SYLOBEAD®
Molecular Sieves for Ethanol Dehydration
Grace Solutions for Ethanol Dehydration

When manufacturing ethanol, specifications require very low amounts of water in the ethanol to avoid the potential for formation of unwanted products in automotive combustion engines. Thorough separation of ethanol and water is achieved with the use of extremely porous composite materials consisting of zeolite and binder. These composite materials, known as molecular sieves, are the most economical means of drying ethanol.

Grace has been manufacturing molecular sieves for over 60 years, and first produced sieves specifically for ethanol dehydration in the 1970’s. Today Grace’s customers depend on SYLOBEAD® molecular sieves to dry ethanol that is produced from edible feedstock, cellulosic feedstocks, and synthetically produced ethanol. SYLOBEAD® molecular sieves enable ethanol producers to maximize profitability via:

- Very good adsorption kinetics
- Low co-adsorption of ethanol
- High attrition resistance of the beads
- Lowest level of by-products formation

Zeolite Adsorption

The zeolite is the active component of a molecular sieve. Manipulation of the zeolite during manufacturing is the key to optimized performance in ethanol plants.

Porosity plays a critical role in adsorption and desorption rates. The ethanol-water mixture must pass through the pores of the molecular sieve, into the zeolite crystal and ultimately into the zeolite cage, where the separation occurs.

The zeolite component of the molecular sieve is a crystalline material that is engineered by Grace to specifically adsorb water molecules with minimal pickup of competing molecules. This is accomplished by optimizing the size and number of the zeolite crystals, the zeolite content within the molecular sieve, and the aperture of the zeolite crystal.

Molecular Sieve Technology

Ethanol dehydration typically occurs in a PSA unit. Water is adsorbed into the molecular sieve from the ethanol-water feed. During the regeneration phase, the adsorbed water must be removed to make the sieve available for reuse. By lowering the pressure in the vessel, water is released and the sieve is regenerated. To achieve optimal regeneration, sometimes a purge with dry ethanol may be required.

Molecular sieve beds can have a significant impact on capital and operating costs for ethanol producers. Molecular sieves used to dehydrate ethanol should have the following characteristics:

- Mechanical integrity to withstand demands of pressure swings with minimal breakage or dust generation
- Adsorption efficiency and selectivity to allow for rapid removal of water with minimal ethanol co-adsorption

Pressure Swing Adsorption (PSA) Unit
Low Co-adsorption: Selective Dehydration Reduces Operating Costs

Selective adsorption is the process of capturing only the targeted compounds, and it is a key design parameter for SYLOBEAD® molecular sieves. Commercial applications support a higher water adsorption rate and lower ethanol co-adsorption for SYLOBEAD® molecular sieves compared to competitor materials.

Higher co-adsorption of ethanol results in imperfect regeneration, reduced drying performance, reduced throughput, and higher energy consumption. The drying performance and throughput can be improved by applying a lower vacuum and/or a higher purge gas flow. However, this will then result in an even higher energy consumption to maintain the lower vacuum plus vaporize the increased flow to the rectifier column, as well as further reduction of the ethanol production capacity.

SYLOBEAD® molecular sieves have been designed to minimize ethanol co-adsorption which increases ethanol production capacity and reduces energy costs.

High Attrition Resistance: The Key to Longer Bed Life

Attrition is a measure of dust generated from bead on bead contact, which is the source of dust in ethanol units. Part of this dust will block the voids between the beads, increasing the pressure drop. Part of this dust leaves the bed, reducing the capacity of the bed and potentially blocking downstream filters. Lower dust generation leads to longer life of the molecular sieve bed. When individual beads are tested for crush strength, they fracture into larger particles at pressures that are atypical for standard PSA operations. Attrition resistance is therefore a better indicator of operational performance than crush strength.

SYLOBEAD® molecular sieves have been tailored to maximize attrition resistance.

Up to 15% cost savings

Figure 2: SYLOBEAD® molecular sieves have been tailored to maximize attrition resistance.

Crush Strength for PSA

Crushed beads still perform and create minimal to no dust.

SYLOBEAD® Molecular Sieves

Figure 3: SYLOBEAD® molecular sieves have ample crush strength and exceed typical PSA Operation requirements.
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Strong Technical Service and Support
Global technical support for adsorption applications is fortified by an experienced team of professional technicians, scientists and engineers. Direct experience with a range of adsorption applications allows Grace to support customers with a portfolio of services including:

• Custom design solutions for individual adsorption unit loadings and operational consulting and problem solving
• Supervision of material loading
• Analytical support
• Performance evaluation and reporting
• Customer seminars

A comprehensive understanding of industry-specific processes and issues enables Grace to work with customers to ensure the maximum value from our products.

About W. R. Grace & Co.
Built on talent, technology, and trust, Grace is a leading global supplier of catalysts and materials technologies that help improve the products and processes of our customers in more than 85 countries around the world with global headquarters in Columbia, MD USA.

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