ABOUT MVS

Since its inception in 1977, MVS Engineering has been at the forefront of technology and has supplied over 7500 air and gas equipment worldwide. We are a turnkey supplier of Air & Gas equipment and have been a market leader in developing and executing on-site systems for continuous uninterrupted supply of high purity gases such as Hydrogen, Nitrogen and Oxygen and Dry Air.

Our products are offered in Technical collaborations with world leading companies such as CarboTech AC GmbH (Germany), Air Liquide (USA), Proton OnSite (USA) and Cryomech (USA). Our customers benefit from world leading technology and also very attractive prices due to low cost manufacturing in India.

TECHNICAL FACTS

<table>
<thead>
<tr>
<th>Hydrogen Flow Rate</th>
<th>1 to 500 nm³/hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purity of Hydrogen</td>
<td>Low purity model: 99.8%</td>
</tr>
<tr>
<td></td>
<td>High purity model: 99.9999%</td>
</tr>
<tr>
<td>Pressure</td>
<td>15 barg</td>
</tr>
<tr>
<td>Dew Point</td>
<td>(-) 60°C</td>
</tr>
</tbody>
</table>

FEATURES

• SAFETY
  Our Hydrogen generators have several monitoring parameters and interlocks that are continuously monitoring the health and operations of the hydrogen generation process. In the event of any deviation from preset value or a signal is absent or the value is outside of range, the system will go into a controlled safe shutdown.

• RELIABILITY
  Our systems are designed with quality components of reputed brands. Furthermore, we design the system as per our customer’s site conditions and as a result our generators are very safe and reliable.

• FULLY AUTOMATED CONTROL
  Complete operation of hydrogen plant is through PLC which ensures comprehensive, precise and reliable process control.

• EASY INSTALLATION
  We design our hydrogen plants in multiple skids which allows for easy transportation and simple hook-ups when skids get to customer site.

• CUSTOMIZABLE
  We take pride in offering customized systems to suit the customer’s requirements. Our ability to tailor-make our equipment is a key differentiator and we are able to do so without any major cost implication.

• LOW POWER CONSUMPTION
  Power consumption in our electrolyzer is only 4.8 kW/nm³ of Hydrogen

BEENEFITS

• SPACE SAVING
  Compared to knowles cells, also known as unipolar design, our bipolar hydrogen generators can be installed in as little as half the space. This is due to simpler design, fewer components and more compact skids. Due to Hydrogen from the electrolyzer coming at high pressure in our bipolar design, as there is no need for bulky floating-roof gas holders needed in unipolar design.

• EASY MAINTENANCE
  We design our systems to be maintained in a simple manner. We provide ample access points in our skid such that technicians have easy access to all components that require maintenance. With fewer equipment, customers will appreciate having much lesser maintenance to do compared to older unipolar type gas plant.

• LONG LIFE
  Hydrogen generators are designed to give 10+ years of life and our customers are able to achieve this with routine maintenance.

• SUFFICIENT PRESSURE FOR DIRECT USE AND STORAGE
  Our Bipolar hydrogen generators are designed to deliver hydrogen gas at a pressure of 1.5 barg at the outlet without any mechanical compression. Unlike the unipolar systems which require several multi-stage hydrogen compressors, bipolar design does not need any compressor to deliver gas at the rated pressure. 1.5 barg is sufficient pressure for most industrial uses and for sufficient storage in tanks.
TECHNOLOGY

THE MAIN COMPONENTS OF THE HYDROGEN GENERATOR

- **TRANSFORMER & RECTIFIER**
  Electrolyzer needs DC electrical power at low voltage. So, transformer and rectifier convert this power as per electrolyzer requirement. In big size hydrogen plants input power to transformer is at 3.3 KV or 6.6 KV or 11 KV. While in sizes up to 25 NM3/hr, 400 Volts LT power is used.

- **ELECTROLYZER**
  Our SJH Electrolyzer is of Bipolar design where high purity DM water is broken to H2 and O2 using DC power supplied by Rectifier. Hydrogen is evolved on cathode side of cells and Oxygen on anodes of cells. This design makes the SJH Electrolyzer unit very compact in size. This is a specially developed cell unit producing gases at high pressure 15 Bar directly. So, no Hydrogen compressor is needed for medium Hydrogen pressure requirements.

- **H2 & O2 SEPARATOR & WASHER UNITS**
  Hydrogen & Oxygen come out separately from cells into Hydrogen separator and Oxygen separator. These are cooled in heat exchangers by cooling water, separated from electrolyte by gravity. Then gases are washed by DM water. Finally clean gases come out through demisters which are located on top of washers.

- **GAS DRYING UNIT**
  Then to dry H2 gas, it is passed through a Molecular sieve Dryer unit where moisture of gas is removed to (~) 60°C Dew point. It has thermal regeneration heaters and automatic switching Pneumatic valves.

- **GAS ANALYZERS**
  Online gas analyzers are provided which continuously indicate Hydrogen purity, Hydrogen dew point, and Oxygen PPM in Hydrogen gas. In case the hydrogen purity falls, you get an alarm on the control panel and the gas plant is shutdown safely.
TECHNOLOGY ADVANCEMENT – PROTON EXCHANGE MEMBRANE

With advancements in bipolar technology, alkaline catalytic solution is possible to be replaced by a non-alkaline system. We are partners of Proton OnSite (USA) that manufactures non-alkaline – Proton Exchange Membrane (PEM) hydrogen generators. These systems are suitable for specific customers who are looking for extremely compact, cabinet-type systems with very high levels of safety and leading certifications like CE-mark and ISO conformity. Proton Hydrogen generators are suitable for Safe area installation. These systems are higher priced than conventional bipolar alkaline systems. However, in the long run, cost of ownership of alkaline and non-alkaline systems is roughly the same. Do ask us if the Proton OnSite (USA) system may be suited for your needs.

PROTON OFFERS THE FOLLOWING MODELS RANGE

<table>
<thead>
<tr>
<th></th>
<th>Lab range (G Series)</th>
<th>S- Series</th>
<th>H- Series</th>
<th>C- Series</th>
<th>M- Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow range</td>
<td>200 cc/min</td>
<td>0.25 nm3/hr</td>
<td>2 nm3/hr</td>
<td>10 nm3/hr</td>
<td>100 to 400 nm3/hr</td>
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<tr>
<td></td>
<td>400 cc/min</td>
<td>0.53 nm3/hr</td>
<td>4 nm3/hr</td>
<td>20 nm3/hr</td>
<td></td>
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<tr>
<td></td>
<td>600 cc/min</td>
<td>1.05 nm3/hr</td>
<td>6 nm3/hr</td>
<td>30 nm3/hr</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4800 cc/min</td>
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</tr>
<tr>
<td>H2 Purity</td>
<td>99.9999+%</td>
<td>99.9995%</td>
<td>99.9995%</td>
<td>99.9998%</td>
<td>99.9995%</td>
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<tr>
<td>Pressure</td>
<td>3 to 8 barg</td>
<td>13.8 barg</td>
<td>15 or 30 barg</td>
<td>30 barg</td>
<td>15 or 30 barg</td>
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<tr>
<td>Dew point</td>
<td>&lt; 5ppmv</td>
<td>(-) 65°C</td>
<td>(-) 65°C</td>
<td>(-) 72°C</td>
<td>(-) 65°C</td>
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<tr>
<td>Generator Style</td>
<td>Table Top/Cabinet</td>
<td>Cabinet</td>
<td>Cabinet</td>
<td>Cabinet</td>
<td>Open skid</td>
</tr>
</tbody>
</table>

![Image of Proton OnSite hydrogen generators](image-url)