PRAJ RenGas Technology

Partnering for Better Tomorrow with Compressed Biogas (CBG)
The Next Generation Biofuel

Viable CBG/ Biopower Plants
Agri-residues, Pressmud, Liquid effluents
Customized Microbial Biomass Pretreatment
Energy & Yield Efficient Plant Engineering
Advanced Gas Cleaning (H₂S & CO₂ removal)
Proprietary Multiphase Biomethanation

PRAJ Renewable Gas/ CBG Technology

RNG: Biomethane produced by anaerobic digestion of Agri-residues/organic wastes
Reduces GHG & Carbon Emissions
Lower costs than Fossil fuels
Agro-based- Improves internal economies
PRAJ – Leading the way in Renewable Gas:

As global leader in Biofuels Technology & Plants, PRAJ has a strong track record in Renewable Gas Plants. Over 40 Industrial Installations with capacities up to 1500 M³/Hr

PRAJ RenGas technology results from extensive research & development on

- Compositional data of Agro-residues & Sugar / Grain Plants Co-products
- Unique Microbial Consortia for Feedstock Pretreatment & Anaerobic digestion
- Industrial Biomethane Fermentation Process Development
- Digestate processing into Value added Soil Conditioner co-products
- Advanced cost effective biogas cleaning techniques to give Pure Methane

PRAJ Multi-feed Multi-products RenGas Plants

- Agri-Residues: Rice/Wheat/ Corn straws, Cane bagasse /Beet pulp
- Sugar Processing co-products Like Pressmud /Spentwash (Vinnase)
- Composite or Mixed Industrial waste streams

Efficiently engineered Advanced Process plants

- Continuous Microbial Feedstock treatment / stabilization
- High yield Multi-phase Anaerobic digestion with selected Microbial consortium
- Cost effective advanced Gas purification

- CBG for Transport and Grid Applications
- Combined Heat and Biopower (CHP) Applications
- Value adding Organic soil conditioner co-products

PRAJ has developed “3 Key unique Technologies” for high gas yields & purity in Renewable Gas plants

- Feedstock Pretreatment for Preservations & High Yields • Proprietary Microbial Consortium development • Hydrolysis & Preservation of TVS in convertible form

- High Efficiency & Fast Biomethane Production • Proprietary Rumen Microbe consortium development • High Biogas & Methane Yields with CO₂ reduction

- Biogas cleaning to CBG • Efficient Low cost Chemical H₂S Removal • Efficient water based CO₂ Removal • Cleaning and drying through the Molsieve Technique
The PRAJ Edge...

Flexible Rengas Technology:
1) Rice straw & other Agri-residues
2) Pressmud & Distillery Spent wash
3) High yield of CBG & Bio-fertilizer
4) Combined Heat and Power option

Benefits of CBG Plant:
1) Round the Year Operation
2) Low cost of CBG Production
3) High Co-product credit from Organic soil conditioner
4) Customized Multi-application designs: CBG / Biopower / Industrial gas

Advanced Plant Engineering:
1) Based on innovative reaction engineering
2) Efficient & low energy Reactor designs
3) Skid mounted systems Culture Propagation, S-L separation & Gas cleaning
4) Advantage of quick execution

Partnership:
1) Pre-feasibility studies & licensing assistance
2) Operation training and commissioning
3) After sales support services

Under one Roof:

<table>
<thead>
<tr>
<th>Technology License</th>
<th>EPC / Turn Key Plant supply</th>
<th>Basic &amp; Detailed Engg.</th>
<th>Equipment &amp; Systems supply</th>
<th>Piping / E&amp;I &amp; Automation</th>
<th>Civil &amp; Structural</th>
</tr>
</thead>
</table>

Across 5 continents | More than 75 countries | Over 750 References

Praj Industries Limited
"Praj Tower" 274 & 275/2,Bhumkar Chowk-Hinjewadi Road, Hinjewadi,Pune : 411057, INDIA.
+91-20-71802000 / 22941000 / 020-22941299
To know more, write us on: info@praj.net
Press Mud:
- Solid residue coproduct from cane juice clarification.
- Rich in Convertible Total Volatile Solids (TCVS) that give Biogas by AD process.
- Biogas plant from press mud generates multiproduct revenue streams viz BioCNG, solid & liquid fertilizer.

Press Mud to BioCNG Technology: Opportunities from PRAJ
- The pressmud can be converted to high value BioCNG / biopower and premium co-products like solid / liquid biofertilizer.
- Complete green operation helping reduce GHG.
- 3 to 4 times value enhancement from Pressmud.

Pressmud to BioCNG Plant Schematic

Pressmud proprietary Microbial Treatment

Stabilized storage of pressmud

Specialized Microbial Consortium Prefermentation

Liquid recycle to biomethanation

Solid – Liquid decantation

Multi-phase duel plug flow biomethanation

Purge Liquid

Wet Solids

Biogas to Cleaning

Bio-fertilizer

Sulfur

H₂S removal system

Co₂ removal system

Moisture removal system

Power & Heat to Plant

Gas Engine

Compression and Bottling

BioCNG
PRAJ USPs:

- Unique PM stab pressmud pre-treatment: Allows preservation up to 6 M, enabling RTY BioCNG operations.
- Unique Rumen culture AD process: Runs AD process stably for annual operations with high gas and methane yields.
- Economical & robust gas cleaning for high quality BioCNG.
- High quality solid & liquid ferti-irrigation co-products.
- Process know how especially for digester startup and stabilization.

PRAJ Offerings:

- Customized plant designs from 100 to 400 TPD.
- Industry’s highest biogas yields from press mud (Depending on the TCVS range of 18.5 to 23.0 % w/w).
- Premium grade organic manure with NOCA Organic certification.
- Commercially sound projects with high IRR and low payback periods.
- Complete turnkey / EPC Plant & technology supply with O&M options.
- Partnership for complete project development.
The Biogas produced from different feedstocks contain 55 to 62% methane, 35 to 39% CO₂, H₂S between 0.01 to 3% and other impurities like NH₃, CO₂, and moisture. Various applications of Biogas demand different purity of methane and tolerable extent of impurity levels. For instance,

- BioCNG needs 96% Methane, 3% maximum CO₂, H₂S < 20 PPM and moisture < 100 PPM.
- Biogas used for engines can tolerate CO₂ but H₂S needs to be lower than 50 PPM.
- Some industrial applications of Biogas demand H₂S content below 200 PPM.

Keeping quality requirements in view, PRAJ has developed commercial Biogas cleaning / upgradation systems to remove impurities that are based on simple principles, are robust and cost-effective.
**CO₂ removal system:**

**Removal of Hydrogen Sulfide:** The system uses polyvalent metal ions chelates of iron in aqueous medium to react with the sulfur of H₂S from biogas. The hydrogen sulfide is precipitated as elemental sulfur - a co-product for fertilizer application. The catalyst is continuously regenerated and recycled.

**Carbon dioxide removal:** The system uses differential solubility of CO₂, CH₄, and H₂S in water. This is enhanced by the use of pressurized chilled water which removes CO₂ and trace impurities by dissolution.

**Final conditioning:** The purified methane is then subjected to molecular sieve drying and sent to compression and cylinder filling.

---

**PRAJ USPs:**

- Robust & Economical Gas cleaning.
- Low maintenance costs.
- Highly efficient removal of H₂S, CO₂ and other impurities for different grades.
- Generates valuable sulfur co-products.

---

**PRAJ Offerings:**

- Customized Plant Designs 100–2000 M³/Hr biogas flow.
- Standalone supply for existing Biogas plants.
- System engineering as per the end-use grade specification (BioCNG/Biopower).
- Skid mounted (Prefab) designs available for short installation time and quick start-up.
- Can remove 0.01–3% H₂S & up to 40% CO₂.
Biomass to BioCNG/Biopower Technology

Biomass - Agri-residue:
- Agri-residue such as straw and stover are abundantly available in the annual farming systems.
- Cellulose, Hemicellulose and other organic matter in these can be converted to convertible total volatile solids through microbial pre-treatment.
- The TCVS can further be processed through AD process.

Praj's Biomass to BioCNG Technology
- The biomass can be converted to high value BioCNG / Biopower and premium co-products like solid / liquid biofertilizer.
- Complete green operation helps reduce GHG emissions.
- Biogas and BioCNG adds substantial value.
- Round-the-year operation of Biogas / BioCNG plants.

Biomass to BioCNG plant schematic with proprietary microbial prehydrolysis

- **Biomass preparation section**
- **Prepared Biomass**
- **BM solve hydrolysis treatment with specialized microbes**

  - Liquid recycle to biomethanation
  - Solid – liquid decantation
  - Dual plug flow multi-step biomethanation with RC consortium

  - Purge liquid
  - Wet solids
  - Biogas to cleaning

  - Bio-fertilizer
  - Sulfur

  - Power & heat to plant
  - Gas engine

  - Compression and bottling
  - BioCNG

  - H₂S removal system
  - Co₂ removal system
  - Moisture removal system
Agri-residues - biomass Sugarcane bagasse / rice straw / wheat straw / corn straw / corn cobs / dry grass

BM Solve Microbial Pretreatment Mild pretreatment with high hydrolysis

Biogas by Anaerobic Digestion Process Dual plug flow reactor system

BioCNG by Gas cleaning Highest yields in industry

Solid Biofertilizer (30% solids) NOCA certification

Liquid Biofertilizer NOCA certification

PRAJ USPs:
- Unique microbial biomass pretreatment to convert cellulose polymers into TCVS.
- Mild environment-friendly pretreatment not involving extreme conditions.
- Specially adapted rumen consortia for fiber digestion and high biogas yields through AD process.
- Economical and robust gas cleaning for high quality BioCNG.
- High quality solid and liquid fert-irrigation co-products.

PRAJ Offerings:
- Customized plant designs from 75 to 250 TPD.
- Industry's highest biogas yields from biomass (Depending on the TCVS range 65 to 80 % w/w).
- Premium grade soil amendment with NOCA organic certification.
- Commercially sound projects with high IRR and low payback periods.
- Complete turnkey / EPC Plant & technology supply with O&M options.
- Partnership for complete project development.