Molecular Sieve Adsorbents
Molecular sieve adsorbents are crystalline alumino-silicates known as zeolites. Their unique structure allows the water of crystallization to be removed, leaving a porous crystalline structure. These pores or “cages” have a high affinity to re-adsorb water or other polar molecules. Aided by strong ionic forces (electrostatic fields) due to the presence of cations such as sodium, calcium and potassium and by the absolutely enormous internal surface area of close to 1,000 m²/g, molecular sieves will adsorb a considerable amount of water or other compounds. If the fluid to be adsorbed is a polar compound, it can be adsorbed with high loading, even at very low concentrations of the contaminants. Molecular sieves can therefore remove many gas or liquid impurities to very low levels (ppm or less).

Another feature of molecular sieve adsorbents is their ability to separate gases or liquids by molecular size or polarity. The pore or “cage” openings are of the same size as a range of different molecules; for example, in the case of hydrocarbon paraffins, the normal, straight-chained molecules can fit into the pores and be adsorbed, while the branched molecules cannot enter the pores and pass through the molecular sieve bed un-adsorbed.
Zeochem manufactures a wide range of zeolites used as molecular sieve adsorbents. Some of the more common types of molecular sieves and some typical applications include the following:

**Type 3A:**
Will exclude most molecules except water. Type 3A is used for drying natural gas, ethanol and reactive monomers such as olefins etc. Type 3A is usually made by ion-exchanging potassium onto Type 4A in place of sodium.

**Type 4A:**
The sodium form of Type A is widely used as a general purpose drying agent. Under certain conditions it can also be used for removal of carbon dioxide.

**Type 5A:**
This is the calcium-exchanged form of the Type A zeolite. The strong ionic forces of the divalent calcium cation make 5A an excellent choice for removing carbon dioxide, carbon monoxide, hydrogen sulphide and other weakly polar molecules. This product is also effective for the bulk separation of normal and iso-paraffin hydrocarbons.

**Type 13X:**
The sodium form of zeolite X has a much larger pore opening than the Type A crystals. It also has the highest theoretical capacity of the common adsorbents and very good mass transfer rates. Type 13X removes impurities too large to fit into the Type A zeolites and is also often used to separate nitrogen from air to produce a high purity oxygen stream.

**Type Y:**
Similar in structure to the Type X, Type Y has a higher silica to alumina ratio, offering some improved adsorption of hydrophobic compounds and imparting some acid resistance.

**Pentasil:**
Pentasil is also known as Zeolite MFI or ZSM-5. A high silica/alumina ratio makes this family hydrophobic and an excellent choice to adsorb selectively organic impurities from aqueous liquids or from water-laden gas streams such as air.

**Mordenite:**
This zeolite is a highly acid resistant adsorbent or catalyst carrier.
Applications

Process Industry Applications

Natural Gas Processing
• Dehydration of natural gas and natural gas liquids such as propane and butane
• Removal of CO₂, H₂S, mercaptans and other impurities from natural gas or natural gas liquids

Hydrogen Production or Recovery
• Drying and purification of H₂ using either thermal swing or pressure swing adsorption

Basic Petrochemical and Synthesis Gas Processes
• Purification of natural gas feed
• Drying and purification of the reformer gas prior to the ammonia loop
• Treating of ammonia off-gas streams
• Olefin and polyolefin production
• Drying of cracked olefin gas, ethylene and propylene products
• Dehydration and purification of ethane feed to the cracker
• Impurity removal from polyolefin plant feed (catalyst protection from oxygenates, sulfides)

Industrial Gases
• Dehydration and CO₂ removal from air for cryogenic processing
• Separation of high-purity oxygen from air via Pressure Swing Adsorption (PSA) or Vacuum Swing Adsorption (VSA)
• Recovery of inert gases by adsorption

Petroleum Refining
• Dehydration of light-ends (e.g. olefin) for cryogenic recovery
• Purification of feed to catalytic processes such as isomerization, dimerization and alkylation units

Chemical Storage
• Underground cavern drying and treating
• Storage tank breathers
• Product recovery from vent streams

Fuel Ethanol Production
• Bulk water removal at the azeotrope
• Purification of food- and pharmaceutical-grade ethanol

Miscellaneous Petrochemicals
• Drying of solvents
• Purification of feed streams to catalytic processes such as for ethyl benzene
Industrial Applications

**Insulating Glass**
- Prevention of condensation in the insulating glass space of windows

**Package Protection**
- Dehydration and trace contamination removal in enclosed spaces
- Removal of odors

**Pollution and VOC Control**
- Containment and concentration of solvent vapors

**Polymer Processing**
- Removal of water of reaction in urethane formulations
- Cell size control in blown foams
- Plastic pellet driers prior to blow- or injection-molding

**Systems Protection Devices**
- Dehydration and filtration of refrigerant loops
- Dehydration and purification of compressed breathing air
- Dehydration of compressed air for pneumatic tools
- Truck and railroad air brake driers

**Medical Uses**
- Oxygen concentrators for respiratory therapy
Research & Development

Since its foundation, Zeochem has been at the leading edge of molecular sieve technology.

Zeochem R&D developed an ultra-stable molecular sieve able to withstand thousands of thermal regenerations with delayed decay and exceptional capacity retention.

Zeochem R&D efforts have been rewarded in recent years with numerous patents on zeolite manufacture and applications.

These examples of unilateral product and process development are mirrored by Zeochem’s R&D focus on real-world applications and participation in joint development projects together with customers. Well-equipped laboratories and pilot facilities support our researchers, who also have close relationships with numerous universities and private laboratories with their own specialized facilities and expertise.

Technical Service

Zeochem employs technical service engineers and scientists who have years of experience in adsorber design, operation and maintenance.

From the beginning of each project, Zeochem’s technical service engineers can provide conceptual advice and design support. As the project moves forward, Zeochem can review the detailed designs and procedures. In the end phase Zeochem offers consultation on last-minute change orders and start-up assistance, when the unit is to be commissioned. Follow-up service is available for troubleshooting and performance optimization.

Of increasing importance is the training Zeochem can provide to customer’s engineers, supervisors and operators. Zeochem’s expertise in the field has been recognized and demonstrated the world over in seminars, conferences, papers and individual presentations.

Manufacturing

Zeochem’s proprietary manufacturing processes utilize the latest processing equipment and computerized process control systems. Special efforts have been made to instrument, monitor and control all phases of manufacturing.

Vendors are required not just to meet Zeochem’s stringent raw material specifications, but also to have in place extensive quality systems geared towards continuous improvement of their products and processes.

We demand that of ourselves and extend that expectation to our suppliers. Zeochem continues to upgrade and expand our processes and manufacturing capabilities including toll manufacturing, regeneration of spent product and custom manufacturing.

This continuous improvement allows Zeochem to meet the challenges of the 21st century.
Quality control
All finished products are analyzed and certified against specifications by our quality control lab, which is independent of the manufacturing operation. Zeochem uses test methods according to international norms and has also developed proprietary test procedures specific to customer applications to ensure that Zeochem’s products give the expected performance.

We are in compliance with the standard of international quality system boards (ISO 9001) and with those of scores of critical customers in demanding industries.

Safety
Zeochem conforms to all the requirements imposed by existing legislative regulations in order to guarantee the safety and health of our employees, with particular consideration for the safety regulations of the Federal Coordination Commission for Occupational Safety (FCOS) and the US Occupational Safety and Health Administration (OSHA). Zeochem operates in accordance with all applicable regulations and provides regular training and health advice to all its employees.

Environment
Zeochem meets or exceeds all requirements set by the Swiss and US authorities and regards the careful use of natural resources and safe production processes, as well as ensuring minimal pollution, among its critical goals. Our company is a member of the Swiss Private Sector Energy Agency and is committed to the principles of “Responsible Care”.

Quality & Environment