Nitrogen adsorption plants and stations
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, KazMunaiGas, 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.
Over the 12 years of its operations, Grasys has accumulated a unique experience in implementing projects of any complexity for customers in various industrial sectors.

Grasys nitrogen plants based on adsorption technology are cost-effective and highly reliable solutions allowing high-purity nitrogen production from the air. With many advantages offered by membrane systems, such as a high automation degree and ease of operation, adsorption plants compare favorably in terms of capital expenditure.

Among the large-scale projects implemented by the company are 3000-5000 m³/h nitrogen plants using the adsorption technology of gas separation for petroleum and petrochemical Russian companies.

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

Testing and upgrading the adsorption process used in the nitrogen plants and stations are 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 involved in technical audit and expediting activities (control of manufacturing timeline and scope, assessment of order related risks) for our Clients.

All company nitrogen plants and stations have «Permit for Use» issued by the Federal Service for Environmental, Technological and Nuclear Supervision (Rostekhnadzor).
Petroleum industry
Nitrogen is mainly used for generation of inert environment for assurance of explosion and fire safety of technological processes as well as safe transportation and transfer of hydrocarbons. Nitrogen is also used for testing and purging pipelines and cleaning process tanks at transport and storage facilities for hydrocarbon products etc.

Metallurgy
In metallurgy nitrogen is mainly used for protection of ferrous and non-ferrous metals during annealing. Nitrogen is also used in such industry-specific processes as neutral tempering, cementation and brazing, stress relieving, cyanation, agglomeration with powder metal, cooling extrusion matrices etc.

Laser metal cutting
Nitrogen is used in laser metal cutting to prevent undesirable oxidation of metal. Nitrogen-aided cutting is the best solution for treatment of stainless steel and aluminum. Cutting in nitrogen ensures that metal melts without burning or evaporating.

Chemical and petrochemical industry
The primary and most important application of nitrogen in chemistry and petrochemistry is purging and generation of nitrogen blanket in various technological processes for safety assurance purposes.

Paint industry
In paint and varnish industry, nitrogen is used for generation of inert environment in process vessels to ensure process safety and for products packing to avoid oils polymerization.

Food industry
In food industry, nitrogen is used for packing food products in inert environment to extend the shelf life of finished products.

Pharmaceutical industry
In pharmaceutical industry, nitrogen is used in packing medicines, assurance of explosion and fire safety when handling fine-dispersed and explosive substances.

Economic efficiency of various methods of nitrogen delivery and production
The technology of gaseous nitrogen generation from the air based on adsorption processes is well studied and widely used in industrial installations for production of high-purity nitrogen. Most commonly used worldwide are pressure swing adsorption (PSA) plants.

The principle of operation of a nitrogen PSA plant is based on the difference in the rate of adsorption of certain gas mixture components supplied under pressure through the adsorbent layer.

At the adsorption stage associated with pressure buildup the adsorbent preferentially takes in one component of the gas mixture (oxygen) to ensure generation of the product gas (nitrogen). At the regeneration stage, the component adsorbed is exuded and discharged into the atmosphere. Then the process is repeated multiply. With this pattern, the nitrogen is produced by the plant at a pressure above the atmospheric pressure. The process of nitrogen generation from the air includes simultaneous removal of moisture and the nitrogen dew-point reaches -70°C.
The operation of industrial adsorption nitrogen plants is arranged as follows: the compressed air from the compressor or another source is supplied to the air treatment system consisting of filters and dryers; the air flows to the air receiver used to mitigate pressure fluctuations and enters the nitrogen generator. The nitrogen generator is the “heart” of the plant where the nitrogen generation process is implemented through pressure swing adsorption.

The air treated is supplied alternately into the two adsorbers. While the air is supplied into the first adsorber, the adsorbent retains the oxygen and allows the nitrogen to freely flow toward the nitrogen receiver. The adsorbent is gradually getting saturated and the valves switch the gas flows so that the air is supplied into the second adsorber. While the adsorbent in the pressurized adsorber takes in the oxygen, the other adsorber is depressurized and the adsorbent is regenerated. The nitrogen flow supplied from the operating adsorber enters the receiver and is further delivered to consumers. A small part of it is diverted to the adsorber undergoing regeneration for displacement of the residual oxygen discharged into the atmosphere. The adsorbers operate in reversed phase to ensure permanent nitrogen supply at a set pressure and purity.

The functions of valve switching, control of the main process parameters and operation of the nitrogen plant are performed in a fully automatic manner.

**Process flow diagram of adsorption nitrogen plant**
Grasys nitrogen plants using the principle of adsorption air separation are rated for production of up to 10,000 m³/h of nitrogen, with a maximum nitrogen purity of 99.9995%.

Assuring a high purity of the product nitrogen, previously attainable with cryogenic technologies only, Grasys adsorption plants efficiently replace complex and bulky cryogenic facilities. The wide popularity of adsorption plants is explained by their advantages, such as relatively low cost of nitrogen production, ease of operation and compact size.

Grasys adsorption plants may be designed for both indoor and outdoor operation. A typical adsorption plant consists of two adsorbers filled with several layers of adsorbent, valve system, air treatment unit, compressor unit and control system. Ultra-purity nitrogen is produced by adding purification stages to reduce the concentration of such gases as oxygen, CO, hydrocarbons etc. to less than 1 ppm. Intelligent control system for adsorption nitrogen plants Grasys Intelligent Control-7R Grasys adsorption and membrane gas separation plants are completed with the standardized intelligent control systems GRASYS Intelligent Control-7 based on modern internationally adopted microprocessor hardware.

Grasys equipment completed with the GRASYS Intelligent Control-7 system is supplied to the largest national oil and gas fields, strategic and international projects in the petroleum industry. Among them are Vankorskoe, Korchaginskoe, Ust-Tegusskoe fields, Nord Stream pipeline facilities, nitrogen stations commissioned by Gazprom, Rosneft, Lukoil, Kazakhmys, KazMunaiGaz, Oil Industry of Serbia and many other Russian and foreign majors.

### General specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purity, %</td>
<td>up to 99.9995</td>
</tr>
<tr>
<td>Capacity, m³/h*</td>
<td>up to 10,000</td>
</tr>
<tr>
<td>Pressure, bar</td>
<td>up to 350</td>
</tr>
<tr>
<td>Dew point, °C</td>
<td>up to -70</td>
</tr>
<tr>
<td>Warm-up period, max, min</td>
<td>20**</td>
</tr>
</tbody>
</table>

*The capacity is referenced to the normal conditions (t=20 °C, P=1 atm)

** Depending on nitrogen concentration
The fail-safe distributed control system GRASYS Intelligent Control-7 was specially designed for operation of adsorption plants at enterprises with a continuous operating cycle. The control system ensures enhanced fail safety of hazardous industrial facility due to architecture hardware redundancy.

GRASYS Intelligent Control-7R system offers modular type software using specialized libraries and patented control algorithms.

Before commissioning, all Grasys control systems undergo the factory acceptance testing with program loading and 100% functional check.

GRASYS Intelligent Control-7R system allows:

- Automatic (unattended) monitoring of operation of all systems excluding human factor effects.
- Manual, automatic and remote operation.
- Integration of the GRASYS Intelligent Control-7R system into the factory control system.
- Implementation of automatic emergency shutdown algorithms in compliance with the international standard EC 61508 (GOST R 61508), tracking deviation of the main process parameters and possible knowingly erroneous operator response.
- Switching into standby mode during periods of zero nitrogen consumption.
- Opportunity for remote access to automatic process control system APCS via the company’s proprietary dedicated web server Intelligent Control Data Center (ICDC). This affords remote web users access to the graphic operator interface, including the control functions, and allows Grasys specialists to promptly solve diagnostic and maintenance tasks.
- Archiving the plant process parameters.
ADSORPTION
NITROGEN STATIONS

Advantages of Grasys nitrogen stations:

- Containerized package and high mobility
- Nitrogen purity adjustment up to the highest level
- Minimum maintenance costs
- Full automation with diesel engine
- High reliability and fail safety
- Wide range of operating temperatures
- High automation and ease of operation
- Unattended operation
- Quick startup and shutdown
- Extended service life

Grasys adsorption nitrogen stations are produced in standard 40-foot or 20-foot containers or on skids of the required size and configuration. The company’s adsorption nitrogen stations offer all the advantages of adsorption plants and may be carried with all land and water-borne transport means. The nitrogen stations are completed with automatic ventilation, heating, security and fire alarm, indoor and emergency lighting systems.

The equipment set of adsorption nitrogen stations includes the compressor equipment and air treatment equipment of the world’s leading producers.

**General specifications**

<table>
<thead>
<tr>
<th>Nitrogen parameters at the plant output</th>
<th>Purity, % up to 99.9995</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity, m³/h*</td>
<td>up to 200</td>
</tr>
<tr>
<td>Pressure, bar</td>
<td>up to 350</td>
</tr>
<tr>
<td>Dew point, °C</td>
<td>up to -70</td>
</tr>
<tr>
<td>Operating ambient temperature, °C</td>
<td>-60 - +50</td>
</tr>
<tr>
<td>Warm-up period, min</td>
<td>20**</td>
</tr>
<tr>
<td>Service life, thous. hours</td>
<td>70 – 120</td>
</tr>
</tbody>
</table>

*The capacity is referenced to the normal conditions (t=20 °C, P=1 atm)
** Depending on nitrogen concentration
TURN-KEY
CONSTRUCTION OF PLANTS

GRASYS – YOUR EPCM CONTRACTOR
Grasys has a profound experience in the performance of turn-key projects (EPCM contracts) in the field of air and gas separation, APG recovery. The company’s track record includes the largest adsorption and membrane nitrogen plants constructed in CIS and Eastern Europe, APG conditioning plants unrivaled worldwide and other facilities.

Engineering
Grasys renders the engineering services, including selection of efficient technologies, supply and assembly of necessary equipment and accessories, development of design documentation and obtaining permits, equipment installation.

Design
- Development of key process solutions
- 3D engineering
- Development of design and detailed documentation
- Industrial safety examination and state expert review
- Development of process procedures, manuals and instructions

Maintenance
Grasys offers the full range of repair and maintenance services for proprietary and purchased equipment:
- Pre-commissioning
- Pilot operation
- Scheduled equipment maintenance
- Overhaul and running repairs
- Equipment upgrading
- Personnel training

EPCM – engineering, procurement, construction management – includes entering into a master contract for engineering, procurement, equipment manufacturing, construction and delivery to Customer of a ready-for-use industrial facility.
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