

# INTEGRATED INDUSTRIAL SOLUTIONS



Salavat  
Catalyst Plant



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## About the company

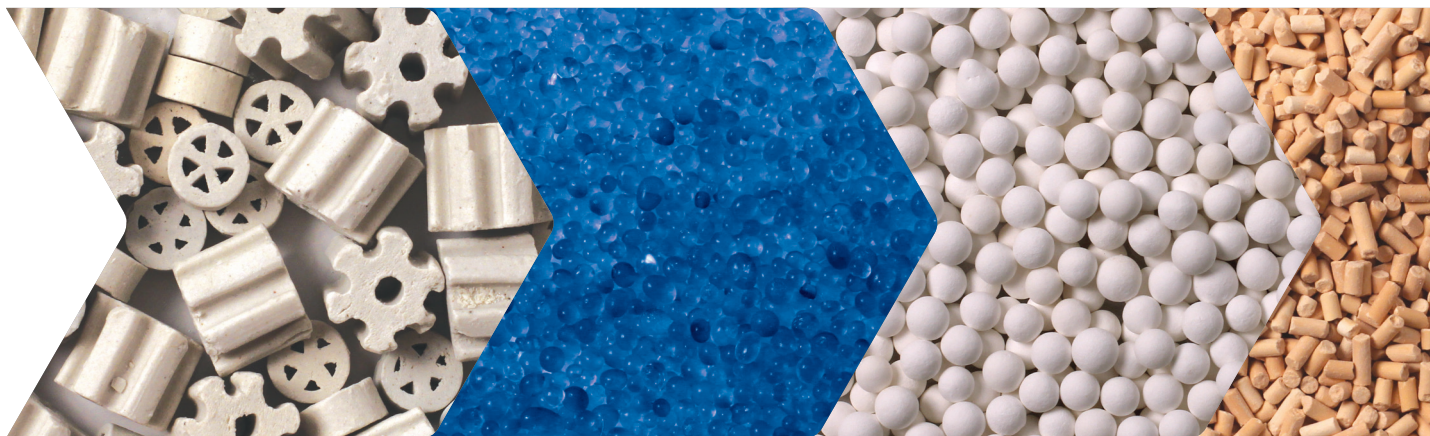
Salavat Catalyst Plant is one of the largest Russian manufacturers and suppliers of catalysts and sorbents providing the full range of services for the refining, petrochemical and gas-processing industries. Thanks to its 60 years of successful industrial experience, advanced technologies, highly-qualified team and close collaboration with the fundamental sciences in the field of adsorption and catalysis, the company offers a complete service program providing customers with high-quality catalysts and adsorbents.

The products and services provided by Salavat Catalyst Plant meet and exceed the expectations and requirements of customers thanks to its unwavering commitment to quality. The adsorbents and catalysts service program includes the selection of sorption system, start-up, loading and unloading assistance, performance follow-up as well as recommendations on process optimization. The company's unique engineering decisions are implemented at the largest gas processing plants and refineries.

The products of Salavat Catalyst Plant are certified for quality per ISO 9001.

Salavat Catalyst Plant closely cooperates with all leading R&D centers including the Boreskov Institute of Catalysis (Siberian Branch of the Russian Academy of Sciences in Novosibirsk), Gazprom VNIIGAZ (Russian Research Institute for Natural Gases and Gas Technologies, Moscow), etc.

The company is ready to implement decisions of any complexity in adsorption processes, pretreatment of hydrocarbons of varying composition, and technical gases, including a wide range of gas-separation technologies.





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# Gas Treatment

*Raw materials extracted from oil, gas and gas condensate wells are multiphase compound mixtures. Oil gas, natural gas and LPG saturated with moisture may contain a significant amount of acid gas ( $\text{CO}_2$ ,  $\text{H}_2\text{S}$ ), sulfur compounds and other impurities that may cause hydrate formation and the corrosion of equipment.*

*A sure way to solve the problem is by using the adsorption method for gas treatment.*

The use of Salavat Catalyst Plant adsorbents effectively meets the customer's requirements in terms of:

- Drying of natural gas (NG) and associated petroleum gas (APG)
- Drying and stripping of natural gas at gas treatment facilities
- Drying of NG and APG with removal of carbon dioxide
- Drying of NG with removal of  $\text{CO}_2$ ,  $\text{H}_2\text{S}$  and other compounds
- Drying of LPG with removal of  $\text{CO}_2$ ,  $\text{H}_2\text{S}$  and other compounds
- Removal of sulfur-containing substances from NG and APG
- Removal of mercury from NG

# Adsorbents for Gas and Liquid-Hydrocarbon Treatment

Description	Application	Characteristics
<b>Natural Gas and Associated Petroleum Gas</b>		
GP-SORB APG	Drying	Increased water capacity compared to analogues. Abrasion resistance. Increased coking resistance
GP-SORB 621	Drying and purification	High activity in the removal of methanol
GP-SORB 622	Drying and purification	High selective activity of H <sub>2</sub> S, CS <sub>2</sub>
GP-SORB 632	Drying and purification	RSH high dynamic activity. Low regeneration temperature
GP-SORB 642	Drying and purification	H <sub>2</sub> S and RSH high dynamic activity
GP-SORB 652	Drying and purification	Effective sweetening
GP-SORB 623	Drying and purification	High sorption water and carbon dioxide activity
GP-SORB 643	Drying and purification	High sorption water and acid gas activity. High mechanical strength
GP-SORB Hg	Drying	Effective mercury removal. High mechanical strength
Zeolite type NaX-BS (13X)	Drying and purification	H <sub>2</sub> S and low molecular mercaptan adsorption
Zeolite type NaA-BS (4A)	Drying and purification	High mechanical strength
Zeolite type CaA-BS (5A)	Drying and purification	H <sub>2</sub> S and low molecular mercaptan adsorption
ASM	Drying and topping	Increased water capacity and mechanical strength compared to similar products
ASM-WS	Drying, protection from condensed moisture	Hydrostable silica gel sorbent for main bed protection (ACM)
<b>Liquefied Petroleum Gas</b>		
GP-SORB 615	Drying	Increased water capacity and mechanical strength
GP-SORB 625	Drying	Increased water capacity compared to similar products
GP-SORB 646	Purification	High capacity for H <sub>2</sub> S, CO <sub>2</sub> and ammonia



# Petrochemical and Gas-Processing Industry

*The adsorption process is widely used for raw materials pretreatment in the petrochemical and gas-processing industries.*

*Salavat Catalyst Plant adsorbents are highly effective for the drying and purification of cracking gas, propane-propylene and ethane-ethylene fractions, etc. The application of alumina-based sorbents and synthetic zeolites (molecular sieves) manufactured by Salavat Catalyst Plant makes it possible to obtain high-quality end products in the process of sweetening liquid hydrocarbons, NGL, LPG, etc.*

- Drying of saturated hydrocarbons
- Drying of unsaturated hydrocarbons
- Drying of isomerization gases and gases of catalytic reforming (HBG, CO<sub>2</sub>, Nitrogen)
- Drying of pyrolysis products (cracking gas, propane-propylene, butane-butylene, ethane-ethylene fractions)
- Drying of cracked gases
- Removal of polar compounds from unsaturated streams
- Removal of sulfur compounds (H<sub>2</sub>S, COS, RSH) from unsaturated streams
- Removal of oxygenates and sulfur compounds from unsaturated streams
- Drying and purification of liquid hydrocarbons

# Adsorbents for Gas and Liquid-Hydrocarbon Treatment

Description	Application	Characteristics
<b>Saturated Hydrocarbons</b>		
GP-SORB 143	Purification	H <sub>2</sub> S, RSH and CO <sub>2</sub> high sorption activity
GP-SORB 153	Purification	H <sub>2</sub> S, CO <sub>2</sub> and NH <sub>3</sub> increased sorption capacity
GP-SORB 156	Paraffin separation	N-iso paraffin separation
GP-SORB 164	Purification	Effective removal of aromatic hydrocarbons with branched radicals
GP-SORB 711	Drying	Low degree of co-adsorption of unsaturated hydrocarbon streams
GP-SORB 712	Drying	Effective drying of liquid olefins. Low adsorption of unsaturated hydrocarbons
GP-SORB 727	Purification	Effective CO <sub>2</sub> removal from olefins. Low co-adsorption of olefins
GP-SORB 728	Purification	Effective drying of olefins with removal of sulfur compounds
GP-SORB 731	Drying	NGL and liquid-hydrocarbon selective drying
GP-SORB 738	Purification	High adsorption of H <sub>2</sub> S and RSH. Increased mechanical strength
GP-SORB 748	Purification	Effective removal of acid components from olefins. High mechanical strength
GP-SORB 758	Purification	Effective removal of branched isomeric RSH from olefins
GP-SORB 760	Purification	Effective removal of oxygen-containing hydrocarbons
<b>Unsaturated Hydrocarbons</b>		
Zeolite type KA-GNS (3A)	Drying	Drying of cracking gas, LPG
Adsorbent type A & B	Purification	Effective removal of impurities from paraffins
Alusorb COS	Purification	Polar and H <sub>2</sub> S removal from unsaturated hydrocarbon streams (H <sub>2</sub> S, COS, RSH)
Alusorb CD	Purification	Effectively removes polar and oxygen-containing hydrocarbons (alcohols, ketones, aldehydes, peroxides, ethers), RSH, sulfides and nitrogen compounds (NH <sub>3</sub> , amines, nitriles) from unsaturated hydrocarbon streams
<b>Reforming and Isomerization Gases, Inert Gases</b>		
GP-SORB 145	Purification	Sweetening of inert gases
GP-SORB 155	Purification	Effective removal of acid and inert gases
GP-SORB 714	Drying	Increased water capacity and mechanical strength compared to similar products
GP-SORB 734	Drying	High water capacity and adrasion resistance
<b>Saturated Hydrocarbons</b>		
GP-SORB 716	Drying	Effective drying of saturated hydrocarbon compounds. High coking resistance
<b>Hydrocarbons</b>		
Claus and Sulfren Catalysts	Purification	Use in Claus or Sulfren processes, based on H <sub>2</sub> S oxidation reaction at sulfur recovery units



# Air Treatment

*Compressed air is used in all industrial areas. In the process of compression, the relative humidity of compressed air increases which causes the formation of water drops. The ingress of micro-water emulsion into the equipment may result in operating problems and damage. Salavat Catalyst Plant produces reliable adsorbents for use in compressors of varying pressures.*

*Synthetic zeolites type NaX-BSO (13X) are used for the comprehensive removal of water vapor, CO<sub>2</sub>, C<sub>2</sub>H<sub>2</sub> and other hydrocarbons from compressed air at modern air-separating units operating under high- and medium-pressure cycles in the cryogenic industry.*

- Drying of compressed air
- Drying of air with removal of CO<sub>2</sub> before its separation into nitrogen and oxygen
- Air separation into oxygen and nitrogen in pressure-swing adsorption systems
- Drying of compressed air in the break systems of heavy and medium-duty vehicles
- Drying of air in multiple glass units to avoid the formation of condensate
- Removal of sulfur from high-purity food carbonic acid
- Indoor air drying

## Sorbents for Air and Inert-Gas Treatment

Description	Application	Characteristics
GP-SORB 911	Drying	Deep drying of technical gases
GP-SORB 922	Drying and purification	High capacity for water, CO <sub>2</sub> and other compounds
GP-SORB AIR	Drying and purification	Deep dehydration and removal of acid gases. Abrasion resistance
Zeolite NaX-5CO	Drying and purification	H <sub>2</sub> O and CO <sub>2</sub> high sorption activity provides for the effective operation of complex air-purification units and cryogenic process
<b>Silica Gel Sorbents</b>		
KSMG	Drying	Effective air drying at relative air humidity up to 70%
KSKG	Drying	Effective air drying at relative air humidity 70–100%
GP-SORB A	Drying and purification	Hydrocarbon capture from the air. Drying of air or inert gases to dew-point temperature minus 60. Sufficient regeneration temperature + 200 °C
GP-SORB H	Drying and stripping	Drying
GP-SORB WS	Protective functions	Does not deteriorate under the action of condensed moisture. High mechanical strength
Indicating silica gel (blue)	Relative humidity control	Effective humidity control
Indicating silica gel (orange)	Relative humidity control	Effective humidity control. Non-toxic, permitted for use in the EU
<b>Carbon Sorbents</b>		
GP-SORB–AIR SEP	Air separation	Ability to yield oxygen up to 99,5% purity and nitrogen up to 99.999% purity



# Integrated Solutions

## 1. Simulation of the gas-drying/ gas-purification process

The unique software developed by Salavat Catalyst Plant allows for the simulation of adsorption processes, including:

- Distribution of feedstock and regeneration gases inside the reactor
- Calculation of the level of saturation of adsorption layers with water and other compounds
- Heat effects in adsorption and regeneration processes
- Desorption of different compounds in recovery processes

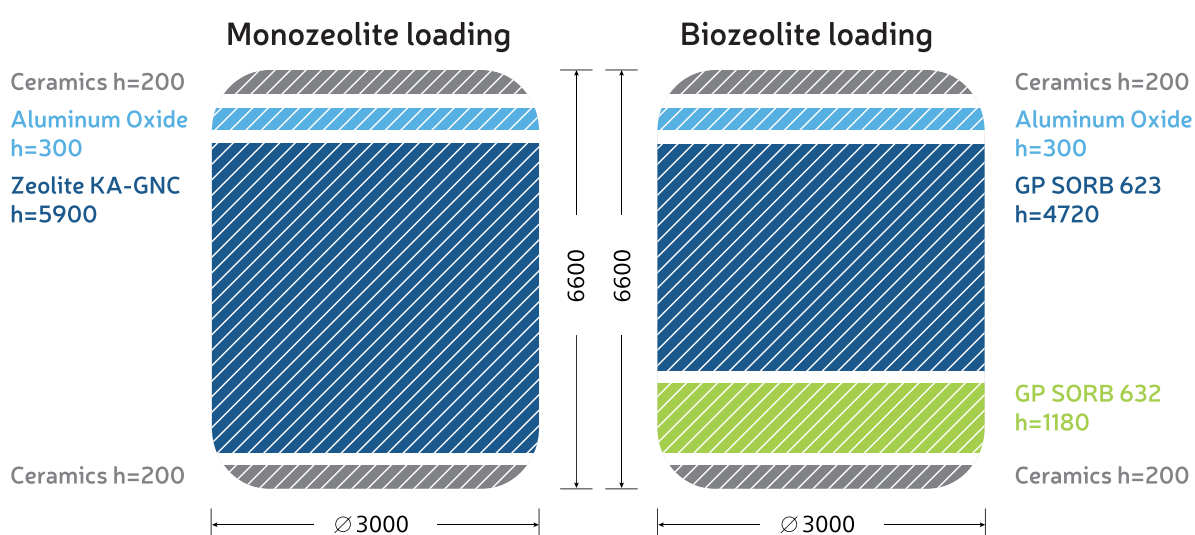
This data makes it possible to offer the most effective sorption system (one or several types of adsorbents) and to optimize the regeneration cycle.



Process simulation makes it possible to swiftly:

- Calculate changes in the adsorption characteristics of the system under a modification of operating conditions (temperature, pressure, stock consumption), stock composition (considering each component of the mixture, including injections of individual components, the addition of new components, etc.)
- Calculate the thermodynamic parameters of the system
- Set the required parameters under selection of the adsorption complex
- Choose the type and properties of the adsorbent, depending on stock composition and operating conditions. In the case of adsorption complexes – to optimize the amount of each layer, depending on the qualitative requirements of the resulting commodity
- Optimize material flow distribution, depending on internal structure and adsorbing elements
- Calculate temperature and pressure fluctuations at any time during the operating cycle
- Calculate the adsorbent recovery cycle, based on the unique sorption or desorption qualities of the individual components of the gaseous mixture
- Optimize recovery parameters, where a broad change in parameters is impossible due to technical considerations
- Estimate the lifespan of the adsorption system with recommendations for its extension

## 2. Complex Loading



Given all of the possible deviations in adsorbent operation (variations in stock composition, changes in adsorbent load, etc.), on the basis of simulation and experience in the use of sorbents in similar systems, we can offer different load options.

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Comprehensive adsorbent-loading solution:

- Unit loading with one or more types of sorbents, depending on process requirements
- Choice of gas-separating material, based on the data yielded through mathematical modelling and experience in the operation of similar adsorbents and adsorbents in similar processes
- Decision-making on loading and the choice of additional layers in order to prevent emergencies (periodic releases of moisture, liquid hydrocarbons, etc.)

### **3. Control over sorbent loading, protective and gas-separating layers**

- Presence of technical specialists at the time of adsorbent loading
- Loading of adsorbents under various methods by a professional team of specialists (hose method, dense unit loading with an increase in loading density)

### **4. Audit, monitoring and consultation in the process of adsorbent operation**

- Audit of adsorption systems to identify process «bottlenecks» and formulate recommendations for efficiency improvements
- Constant monitoring of the operation of adsorbent units
- Recommendations on the modification of operating conditions in connection with a change in stock composition or technological factors
- Projecting and providing recommendations on increasing system lifespan based on an analysis of sorbent operation





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