ADSORBENT SOLUTIONS FOR AIR SEPARATION UNITS

High-performance adsorbents for increased adsorption capacity and reduced operating costs.

UOP Adsorbents



Honeywell UOP

ADSORBENT SOLUTIONS FOR AIR SEPARATION UNITS

Built on decades of dedicated research and development in adsorbents for air separation units, Honeywell UOP offers the most complete package of adsorbent solutions for cryogenic air pre-purification units and non-cryogenic oxygen and nitrogen plants in the industry.

HIGH PERFORMANCE AND HIGH REWARD

Honeywell UOP adsorbents for air separation units and other industrial gas plants can help improve your process economics and plant reliability. The high adsorption capacity and selectivity of these adsorbents can reduce capital and operating costs for plants producing high purity gases such as oxygen and nitrogen, in addition to minimizing the risk of unscheduled plant shutdowns.

FIRST-TO-MARKET ADSORBENT TECHNOLOGY

Honeywell UOP pioneered the adsorbents industry with the invention of the first synthetic zeolites for use as molecular sieves in 1949. Our expertise and commitment to innovation can help create custom, flexible and future-forward solutions that fit your operations. With UOP adsorbents, you gain contaminant removal solutions alongside years of industry experience, operating knowledge, adsorber design capability and technical service expertise.

GLOBAL EXPERTISE AND SUPPORT

As worldwide leader in the development and manufacture of adsorbents, we operate production facilities in the United States, Italy, China and Japan to quickly and efficiently meet your product needs.

UOP also offers a comprehensive package of technical services to help you get the most value from your UOP adsorbents.

Technical services available for air pre-purification units

- Unit design for optimized CapEx and OpEx, including performance calculations of APPU, cycle time, absorbent quantity, bed dimensions, pressure drops and regeneration requirements.
- Unit operation optimization and troubleshooting assistance, unit health check, data review and lifetime estimation.
- Vessel internal inspection and consultation, supporting reloading, upgrading and redesigning based on new conditions.
- Operational time sequence optimization.

Technical services available for air pre-purification units

- Adsorbent sample analysis.
- Vessel internal consultation.
- Vessel loading and unloading assistance.
- Operation review and technical recommendations.
- Operational debottlenecking and optimization support.

- Cryogenic air pre-purification units (APPU).
- Pressure swing adsorption (PSA).
- Vacuum swing adsorption (VSA).
- Biogas enrichment.
- Synthesis gas (syngas) purification in ammonia (fertilizers) and methanol plants.
- CO_2 direct air capture.
- Medical oxygen generators.





ADSORBENT APPLICATIONS DESIGNED FOR YOUR BUSINESS

	APPU	PSA	VSA	BIOGAS ENRICHMENT	SYNGAS	CO_2 DIRECT AIR CAPTURE	MEDICAL OXYGEN GENERATORS
UOP Molsiv™ APG X APG Ultra APG III 13X APG	✓			✓	✓		
UOP Activated Alumina D-201/A D-201A A-201	✓	✓		✓		✓	
UOP Hydrasiv™ Silica Gel HS-200 HS-100						✓	
UOP DACSIV™ Capture						✓	
UOP Molsiv™ 13X HP 13X					✓		
UOP Molsiv™ VSA-11 VSA-6			✓				
UOP Molsiv™ PSAO2-XP PSAO2-HP		✓	✓				
Oxysiv™ MDX Pro MDX 2 5XP HP 5XP MDX							✓

High Performance
Continuous research and development for greater adsorption capacity and high selectivity.

Reduced Operating Costs
Improved efficiency, reduced pressure drops and lower regeneration energy consumption.

Comprehensive Solutions
A team of experts is dedicated to designing and producing a custom solution for you.

Global Support
Unparalleled worldwide service to help you maximize the use and life of your UOP adsorbents.

CRYOGENIC AIR PRE-PURIFICATION ADSORBENTS

The air pre-purification unit is a key component of a cryogenic air separation plant. The unit must remove water, carbon dioxide and other impurities from the air to very low levels to avoid freezing in the downstream cryogenic equipment. The APPU typically consists of two or four beds of adsorbent operating in parallel as seen in Figure 1.

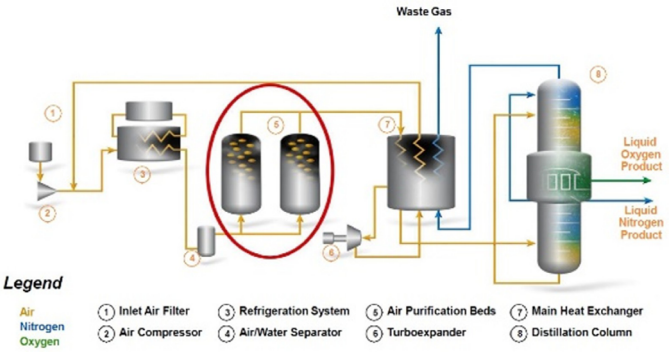


Fig 1. Two Bed Air Pre-Purification Unit

Molsiv APG X: improved performance and lower regeneration cost

Molsiv APG X is the latest addition to our range of high-performance APPU adsorbents developed specifically for the removal of trace contaminants such as carbon dioxide, water, N_2O and hydrocarbons.

It is among the highest performers in UOP's APPU absorbent range, **with 19% greater CO_2 equilibrium capacity** than APG III adsorbent (see Figure 2).[1]

For new unit designs, Molsiv APG X adsorbent enables the reduction of vessel sizes, decreases pressure drops and lowers regeneration costs.

For existing units, Molsiv APG X adsorbent facilitates increased throughput while adhering to the pressure drop constraints of the design. Operators can achieve lower running costs while extending the lifespan of both existing and new units.

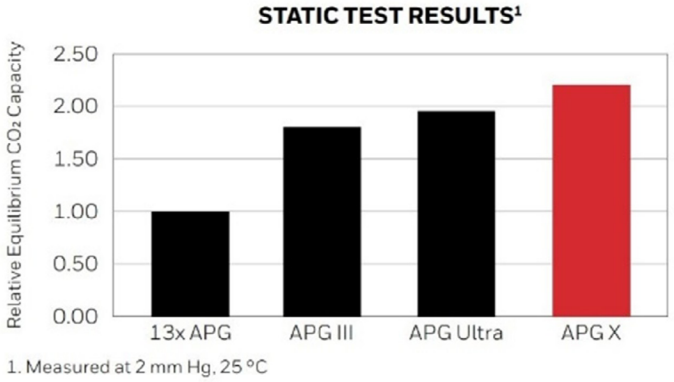


Fig 2. Relative equilibrium CO_2 capacity

ADSORBENT SOLUTIONS FOR AIR PRE-PURIFICATION

UOP Molsiv APG X	Top-performing adsorbent for the removal of H_2O, CO_2, N_2O and hydrocarbons
UOP Molsiv APG Ultra	High-performance adsorbent for the removal of H_2O, CO_2, N_2O and hydrocarbons
UOP Molsiv APG III	High-performance adsorbent for the removal of H_2O, CO_2, N_2O and hydrocarbons
UOP Molsiv 13X APG	Removes H_2O, CO_2, N_2O and hydrocarbons
UOP Activated Alumina D-201/A	Water removal in compound beds, with enhanced resistance
UOP Activated Alumina A-201	Water removal in compound beds

PSA AND VSA NON-CRYOGENIC OXYGEN PRODUCTION

UOP pioneered the use of molecular sieve adsorbents for the non-cryogenic production of oxygen. The two primary non-cryogenic production cycles are pressure swing adsorption and vacuum swing adsorption.

Both PSA and VSA units usually consist of two beds operating in parallel. In one bed, the molecular sieve adsorbent selectively removes water, CO_2 and N_2 from the feed air. The resulting product stream contains greater than 90% O_2. Simultaneously, the adsorbent in the other bed is purged at reduced pressure.

UOP Molsiv PSAO2-XP: high-purity PSA oxygen
UOP Molsiv PSAO2 XP adsorbent is our top-performing molecular sieve specifically designed for use in industrial oxygen generators that employ a PSA cycle for high purity (90-95%) oxygen.[2]

PSAO2 XP adsorbent is ideally suited for both drop-in and recharge use in existing oxygen generators designed around PSAO2 HP adsorbent, as well as new optimized designs for PSAO2 XP.

PSAO2 XP offers superior performance, which is directly related to its enhanced N_2/O_2 selectivity relative to PSAO2 HP adsorbent. The reduction in oxygen adsorption, as seen in the Figure 3 isotherm graph, provides greater oxygen recovery.

UOP MOLSIV PSAO2 XP RECHARGE AND DROP-IN BENEFITS:

- 10-20% increased oxygen output at the same oxygen purity[2]
- Increased oxygen purity (up to 95%)[2]
- Reduced energy use per volume of oxygen
- Increased cyclic nitrogen capacity will provide oxygen output and purity stability during process variability

UOP Molsiv VSA-11: improved VSA oxygen production and reduced energy consumption
UOP Molsiv VSA-11 is our top-performing lithium-exchanged molecular sieve specifically designed for use in industrial oxygen generation processes that employ a vacuum pressure swing cycle for the generation of high purity oxygen.

VSA-11 adsorbent is suited for recharge or drop-in replacement of adsorbent in existing oxygen generators and for optimized designs of new oxygen generators. Its superior performance is directly related to its improved mass transfer properties relative to VSA-10 absorbent, which improves oxygen yield (See Figure 4).

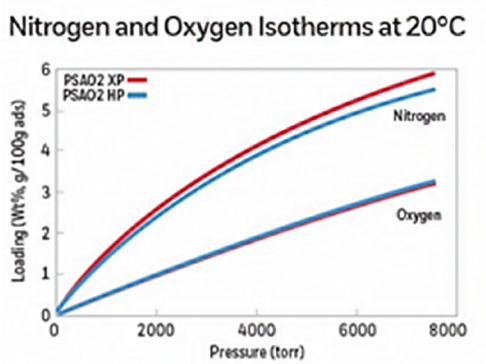


Fig 3. PSAO2 XP and HP Nitrogen and Oxygen Isotherms[2]

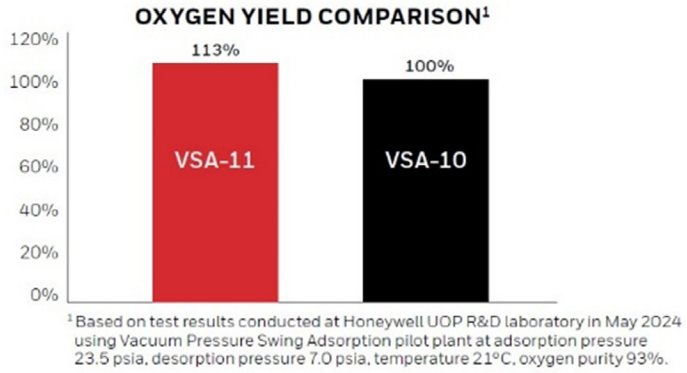


Fig 4. VSA-11 and VSA-10 Oxygen Yields[3]

ADSORBENT SOLUTIONS FOR NON-CRYOGENIC PSA AND VSA

UOP Molsiv PSAO2-XP	High-capacity molecular sieve for high-purity PSA oxygen
UOP Molsiv PSAO2-HP	Molecular sieve for high-purity PSA oxygen
UOP Activated Alumina D-201/A	Removes H_2O, with enhanced resistance
UOP Activated Alumina A-201	Removes H_2O
UOP Molsiv VSA-11	Lithium-exchanged molecular sieve with high N_2/O_2 selectivity for PSA/VSA/VPSA O_2 production
UOP Molsiv VSA-6	Calcium-exchanged molecular sieve with high N_2 capacity for VSA O_2 production

BIOGAS ENRICHMENT

UOP APG and 13X Series for biogas upgrade
Honeywell UOP's APG and 13X product series are highly effective adsorbents employed in crucial industrial processes. One prominent application is for biogas upgrading, where these adsorbents serve as vital components for the removal of carbon dioxide and hydrogen sulfide. These gases are common impurities in raw biogas and must be removed to ensure the biogas achieves the desired quality and performance required for energy generation, transportation applications or distribution within natural gas grids.

By integrating the APG and 13X product series, industries can significantly enhance the purification and usability of renewable biogas resources, support environmental sustainability and advance clean energy technologies.

SYNGAS PURIFICATION IN AMMONIA AND METHANOL PLANTS

UOP APG and 13X Series for high ammonia yields
These adsorbents also play a pivotal role in ammonia production processes, where they are utilized in syngas purifiers.

The syngas purification step is critical for removing water and carbon dioxide from the syngas stream to facilitate efficient ammonia synthesis. This purification ensures optimal operation and high yields in ammonia production facilities.

Considering the vast applications of ammonia, its role in the global economy is substantial, with the fertilizer industry representing its largest consumer. Anhydrous ammonia is a key raw material for producing various nitrogen-based fertilizers essential for agricultural productivity worldwide.

By integrating Honeywell UOP's APG and 13X adsorbents into ammonia facilities, manufacturers achieve superior quality outputs and operational efficiency, supporting the agricultural sector's growing demand for fertilizers to meet food production needs.

ADSORBENT SOLUTIONS FOR BIOGAS AND SYNGAS

UOP Molsiv APG X	Highest-capacity adsorbent for CO_2 removal
UOP Molsiv APG Ultra	High-capacity adsorbent for CO_2 removal
UOP Molsiv APG III	High-capacity adsorbent for CO_2 removal, commercialized for more than 20 years and used in many installations
UOP Molsiv 1APG IIA	Mid-grade adsorbent for CO_2 removal
UOP Molsiv 13X-HP (AL-II)	Mid-grade adsorbent for CO_2 removal
UOP Molsiv 13X APG	Higher CO_2 removal capacity than typical 13X adsorbents
UOP Molsiv 13X HP	Higher CO_2 removal capacity than typical 13X adsorbents
UOP Molsiv 13X	Water and CO_2 removal
UOP Activated Alumina D-201/A	Water removal in compound beds, with enhanced abrasion resistance
UOP Activated Alumina A-201	Water removal in compound beds

CO_2 DIRECT AIR CAPTURE

Increasing public awareness and the mounting pressure to address the imminent climate crisis are compelling both industries and governments to adopt more stringent CO_2 emissions targets.

Achieving net zero carbon emissions will require a range of technological solutions. Nevertheless, CO_2 Direct Air Capture (DAC) stands out as an immediately available and viable solution capable of addressing both future and legacy CO_2 emissions.

Unlike other forms of carbon capture, which reduce CO_2 directly from industrial sources such as flue gas, DAC extracts CO_2 directly from ambient air.

DAC technologies have gained support from policymakers and industry operators due to its ability to diminish otherwise non-abatable emissions, as well as its flexibility of location, ease of monitoring and scalability.

UOP DACSIV Capture: exceptional selectivity and extended lifespan

UOP's DACSIV Capture is the premier zeolite-based adsorbent solution for CO_2 DAC, specifically developed for selectively removing CO_2 from ambient air with higher CO_2 capacity, at lower CO_2 concentrations, compared to existing market alternatives.

UOP DACSIV CAPTURE BENEFITS:

- High CO_2 capacity at lower CO_2 concentration
- Can be regenerated for reuse by purging at elevated temperatures
- Durable and long-lasting, enabling reduced regeneration costs
- Available at scale, to help you on your journey to carbon neutrality

Offering improved selectivity and lifespan, the superior performance of DACSIV results in achieving higher yields with lower regeneration and lifetime operation costs.

ADSORBENT SOLUTIONS FOR CO_2 DIRECT AIR CAPTURE

UOP DACSIV Capture	Premier zeolite-based adsorbent solution for CO_2 direct air capture where CO_2 concentration is low
UOP Hydrasiv Silica Gel HS-200	Air dehydration water-resistant silica gel designed for sever conditions
UOP Hydrasiv Silica Gel HS-100	Air dehydration suitable for units with limitations in regeneration
UOP Activated Alumina D-201/A	Water removal from air with enhanced resistance
UOP Activated Alumina A-201	Water removal from air

MEDICAL OXYGEN GENERATORS

An essential, life-saving treatment for many respiratory diseases, medical oxygen is a critical resource with global demand.

Our molecular sieve adsorbents help medical oxygen concentrators perform optimally. The high efficiency of our sieves means concentrators can be designed in a smaller footprint and require less power, which allows for prolonged battery life. They're also lightweight for smaller and more mobile portable concentrators.



UOP OXYSIV MDX Pro for high-purity oxygen
OXYSIV MDX Pro is UOP's top-performing lithium-based adsorbent for medical oxygen concentrators, which can be used with pressure swing adsorption or vacuum pressure swing adsorption (VPSA) systems to produce high-purity oxygen.

OXYSIV MDX Pro adsorbent is recommended for use in lightweight and portable medical oxygen concentrators to generate high-purity (90-96%) oxygen.[4]

This high-performance molecular sieve has more nitrogen capacity as well as superior nitrogen and oxygen selectivity that results in the use of significantly less material relative to other molecular sieve adsorbents—without sacrificing oxygen throughput or purity.

OXYSIV MDX Pro adsorbent is suited for both drop-in or recharge use in existing oxygen generators designed around OXYSIV MDX adsorbent and other lithium-type adsorbents.

TYPICAL PHYSICAL PROPERTIES (NOMINAL)

Nominal particle diameter (mm)	0.4
Density (lb/ft³)	37
Density (kg/m³)	590
Dynamic N2 adsorption capacity	4.2
Static N_2 adsorption capacity, %	2.90
Water content, as shipped (wt-%)	0.5

Fig 5. OXYSIV MDX PRO Physical Properties[4]

ADSORBENT SOLUTIONS FOR MEDICAL OXYGEN GENERATORS

Oxysiv MDX Pro	Top-performing lithium-based adsorbent for medical oxygen concentrators, for high-purity oxygen
Oxysiv MDX2	High-performing lithium-based adsorbent for medical oxygen concentrators, for high-purity oxygen
Oxysiv 5XP	A high-performing Na-exchanged molecular sieve that has high N_2 removal capacity and selectivity to optimize performance for all concentrators, including portables
Oxysiv HP 5XP	A Na-exchanged molecular sieve that has high N_2 removal capacity and selectivity to optimize performance for all concentrators, including portables

1. UOP MOLSIV APG X ADSORBENT datasheet. Honeywell UOP. 2025.
2. UOP MOLSIV PSAO2 XP ADSORBENT datasheet. Honeywell UOP. 2020.
3. UOP MOLSIV VSA-11 ADSORBENT datasheet. Honeywell UOP. 2024.
4. UOP OXYSIV MDX Pro datasheet. Honeywell UOP. 2024.

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