Hytron
Company’s History

• Technology company founded in 2003
  • Spin-off from Hydrogen Laboratory (DAP - IFGW), Unicamp
  • Strong R&D activities, focused on innovative applied solutions
  • Expertise in Hydrogen Production and Alternative Energy Systems
    • Multidisciplinary team of specialists, inc. PhD’s and MSc’s
      • Technology development
        • System design, integration and supervision
  • 2015: New Headquarters (Sumare, SP - Brazil)
    • Facility dedicated to R&D (current and future portfolio), fabrication and testing („cold“ and „hot“ runs)
Press Release

NEA GROUP acquired HYTRON Energy & Gas

Machinery and Plant Manufacturer strengthens leading position in hydrogen solutions

The NEUMAN & ESSER (NEA) GROUP from Übach-Palenberg acquired HYTRON Energy & Gas (HYTRON)

Nov 19, 2020
28 Companies in 10 Strategic Countries

Employees: 1,230
Consolidated Sales 2020: 230 Mio. EUR
The NEA GROUP Portfolio for the H₂ Value Chain

Primary Energy
- Wind, Solar, Hydro
- Surplus Power from Conventional Power Plant

Conversion & Processing
- Refinery & Processing and Liquefaction Plants
- Hydrocracking Desulphurization Synfuels
- H₂ Generation Electrolyzers, SMR+CCS, Pyrolysis, ...

Storage
- Gas Storage
- Salt Cavern H₂ Storage
- 200-5000 Nm³/h 1-30 to 500 bar

Transport & Distribution
- H₂ Transportation, LH₂ Regasification, LOHC
- Natural Gas Grid
- H₂ feed in 100-200 kNm³/h 1-30 to 70-80 bar (10-20%)
- H₂ Pipeline Grid
- 200-2000 kNm³/h 30 to 70-80 bar

Final Energy Demand
- Service & Commercial
- Industry, e.g. Steel, Glass, ...
- Fuel Cell Power Plant
- Residential

800-5000 Nm³/h 30-200 to 500-900 bar
Use of renewable sources
H₂ and O₂ production
Green H₂ applications
Higher electrical consumption compared to reformers
Higher global demand for modular applications

Electrolyser

Steam Reforming
Use of local feedstocks
Pure H₂ or H₂ + CO production
Continuous production (no intermittence)
Interest of the NG industry
Green Solutions:
(Biomethane end ethanol)

Pressure Swing Adsorption
H₂ Purification
Methane Purification (others)
It may be included in our equipment, or sold separately
HyPEM
ELECTROLYSER

https://www.youtube.com/watch?v=FTJaI93xHKA
HyPEM Water Electrolysis
System Attributes

Rated productions up to 1,000 Nm³ H₂/h or 5 MW (per module)

Integrated and autonomous solutions (“Turn-Key”):
- H₂ and O₂ production module
- Gas purification & Purity supervision
- Thermal management & Utilities:
  - Heat rejection, Instrument air provision, Process water production, Chilled water
- Power electronics, Controls & Cabinet (outdoor installation)

Proprietary control software & Supervisory platform (SCADA)

Hydrogen purity up to 99.9999% (6.0)

Maximum operating pressure: 40 bar₉
## HyPEM Water Electrolysis

### Plant Sizes

<table>
<thead>
<tr>
<th>“Small-Scale”</th>
<th>Industry / Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>HyPEM 10-40 10 Nm³ H₂/h; 40 bar$_g$ (50 kW Plant)</td>
<td>HyPEM 60-40 60 Nm³ H₂/h; 40 bar$_g$ (300 kW Plant)</td>
</tr>
<tr>
<td>HyPEM 20-40 20 Nm³ H₂/h; 40 bar$_g$ (100 kW Plant)</td>
<td>HyPEM 100-40 100 Nm³ H₂/h; 40 bar$_g$ (0.5 MW Plant)</td>
</tr>
<tr>
<td>HyPEM 30-40 30 Nm³ H₂/h; 40 bar$_g$ (150 kW Plant)</td>
<td>HyPEM 200-40 200 Nm³ H₂/h; 40 bar$_g$ (1 MW Plant)</td>
</tr>
<tr>
<td></td>
<td>HyPEM 400-40 400 Nm³ H₂/h; 40 bar$_g$ (2 MW Plant)</td>
</tr>
<tr>
<td></td>
<td>HyPEM 600-40 600 Nm³ H₂/h; 40 bar$_g$ (3 MW Plant)</td>
</tr>
<tr>
<td></td>
<td>HyPEM 800-40 800 Nm³ H₂/h; 40 bar$_g$ (4 MW Plant)</td>
</tr>
<tr>
<td></td>
<td>HyPEM 1,000-40 1,000 Nm³ H₂/h; 40 bar$_g$ (5 MW Plant)</td>
</tr>
</tbody>
</table>

PS: the association of HyPEM 1,000-40 systems creates Multi-MW solutions
HyPEM Water Electrolysis
5 MW Plant Structure – Overview

Production & Rectification
40’ High Cube ISO Container
(21 Ton)

05 x 1 MW PEM Stack

Rectification

BoP, Utilities & Control Panel
40’ High Cube ISO Container
(12 Ton)

Dry-Cooler
(Heat Rejection)

H₂ Purification & Analysis

H₂/Water Separation Vessels

O₂/Water Separation Vessel & Analysis

Process Pumps

Heat Management Pump

Control Panel & Utilities

Process Water Production Module
Compressed Air
Water Chiller

© NEA GROUP
H₂ FROM ELECTROLYSIS
Power to X

https://www.youtube.com/watch?v=MfZpdNxxCUM
CO2CHEM

Power to X

[Diagram showing the process of converting CO₂ into green fuels using electrolysis and renewable energy sources like wind and solar.]

Different sources of CO₂

- Air
- E&P operations

Electrolysis using water + Wind or photovoltaic energy

Green fuels

\[ \text{H}_2 \text{C-}\text{C-}\text{C-}\text{C-}\text{C-}\text{C-}\text{C-}\text{H} + \text{H}_2\text{O} \]

Processing plant

Synthesizes green hydrocarbons:
- Green fuels;
- Special paraffin that are used for the production of cosmetics, for example;
- Raw material for green plastic;
- Lubricant oil;
- Green aviation kerosene.

https://www.youtube.com/watch?v=MfZpdNxxCUM
Solutions Portfolio

FUEL REFORMING
Fuel Reformers
System Attributes

• Rated productions up to **350 Nm³ H₂/h** (per module)
• Integrated and autonomous solutions ("Turn-Key"):
  • Feed treatment, Reforming & Shift conversion
  • PSA gas purification & Purity supervision
  • Thermal management & Utilities:
    • Heat recovery, Instrument air provision, Process water production
    • Controls & Cabinet (outdoor installation)
• Proprietary control software & Supervisory platform (**SCADA**)  
• Hydrogen purity up to 99.9999% (**6.0**)  
• Operating pressure: **10 bar**
Fuel Reformers
Product Performance – Biomethane

Process: Steam-Reforming
H₂ Purification: PSA (Pressure Swing Adsorption)
H₂ Purity: up to 99.9999% (SAE J2719 / DIN EN 17124 compliant)
H₂ Pressure: 10 bar (typical)

Biomethane / NG
4.85 Nm³ / kg H₂

Water
35 L / kg H₂

Electricity
4.71 kWh / kg H₂

Hydrogen
up to 750 kg/day
Fuel Reformers
Product to Come – Ethanol

Process: Steam-Reforming

H₂ Purification: PSA (Pressure Swing Adsorption)
H₂ Purity: up to 99.9999% (SAE J2719 / DIN EN 17124 compliant)
H₂ Pressure: 10 bar (typical)

Ethanol
7.65 L / kg H₂

Water
30 L / kg H₂

Electricity
2.35 kWh / kg H₂

Hydrogen
up to 750 kg/day
Advantages of Using Ethanol for H₂ Production

Ethanol as Green Hydrogen Carrier

- Fact of being a renewable fuel
- Ease of transportation (usual for the Brazilian case)
- Brazil's potential as an important global player
- There is already an entire value chain established
- It is not a toxic fuel
- Enables the flat production of Green H₂ (without itermitence)
- Easy to store
- Enables local production of H₂ close to consumption
### Some Numbers from Ethanol Industry

**Ethanol as Green Hydrogen Carrier**

<table>
<thead>
<tr>
<th>INPUT</th>
<th>QUANTITY</th>
<th>UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethanol 1G</td>
<td>80</td>
<td>L / t (sugar cane)</td>
</tr>
<tr>
<td>Ethanol 2G</td>
<td>32</td>
<td>L / t (sugar cane)</td>
</tr>
<tr>
<td>Biogas</td>
<td>8,9</td>
<td>Nm³ CH₄ / t (sugar cane)</td>
</tr>
<tr>
<td>E. Energy</td>
<td>49</td>
<td>kW / t (sugar cane)</td>
</tr>
<tr>
<td><strong>Ethanol 1G + 2G</strong></td>
<td><strong>15</strong></td>
<td>kg H₂ / t (sugar cane)</td>
</tr>
<tr>
<td>Biogas</td>
<td>1,84</td>
<td>kg H₂ / t (sugar cane)</td>
</tr>
<tr>
<td>E. Energy</td>
<td>0,92</td>
<td>kg H₂ / t (sugar cane)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>17,76</strong></td>
<td>kg H₂ / t (sugar cane)</td>
</tr>
<tr>
<td></td>
<td><strong>198,91</strong></td>
<td>Nm³ H₂ / t (sugar cane)</td>
</tr>
</tbody>
</table>
CHARACTERISTICS WITH THE USE OF ETHANOL

✓ 7.6 liters of ethanol produces 1 kg of H₂ (Hytron Reformer)
✓ H₂ storage in the car ranges from 5 kg to 7.5 kg H₂
✓ BOSCH Fuel Cell: 1 kg H₂ → 150 km
✓ Autonomy: 750 km to 1,125 km
✓ ETHANOL Consumption: 38 liters to 57 liters
✓ 57 liters of Ethanol → 1,125 km (~20 Km/L)
✓ Refueling time: 3 min

THIS IS JUST THE BEGINNING!
NEUMAN & ESSER GROUP
AGILE. SOLUTION. EXPERTS.
HYDROGEN GENERATION PLANTS
HRS PROJECT REFERENCE

• Electrolyzer Unit
  • One 20” standard container for Electrolysis system

• Compressor Unit & Storage Unit
  • One 20” standard container for Compressor system

These dimensions are only for reference. NEUMAN & ESSER solutions for Hydrogen plants are tailor made for each customer and application. Actual plant dimensions are defined during Technical discussions and Engineering phase.
## HyPEM 20-40

<table>
<thead>
<tr>
<th>EQUIPMENT</th>
<th>HyPEM ELECTROLYSER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cabinet</td>
<td>20’ container, including process and controls</td>
</tr>
<tr>
<td>Ambient Conditions</td>
<td>up to +50°C</td>
</tr>
<tr>
<td>Rated Production (H₂)</td>
<td>20 Nm³/h (1.8 kg/h)</td>
</tr>
<tr>
<td>Installed Power</td>
<td>120 kW</td>
</tr>
<tr>
<td>Raw Water Consumption *</td>
<td>34 L/h (may vary depending on the quality of water available locally)</td>
</tr>
<tr>
<td>H₂ Purity (higher purities also available)</td>
<td>99.999% (5.0) → SAE J2719 / DIN EN 17124 compliant</td>
</tr>
<tr>
<td>Maximum H₂ Delivery Pressure</td>
<td>40 bar₉</td>
</tr>
<tr>
<td>Operating Range</td>
<td>10 to 100%</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>Only for maintenances</td>
</tr>
<tr>
<td>Compressed Air</td>
<td>5 – 7 bar₉ (ISO 8573.1, 2010, class 2.4.1; Included and only used for piloting purposes)</td>
</tr>
<tr>
<td>Electrical Standard (typical)**</td>
<td>380 Vac / 3 / 60 Hz (Different power supply standards can be provided)</td>
</tr>
</tbody>
</table>
HYDROGEN GENERATION PLANTS

Compressor Units

HOFER Diaphragm Compressors

HOFER Hydraulic Driven Compressors
HYDROGEN GENERATION PLANTS

Storage

• High pressure hydrogen storage for both stationary and mobile applications

• Storage solutions for pressures of 200 bar up to 1,000 bar

• Type II or IV pressure vessels
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Antonio Marin, Technical Director (antonio@hytron.com.br)

https://www.hytron.com.br

THANK YOU!