Oxygen adsorption plants and stations
Grasys core business lines:

- Development and manufacture of air separation and gas separation equipment
- Natural and associated petroleum gas treatment, recovery of associated petroleum gas (APG)
- Engineering and design
- Implementation of integrated «turn-key» projects (EPC and EPCM contracts) with a main focus on air and gas separation, APG recovery and natural gas treatment

ABOUT COMPANY

Grasys is the leading developer, manufacturer and EPCM contractor in the field of air and gas separation active in the former Soviet Republics and Eastern Europe.

The research and production company Grasys has implemented more than 750 projects for 350 companies. The equipment produced by Grasys is used by such companies as Gazprom, Rosneft, Lukoil, Surgutneftegaz, Slavneft, Tatneft, Gazprom neft, Transneft, NOVATEK, RITEC, Oil Industry of Serbia, TurkmenGaz, KazMunaiGaz, Kazakhmys, Zarubezhneft, Exxon Mobil, Shell, Enel, Eni, Conoco Phillips, Petrofac Khimmash, Sibur, Eurochem, Irkutsk Oil Company, Samara-Nafta, Neftisa, Belorusneft, Naftogaz of Ukraine, Russneft.

The company is staffed with the industry leading specialists – graduates of the best national technical and economic higher education institutions, candidates and doctors of science. Building on their unique experience and knowledge, Grasys specialists develop new solutions and accomplish superior results ensuring the company sustainable development for more than 12 years.

Grasys has all necessary permits and certificates to properly carry out its activities. The company quality management system complies with international standards ISO 9001:2008.

Grasys manufactures its equipment in accordance with the ASME, CE standards as well as the corporate standards of Total, Gazprom; develops and issues documentation in line with the world standards generally adopted for EPCM contracts.
Availing itself of the profound production experience in combination with advanced engineering solutions Grasys produces high-quality oxygen plants and stations.

Oxygen equipment of Grasys is fitted with reliable compressors of the world’s leading producers. The use of the advanced Grasys Intelligent Control-7 microprocessor control system ensures control of operation of oxygen systems in line with the world standards.

Reliable mobile oxygen stations are designed to produce oxygen and fill oxygen cylinders in the most remote and hard-to-reach areas.

Competences
Grasys specialists continuously search and implement new technical and engineering solutions in the field of adsorption air separation.

Upgrading the adsorption process used in the oxygen plants and stations is performed at test benches developed by Grasys as one-of-a-kind equipment unrivaled in Europe.

The company’s continuous scientific research in the field of membrane and adsorption technologies of air and gas separation gives start to new solutions facilitating the development of science and industry.

Grasys puts a special emphasis on the quality of its products. The company’s equipment is produced at a modern production site in Stupino, Moscow region, which includes: manufacturing shops, warehouses, utility areas, office space, research laboratory. The daily production activities of Grasys are carried out by its high-professional employees responsible for production organization, equipment assembly, quality control and acceptance and employing the most recent project management methods.

The level of Grasys production system meets the highest contemporary standards of independent auditor companies (Swiss Engineering Group (SEG), Moody’s) involved in technical audit and expediting activities (control of manufacturing timeline and scope, assessment of order related risks) for our Clients.

All company oxygen plants and stations have «Permit for Use» issued by the Federal Service for Environmental, Technological and Nuclear Supervision (Ros-tekhnadzor).
Metal gas welding, cutting and brazing
One of the most important applications of oxygen is associated with its use in gas welding operations through generation of high-temperature flame in welding torches to ensure high quality and speed of welding works.

Metallurgy
In metallurgy, oxygen is used to increase the temperature of burning in the production of ferrous and non-ferrous metals, which helps significantly improve the process efficiency.

Chemical and petrochemical industry
In chemistry and petrochemistry oxygen is widely used to oxidize chemical agents for production of nitric acid, ethylene oxide propylene oxide, vinyl chloride and other important chemical compounds.

Petroleum industry
Oxygen is used to improve the capacity of oil cracking plants to ensure more efficient processing of high-octane components and reduce sulfur deposits in refineries.

Medicine
In medicine, oxygen is used for generation of breathing mixtures, in particular, for anesthesia, in rooms with a special microclimate.

Fish breeding
The use of oxygen in fish breeding helps improve the survival rates and juvenile yield and decrease the incubation period. Apart from fish breeding, oxygen is used for breeding shrimps, crabs and mussels.

Glass industry
Oxygen is efficiently used in glass furnaces to increase the temperature and improve the burning process.

Waste disposal
The use of oxygen in incinerators allows dramatically increasing the flame temperature, which eventually helps improve economic efficiency and capacity of furnaces.
**Adsorption Gas Separation Technology**

**Adsorption principle**
The process of gas separation by adsorption systems is based on the ability of a solid substance called adsorbent to bind individual components of a gas mixture. This effect is physically driven by the forces of interaction between molecules of gas and adsorbent.

**Effects of temperature and pressure**
To date, the adsorption methods of gaseous oxygen generation from the air have been nearly brought to perfection. The operation of a modern oxygen adsorption plant is based on the fact that gas adsorption by the adsorbent depends heavily on the temperature and partial pressure of gas components.

This way, the processes of gas adsorption and adsorbent regeneration may be regulated by adjusting the pressure and temperature.

**Pressure swing adsorption technology**
The operation of an oxygen plant is arranged so as to allow the adsorbent to take in easily adsorbed components of a gas mixture (nitrogen, water, carbon dioxide), while other components (oxygen, argon) flow through the plant.

Today, there are three most commonly used methods of organization of a cyclic pressure-swing adsorption process of air separation: pressure based (PSA), vacuum based (VSA) and mixed ones (VPSA). For pressure based process flows the oxygen is produced at above atmospheric pressure, and the adsorbent is regenerated at atmospheric pressure. In vacuum systems, the oxygen is produced at atmospheric pressure and regeneration – at a negative pressure. The operation of mixed systems provides for pressure variation from positive to negative.

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**Diagram:**
- **Oxygen output**
- **Throttle**
- **Air input**
- **Oxygen production stage** (Adsorbent takes in nitrogen)
- **Regeneration stage** (Adsorbent discharges nitrogen)
- **Valve, throttle is closed**
- **Valve, throttle is open**
- **Nitrogen**
- **Oxygen**
Commercially, the most common type of oxygen generation plants is PSA installations. The operation of PSA plants is arranged as follows: the air compressor compresses the atmospheric air, which then flows to the air receiver dampening pressure pulsations and enters the air treatment system. After air cleaning of mechanical impurities, condensed moisture and oil vapors and reduction of the dew point, the air is supplied to the adsorption air separation unit.

The air separation unit consists of two adsorbers containing the adsorbent – a granulated substance selectively adsorbing the nitrogen and water vapor from the air. During operation, adsorbers continuously switch between the adsorption and regeneration stages. At the adsorption stage, the adsorbent takes in the nitrogen to ensure generation of the product oxygen, which flows to the oxygen receiver. At the regeneration stage, the adsorbed nitrogen is displaced from the adsorbent and discharged into the atmosphere. Then the process is repeated multiply.

The oxygen from the receiver may be delivered to consumers or supplied to the booster compressor for production of high-pressure oxygen with subsequent filling of oxygen cylinders.
Grasys designs and manufactures adsorption oxygen plants with a capacity of up to 6,000 m³/h and oxygen purity of up to 95%. Where necessary, the product oxygen may be additionally treated to reach the concentration of 99%. Oxygen plants designed for indoor operation efficiently produce gaseous oxygen from the atmospheric air.

Structurally, Grasys adsorption oxygen plant is a module consisting of several adsorbers, compressor unit, air treatment unit, valve system and plant control system. In the simplest case, the adsorber is a column filled with specially selected layers of adsorbents – granulated substances that preferentially take in easily adsorbed components mixture. All adsorption oxygen systems of Grasys use the last-generation adsorbent ensuring a high production capacity and stability of equipment operation.

The undoubted advantage of oxygen plants using the adsorption method is the low cost of oxygen production where the oxygen is not subject to especially rigid purity requirements.

**General specifications**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
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<tbody>
<tr>
<td>Purity, %</td>
<td>up to 95 – 99*</td>
</tr>
<tr>
<td>Capacity, m³/h**</td>
<td>up to 6,000</td>
</tr>
<tr>
<td>Pressure, bar</td>
<td>up to 5</td>
</tr>
<tr>
<td>Dew point, °C</td>
<td>up to -70</td>
</tr>
<tr>
<td>Service life, thous. hours</td>
<td>70 – 120</td>
</tr>
<tr>
<td>Warm-up period, min</td>
<td>10 – 20</td>
</tr>
</tbody>
</table>

*With additional purification stage
**The capacity is referenced to the normal conditions (t=20 °C, P=1 atm)
Grasys adsorption plants are designed to produce up to 1,000 oxygen cylinders per day with oxygen purity of up to 99%. The plants are intended for indoor operation and allow deploying the entire cycle of oxygen production from the atmospheric air and filling oxygen cylinders at 150 bar with a minimum footprint. The standard delivery set of an oxygen plant includes air compressor unit, air treatment unit, adsorption gas separation unit, oxygen booster compressor, and oxygen filling manifold. Further, the supply package may include flow meter to monitor the plant capacity.

The use of exclusively highest-quality components and strict control of all production stages guarantee system reliability.

The control of Grasys systems is ultimately simplified to allow their operation by personnel inexperienced in handling air separation system.

An important advantage of the plants is a quick warm-up of the oxygen generator taking no more than 10-20 minutes until recovery of the required-purity gas.

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<tr>
<td>Purity, %</td>
<td>95 – 99*</td>
</tr>
<tr>
<td>Capacity, m³/h**</td>
<td>up to 250</td>
</tr>
<tr>
<td>Capacity, cylinder/day***</td>
<td>up to 1,000</td>
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<tr>
<td>Pressure, bar</td>
<td>up to 350</td>
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<tr>
<td>Dew point, °C</td>
<td>up to -70</td>
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<tr>
<td>Warm-up period, min</td>
<td>up to 20</td>
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*** 40-liter cylinders under 150 bar
Serial oxygen systems are provided in container units with the dimensions of 2500 x 2500 x 6000 mm, and may be easily mounted on chassis and delivered to the target location. All equipment is installed inside the container fitted with ventilation, heating, fire and gas safety systems. The temperature modes in the container are maintained automatically. The container is provided with anti-vandal grating and access control system to ensure equipment integrity.

The stations do not require foundation and utility systems and only depend on 380V power supply.

A distinct advantage of Grasys oxygen stations is the short period of system startup and shutdown taking no more than 10 minutes. This prompt warm-up allows the Customer to produce oxygen on an as needed basis. Another benefit is brought by the use of efficient and reliable compressors for cylinders filling. These compressors have a life cycle considerably exceeding the current analogues, which improves reliability of Grasys oxygen systems.

Mobile oxygen stations of Grasys allow quickly deploying an on-site complex of oxygen generation and cylinders filling at 150 bar.
Advantages of Grasys oxygen plants:

- Full automation and ease of operation
- High fail safety and reliability
- Unattended operation
- Quick startup and shutdown
- High product oxygen purity
- Moderate dimensions and weight
- Low energy consumption
- Extended service life
- Low maintenance costs
- Absence of special requirements to premises
- Easy installation and integration into factory existing pneumatic system

General specifications

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<tr>
<td>Purity, %</td>
<td>95 – 99*</td>
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<tr>
<td>Capacity, m³/h**</td>
<td>up to 40</td>
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<tr>
<td>Capacity, cylinder/day***</td>
<td>up to 160</td>
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<tr>
<td>Pressure, bar</td>
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<td>Dew point, °C</td>
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<tr>
<td>Warm-up period, min</td>
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*** 40-liter cylinders under 150 bar.