



SWEET SORGHUM TO ETHANOL

Technology, Plant & Machinery

Conventionally, Ethanol has been produced from sugar bearing feedstocks like cane/beet juice and molasses or from starch based feedstocks like wheat, corn or even tubers like cassava.

Application of alcohol as transport fuel has created a need for newer energy feedstocks.

Praj undertook a programme for introduction of one such feedstock, namely Sweet Sorghum. The driving factors in the selection of such a feedstock was,

- Relatively low water requirement for cultivation and processing
- Wider adaptability
- High yields
- Co-product possibility.

Sweet Sorghum as a new feedstock for bioethanol:

PRAJ, through its Development Center (Matrix- the Innovation Center), conducted studies and evaluated options for optimizing sweet sorghum based alcohol production. This effort was conducted in two phases:

- Agricultural trials and studies for evaluating suitability, technical feasibility and commercial viability of using various sweet sorghum varieties as direct feedstock for alcohol, either singly or in combination.
- Experimentation, trials and scale-up of viable process technology for industrial scale alcohol production.

Merits of Sweet Sorghum as feedstock for bioethanol production:

Unlike grain Sorghum, Sweet sorghum or “Sorgo” or “kadwal” stalks are taller and juicier and have high sugar content, similar to sugarcane. Conventionally, some sweet sorghum varieties are grown for syrup production, while others are grown for forage.

The stem juice of sweet sorghum is rich in fermentable sugar and is useful for alcohol production

After study, Praj established following advantages of using sweet sorghum for alcohol manufacturing.

1. Can be uniformly grown in warm, sunny weather.
2. The crop is a known to farmers.
3. Harvesting & cultivation practices are easier and are identical to sugar cane.
4. Sweet sorghum requires less water and fertilizers compared to sugarcane.
5. Crop cycle is short- 3.5 to 4 months. Usually, two cycles are possible from same piece of land annually, provided irrigation is possible.
6. Sweet Sorghum, on crushing to extract juice, gives bagasse as co-product which can be a principal source of energy for operation of distillery in the form of boiler fuel. This practically makes alcohol production free of energy cost and improves possibility of operation in remote areas.

Table : Comparison of Sweet Sorghum with Sugarcane.

Parameters	Sugar Cane	Sweet Sorghum
Harvesting Cycle	9-14 Months	4 Months
No of cycle in a year	One	Two
Water Requirement	100%	65- 70%
Fertilizer requirement	100%	35 -40%
Stalks production, MT/Hectare/Cycle	65 to 80	42 to 55 for one cycle /year 84 to 110 for two cycles/year
Fermentable sugars concentration in stalk (% w/w)	10.0 to 14.0	9.0 -12.0
Yield of fermentable sugar, MT/Hectare/Cycle	6.0 to 10.5	3.6 to 6.2 for one cycle /year 7.2 to 12.4 for two cycles /year
Ethanol (100% basis) yield lits/Hectare /cycle	3400 to 6000	2020 to 3500 for one cycle /year 4000 to 7000 for two cycles/year
Bagasse MT/Hectare/cycle 50% w/w moisture	19 to24 (30% on cane weight)	10 to 14 for one cycle /year (25% on stalk) 20 to 28 for two cycles /year

Distilleries can be designed to operate on sweet sorghum between 6 to 10 months a year. Where cultivation season is 6-8 months, distilleries would require additional feedstock such as sweet sorghum syrup or sugar cane molasses or sugar cane juice or sugar beet.

Accordingly, sweet sorghum can be used as feedstock for alcohol in following ways:

Distilleries attached to sugar factories

These distilleries normally use molasses as feedstock. Actual production of molasses in these units takes place over a period of 4 to 7 months based on sugarcane crushing season. Molasses produced can be consumed within 4 to 6 months, depending on capacity of the distillery. Sweet sorghum can be cultivated and processed for alcohol during the additional, non-crushing season. Cane-sugar factory machinery can be used with modifications for processing sweet sorghum.

Bagasse produced can be used as fuel for generation of steam and electricity for operation of the distillery. If sweet sorghum is to be used for extended period, then separate pretreatment section (independent of sugar factory) has to be installed.

Existing or proposed standalone distilleries

In regions where favourable climatic conditions allow sweet sorghum cultivation and harvesting for more than 7

to 8 months, standalone distilleries can use sweet sorghum as major feedstock. Standalone distilleries need to install preprocessing machinery designed to extract juice from sweet sorghum and for its clarification / evaporation.

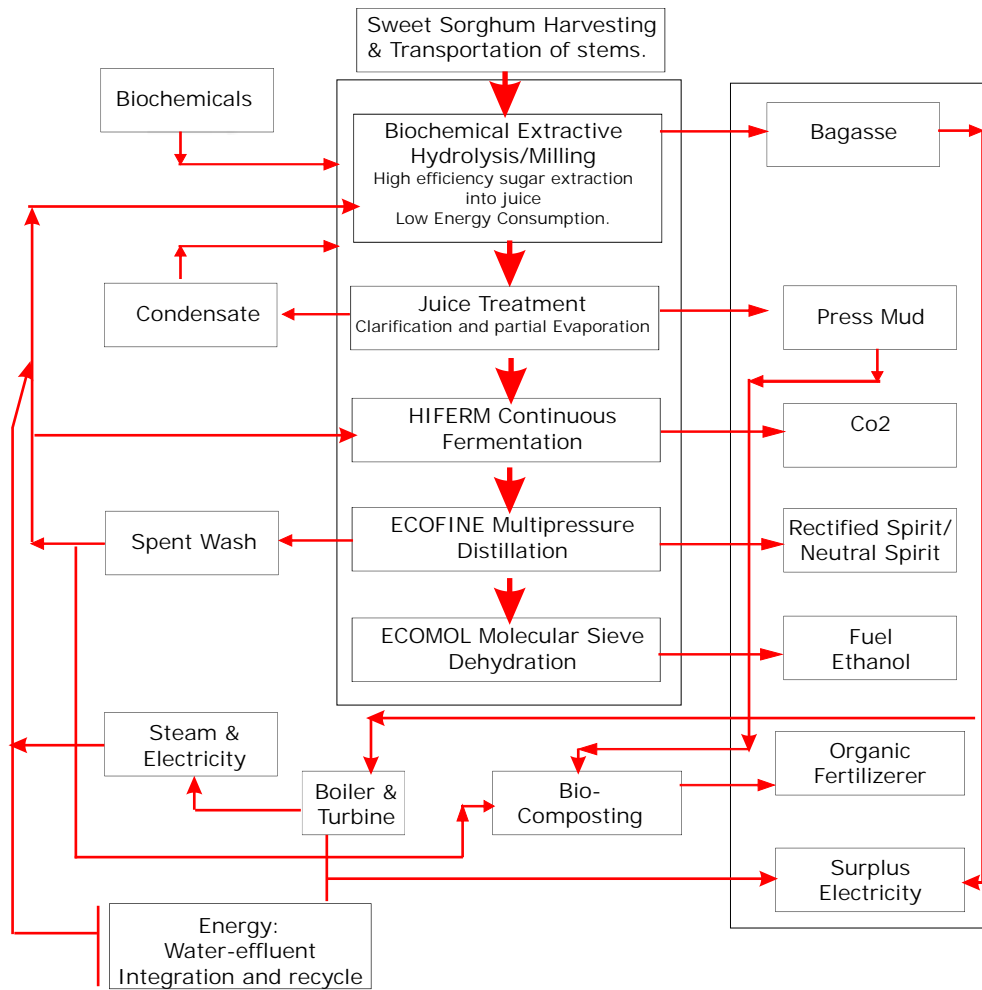
Wastewater from the distillery can be composted using press mud produced from clarification of juice. There is also the possibility of excess electricity (co-generation) generation for commercial sale. These factors reduce cost of production of alcohol.

PRAJ Technology and plant design for sweet sorghum based in distilleries:

- Low power consuming machinery for pretreatment section of new projects. Possibility of co-generation of electricity using bagasse to produce steam at high pressure.
- Low wastewater generation 2 to 3 liters / liter of alcohol. The wastewater can be composted using press mud.
- Negligible requirement of process water for distillery operation complete reuse of water from sweet sorghum.



Praj Technology for Alcohol production from Sweet Sorghum.



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