

SYLOSIV[®]

Molecular Sieve Powder



GRACE

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Product Range

SYLOSIV®	Moisture scavengers for coatings and resins
PHONOSORB®	Beaded adsorbents for insulating glass
PHONOSORB MTX®	Polymeric adsorbents for insulating glass
SAFETYSORB®	Desiccants for the pharmaceutical and diagnostics industries
SYLOBEAD®	Adsorbents for process applications
SYLOID®	Matting agents for coatings
SHIELDEX®	Non-toxic anti-corrosive pigments
SYLOWHITE™	Titanium dioxide extenders for paints and printing inks
LUDOX®	Colloidal silicas
SYLOJET®	Pigments for ink receptive coatings
DARACLAR®	Beer stabilisers
TriSyl®	Edible oil refining agents
SYLODENT®/SYLOBLANC®	Toothpaste abrasives and thickening agents
ELFADENT®	Thickener/mild abrasives for the toothpaste industry
PERKASIL®	Reinforcing agents for the rubber industry & for multiple applications
DURAFILL®	Additives for the paper and pulp industry



GRACE®, GRACE DAVISON®, DARACLAR®, LUDOX®, PHONOSORB®, PHONOSORB MTX®, SAFETYSORB®, SHIELDEX®, SYLOBEAD®, SYLOBLANC®, SYLODENT®, SYLOID®, SYLOJET®, SYLOSIV®, and TRISYL® are trademarks, registered in the United States and/or other countries, of W. R. Grace & Co.-Conn. INTELLIGENCE FOR COATINGS™ and SYLOWHITE™ are trademarks of W. R. Grace & Co.-Conn. ELFADENT®, DURAFILL®, and PERKASIL® are trademarks, registered in the United States and/or other countries, of Grace Silica GmbH. Grace Silica GmbH is a wholly owned subsidiary of W. R. Grace & Co.-Conn. SIX SIGMA® is a registered trademark of Motorola, Inc. RESPONSIBLE CARE® is a registered trademark of Chemical Manufacturers Association, Inc. This trademark list has been compiled using available published information as of the publication date of this brochure and may not accurately reflect current trademark ownership. © Copyright 2008 W. R. Grace & Co.-Conn. All rights reserved.

The Company

Grace Davison is an operating segment of W. R. Grace & Co., one of the world's leading specialty chemical companies, specialized in silica and silica alumina technology.

We produce a wide spectrum of products, based primarily on synthetic amorphous silica gel, colloidal and precipitated silicas, zeolites and chromatographic materials.

Our broad material portfolio has contributed significantly to Grace Davison's position as a leading global supplier of silica, zeolitic adsorbents and catalysts. Our specialty chemicals improve product performance and enhance manufacturing processes within an extensive range of industrial applications.

Our key strengths lie in the development of innovative technologies that improve product quality and application performance. Manufacturing flexibility, our global company infrastructure and commitment to close customer relationships ensure a high level of customer satisfaction.

With manufacturing facilities, R&D centres and sales offices worldwide, we are well equipped to meet the challenges of today's global marketplace. The structure of our business combines the strength of a global organization with the flexibility and adaptability of a regional infrastructure for Sales, Marketing and Technical Service.

With sales offices located in all major countries, we can react swiftly to our customers' requirements.

Safety and environment are priority issues for our company. Through the Responsible Care® Program, every Grace Davison facility worldwide fulfills stringent health and safety and environmental requirements.

Material Safety Data Sheets and information regarding the compliance of Grace products with application related regulations are available on request. To ensure a constant high level of product quality, all Grace Davison sites are ISO certified and practice Total Quality Management.

Tailor-made products, on-time deliveries, expert technical assistance and reliable customer support make Grace Davison the preferred industry supplier.

Safety and Regulatory Status

At Grace Davison, our first priority is to ensure the safety of all those who come into contact with our products. This is especially true for applications such as cosmetics, food and pharmaceuticals. SYLOSIV® zeolite powders are non-toxic inorganic materials consisting of silicon, aluminium and alkali/alkaline-earth cations. The final report on the safety assessment of aluminium silicate, an zeolite¹⁾, re-evaluated by the Cosmetic Ingredient Review Expert Panel, concludes that zeolites are safe as used in cosmetic products.

Total Quality Management

We, at Grace Davison, are not only committed to Total Quality Management but also to continuously improving our processes. To maintain our high standards, we employ Grace's Six Sigma® philosophy of process optimization designed to continually investigate and optimize process parameters in order to achieve the highest efficiencies.



Our Six Sigma® initiative involves the improvement of product consistency, production flexibility and capacity, employing advanced statistical methods and evaluation procedures for the benefit of our customers.



Our sites are all ISO 9001 or 9002 certified. External and internal audits are conducted on a regular basis as an important component of our efforts to improve our capabilities, products and services.



European Headquarters Worms, Germany

1) Published in the International Journal of Toxicology, 22 (Suppl. 1): 37-102, 2003

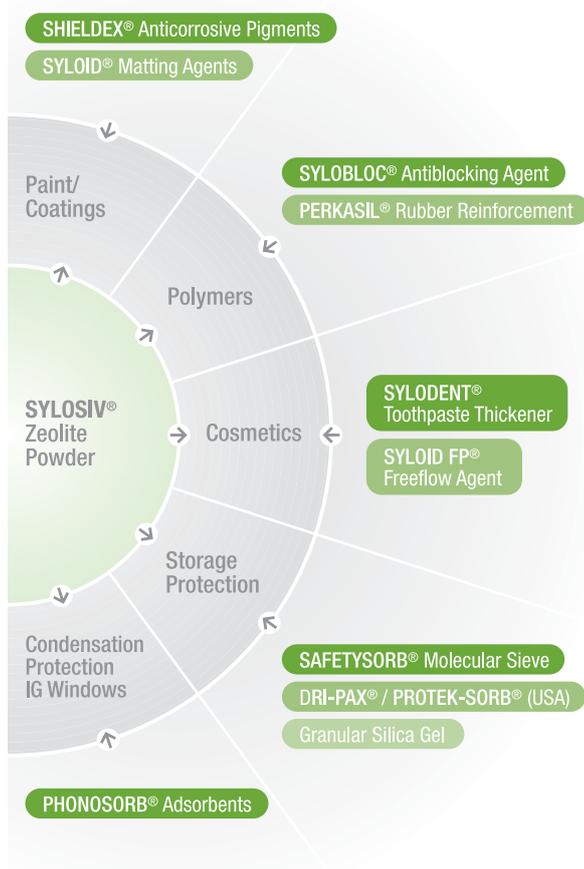
Experience You can Buy

The right Combination of Application Expertise and Product Technology

Grace Davison's interest in zeolite molecular sieves goes back over 40 years, when such materials were first developed and produced on an industrial scale. Grace Davison zeolite powder products since then have been continuously improved and optimized for a variety of application areas such as

- 2K- Polyurethane coatings and mouldings
- 1K- Polyurethane storage protection
- Storage protection for metallic pigment paints
- Polysulfide and silicone systems
- Carriers for chemicals for controlled release
- Processing aid for polymer production
- Desiccant for the production of polymer desiccant materials (such as matrix or other polymeric spacer systems in the Insulating Glass industry)
- Cosmetics additives
- Storage protection additives for highly hygroscopic goods
- Additives for flame retardants
- Shift of chemical reaction by removal of water as by-product

Product Range



While some of these application areas are zeolite specific, others attain broader attention within Grace Davison. One example is the coatings market, where in addition to providing SYLOSIV® powder as a moisture scavenger for PU coatings, Grace is also a technology leader in the development and production of matting agents and anticorrosive pigments based on silica gel. Approaching application areas from various angles allows Grace to develop a deep understanding of the underlying technologies and application needs of customers. This focuses our continual development and optimization of our comprehensive product range.

With our worldwide manufacturing, sales, marketing and technical service network, combined with our commitment to research and development, Grace Davison has become a leading partner for the development and production of commercial molecular sieve powders. Our experience in zeolite technology, however, goes beyond zeolite powder products. Grace is also a leading supplier of beaded zeolite products which are used for refrigerant drying, for the insulating glass industry, for packaging desiccants and process applications such as gas and liquid purification.

What is SYLOSIV® Powder?

An Insight into our Products

SYLOSIV® is a white, free-flowing micronized zeolite molecular sieve powder having a high adsorption capacity for liquids and vapour, e.g. for water. Zeolite molecular sieves are crystalline, highly porous materials, which belong to the class of aluminosilicates. These crystals are characterised by a three-dimensional pore system, with identical pores of precisely defined diameter.



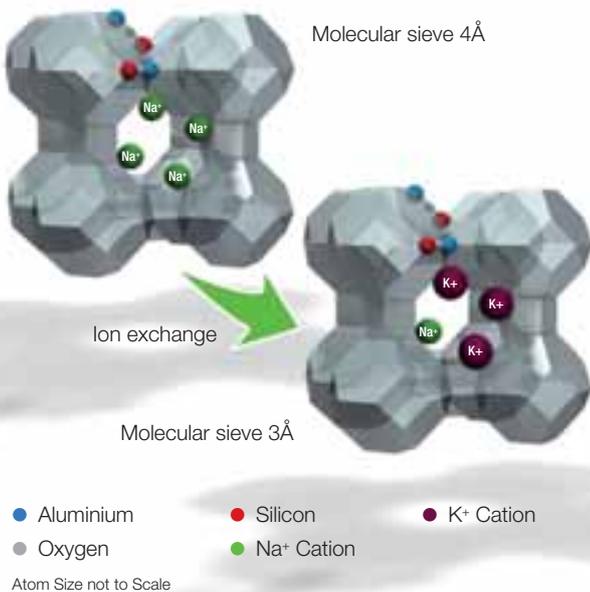
Structure of Zeolite A



Structure of Zeolite X

The rigid structure of such crystals are formed out of silicon, aluminium and oxygen. In addition, cations are loosely attached to the aluminium in the structure which can be exchanged to fine-tune the pore size. For instance, the sodium form of zeolite A has a nominal pore opening of 4 Å (4×10^{-10} m), called 4A molecular sieve. If the sodium ion is exchanged with the larger potassium ion, the nominal pore opening is reduced to 3 Å (3A molecular sieve).

Typical Zeolite Structure



The nominal pore opening of the structurally different zeolite X is 10 Å. The ability to adjust the pores to precisely determined uniform openings allows for molecules smaller than its pore diameter to be adsorbed while excluding larger molecules, hence the name “molecular sieve”.

As a result of its pronounced polar character, water is strongly adsorbed by SYLOSIV® molecular sieve. In the majority of applications, this is the primary function of SYLOSIV® powder. This is especially true for systems in which even the smallest amount of water can be damaging.

The voids in molecular sieves can adsorb not only water but also other substances as long as the diameter of their molecules is small enough to permit passage through the pore openings. Molecular sieve powder with a pore size of 3Å like SYLOSIV® A3, A300 or K300 adsorbs mainly water. Molecular sieves with 4Å pore size like SYLOSIV® A4 can adsorb molecules such as nitrogen and oxygen from the air. SYLOSIV® A10 is in a position to adsorb even larger molecules such as the solvents xylene and toluene. Very large molecules such as certain polyols cannot be adsorbed by any of these molecular sieve types.

In addition to the size, also the polarity of the molecules to be adsorbed influences the adsorption process. The more hydrophilic or polar the substance to be adsorbed, the stronger the adsorption forces and the higher the adsorption capacity.

During the adsorption process, adsorption enthalpy (called Heat of Adsorption) is released. This heat release can be used in special applications like self-heating cosmetics.

The SYLOSIV® crystals are only a few microns across. The particle size of SYLOSIV® powder is optimized to your application needs: it is large enough to ease conveying, transportation and dispersion in your plant, but is free of bulky agglomerates which would cause surface imperfections if e.g. used in a thin film polyurethane application.

SYLOSIV® powders afford the following advantages:

- High capacity and rate of adsorption
- Very finely divided powder with narrow particle size distribution
- Easy dispersibility
- Consistent quality
- Non-toxic

Please refer to the Table on page 7 for information about the most important properties of SYLOSIV® zeolite powders.

Detailed information about specific applications as well as Product Information Sheets about the Grace Davison SYLOSIV® products can be obtained from your local Sales Service team.

We Make the Difference

Grace Technical Customer Service

As a part of Grace Davison Technical Services Group, the Adsorbents Products Group is responsible for molecular sieve application development, customer service and sales support. Our highly trained and experienced team is dedicated in helping you to use SYLOSIV® molecular sieve powders in a wide range of applications. Wherever you are located, you can always expect the same high quality of technical advice and support which is a prerequisite for developing technical co-operations and successful business partnerships in the future.

Addition of SYLOSIV® Powder

SYLOSIV® powders are micronized and can be dispersed by a dissolver. Because SYLOSIV® powder adsorbs moisture spontaneously from the air, special care is required in handling. The powder must be stored in hermetically sealed containers and once opened it should be used as quickly as possible. Less heat will be generated in the final formulation, if water is adsorbed by the SYLOSIV® powder during the handling/addition process. The zeolite, due to its strong water affinity, will dry other water containing ingredients used in the formulation during storage, which therefore will reduce its self-heating ability.

The Right Products for You

Grace Davison SYLOSIV® zeolite products are available in various pore sizes. Small pore zeolites such as SYLOSIV® A4, A3, A300 and SYLOSIV® K300 are recommended. These grades will not adsorb other ingredients of your cosmetic formulation. If the heat release function should be combined with a carrier function (e.g. perfume release), a wider pore zeolite like SYLOSIV® A10 can be used. In addition to zeolites, Grace Davison is also offering various silica gel grades for cosmetic applications such as freeflow agents, dentifrice abrasives, absorbents and viscosity controlling agent. Please contact your regional sales office for advice in selecting the most suitable material for your application. Special Product Information Sheet for each grade are available on request.

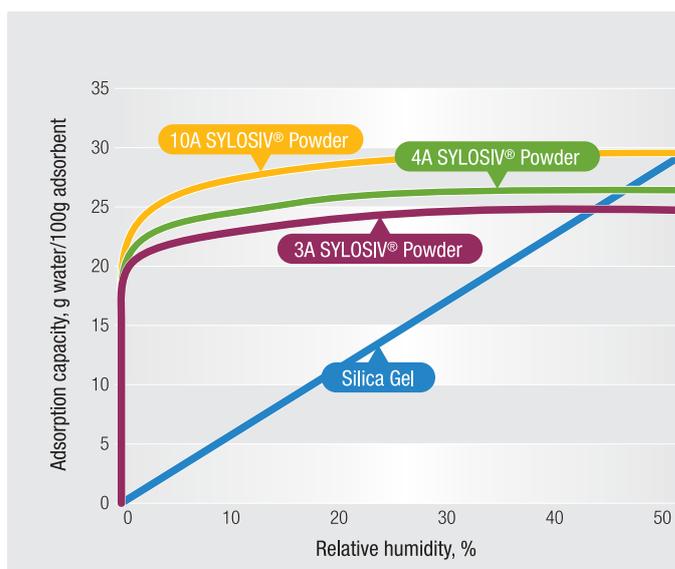
The Primary Function

Removal of Moisture

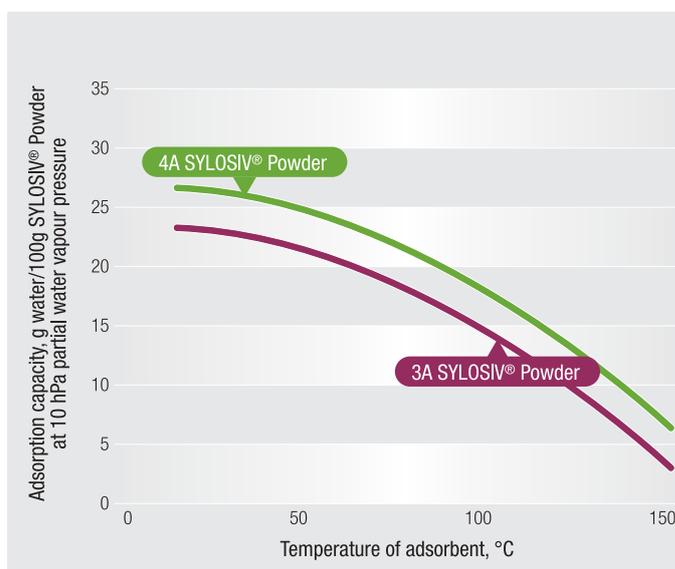
The primary function of SYLOSIV® molecular sieve powder in a majority of applications is water adsorption, the removal of interfering moisture. SYLOSIV® powder is especially well suited for this purpose, since as a result of its pronounced polar character, water is strongly adsorbed. Even at very low moisture concentrations, SYLOSIV® powder can adsorb more than 20% of its weight in water. This high adsorptive capacity, at low moisture levels, distinguishes SYLOSIV® from other drying agents such as silica gels or certain calcium compounds, and makes SYLOSIV® zeolite powder the material of choice especially for such applications in which even the smallest amount of water can be damaging.

In the case of SYLOSIV® powder, the adsorption process is of a purely physical nature and does not cause any side reactions unlike calcium compounds.

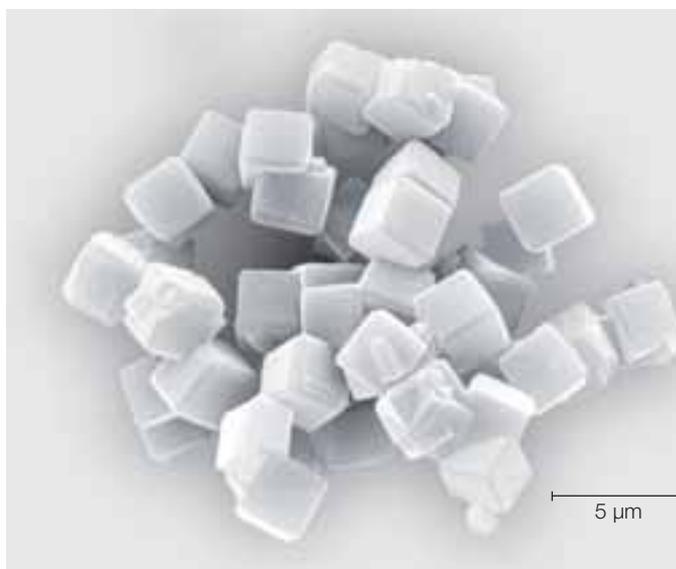
An additional advantage of SYLOSIV® moisture scavengers is the lower sensitivity of the adsorption capacity towards temperature. The adsorption capacity generally decreases with rising temperature, but this effect is less prominent for SYLOSIV® zeolite powder than for alternative materials such as silica gels or calcium compounds.



Adsorption isotherms of water (25 °C)



Adsorption capacity at different temperatures



Scanning Electron Microscope picture of SYLOSIV® Molecular Sieve Powder

Properties of SYLOSIV® Powder

Chemical Properties
Chemical Composition $Me^+_x [(AlO_2)_x (SiO_2)_y] H_2O$ where Me can be cations such as sodium, potassium, calcium, lithium
Stability Chemically stable in basic, neutral and mild acidic environments
pH: basic > 9
Physical Properties
Pore Size Unique pore sizing Zeolite A: ~3 Å or ~4 Å or ~5 Å Zeolite X: ~10 Å
Heat of Adsorption (for water)* 1000 kcal/kg H ₂ O 1800 BTU/lb H ₂ O
Surface Area 800 m ² /g
Effective Pore Volume 0.25 – 0.3 cm ³ /g
Specific Density* 1.9 – 2.3 g/cc
Hardness (Mohs)* 4 – 5 Mohs scale
Particle Size Zeolite A: ~ 6 – 9 µm Zeolite X: ~ 4 µm No particles > 40 µm (Hegmann Reading)
Viscosity in a 50 % Paste in Castor Oil 15 – 20 Pa*s

* Source: Zeolite Molecular Sieves
 Donald W. Breck, Robert E. Krieger Publishing
 Company, Malabar, Florida 1984

A Promise of Quality

Manufacturing and Quality Management

Grace Davison manufacturing of zeolites uses state-of-the-art processes and technologies to assure quality and consistency. Our operations are committed to Total Quality Management and to exceeding environmental and work safety precaution.

SYLOSIV® zeolite powders are manufactured by the crystallization of aluminium hydroxide, sodium hydroxide and water-glass. Under carefully controlled conditions the crystallization process creates the required sodium aluminosilicate structure. The zeolite crystals can then be ion exchanged with either potassium or calcium. After drying the molecular sieve crystals, an exactly determined particle size is obtained by milling which is continuously monitored by means of modern analytical instruments. The milled powders are then calcined and packed.

The resulting products are tightly controlled in our well equipped Quality Control department which works around the clock to ensure constant product quality.

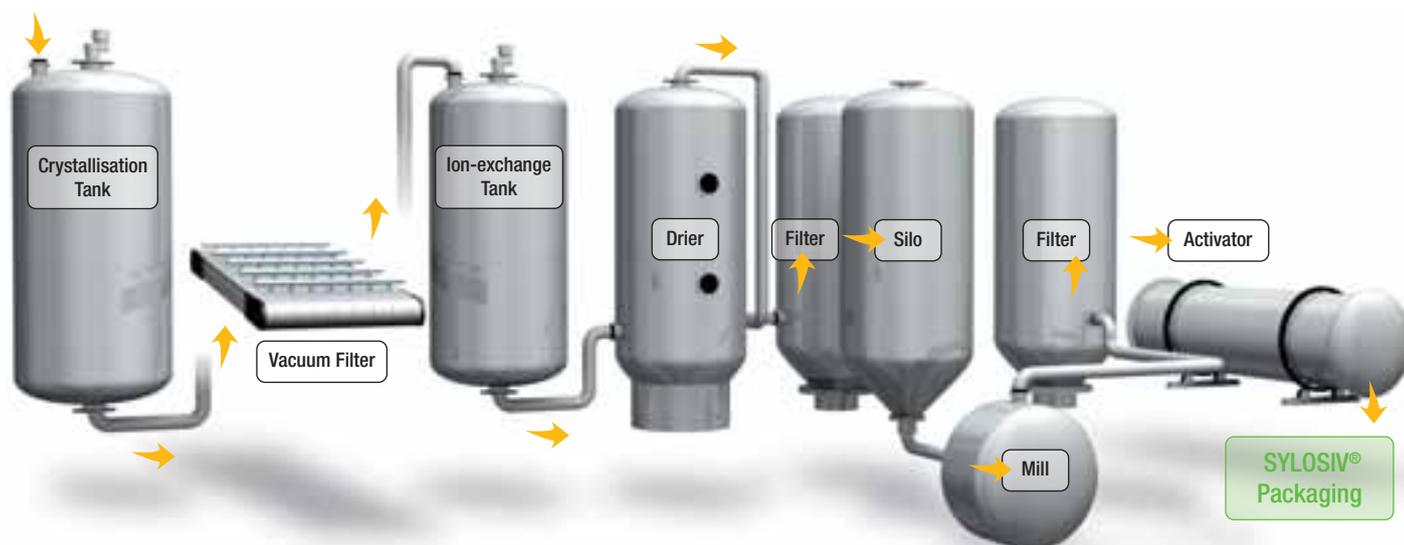
We employ Statistical Process Control (SPC) to monitor and analyse production and related work processes, and strive for continuous process improvement using Grace Six Sigma® tools.

These were designed to investigate process parameters, quantify their effects and optimize these in order to achieve the best possible results.

Packaging and Handling

SYLOSIV® molecular sieves are supplied in bags, big bags or drums. Details can be found in our product information sheets.

The fact that SYLOSIV® in powder form adsorbs moisture from the air spontaneously calls for special care in handling. The powder must be stored in hermetically sealed containers and once opened should be used up as quickly as possible.



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