INTRODUCTION

The reduction of carbon dioxide (CO2) emission has become a major target in efforts to suppress global warming. Bio-ethanol is considered as an important renewable fuel to partly replace fossil-derived fuels. Governments around the world have recognized the role that biofuels will play in a renewable fuels portfolio and have introduced minimum targets for their implementation in the future. Ligno-cellulosic biomass is seen as an attractive feedstock for renewable fuels, particularly ethanol.

The World Energy Outlook (WEO) report of the International Energy Agency (IEA) projects that India’s primary energy demand will increase from 750 Mtoe to 1258-1647 Mtoe between 2011 and 2035 i.e., it will most likely more than double over these 25 years. The oil demand in India will reach more than 8 million barrels per day in 2035, whereas the current domestic production of crude oil has been more or less stagnant over the years. The balance is met through imports of crude petroleum products that cost the country valuable foreign exchange. Volatile oil prices and the uncertainty about sustained oil supplies have led India to search for alternatives, particularly for substituting petroleum products, to promote energy security. Biofuels are considered among the most promising alternative options, as they can be produced locally and can be substituted for diesel and petrol to meet the transportation sector’s requirements. India, like many other countries, is setting targets for the substitution of petroleum products by biofuels.

Globally, countries have been setting varying targets, ranging from 5 percent to 20 percent for blending of transportation fuels with ethanol produced from renewable sources, to be met at various times within the period 2010–2030. Developing countries such as India have multiple constraints and benefits in promoting biofuels, such as promoting energy security, rural development and the reclamation of degraded lands as well as coping with the challenges of land and water scarcity and improving food security.

In developing economies, food-related feedstock (first generation feedstock) like corn, sugar etc. is preferably replaced by non-food raw materials (second and third generation feedstock), such as wheat straw, rice straw, bagasse, cotton stalk bamboo etc. Ethanol for use as bio-fuel is produced by fermentation where certain species of yeast or bacteria metabolize sugars in oxygen-lean conditions to produce ethanol and carbon dioxide. The main reasons for the enhanced development of bio-ethanol are its use as a favorable and near carbon neutral renewable fuel, thus reducing CO2 emissions and associated climate change.

Whether first, second, or third generation feedstock is used, fermentation produces an alcohol-lean broth only, as such unusable in industrial and fuel applications. The ethanol must hence be purified. Fractional distillation can concentrate ethanol to 95.6 vol% (89.5mol %), corresponding to the azeotropic composition with a boiling point of 78.2 OC. Remaining moisture is captured in dehydration column to produce anhydrous fuel grade ethanol.

EBP – ETHANOL BLENDING PROGRAM IN INDIA

Ethanol blending is the practice of blending petrol with ethanol. Many countries, including India, have adopted ethanol blending in petrol in order to reduce vehicle exhaust emissions and also to reduce the import burden on account of crude petroleum.
The renewable ethanol content, which is a by-product of the sugar industry, is expected to result in a net reduction in the emission of carbon dioxide, carbon monoxide (CO) and hydrocarbons (HC). Ethanol itself burns cleaner and burns more completely than petrol it is blended into. In India, ethanol is mainly derived by sugarcane molasses, which is a by-product in the conversion of sugar cane juice to sugar. With ligno-cellulosic biomass to ethanol, technology, more ethanol can be provided.

The practice of blending ethanol started in India in 2001. Government of India mandated blending of 5% ethanol with petrol in 9 States and 4 Union Territories in the year 2003 and subsequently mandated 5% blending of ethanol with petrol on an all-India basis in November 2006 (in 20 States and 8 Union Territories except a few North East states and Jammu & Kashmir). Ministry of Petroleum and Natural Gas, on 1 September, 2015, has asked OMCs to target 10% blending of ethanol in Petrol in as many States as possible. The ethanol requirement in future for 5%, 10% and 20% blending in petrol.

OBJECTIVE

Production of 100 KLPD fuel grade ethanol meeting specifications for ethanol as per IS 15464 : 2004.

CONFIGURATION

The 2G Ethanol plant configuration is considered as given below:

- Ethanol unit.
  - Biomass Handling and Size reduction
  - Biomass Pre-treatment Section
  - Enzymatic Hydrolysis
  - Fermentation
  - Distillation for Ethanol Recovery
- CO2 Recovery and liquefaction plant
- Multiple Effect Evaporation and RO system (Zero Liquid Discharge).
- Lignin fired process steam boilers. Two Process Boilers based on Lignin fuel at 60% of the required capacity. i.e. 2 x 30 TPH
- Power required for the 2G Plant is imported from Bina refinery.
- Raw water is obtained from the Bina refinery.

BIOMASS FEED

 Locally available wheat straw and soya stalk has been considered as the biomass feed for this 2G ethanol plant.

LOCATION

The proposed location for this 2G ethanol plant shall be at Agasode village, Bina Tehsil, Sagar district, Madhya Pradesh, India.

PROCESSING UNITS

The following are the major sections in the 100 KLPD 2G ethanol plant.

I. Biomass handling and size reduction section
II. Biomass pretreatment section
III. Enzymatic hydrolysis section
IV. Co-Fermentation section
V. Ethanol Distillation section
VI. Ethanol dehydration section  
VII. Solid/ Liquid separation section  
VIII. Evaporation section  
IX. Process condensate treatment section.

CHEMICALS/ YEAST/ ENZYMES

The following items will be consumed in the 2G ethanol plant.

1. Chemicals (Acids/ Alkali/ Antifoam agent)  
2. Enzymes  
3. Yeast  
4. Nutrients

FEED SPECIFICATION

The feed for ethanol plant is wheat straw or soya stalk. The total requirement is 400 TPD.

BY-PRODUCTS

The following are envisaged as the by-products considering zero liquid discharge configuration:

1. Fusel oil  
2. Liquid CO2  
3. Ash  
4. Sludge

UTILITY REQUIREMENT

The following utility requirements are envisaged for the proposed project.

<table>
<thead>
<tr>
<th>Utility Requirement</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw Water Treatment Plant</td>
<td>121 m3/hr</td>
</tr>
<tr>
<td>DM Plant</td>
<td>14 m3/hr</td>
</tr>
<tr>
<td>Cooling Tower</td>
<td>3000 m3/hr</td>
</tr>
<tr>
<td>Plant Air</td>
<td>225 Nm3/hr</td>
</tr>
<tr>
<td>Instrument Air</td>
<td>870 Nm3/hr</td>
</tr>
<tr>
<td>Boiler</td>
<td>60 TPH</td>
</tr>
</tbody>
</table>

RAW WATER STORAGE

Treated raw water tank is considered inside the plant of capacity 17900 m3 with operating capacity of 14300 m3.

CHEMICAL, YEAST & ENZYME STORAGE

ISBL chemical, yeast, enzyme etc required for main 2G ethanol process are given below. Liquid chemicals stored in tanks as mentioned below.
Liquid Chemical Storage

<table>
<thead>
<tr>
<th>Sl No</th>
<th>Description</th>
<th>Day of storage</th>
<th>Tanks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Conc. Acid</td>
<td>15</td>
<td>One tank of Volume ~ 150 m3</td>
</tr>
<tr>
<td>2</td>
<td>Conc. NAOH</td>
<td>15</td>
<td>One tank of Volume ~ 150 m3</td>
</tr>
</tbody>
</table>

Other chemical in solid form are stored in warehouse the quantity of storage as tabulated below.

Solid Chemical Storage

<table>
<thead>
<tr>
<th>Sl no</th>
<th>Description</th>
<th>Day of storage</th>
<th>Total quantity for 15 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Nutrients</td>
<td>15</td>
<td>18540 kg</td>
</tr>
</tbody>
</table>

Enzyme and Yeast Storage:

Enzyme shall be stored in cold room in enzyme container (Intermediate Bulk Container, IBC), enzyme storage is considered for 15 days and the quantity is 19 ton. Temperature to be maintained inside the cold room is 4°C. Size of the cold room is 20 x 25 x 5 m (L x B x H).

Yeast storage is not envisaged as it is generated in ISBL.

UTILITY AND OFFSITE FACILITIES

For the proposed configuration, following are main facilities envisaged in the utility block.

a) Raw water (partial requirement)
b) DM Water
c) Recirculating Cooling water
d) Compressed Air
e) Steam, Power and Boiler feed water
f) Fire Water system

Following offsite facilities have been envisaged:

a) Biomass storage and transfer facilities
b) Product Tankage (for Ethanol and CO2)
c) By-product storage (for Ash)
d) Intermediate Tankage

RECEIVING, DISPATCH FACILITIES AND STORAGE

Bio mass for feed shall be sourced externally through truck unloading and biomass storage/transfer shall be part of biomass handling section. The storage of five days for feed and two days for supplementary fuel are envisaged.

The main products from the bio refinery are Fuel Grade 2G ethanol and CO2. Ethanol shall be stored in ethanol day storage tanks and two finished product storage tanks (after excise check) whereas CO2 shall be stored in liquefied form in two tanks of 45 Ton Capacity (each). Ethanol and CO2 shall be dispatched through road tankers. Ash and sludge shall be stored in the storage yard and dispatched from the complex through trucks.
BUILDINGS

Administrative Building, Warehouse, Workshop, Canteen, Laboratory, Control room, Sub-station, fire station, Operator cabin, Security cabin, Medical Centre, Cold Enzyme Storage, Inventory Store and Exercise Office are envisaged in the proposed project.