

<b>Sector</b>	Agro and Food Processing
<b>Sub - sector</b>	Agro Processing Industry
<b>Project No.</b>	AF-34
<b>Project Title</b>	Molasses Based Fuel Ethanol (Bio-Fuel) Plant

## Project Description

The proposed project envisages setting up of a molasses based Fuel ethanol ( Bio-Fuel) plant either as an additional value added processing facilities with a Sugar mill or as a stand alone unit based on molasses available from cooperative Sugar mills in south and central Gujarat area. Sugar industry in Gujarat is reserved for the co-operative sector and hence all Sugar mills projects have come up as co-operative units. This distillery unit will be manufacturing Ethanol and absolute alcohol to be used as Bio-fuel for blending with petrol or diesel. Sugarcane is mainly grown in south and central Gujarat areas, hence most of the Sugar mills have come up in these areas. All these Sugar mills have molasses as a by product of Sugar manufacturing.

### Product Applications

Ethanol is having many chemical uses, apart from its use as potable alcohol in the form of IMFL (Indian Made Foreign Liquor). In fact Ethanol is used as feedstock for manufacturing several chemicals and intermediates.

The largest application developed in recent years for Ethanol is, its uses of as automotive Bio-fuel, or say as Power Alcohol. Thus, this project of Ethanol manufacturing for blending it with petrol / Diesel holds promising future and has multiple benefits.

## Market and Growth Drivers

### Fuel Ethanol Production and Demand Globally

Ethanol, the dominant bio fuel in world markets is gaining importance as an alternative fuel source, as a part of renewable fuels initiatives adopted by number of countries including India. World Ethanol production is summarized in following table:

**World Ethanol Production ( Fuel and Other Uses)**

Sr. No.	Regions Particulars	2005 in Billion Liters	2004 in Billion Liters
1	Brazil	16.7	14.60
2	United States of America	16.60	14.30
3	European Union	3.0	2.60
4	Asia	6.60	6.40
a.	China	3.80	3.70
b.	India	1.70	1.70
5	Africa	0.60	0.60
	World	46.0	41.30

Source: Agri export advantage, July,06

Like Sugar production, Brazil also dominates the world in Ethanol production, producing around 4.8 billion litres and also consuming 4.2 Billion litres as a Bio-Fuel. Ethanol output in China for the year

2004 was 3.70 billion litres and in the year 2005 it remained at a level of 3.8 billion litres. All these Sugar producing countries are also producing Ethanol using molasses the by product of Sugar production in respective countries.

#### **Fuel Ethanol Market at Country Level**

India is the second largest producer and biggest consumer of sugar with production of about 18 million tons per annum. The Indian sugar industry is the second largest agro-industry in the world, which has a turnover of INR 500 billion per annum. It is estimated that in the year 2010, sugar production in India will increase further to a record level of 26.5 million tons. Alongwith increase in Sugar production, increased quantities of Molasses will be available, and production of Ethanol for use as Bio fuel is most promising value added processing for it. As per industry estimates production of Ethanol would reach 2.4 billion litres in the year ending in September 2010.

As per reliable estimates at 5 % blending level, there will be demand of 375 Million litres/ year, while at 10 % level this demand will be 750 Million litres /year. In case of blending 10 % ethanol with Diesel, this alone will generate demand of 3.7 to 3.8 billion litres / year. Thus, there is potential for large demand of Ethanol as automobile fuel. As per modest estimates of Petroleum Ministry in India, 5 % blending of ethanol will save minimum INR 40 million (US \$ 8 million in foreign exchange). This benefit can further be enhanced by increasing the percentage to 10 % level . Also by permitting such blending with Diesel there will be much more savings and also reduction in air pollution in the country.

#### **Ethanol Production and Demand- Present and in 2010**

<b>Sr. No.</b>	<b>Parameters</b>	<b>India ( Now)</b>	<b>India in (2010)</b>
1	Fuel Ethanol Output (t)	525000	
2	Fuel Ethanol Demand (t)		1,300,000
	Total Ethanol	1600,000	23,75,000
3	Total Sugar area (million ha)	4.4	5.0
4	Mandatory Blending	5 % in 9 states	10 % in Country wide
5	Production cost for Ethanol in Rs./ Liter	19.80	25.0

Source: GTZ 2006

Thus, there is opportunity in terms of value added processing by products like molasses by setting up of Ethanol manufacturing unit as diversification for Sugar Mill. However, where molasses is available a stand alone Ethanol unit can also be put up. There are several stand alone Ethanol units in Maharashtra, Uttar Pradesh, Karnataka and Tamilnadu. Since until recently alcohol manufacturing was a controlled industry in Gujarat, and hence though Sugar cane molasses was available very few units of Ethanol have come up.

Now, with the Government of India drive for using ethanol for blending in petrol and increase in Ethanol demand both in domestic and export markets have opened up opportunities for Sugar mills as well as other entrepreneurs for setting up an Ethanol unit in Gujarat.

Present, ethanol capacity in terms of rectified spirit manufacturing and as Fuel Ethanol (Absolute alcohol) in Gujarat is summarized in the following table:

**Rectified Spirit and Fuel Ethanol Capacity in Gujarat**

(Capacity in Liters per Day)

Sr. No.	Name of Co-p Sugar mill	Rectified Spirit	Fuel Ethanol (Absolute Alcohol)
1	Chalthan Sugar mill	60,000	30,000
2	Sayan Taluka Sugar mill	30,000	20,000
3	Gandevi Sugar mill	45,000	40,000
4	Madhi Sugar Sugar Mill	45,000	40,000
5	Mahuva Sugar Mill	35,000	30,000
6	Kamrej Sugar Factory	30,000	30,000
7	Total in Gujarat	2,45,000	1,90,000

Source: Gujarat state cooperative sugar federation, Gandhinagar- annual reports

**Growth Drivers**

The growth drivers for Fuel Ethanol for blending it with Petrol and diesel are as under:

- Growth of Vehicle population in the country, especially in urban areas.
- Price of petroleum crude in the international market and its effect on refinery end product prices in domestic market, particularly on prices of Petrol and Diesel to end consumers Vs Ethanol (Power Alcohol) prices in domestic market.
- Pressure on state and central governments for making strict laws regarding vehicular emissions.
- Governments' policy and commitment to give a cleaner environment to coming generation and reduce CO2 emission level in urban areas to overcome green house effect in these areas.
- Demand of Ethanol by other consuming industries including as potable alcohol. The availability of alternate raw materials at cheaper rate for alcohol based chemical industries.

**Why Gujarat?**

- The Narmada Canal irrigation system will ensure additional availability of water in Gujarat. This will boost up sugarcane cultivation and sugar production in the coming years. This will also increase availability of molasses in Gujarat, and Ethanol manufacturing is a value added opportunity for existing sugar mills.
- Raw material availability - there are about 20 operating sugar mills in Gujarat with a combined installed capacity of about 12.5 Lac tons of sugar production per annum. Gujarat is having production of 4.5 Lac MT of molasses, out of which currently on 2.5 Lac MT is used for

manufacturing Ethanol and rest is sent outside state for processing. Hence, surplus raw material is readily available.

- With improved cash flows of the sugar manufacturers, after spiraling sugar prices in India and world over in the last 18 months, now manufacturers can take up this opportunity to set up value added processing units like manufacture of Ethanol from their byproduct Molasses.

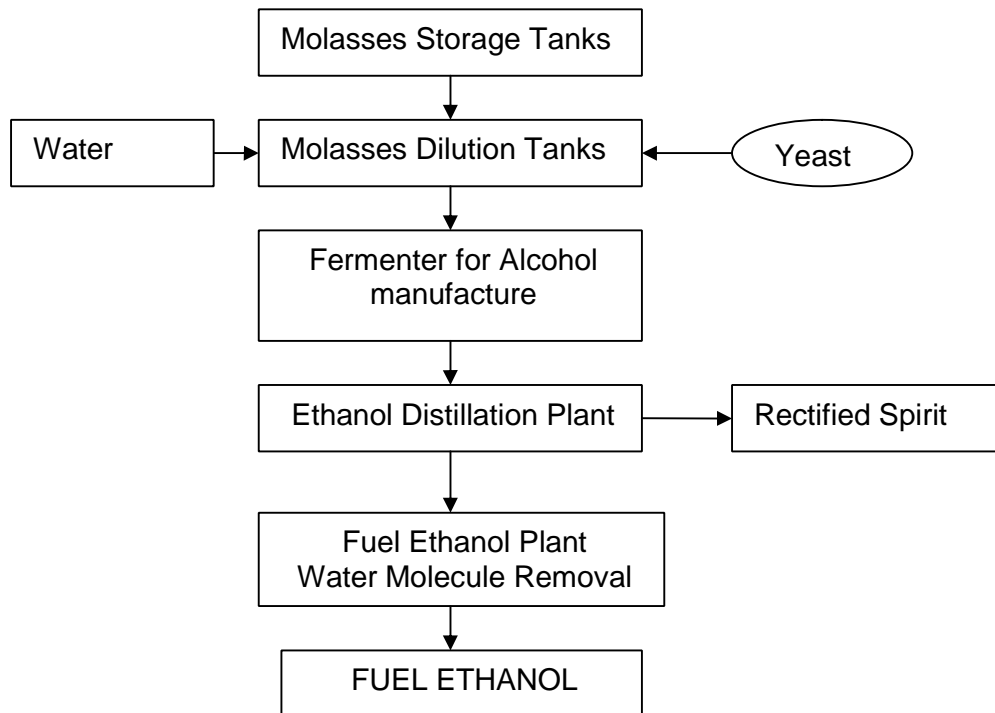
## Manufacturing Process

Molasses is the main raw material used for production of Ethanol. It contains about 50% of the total sugar; of which 30 to 33% is cane sugar and rest is reducing sugar. During the fermentation, yeast strains to the species *Saccharomyces Cerevisiae*, a living micro organism belonging to class fungi converts sugar present in the molasses such as sucrose and glucose to alcohol. This conversion is done in large tank type Fermenters.

There will be machinery for separation of this ethanol from aqueous solution which is low temperature distillation using low pressure steam for heating. This ethanol is further purified using multiple distillation process and forming azeo-tropic mixture with Benzene to get total anhydrous alcohol, which is used for blending with petrol or diesel. In modern Fuel Ethanol plants, molecular sieve technology is used for removing water molecules from alcohol and manufacture alcohol, which gives substantial savings in terms of energy consumption.

The Ethanol manufacturing process from Molasses is schematically shown in the following Material Flow chart.

### ETHANOL MANUFACTURING FLOW CHART



## Technology sources

There are three main suppliers dealing in Ethanol production technology in India. The name of technology supplier and services offered by them is as below:

- a) Praj Industries Ltd, Pune Cascade System Multi Fermenter with yeast recycles
- b) Alfa Laval ( I) Ltd, Pune Bio-still Process –Single Fermenter yeast recycles  
High speed separator
- c) Naran Lala Metal Work Ltd,Navsari Fercen Process Two Fermenter with yeast recycle  
And high speed separator

All above technologies are for production of ethanol from Molasses, which is separated using low temperature distillation process and low pressure steam. This ethanol is processed further to manufacture, Fuel Ethanol (Absolute Alcohol) by removal of water content in alcohol either by using Azeo tropic distillation or Molecular sieve process.

However, the latest technology, which is totally environment friendly and ensures pollution free Fuel ethanol production, is offered from M/s. Crest Biotech Limited, Delhi. This technology ensures minimum energy consumption in Fuel alcohol production, and has environment friendly process. Apart from this company there are several companies offering technology on turn-key basis for Ethanol and Power alcohol manufacturing. There are few consultants also offering turn-key consultancy for such projects.

## Raw materials

As per alcohol industry the average efficiency of conversion of sugar from molasses to alcohol is 80 to 85% in batch type distillery. The average yield of alcohol from 1 MT of Molasses is about 230 liters. To produce 100,000 Liter alcohol per day there is need of crushing capacity of approx.1500 TCD cane crushing. However, since the sugar mills are normally running for 180 days, while alcohol plant will run for 250 days in a year, hence surplus molasses can be processed in the remaining period when sugar mills are not operating.

As indicated earlier key raw material is molasses from sugar industry. There are several large co-operative sugar projects in South Gujarat, which are having even larger molasses production than their own use. However, optimal size of project is suggested so that even in case of Sugar cane shortage also the project can operate at viable capacity. Apart from this, there will be need for yeast for fermentation process, Benzene for making anhydrous alcohol (Power alcohol), and other chemicals for effluent treatment etc; South Gujarat being a well developed industrial belt including chemical industries, there will sufficient availability of all these raw materials in this region.

Molasses Production in Gujarat is around 4.5 to 5.60 Lac MT per year. Molasses production for last three years has been summarized in following table:

Sr. No.	Year of Production	Net Molasses Production in MT
1	2002-03	560606
2	2003-04	445401
3	2004-05	325992

Source: Gujarat state cooperative sugar federation, Gandhinagar- annual reports

## Plant and Machinery

The main plant and machinery required are as under:

- a) Fermentation Plant for Ethanol manufacturing including Molasses storage, Molasses weighing, preparatory and yeast preparatory, Fermenter, and yeast settling tanks etc;
- b) Distillation plant for Ethanol separation and yeast recycling
- c) Rectified spirit, Industrial alcohol manufacturing plant
- d) Anhydrous alcohol manufacturing multiple distillation facilities, using low pressure steam for heating process or Molecular sieve plant.

The exact equipment list will vary depending upon the selection of technology (batch process or continuous process) and supplier for the proposed project. The detailed list of plant and machineries has not been included here for this reason.

## Suggested Plant Capacity and Project Cost

The suggested plant capacity for the proposed project is 100,000 Liters / day and considering 250 days working in a year the proposed Ethanol unit will have capacity to manufacture, 25000 KL Ethanol per year. The indicative project cost for the proposed unit is around INR 200 million (US\$ 4.45 million).

### Estimated Project Cost & Means of Finance

Sr. No.	Cost of project	INR in Million
1	Land and Land development	12.00
2	Building & Civil Works	20.00
3	Plant & Machinery 100 KL/ day	115.00
4	Miscellaneous Fixed Assets	12.00
5	Preliminary & Pre-operative	10.00
6	Provision for contingencies	10.492
	<b>Total Fixed Assets</b>	<b>179.492</b>
7	Margin Money for working capital	20.508
	<b>Estimated Block Capital Cost of Project</b>	<b>200.00</b>
	<b>Means of Finance</b>	
8	Promoters contribution	66.667
9	Term loan	133.333
	<b>Total Means of Finance</b>	<b>200.000</b>

As indicated above, the proposed project will require 20000 sq. mt of land with proposed built up area of 5000 sq. mt. Considering 250 working days in a year the unit is proposed to have an installed capacity of 25000 KL Ethanol manufacturing p.a. The total fixed cost of the project is estimated at INR 179.492 million and INR 20.508 million is the working capital margin which together makes the total capital cost of INR 200 million. The unit being proposed to cater to domestic as well as to International demand of Ethanol on commercial basis and hence it is suggested to have a Debt equity ratio of 2:1. Thus, the estimated term loan amounts to INR 133.33 million and Equity at INR 66.667 million.

## Utility

The utility requirement for the proposed project is steam, electric power and cooling water. Depending upon the technology selection utility consumption will vary. As per standard industry norms the proposed project of Ethanol with 100 KL per day capacity will require 450 KWH power and water consumption would be 1620 to 1800 KL per day for dilution of molasses and cooling water requirement will be 1080 KL per day.

As per conventional technology there will be need for 2 to 2.3 MT of steam for 1 KL of alcohol production. The same can be reduced to 1.7 to 1.9 MT using latest Molecular sieve separation technology. Similarly there will be power consumption of 60 -65 Kw / KL of Anhydrous alcohol. There will be a need of 4 to 5 M3 of cooling water / KL of Anhydrous Alcohol.

## Manpower Requirement

There will be need for 60 persons as direct manpower for the proposed project and approx.40 indirect manpower will be employed in various activities as contract labor in the proposed project for manufacture of Fuel Ethanol.

## Suggested Location

The suggested locations for the proposed project could be Vadodara, Surat, Bharuch and Valsad districts in central and south Gujarat.

## Project Time Line

The proposed project will have project time line of 6 to 8 months for obtaining necessary clearances from concerned authorities and pollution control board and the project implementation period of 12 to 16 months is estimated.

## Financial Indicators

Based on the profitability projections worked out for the proposed project, key financial indicators are as summarized below:

### Key financial indicators

Sr. No	Financial Ratios	1 <sup>st</sup> Year	2 <sup>nd</sup> Year	3 <sup>rd</sup> Year
A	Break-Even Point in % capacity	37.98	34.20	31.07
B	Debt-service Coverage Ratio	1.73	2.28	2.88
C	Average DSCR	<b>2.30</b>		

Sr. No	Financial Ratios	1 <sup>st</sup> Year	2 <sup>nd</sup> Year	3 <sup>rd</sup> Year
D	Return on Investment (ROI)	39.20 %	47.43%	55.65%
E	<b>IRR for a 10 Years Project Period</b>	<b>47%</b>		

The proposed Fuel Ethanol project will have an indicative IRR of approx 47% considering initial 10 years operation. Proposed project being a commercial unit the suggested Debt equity ratio is 2:1.

### **Clearances Required**

The proposed unit will have to register itself with Secretariat of Industrial Approvals (SIA), Ministry of Industries and Government of India, by filing Industrial Entrepreneur's Memorandum (IEM), as it will have plant and machinery investment of more than INR 10 million.

The proposed project is for setting up of a distillery unit, which will require its registration with Central Excise authorities and state prohibition department as Gujarat is having ban on potable alcohol manufacturing.

The unit will get EOU registration from RBI, DGFT and with Public Sector Petroleum refinery units as registered manufacturer of fuel Ethanol to supply its finished products to them for blending with Petrol and Diesel.

The unit will require obtaining clearance from Gujarat State Pollution control Board for their Effluent treatment process and discharge of treated effluents in public streams.

### **Agencies to be Contacted**

Industrial Extension Bureau

Mott MacDonald India

Gujarat Agro Industries Corporation Ltd