzyme technology has been scaled up to 5,000 L bioreactor with more than 10 FPU/ml enzyme titer value. Specific strategies for improving the specific activity of the enzyme and rate of production have been recommended to increase productivity of a highly active enzyme. Efforts are on for scale-up, cross validation, demonstration and IP protection.

DBT- ICT has evaluated the enzymes developed by ICGEB/ IOC Centres by making cocktails with β-glucosidase (BGL) addition and comparing the mixtures with commercial samples. This has helped other Centres as a good third-party evaluation. The DBT-Pan-IIT Centre produced a structure-based engineered β-glucosidase, a chimera of endoglucanase-βglucosidase, as supplements to fungal enzyme cocktails.

Hyperthermophile enzyme hydrolase research centre (HERC) has been set up at IISER Mohali as a repository for thermophilic and hyperthermophilic organisms and their enzymes. This centre has cloned and produced several carbohydrate active enzymes which will be evaluated for use in 2G Ethanol and biorefinery applications.

(ii) Improved Fermentation of hexoses and pentose

A yeast strain that can ferment both hexoses and pentoses rapidly is a critical need for higher yields of alcohol. Hence efforts taken by DBT-IOC Centre in which a two-stage fermentation protocol developed in which hemicellulosederived sugars are fermented first before enzymatic release of glucose from cellulose and further fermentation of glucose to ethanol. This integrated process avoids catabolite repression and supports almost complete fermentation of initial xylose.

A genetically modified yeast strain (FM19) was constructed at DBT-ICGEB center for xylose fermentation This strain fermented a mixture of 50g/L glucose and 50g/L xylose and produced 41g/L ethanol at a yield of 0.47 g ethanol /g of total sugar fermented: resulting in highest volumetric productivity and highest specific productivity.

(iii) Lignin Valorization

Lignin Valorization is important to overall make the 2G ethanol cost effective. Hence under this study Post-fermentation 2G lignin residue was fractionated by solvent extraction to lignin, silica and carbohydrates. Proof of concept demonstrated for production of levulinic acid & lactic acid from the carbohydrate fraction. Utilization of 2G lignin residue as such in bitumen is also being explored.

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