Bio Waste To Bio Hydrogen Plant with Cylinder Filling

Vivacious High-Tech Civil & Engineering Solutions Private Limited

HIGH RECOVERY HIGH PURITY BIOGAS CONCENTRATION PLANT

+

BIO CNG TO HYDROGEN PLANT

Synopsis: Energy From Biowaste can be recovered by biologic metabolism of bio waste to Methane. Further, methane can be processed to Hydrogen using steam reforming process.

Project Head: Vivacious High-Tech Civil & Engineering Solutions Private Limited

Consultant: Finsen Ritter Technologies EU BV

Technology: Hybrid Membrane + VPSA separation of raw biogas to achieve high Methane purity + Steam Reforming of Bio Gas to Achieve Hydrogen

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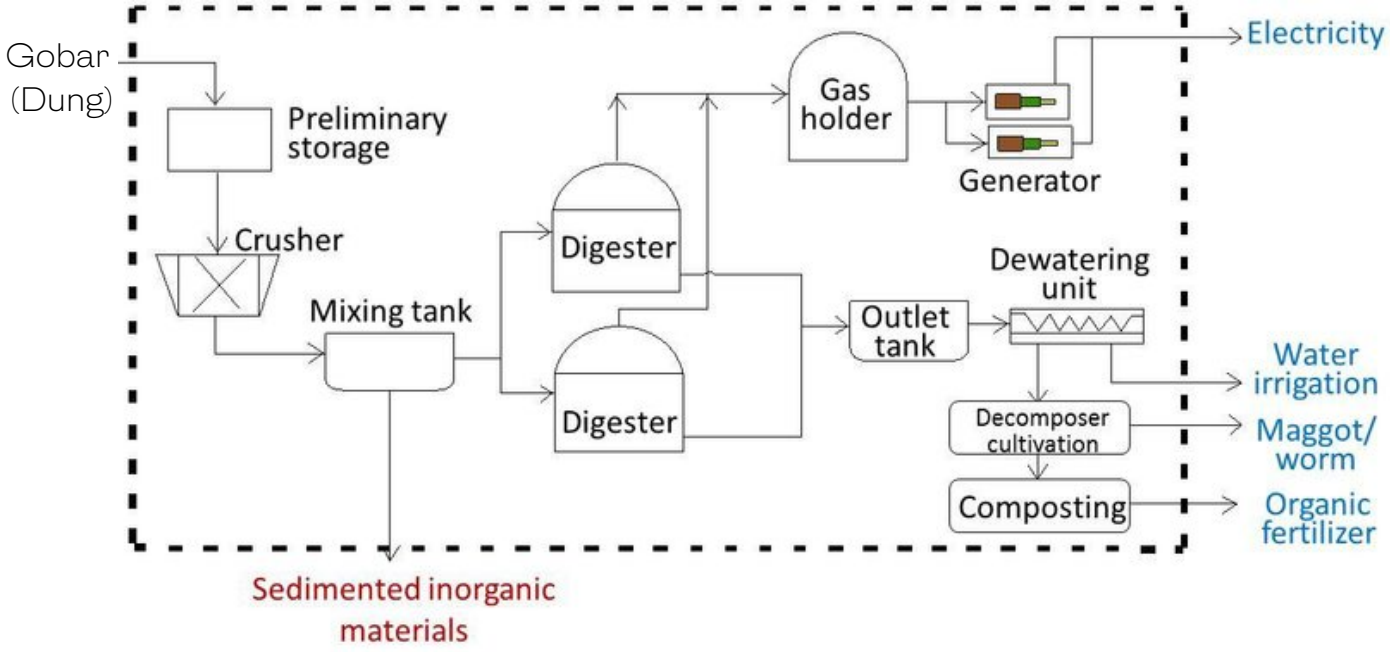
OVERVIEW OF PRESENT TECHNOLOGIES

Digestion Process Of Biomass



Working Principle

- Water and dung is mixed in 1:1 ratio
- After water addition, homogenous mixture (Slurry) is prepared through agitator
- The slurry is transferred to the Anaerobic Digestor
- In digester, dung degrades in presence of anaerobic bacteria to produce Biogas.

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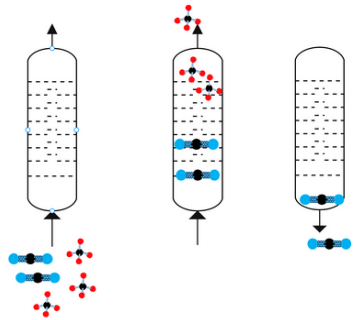
OVERVIEW OF PRESENT TECHNOLOGIES

Vacuum Pressure Swing Adsorption (VPSA) Gas Separation

Working Principle

- Adsorbents like 5A Molecular Sieve selectively adsorbs Methane and Carbon Dioxide
- On increasing the pressure Carbon Dioxide gets adsorbed on the surface of the Molecular Sieve
- Methane Passes through
- On purging cycle the Carbon Dioxide is flushed out



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OVERVIEW OF PRESENT TECHNOLOGIES

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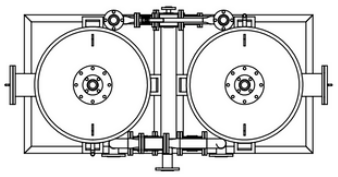
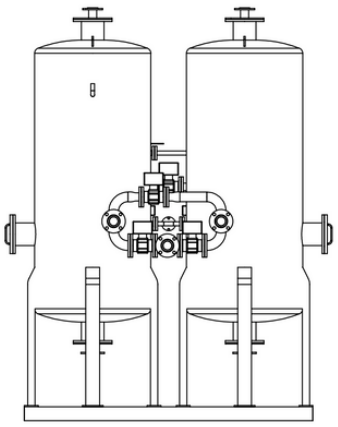
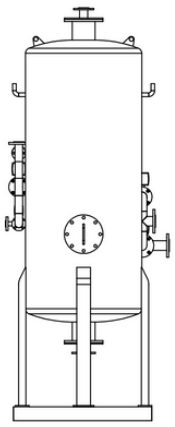


TOP



FRONT



SIDE

Advantages

- Reliability (96% availability)
- Ideal for large plants and landfill gas upgrading
- Only technology to remove Carbon Dioxide, Nitrogen and Oxygen in one stage
- Can upgrade biogas with high Oxygen and Nitrogen
- All pollutants removed (not released with the exhaust)
- Low consumables consumption

Disadvantages

- Lower Recovery rate
- Venting of the usable product Methane in the exhaust cycle

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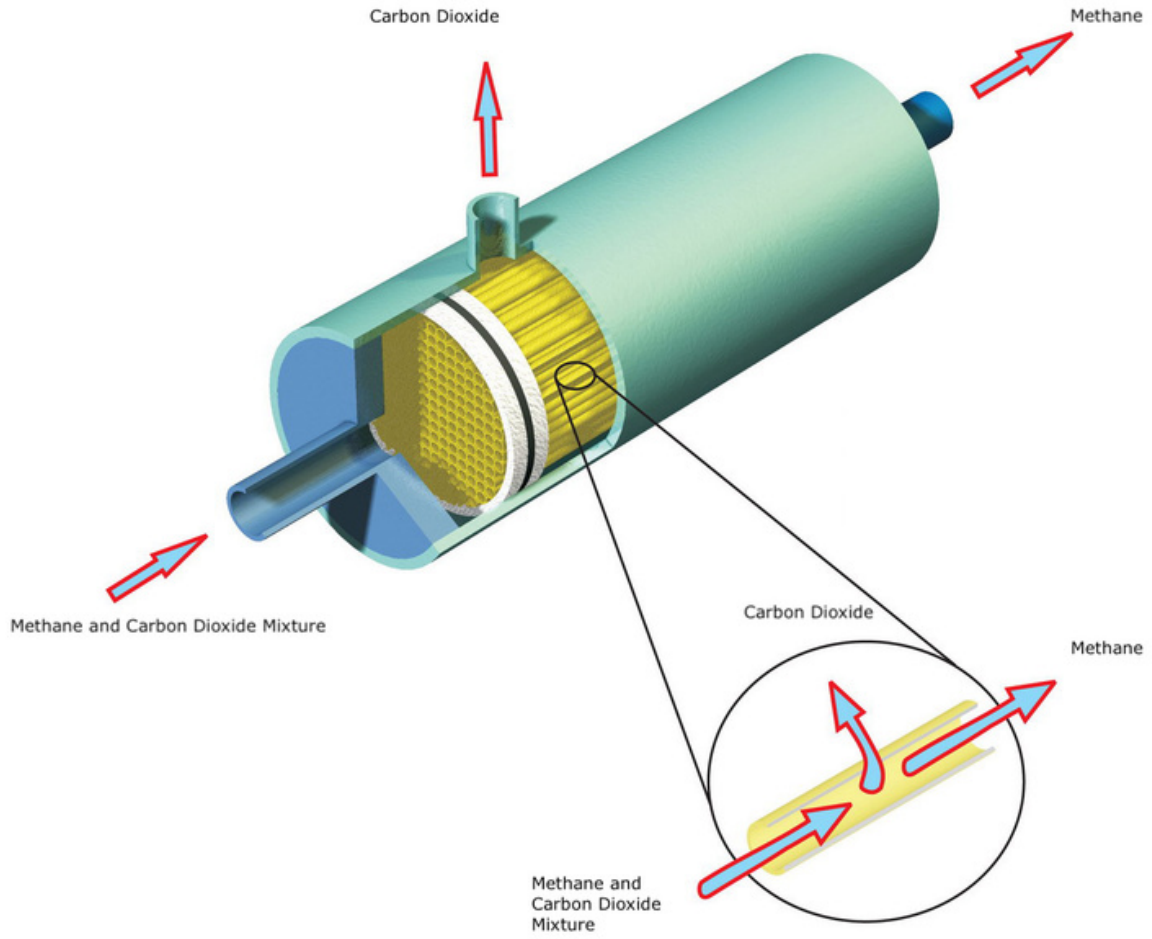
OVERVIEW OF PRESENT TECHNOLOGIES

Membrane Air Seperation



Working Principle

- Membrane is selectively porous to methane and carbon dioxide
- Gas flow is sent in at a higher pressure to provide driving force (typical operating pressure is usually between 10-20 bar)
- Two types of membranes for biogas/natural gas separation, cellulose acetate (CA) spiral wound and polyimide (PI) hollow fiber membranes

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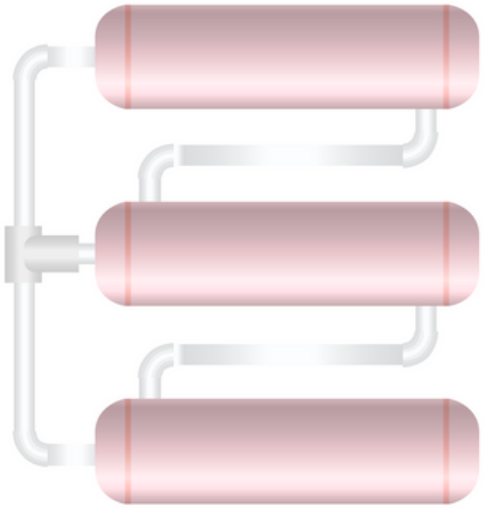
OVERVIEW OF PRESENT TECHNOLOGIES

Membrane Air Seperation



Advantages

- High methane yield of up to 99,5%,
- Excellent modularity and turndown capacity
- Possible elimination of exhaust treatment with high recovery three stage membrane configuration (extremely low methane slip, less than 1% possible)
- Ideal for small to medium plants from10 to 1.400 NCMH, easily scalable
- Excellent energy efficiency for upgrading (<0.2 KWh/Nm3 crude biogas, <0.4 KWh/Nm3 biomethane)
- Ease of maintenance

Disadvantages

- Higher Capex
- Less reliability in case to get very high purity of methane

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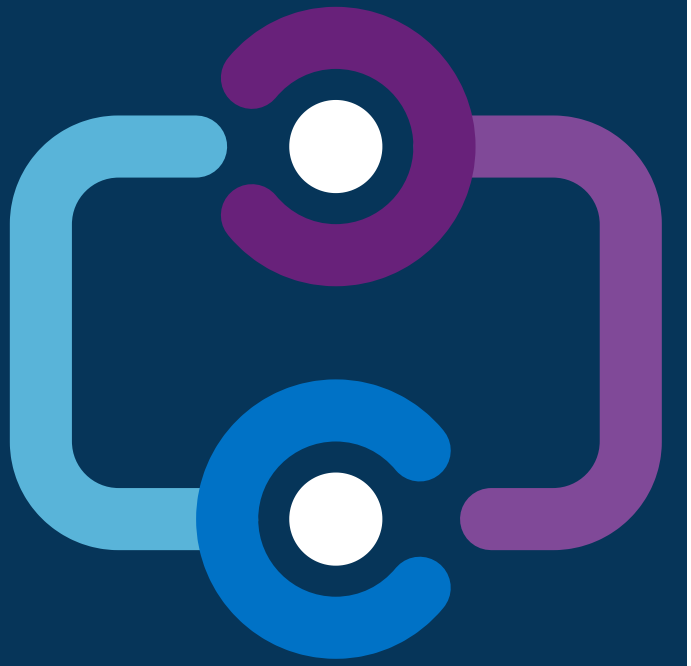
ADAPTATION OF THE BEST FEATURES OF BOTH THE TECHNOLOGIES



WE PROPOSE HYBRID PLANT OF MEMBRANE + VPSA SEPARATION OF RAW BIOGAS TO ACHIEVE HIGH METHANE PURITY

- Reliability and long life of a PSA
- Modularity and turndown capability of membranes
- Excellent flexibility and overall system performance
- Excellent recovery of methane (99%)
- High gas purity (99%) - if required
- Oxygen / Nitrogen removal - if required
- Competitive investment (capex)
- Lower overall operating costs (opex) due to VPSA

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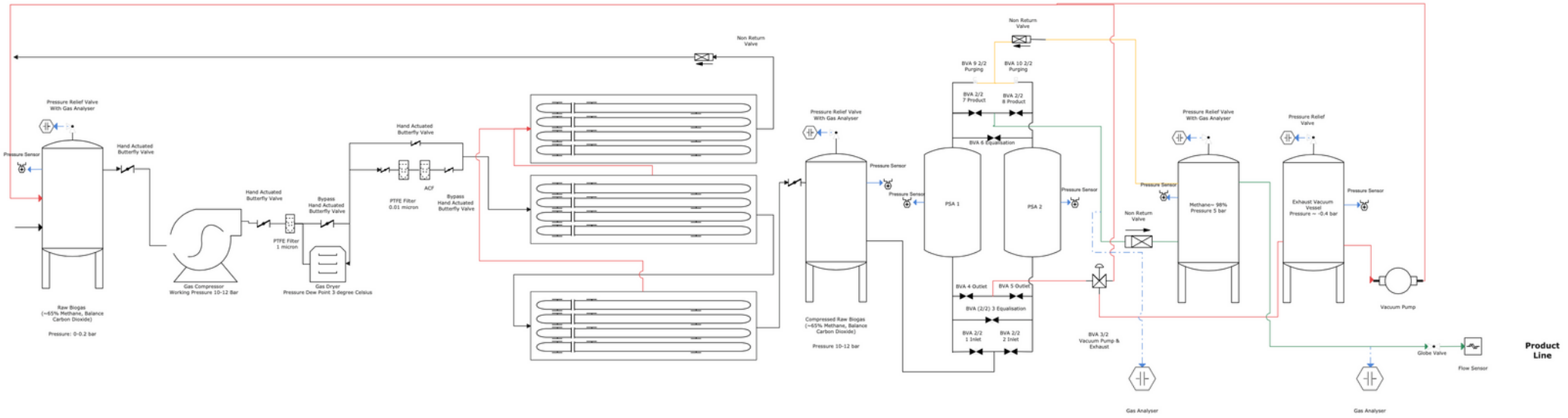
P&ID DIAGRAM OF 5 STAGE MEMBRANE + VPSA METHANE CONCENTRATION PLANT



Stage 1: Compression Stage

Stage 2: Three Stage Membrane Seperation

Stage 3: Vacuum Pressure Swing Adsorption

Stage 4: Byproduct Regeneration

Stage 5: Product

FINSEN RITTER	Title: P&ID Diagram for Methane Concentration Plant (1000 Nm3/hr Plant)
Finsen Ritter Technologies Private Limited	Date: 07/10/2021
Technology: Hybrid Membrane + Vacuum Pressure Swing Adsorbtion	Approved By: Aniket Awasthi

Serial	Item	Remark
1		Ball Valve With Actuator
2		Globe Valve
3		Gas Analyser
4		Pressure Sensor
5		Flow Sensor
6		2/2 Ball Valve with Actuator
7		3/2 Ball Valve with Actuator
8		Frame Breather Valve NC
9		Product Line
10		Input Line
11		Exhaust Line
12		Sensor Line
13		Purging Line

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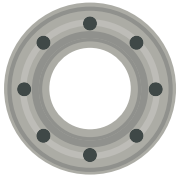
FINSEN RITTER GAS PLANTS

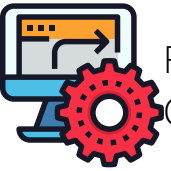
KEY FEATURES OF FINSEN RITTER PROPOSED DESIGN

Energy Efficient Design per NMCH gas separated

High Reliability due to Stainless Steel Grade 304 Piping



Completely Flange end pipe coupling

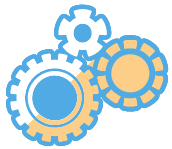


Fully Automated PLC Controlled Plant

SCADA integration

Safe design with all electronic sensors and redundant control systems

Completely in house design of plant providing reliable after sales support



Use of state of the art quality equipment like Siemens PLC, Festo Valves and fittings, SS 304 Piping, Honeywell sensors

Very high recovery rate of 99% allowing almost all Methane to be recovered with minimal wastage

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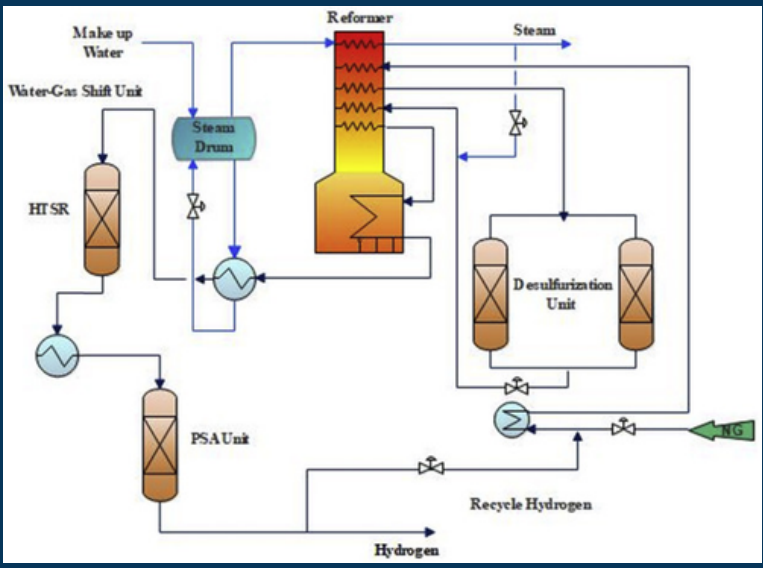
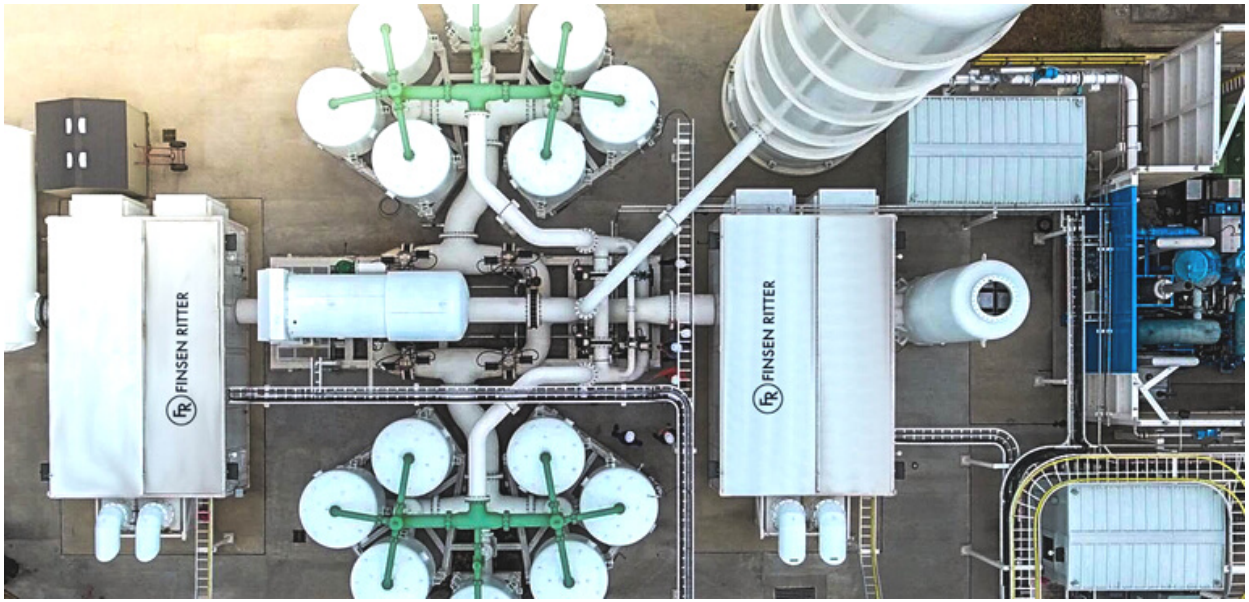
METHANE STEAM FORMING



HYDROGEN FROM METHANE

- Steam reforming is the most widespread process for the generation of hydrogen-rich synthesis gas from light carbohydrates.
- The feed materials natural gas, liquid gas or naphtha are endothermically converted with water steam into synthesis gas in catalytic tube reactors.



$$CH_4 + H_2O \leftrightarrow CO + 3H_2 \qquad \Delta H_{295} = -206\ \mathrm{kJ/mol}$$
$$CO + H_2O \leftrightarrow CO_2 + H_2 \qquad \Delta H_{298} = -41\ \mathrm{kJ/mol}$$
$$CH_4 + 2H_2O \leftrightarrow CO_2 + 4H_2 \qquad \Delta H_{298} = 165\ \mathrm{kJ/mol}$$

ABOUT THE COMPANY

WE SPECIALISE IN INDUSTRIAL TURNKEY SOLUTIONS. WE HAVE DEVELOPED OUR IN-HOUSE TECHNOLOGIES IN THE DESIGN, SUPPLY, INSTALLATION AND TESTING OF CHEMICAL AND GAS PLANTS.

WE HAVE BUSINESSES IN EUROPE AND INDIA. OUR DESIGN CENTRE IS IN AMSTERDAM, THE NETHERLANDS AND THE MANUFACTURING CENTRE IN INDIA.

WE HAVE EXPERTISE IN OXYGEN, NITROGEN, HYDROGEN, ANA, UVGI EQUIPMENT, WATER TREATMENT, BREWING EQUIPMENT, SOLAR POWER PLANT, MILK CHILLER PLANTS, CHLORINATION PLANT, BIOGAS PLANT, BIO CNG PLANT, NOISE MONITORING DEVICES ETC

WE FOLLOW THE STATE OF THE ART INDUSTRY 4.0 STANDARDS ACROSS ALL OUR EQUIPMENT AND PLANTS DELIVERING THE BEST OF EQUIPMENT TO OUR CLIENTS.

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