

BONDS THAT CREATE A BETTER WORLD

HSP Adsorbents

Honeywell
UOP

OVERVIEW

Honeywell Separation & Purification Solutions (HSP)
is a trusted provider of one of the most innovative,
comprehensive and reliable adsorbent portfolios available.

As the pioneer of the molecular sieve adsorbents industry in 1949, and with the addition of activated alumina-based adsorbents in 1999, our expertise and commitment to innovation can help create custom, flexible and future-forward solutions that fit your operations. With HSP Adsorbents, you gain contaminant removal solutions alongside years of industry experience, operating knowledge, adsorber design capability and technical service expertise.

WHAT ARE ADSORBENTS?

Adsorbents are solid substances that collect liquid and gas particles to prevent materials from becoming corroded, damaged or dangerous. Our adsorbent solutions can help you avoid costly equipment failure and plant shutdowns, reduce hazardous conditions and meet high-purity product specifications across applications.

BRIEF HISTORY OF ADSORBENTS

For more than 60 years, HSP has made the world a better, safer place by developing and co-inventing adsorbents that protect the environment and human life. Mission-driven since 1949, when we developed and patented the first commercially significant synthetic zeolites, our rich history of innovation, tenured technical support teams and diverse commercial expertise continue to create the most reliable adsorbents solutions available.

Our portfolio—the broadest, most comprehensive adsorbents portfolio on the market—grows and evolves as the world needs new ways to solve new and existing challenges. Advances made across applications, operations and industries include:

1960s – Our zeolite adsorbents purified and removed harmful compounds from petroleum refining operations.

1970s – Our adsorbents were introduced to window manufacturers as a way to eliminate moisture between dual-pane windows.

1970s – Adsorbents in home medical oxygen concentrators were used to adsorb nitrogen from the air to provide patients with medical-grade purity of up to 95%.

1980s – Adsorbents were used to help clean up nuclear waste at Three Mile Island in Pennsylvania, USA.

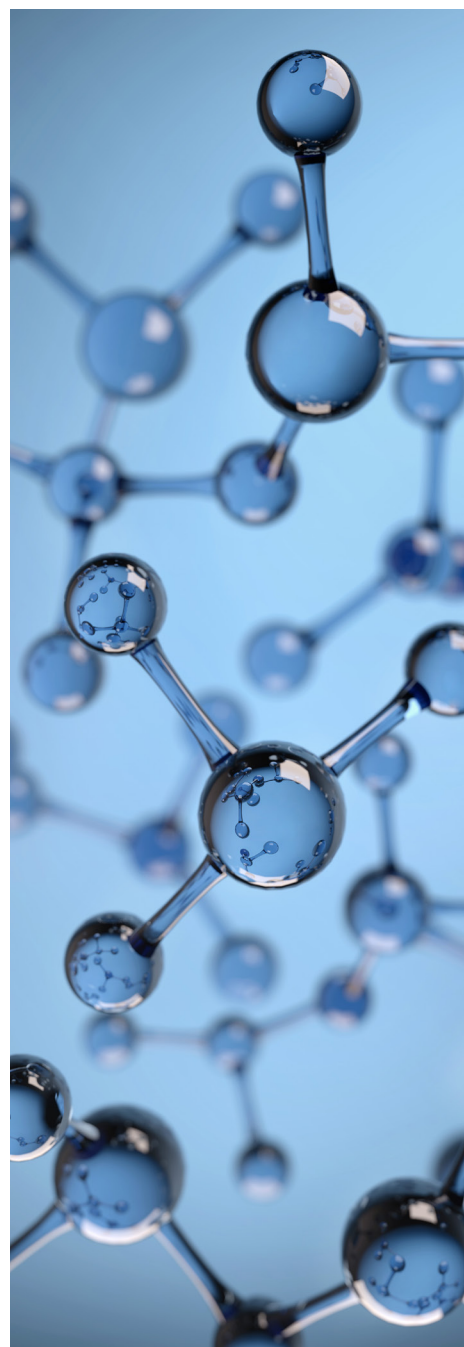
1980s – We developed a regenerative adsorbent for mercury removal in the natural gas industry.

1990s – Adsorbent products help the refrigeration industry meet the Montreal Protocol requirements for non-CFC replacement refrigeration systems.

1990s – UOP broadens its adsorbents portfolio with the addition of activated alumina adsorbents.

2000s – Continuing evolution of improved medical oxygen and air separation products.

No matter the need or utilization, we are the go-to adsorbents solutions provider—and it's been that way since the start. Our portfolio contains the most universally applicable adsorbents in the process industries, first-class science and technologies and measured success in hundreds of commercial systems.



FIRST-TO-MARKET ADSORBENTS TECHNOLOGY

Our trailblazing work, with the invention of the first synthetic zeolites for use as molecular sieves, kickstarted our promise to make the world a better place.

Zeolite molecular sieves' strong attraction for water makes them the ideal adsorbent for dehydration of gas and liquid streams where ppm effluent specifications are required. By tailoring the chemistry and structure of materials used to create synthetic zeolites (and later, our alumina and GB series metal oxides product lines), HSP provides custom solutions to meet a wide range of needs, including:

- Helping prevent unwanted reactions in process streams or complications from equipment corrosion or freeze-up
- Helping meet product specifications
- Protect catalyst beds from deactivation/poisoning
- Dehydration to water content of less than 0.1 ppm
- Low reactivity adsorbents to reduce side reactions while maximizing contaminant removal
- High capacity for water even at temperatures above 200°F (93°C)
- Regenerative and non-regenerative solutions
- Purification and dehydration in one operation
- Dehydration without adsorbing valuable product or altering feed composition
- High product recovery
- Infrequent recharges through numerous purification and dehydration cycles due to the reversible adsorption process of zeolites

We understand that no two situations or needs are exactly alike. To meet your specifications, objectives and requirements, we will work tirelessly on an adsorbent solution that performs optimally, and improves efficiency, productivity and safety.



HIGH PERFORMANCE AND HIGH REWARD

Our legacy and understanding of product application can help you achieve the highest performance to meet your business objectives. We can provide expertise and products across many petrochemical, pharmaceutical, industrial and technological applications:

Petrochemical Adsorbents

Adsorbents are widely used in the petrochemical industry to remove trace contaminants such as water, sulfur compounds, nitrogen compounds, oxygenates and trace metals such as mercury and arsine in the feed, intermediate and product streams. Using the right adsorbent is especially critical for purification of very reactive olefinic streams such as in ethylene plants, and in the production of polymer-grade monomers, as well as the purification of process streams in polymer plants.

- **Petrochemicals:** This offering provides low-reactivity adsorbents for polymer streams, dehydration and purification of NGL/ethane/propane feed, removal of Hg, O₂, CO₂, H₂S and/or COS, the dehydration and purification of salt-dome-stored ethylene, propylene and various other feedstocks and more.

Refining Adsorbents

As the refining industry evolves, effective contaminant removal can help meet challenges like fuel demands, stricter product specifications and environmental regulations.

- **Petroleum Refining:** Includes the dehydration of ethanol, purification of feedstocks to protect isomerization catalysts, the removal of nitriles from etherification feed, the purification by pressure swing adsorption for upgrading hydrocarbon streams and more.

Natural Gas Adsorbents

A reliable and efficient gas processing plant requires effective contaminant removal for impurities. Water and mercury, for example, can impact the quality of your products and damage processing equipment, which might lead to costly plant shutdowns.

- **Natural Gas:** Includes dehydration before cryogenic recovery of natural gas liquids and helium, removal of sulfur compounds from ethane, propane and butane, removal of mercury to prevent damage to aluminum heat exchangers and more.

Honeywell UOP adsorbents remove contaminants from natural gas and natural gas liquid (NGL) streams to help:

- Increase the value of product streams
- Reduce health, safety and environmental hazards
- Prevent corrosion and equipment reliability issues
- Maintain catalyst life and activity at downstream processing facilities

Semiconductor Adsorbents

In semiconductor manufacturing, even trace amounts of impurities can have a significant impact on a final product's quality and performance. Adsorbents are commonly used in this industry to remove unwanted substances from gases and liquids, thereby purifying them. Molecular sieves are often used to purify inert gases used in semiconductor manufacturing processes such as etching, deposition and ion implantation.

Direct Air Capture (DAC) Adsorbents

For the most economical CCUS (Carbon Capture, Utilization and Storage), our specialty adsorbents have a high CO₂ capacity for carbon capture.

In addition, DAC technology is an approach to reducing greenhouse gas emissions by capturing CO₂ directly from the atmosphere; adsorbents can help this process by selectively adsorbing CO₂ from the air while allowing other gases to pass through. Adsorbents in DAC systems can operate at low pressures, low temperatures and in the presence of moisture, allowing for more energy-efficient and cost-effective systems.

Specialty Adsorbents

Our custom solutions can remove moisture and contaminants for various objectives in many different and critical uses:

- **Air Dryers:** Adsorbents dehydrate instrument air, room air with pressure swing (PSA) and thermal swing (TAS) technologies including adsorbent-impregnated dessicant wheels used in the manufacture of plastic pellets before they are molded.

Oxygen Concentrators For

Respiratory Patients:

HSP has developed highly efficient adsorbents that are used in lightweight, portable systems for adsorption of nitrogen from the air using a pressure or vacuum swing system to provide patients with medical-grade oxygen purity up to 95%.

- **Air Brakes:** HSP adsorbents provide reliability for the critical service of braking systems of heavy- and medium-duty trucks, buses and trains. Dehydration of compressed air using pressure swing dryers are used to reduce the dew point of the air in the brake reservoir below ambient temperatures to prevent freeze-up and corrosion of the air brakes.

Insulated Glass (Dual-Pane

Windows):

Includes the removal of initial trapped moisture inside dual-pane windows and moisture that will permeate during the life of the unit to prevent fogging. These adsorbents also remove vapors from organic sealing materials, paint and cleaning solvents during window manufacturing.

- **Polymer Formulations:** Adsorbents are added to poly coatings, epoxies and urethanes to control the curing process of coatings, adhesives, sealants, elastomers, metal-rich paints and vinyl foams to eliminate unwanted water reactions.
- **Radioactive Cleanup:** HSP adsorbents have been specified and used in critical applications for the removal of radioactive nucleotides. Cesium and strontium are removed preferentially with specialty HSP adsorbents to greatly reduce the volume of radioactive waste. Such products are also specified for emergency

readiness in nuclear power plants to prevent pressure build-up by capturing radioactive iodine before it escapes into the atmosphere.

Refrigeration And Air-Conditioning

(A/C) Systems: The dehydration of automotive A/C, transport refrigeration, home refrigerators, freezers, residential A/C, heat pumps and commercial refrigerants to prevent freeze-up, corrosion and protect system materials from adverse chemical reactions.

- **Deodorization:** Removal of odor or taste from personal care products and plastics with high silica (hydrophobic) zeolite molecular sieves. Odors are absorbed, not masked; these products retain high capacity for odors even in the presence of moisture.

Volatile Organic Compound (Voc)

Removal:

Removal of trace volatile organic compounds from air streams and moisture-laden process streams.

- **Package Dehydration:** When low-humidity conditions are required, dehydration with adsorbents in small desiccant packets or tablets protects products such as pharmaceuticals, medical diagnostic reagent kits, vitamins, food, etc.
- **Air Separation:** Purification of air by removal of water and CO₂ prior to liquefaction and cryogenic separation of nitrogen, oxygen and other atmospheric gases.

UOP ARMGuard™ Systems

The UOP ARMGuard system effectively monitors adsorbent unit performance with real-time insights to help:

- Improve operational efficiency
- Empower customers to make smarter process decisions
- Avoid costly unscheduled shutdowns and/or operations at reduced flow
- **Reduce energy consumption**
- Achieve ultra-low water effluent to increase NGL production
- Lengthen adsorbent life
- Reduce turnaround times



Virtual monitoring with UOP ARMGuard can provide real-time information on the performance of a process for quick identification and resolution of issues, minimal downtime and reduced risk of equipment failure. This monitoring can lead to significant cost savings, improved efficiency and enhanced safety with remote access to equipment in potentially hazardous environments.

Data collection and analysis are also available on a large scale, which enables companies to identify trends and patterns in their processes that can be optimized and improved for better productivity and reduced waste.

WE'RE HERE TO HELP

With PhD-level science and more than 200 patents issued, our customers have access to a broad portfolio of adsorbents, a knowledgeable technical support team and complete solutions for their purification needs.

Our success, and the success of your business, rests on our commitment to continually develop innovative, reliable, high-performing products to meet your current and future needs.

Put HSP's experience and technology to work for you.

For more information

<https://uop.honeywell.com/>

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THE
FUTURE
IS
WHAT
WE
MAKE IT

Honeywell