Mahler AGS gas generation and purification plants

Mahler AGS is the leading manufacturer and supplier of cost-effective, safe and reliable gas generation and purification plants for hydrogen, oxygen, nitrogen, biogas and protective gas.

Mahler AGS offers a variety of cost-effective on-site plants for users in a wide field of industries. More than 60 years of experience in plant design and engineering guarantee high operational availability of all Mahler AGS gas generation and purification plants.

**Reforming and PSA technology** - Mahler AGS applies the most economical industrial processes for hydrogen production. The hydrogen generation and purification plants are tailored to the customers' requirements and will be delivered in prefabricated skids.

**VPSA technology** - Mahler AGS applies the most economical industrial process for oxygen production. The oxygen generation plants by means of the VPSA technology are tailored to the customers' requirements and will be prefabricated to the highest possible degree.

**PSA technology** - Mahler AGS applies the most economical industrial process for nitrogen production. The nitrogen generation plants by means of the PSA technology are tailored to the customers' requirements and will be delivered in prefabricated skids.

**HN/HNX Generator** - Mahler AGS' HN/HNX plants applies a very reliable and economic solution for the generation of protective gases. The HN/HNX plants will be delivered in prefabricated skids.

**Biogas upgrading** - PSA technology - Mahler AGS applies biogas upgrading plants for the production of biomethane. The BIOSWING line comprises containerized standard units as well as tailored plants. All PSA plants are based on industrial standards.

**Process gas membrane systems** - Completely packaged membrane units – Mahler AGS supplies packaged membrane systems for process gas purification and separation in a wide range of applications. The package units are tailored to customers' requirements and will be delivered in prefabricated skids.
Mahler AGS – Advanced Gas Systems

Mahler AGS – Advanced gas systems – the experts for gas generation and purification

With more than 4,500 plants built worldwide since 1950, Mahler AGS is a highly respected manufacturer of on-site gas plants for hydrogen generation, oxygen generation and nitrogen generation.

Mahler AGS manufactures cost-effective, safe and reliable on-site generation systems for high quality industrial gases (i.e. hydrogen plants, oxygen plants and nitrogen plants) as well as plants for the purification and recovery of technical gases and process waste gases. Our plants can be used in a wide range of industries.

Highlights: Our hydrogen generator was the first remote controlled hydrogen plant in the world, our oxygen generator technology provides lowest consumption figures and our nitrogen PSA-systems are applied for one of the biggest on-site projects with this technology.

Our services

Understanding that every application and location is unique, Mahler AGS offers a family of cost-effective and reliable on-site generation systems. In cooperation with the customer, Mahler AGS' engineers will analyze the requirements, to offer a system, which meets the specifications for flow, purity and pressure.

The typical scope of supply includes design, manufacturing, installation and start-up of the system. A service team is always available to provide any necessary service or maintenance for the lifetime of the system.

Our goals

The high-quality generation systems have proven reliable and safe, but this is just the beginning. Mahler AGS’ after-sales service, continuous process improvement, trustful cooperation with research institutes and the certification of the Quality Management System (according to DIN EN ISO 9001) will ensure superior products and services.
Hydrogen production plants – hydrogen generation and purification

Mahler AGS offers hydrogen generation systems using a variety of feedstocks such as natural gas, LPG, naphtha, methanol or hydrogen rich gases from several sources.

Mahler AGS has more than 60 years experience and know-how in designing and manufacturing hydrogen generation and purification plants. As one of the internationally leading suppliers of steam reforming and pressure swing adsorption technology, Mahler AGS provides proven and reliable systems which are exactly tailored to the customer’s requirements and can be easily integrated into already existing processes.

Hydrogen is an important utility for numerous applications in multiple industries. Users in a wide range of industries can benefit from operating a cost-effective Mahler AGS hydrogen plant and reduce their production costs significantly.

Applications for hydrogen plants

- Metallurgical and steel industry
- Petrochemical and refining industry
- Glass and float glass manufacturing
- Chemical and pharmaceutical industry
- Production of H2O2
- Food industry
- Electronics industry
- Technical gases

For customers with access to natural gas, LPG or naphtha on-site Hydrogen can be generated most economically using Mahler AGS hydrogen plants based on steam reforming. Mahler AGS offers plants up to 10,000 Nm³/h at purities up to 99,9999 vol.-%.

Methanol cracking is the alternative hydrogen production method at sites with limited access to hydrocarbons (e.g. natural gas). Mahler AGS hydrogen plants based on methanol reforming process meet hydrogen requirements up to 5,000 Nm³/h at purities up to 99,9999 vol.-%.

For the recovery of pure hydrogen from hydrogen rich gas resp. off-gas Mahler AGS can provide hydrogen purification system. These systems are based on pressure swing adsorption (PSA) technology using multiple beds to recover up to 50,000 Nm³/h pure hydrogen at purities up to 99,9999 vol.-%.
Hydrogen generation plant based on steam reforming – HYDROFORM-C

Mahler AGS hydrogen plants based on steam reforming of hydrocarbons cover hydrogen demands from 200 to 10,000 Nm³/h at purities up to 99,9999 vol.-% and typical product pressures from 10 bar to 30 bar(abs).

Steam reforming of natural gas, LPG or naphtha (feedstocks) with subsequent purification is the most economic and thus most common process for hydrogen production and serves 95% of the world’s hydrogen demand.

Basic process steps:
The feedstock is desulphurized, mixed with steam and converted to synthesis gas in the top fired reformer furnace using nickel catalyst. The synthesis gas is cooled down in the heat recovery section and subsequently fed to the high temperature CO-conversion reactor followed by cooling and HYDROSWING PSA purification.

Plant features of the HYDROFORM-C hydrogen plant

- Design for long lifetime
- High operational reliability
- High quality and high safety standard
- First class sub-suppliers for equipment and components
- Fully automatic operation and remote control
- Prefabrication in skids/modules
- Easy maintenance and accessibility

Plant data

Feedstock: Natural gas, LPG, naphtha
Hydrogen capacity: 200 to 10,000 Nm³/h
Hydrogen product pressure: 10-30 bar(abs)
Hydrogen purity: up to 99,9999 vol.-%

Typical consumption data for 1,000 Nm³/h hydrogen:
Natural gas: 450 Nm³ / h
Demineralized water: 900 kg / h
Cooling water: 38 m³ / h
Electric power: 38 kW

Additional/Optional features for hydrogen production units

Individual plant concepts with respect to desulphurization, export steam generation, product compression, turn-key delivery, water treatment, hydrogen product storage etc. can be offered.

Our plants are used worldwide. Especially for Russia, Belarus and Kazakhstan we are able to provide our plants with all necessary TR certificates and declarations for the import and operation in the Custom Union. Our HYDROFORM-C plants are equipped with a serial declaration according TR CU 010/2011 (MD), TR CU 004/2011 (LVD) and TR CU 020/2011 (EMC), valid until beginning of 2020. Certificates or declarations according TR CU 032/2013 for all pressure vessels as well as a TR CU 012/2011 certificate for the entire equipment placed inside areas with potentially explosive atmospheres are also part of our scope of supply.
Hydrogen generation plant based on methanol reforming – HYDROFORM-M

Mahler AGS hydrogen plants based on methanol reforming process meet hydrogen requirements from 200 to 5,000 Nm³/h at purities up to 99,999 vol.-% and typical product pressures from 10 bar to 30 bar(abs).

The hydrogen generation plant based on methanol reforming with subsequent purification is a well-established process for hydrogen production and the alternative method at locations with limited access to hydrocarbons.

Basic process steps:
Methanol water mixture is vaporized and converted to hydrogen rich synthesis gas in the tubular thermal-oil heated reactor over copper catalyst. Synthesis gas from reactor outlet is cooled down, condensate is recycled and the hydrogen rich gas is purified using HYDROSWING PSA technology.

With the use of thermal oil the hydrogen production plant will keep its operating temperature extremely stable and can be restarted at short notice e.g. if a power failure occurs. With Mahlers’ technology and design an overheating of the reactor and the low temperature catalyst, which is highly temperature sensitive is prevented by using a heat transfer media (thermal oil) buffering any temperature peaks. This helps to protect the catalyst for the complete lifetime.

Plant features of the HYDROFORM-M hydrogen plant

- Design for long lifetime
- High operational reliability
- High quality and high safety standard
- First class sub-suppliers for equipment and components
- Fully automatic operation and remote control
- Prefabrication in skids/modules
- Easy maintenance and accessibility

**Pnat data**

<table>
<thead>
<tr>
<th>Feedstock: Methanol</th>
<th>Hydrogen capacity: 200 to 5,000 Nm³/h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrogen product pressure: 10-30 bar(abs)</td>
<td>Hydrogen purity: up to 99,999 vol.-%</td>
</tr>
</tbody>
</table>

**Typical consumption data for 1,000 Nm³/h hydrogen:**

<table>
<thead>
<tr>
<th>Methanol: 630 Nm³/h</th>
<th>Demineralized water: 340 kg/h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooling water: 20 m³/h</td>
<td>Electric power: 45 kW</td>
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</table>

**Additional/Optional features for hydrogen production units**

Individual plant concepts with respect to product compression, turn-key delivery, water treatment, hydrogen product storage etc. can be offered.
Hydrogen purification plant based on pressure swing adsorption – HYDROSWING

Mahler AGS hydrogen purification plants are based on pressure swing adsorption for hydrogen recovery from hydrogen rich gases with capacities from 100 to 50,000 Nm³/h and purities up to 99.9999 vol.-%.

HYDROSWING hydrogen PSA units are designed for the recovery and the purification of hydrogen from different hydrogen rich gases as synthesis gas coming from steam reforming, methanol reforming or from various off-gases. For this task the principle of pressure-swing adsorption (PSA-technology) is applied.

Depending on customers’ focus and demands the hydrogen PSA systems are designed with either 4, 5 or 6 adsorber vessels and different modes of operation. Purities of up to 99.9999 vol.-% hydrogen product quality can be achieved at optimum recovery rates.

The pressure swing adsorption (PSA) technology applies the principle of physically binding the impurities contained in the hydrogen rich gases by individually selected adsorbent materials. Since the binding forces for such impurities depend on the pressure, the PSA operates on an alternating cycle of adsorption at elevated pressures and desorption at decreased pressures.

Plant features of the HYDROSWING hydrogen purification plant

- High recovery rates and low invest cost
- Design for long lifetime
- High availability due to special control system and the feature to switch-back to operation with reduced number of adsorber vessels
- High reliability due to proven first class plant components for PSA-applications (e.g. PSA-valves or butterfly-valves and instruments)
- High quality and high safety standard
- Fully automatic operation and remote control
- Completely pre-manufactured valve skid
- Easy maintenance and accessibility

Plant data

<table>
<thead>
<tr>
<th>Feedstock</th>
<th>Hydrogen rich gas, synthesis gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrogen capacity</td>
<td>100 to 50,000 Nm³/h</td>
</tr>
<tr>
<td>Feed pressure</td>
<td>6-40 bar(abs)</td>
</tr>
<tr>
<td>Hydrogen purity</td>
<td>up to 99.9999 vol.-%</td>
</tr>
</tbody>
</table>

Additional/Optional features for hydrogen purification units

Individual plant concepts with respect to capacity control, adaption of operation mode for varying operation conditions and online purity monitoring etc. can be offered.

Our plants are used worldwide. Especially for Russia, Belarus and Kazakhstan we are able to provide our plants with all necessary TR certificates and declarations for the import and operation in the Custom Union. Our HYDROSWING plants are equipped with a serial declaration according TR CU 010/2011 (MD), TR CU 004/2011 (LVD) and TR CU 020/2011 (EMC), valid until beginning of 2020. Certificates or declarations according TR CU 032/2013 for all pressure vessels as well as a TR CU 012/2011 certificate for the entire equipment placed inside areas with potentially explosive atmospheres are also part of our scope of supply.
Oxygen generation based on vacuum pressure swing adsorption – OXYSWING

Mahler AGS oxygen generation plants are based on vacuum pressure swing adsorption technology for capacities from about 300 to 5,000 Nm³/h and purities up to 94 vol.-%.

OXYSWING VPSA units are designed for the oxygen generation from ambient air. Depending on customers’ focus and demands the VPSA systems are designed invest or energy optimized. Purities of up to 94 vol.-% oxygen product quality can be achieved. Product gas pressures > 1,2 bar(abs) will be achieved by means of subsequent oxygen compression. The vacuum pressure swing adsorption (VPSA) technology employs the basic principle of air separation at ambient temperatures by using zeolite (a material that adsorbs nitrogen to leave a rich stream of oxygen). Individual plant concepts with respect to local situation (building available, etc.), admissible sound emission, integration in the production process can be offered.

Plant features of the OXYSWING oxygen generation plant

- Low cost on-site production
- Fast start-up, fully automatic and unattended operation
- Product flexibility regarding flow and purity
- Automatic part load
- Remote control
- Completely pre-manufactured skids
- High availability and reliability
- Design for long lifetime

Plant data

Feedstock: ambient air
Product gas capacity: 300 to 5,000 Nm³/h
Purity: up to 94 vol.-%
Pressure*: about 1,2 bar(abs)
* at exit oxygen VPSA unit; higher pressures on demand.

Typical applications for oxygen plants

- Metallurgical and steel industry
- Glass and enamel industry
- Pulp and paper
- Cement industry
- Water treatment
- Waste incineration

Additional/Optional features for oxygen generation plants

Our plants are used worldwide. Especially for Russia, Belarus and Kazakhstan we are able to provide our OXYSWING plants with all necessary TR certificates and declarations for the import and operation in the Custom Union, in particular with a declaration according TR CU 010/2011 (MD), TR CU 004/2011 (LVD) and TR CU 020/2011 (EMC) for the entire oxygen plant. Certificates or declarations according TR CU 032/2013 for all pressure vessels are also part of our scope of supply.
Nitrogen generation based on pressure swing adsorption – NITROSWING

Mahler AGS nitrogen generation plants are based on pressure swing adsorption technology for capacities from about 200 to 4000 Nm³/h depending on the purity. Purities up to 99,99 vol.-% can be reached.

NITROSWING PSA units are designed for nitrogen generation from ambient air.

The pressure swing adsorption (PSA) technology employs the basic principle of air separation at ambient temperatures by using carbon molecular sieve (CMS; a material that adsorbs oxygen to leave a rich stream of nitrogen).

Individual plant concepts with respect to local situation (building available, etc.), admissible sound emission can be offered. Furthermore concepts with additional oxygen removal (DEOXO) can be considered in order to achieve oxygen contents < 3 vppm.

Plant features of the NITROSWING nitrogen generation plant

- Low cost on-site production
- Fast start-up, fully automatic and unattended operation
- Product flexibility regarding flow and purity
- Completely pre-manufactured skids
- High availability and reliability
- Design for long lifetime

Plant data

| Feedstock: | ambient air |
| Nitrogen capacity: | 200 to 4000 Nm³/h |
| Purity: | up to 99,99 vol.-% |
| Pressure*: | 6-9 bar (abs) |

* at exit nitrogen PSA unit; higher pressures on demand.

Typical applications for nitrogen plants

- Metallurgical / heat treatment
- Chemical and petrochemical industry
- Float glass
- Food industry
- Electronic industry
- Oil and gas

Additional/Optional features for nitrogen generation plants:

Our plants are used worldwide. Especially for Russia, Belarus and Kazakhstan we are able to provide our plants with all necessary TR certificates and declarations for the import and operation in the Custom Union. Our NITROSWING plants are equipped with a serial declaration according TR CU 010/2011 (MD), TR CU 004/2011 (LVD) and TR CU 020/2011 (EMC), valid until beginning of 2020. Certificates or declarations according TR CU 032/2013 for all pressure vessels as well as a TR CU 012/2011 certificate for the entire equipment placed inside areas with potentially explosive atmospheres are also part of our scope of supply.
HN/HNX gas generation – Protective gas

Mahler AGS HN/HNX gas generation plants are based on the combustion of hydrocarbons to cover protective gas demands for up to 1.200 Nm³/h. Hydrogen contents between 1 - 12 vol.-% can be achieved.

The sub stoichiometric combustion of hydrocarbons (NG, LPG) with subsequent conversion of CO to CO2 followed by removal of CO2 by means of Mono Ethanol Amine (MEA) is a well-established process for the generation of protective gas. Depending on customers’ demands the HN/ HNX gas generation plants can deliver a protective gas with a hydrogen content between 1 vol.-% to 12 vol.-%.

Individual plant concepts to cover higher capacities and different hydrogen contents, as well as back-up systems to guarantee a continuous gas supply can be offered.

Plant features of the HN/HNX gas generation plants

- Low cost on-site production
- Fully automatic and unattended operation
- Product flexibility regarding flow and H2-content
- Completely pre-manufactured skids
- High availability and reliability
- Design for long lifetime

Plant data

| Feedstock: | Natural gas (NG), liquefied petroleum gas (LPG) |
| Product gas capacity: | 350 to 1,200 Nm³/h |
| H2-content: | 1-12 vol.-% |
| Delivery pressure*: | about 1,1 bar(abs) |

* at exit oxygen VPSA unit; higher pressures on demand.

Typical applications for HN/HNX gas generation plants

- Metallurgical industry (e.g. galvanizing, annealing)
- Float glass industry
Biomethane generation based on pressure swing adsorption – BIOSWING

Mahler AGS biogas upgrading plants are based on pressure swing adsorption technology for capacities from about 500 to 5000 Nm³/h.

BIOSWING PSA units are designed for the biomethane generation from biogas.

The pressure swing adsorption (PSA) technology employs the basic principle of gas separation at ambient temperatures by using carbon molecular sieve (CMS; a material that adsorbs carbon dioxide to leave a rich stream of biomethane).

**Plant features of the BIOSWING biomethane generation plant**
- High methane recovery and product purity
- Low energy demand
- Fast start-up, fully automatic and unattended operation
- Automatic adjustment to biogas quality
- Remote control
- Containerized units
- High availability and reliability
- Design for long lifetime

**Plant data**
- Feedstock: Biogas / landfill gas
- Upgrading capacity: 500 to 5000 Nm³/h
- CH4 recovery rate: up to 98 %
- Product purity: > 96 vol.-% CH4
- Pressure*: 4 – 7 bar(abs)
  * at exit biomethane generation plant; higher pressures on demand.

**Additional/Optional features for BIOSWING biomethane generation plants**

Subsequent oxygen removal (DEOXO-unit) to meet EASEE requirements can be offered.
Process gas purification and separation by membrane technology – Process gas membrane

Mahler AGS process gas membrane systems are custom made package units for a wide range of applications. Various process gas mixtures can be handled with a product recovery of 99 % and product purities up to 99 vol.-%.

Mahler AGS process gas membrane units can be employed in numerous processes. The application area can range from purification or recovery of waste gas streams to generation of a high quality product (e.g. hydrogen, methane, syngas, helium).

Package units including process gas compression, pre- and after-treatment can be realized. A typical membrane system includes a treatment unit with filter and a heater for performance adjustment of the separation process itself. Additional after-treatment units can consist of optional drying units, heat management systems or even high-purity PSA systems. Also units including high pressure process gas compressors can be provided.

A unique selling point of Mahler AGS systems is the possibility of tailor made control systems for adjustable part-load operation and the design and execution of the plant based on customer’s specifications.

Features of the process gas membrane units

- Manual or automatic and unattended operation options
- Product flexibility regarding flow, purity and recovery
- Completely pre-manufactured skids
- High availability and reliability
- Design for long lifetime

Plant data

Feedstock: Process gas / natural gas / fuel gas
Feedstock capacity: 5.000 to 60.000 Nm³/h
Feed pressure: 20 bar(abs) to 160 bar(abs)
Product purity: Up to 99 vol-%
Recovery of product: Up to 99 %

Typical applications for process gas membrane units

- Chemical and petrochemical industry
- Oil and gas
- Refineries
- Electronic industry
Our service concept

Our after sales team offers a broad range of services. Whether conventional maintenance or customized solutions, Mahler AGS provides the complete service package.

Worldwide after sales service

High availability, long lifetime and reliable performance, these are the major requirements for process plants. With our broad variety of service capabilities we offer our customers active support based on highest technical standards all around the world. Mahler’s philosophy is to find the most suitable solution for our clients, having close contact and a relationship built on a long term cooperation. Furthermore Mahler makes all necessary efforts to support the clients and to take care of their plants during the complete life time.

Consulting

The customer can contact us directly for support or advice via telephone or email. Exchange of experience and individual advisory service forms the basis for a partnership to the benefit of both parties.

Installation

Experienced and competent field engineers assure the correct and proper installation of a plant. At any time they can revert to the assistance of our qualified office staff. In addition Mahler AGS provides time and working schedules as well as documentation in order to ensure timely completion.

Commissioning

Starting from final check of erection and mechanical completion until performance test we provide all commissioning services. The commissioning includes catalyst and adsorbent loading of reactors and vessels, carrying out numerous function tests, plant startup, adjustment of process parameters and check of all safety functions. Our target is to reach the specified performance parameters and client’s full satisfaction while keeping the time schedule.

Spare part service

Our strength is to react fast and to come up with cost-effective solutions to keep the plants in operation throughout the service life of your plant, even if the plant is more than 40 years old. Due to clear identification for every component, we are able to determine and offer every spare part you may require. We will offer the best and most economical solution for your purposes for either defective or modification parts.
Inspection and maintenance

Regular inspection and maintenance ensures long-term functioning, avoids damage and prevents unexpected malfunctions. This service includes a comprehensive check of the plant status and functional tests of all relevant components and leads to a recommendation for maintenance and required spare parts. Also service on sub-suppliers’ equipment and machinery can be provided. The quality of such specialized service is assured by permanent training of our personnel. Finally Mahler AGS adjusts and optimizes your plant for its particular operating condition.

Remote service

Mahler AGS offers a direct line between your plant and our experienced office personnel. The possibility of remote access and data transfer between your plant control system and our service center enables us to assist quickly, whenever required all over the world, in case operational problems or malfunctions occur. Adaptations to changed operating conditions or precautionary checks of operating data are possible. In addition Mahler offers remote service packages, individually adapted to your requirements, with access to our service hotline.

Optimizing, modernizing, overhaul and relocating

If you require capacity or performance upgrades, modernization of individual components or complete systems or even a relocation of a plant, Mahler AGS plans and carries out all necessary activities considering local regulations and clients’ specifications.

Training

Technical understanding of the process and getting familiar with the equipment is essential for your operators. We offer specific training for operation, maintenance and repair of every component. The training can be carried out during commissioning on site or on demand.
References

More than 4,500 plants in over 70 countries show the experience and know-how of Mahler AGS.

Mahler AGS has delivered more than 4,500 plants in more than 70 countries. Our gas generation plants and purification plants are applied in all kind of industries.

In order to protect the production data from our customers we do not publish all details.

Please call us for more details in your specific case.

Contacts

Do you have any further questions or do you require additional information? Do you want to inquire about our products or do you need some advice? Contact us! Our qualified staff will be pleased to be of assistance to you.

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