

PHONOSORB®

Desiccants for Insulating Glass



GRACE

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Product Range

PHONOSORB®	2
Beaded adsorbents for insulating glass	
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Polymeric adsorbents for insulating glass	
SAFETYSORB®	4
Desiccants for the pharmaceutical and diagnostic applications	
SYLOSIV®	7
Molecular sieve powder for the polyurethane industry	
SYLOBEAD®	8
Adsorbents for cleaning, drying and separating gases and fluids	
TriSyl®	10
Silica gel for refining edible oil	
DARACLAR®	12
Beer stabilisers	
SYLOBLOC®	13
Anti-blocking agents for polymer films	
SYLOID®	14
Matting agents for coatings	
SYLOBLANC®/SYLODENT®	
Abrasive and thickening agents for toothpaste	
SHIELDEX®	
Non-toxic anti-corrosion pigments	
SYLOJET®	
Pigments for Ink Jet Coatings	
LUDOX®	
Colloidal Silica	
SYLOWHITE™	
Titanium dioxide extenders for paints and printing inks	
ELFADENT®	
Thickeners/mild abrasives for the toothpaste industry	
PERKASIL®	
Reinforcing agents for the tyre and rubber industry	
DURAFILL®	
Special pigments and fillers 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.

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The Company

Grace Davison is a business division of W.R. Grace & Co. one of the world's largest companies for specialty chemicals. Grace Davison has a focus on silica technology and silica/aluminium oxide technology products.

We produce a wide range of products including synthetic, amorphous silica gel, colloidal and precipitated silicas, zeolites, silicic acid and materials for chromatography.

This extensive material portfolio has contributed to Grace Davison's position as a leading global supplier of silica and zeolite adsorbents and catalysts. These specialty chemicals improve product performance or enhance manufacturing processes within a wide range of industrial applications.

In the process, our key strengths lie in the development of innovative technologies through which product quality and application characteristics are improved. Manufacturing flexibility, global infrastructure and the commitment of our company to close customer relationships are factors which provide high levels of customer satisfaction.

With manufacturing sites, research & development centres and sales offices around the globe, we are well prepared to meet the challenges of global market requirements. When it comes to sales, marketing and technical customer services, our business structure combines the strengths of a globally operating company with the flexibility and ability to adjust to regional infrastructure.

With our sales offices in all key countries, we are able to quickly react to the needs of our customers. Safety and environmental considerations are the main points that our company focuses on. Safety data sheets and information concerning the way in which Grace's products adhere to application-related provisions are

available on request. In order to guarantee a constantly high level of product quality, all of Grace's sites are ISO certified and carry out Total Quality Management.

Products which are tailored to the needs of the customer, punctual deliveries, specialist technical support at a high level and a reliable customer service department are all factors that go to make Grace a preferred supplier within the industry.

Safety First

Our first priority is to ensure the safety of all those who work with us or come into contact with our products.

At Grace Davison, the environment is a major issue and we are proud to maintain an outstanding record of leadership in safety standards and good corporate citizenship.

Through the Responsible Care® Program, every Grace Davison facility worldwide fulfils both stringent health and safety requirements as well as environmental requirements.

Grace Davison's Commitment-to-Care® Program demonstrates the high priority of work safety within the organisation, which has led to a substantial reduction in workplace injuries, bringing the company close to the goal of zero accidents.



European Headquarters at Worms, Germany

For a Better View – PHONOSORB® Desiccant Solutions

The most important property of window glass is its clarity, enabling a clear, unobstructed view. We cannot influence what you see, but we can certainly influence the way you see it, helping you to maintain a clear view over a long period of time.

The first generation of double glazing did not include desiccants and the product lifecycle was significantly shorter than that of today's windows: Moisture contained in between the dual panes tended to condense after a certain period of time.

The second generation of insulating glass windows contained desiccants, but these were not optimised for this application leading to a deflection of the panes and a distorted view. To avoid such problems, Grace Davison developed the PHONOSORB® products being widely used in today's windows.

PHONOSORB® Desiccants – See the difference

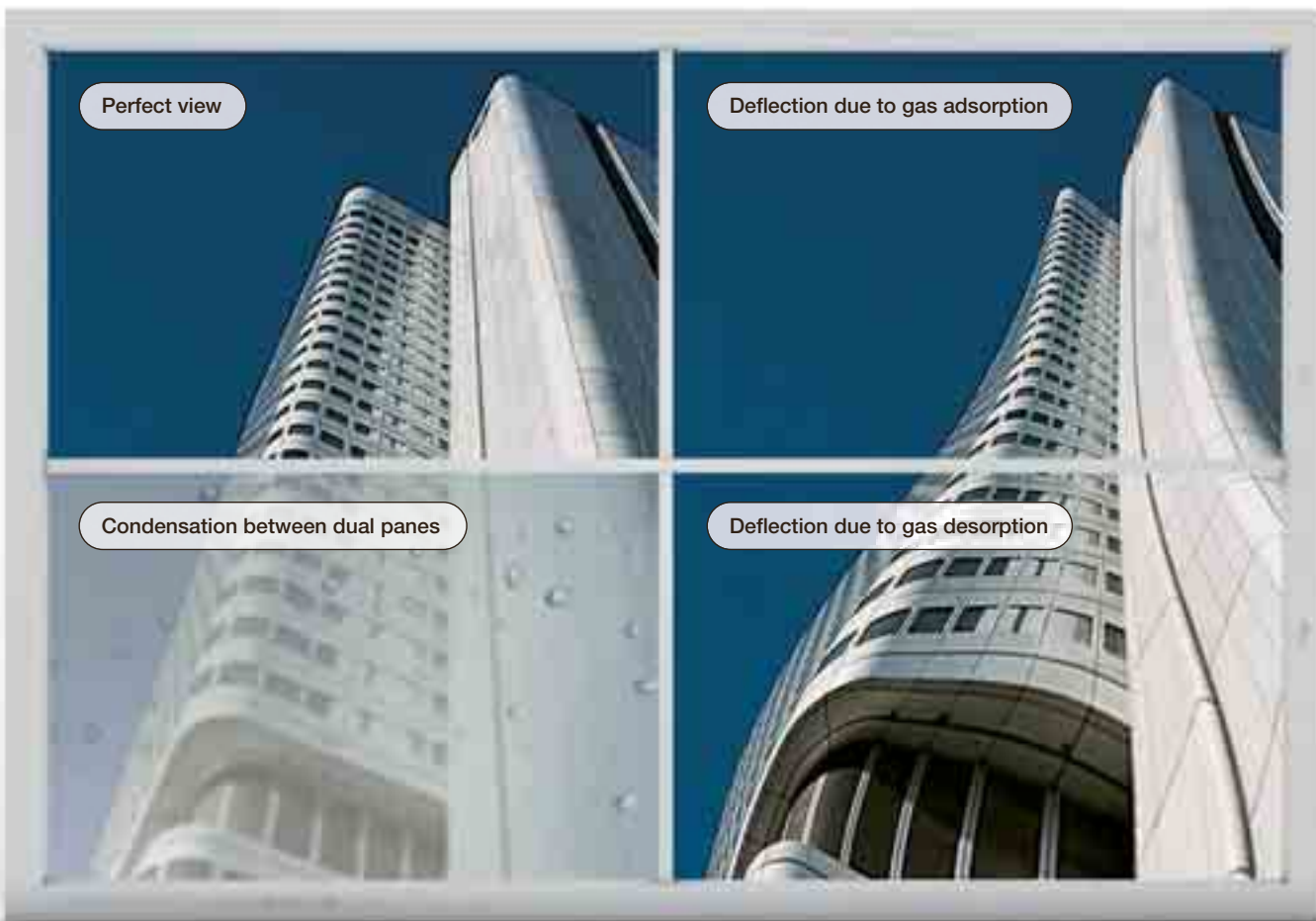
PHONOSORB® molecular sieves have been specifically engineered to help maintain your insulating glass window quality, performance and reliability. They work to preserve the appropriate low dew point or water vapour concentration in

the air space between the inner and outer glass panes of an Insulating Glass unit. This is achieved through the specific adsorption of water and solvents introduced during insulating glass unit manufacturing.

Simultaneously, PHONOSORB® desiccants minimise pressure changes inside the double pane window space which could eventually lead to the functional failure of the insulating glass unit. The consistent composition and structure of PHONOSORB® products and their corresponding properties provide insulating glass manufacturers with the necessary adsorption characteristics to ensure the highest product quality.

PHONOSORB® molecular sieve products features & benefits include:

- High water adsorption capacity
- Lower dew points
- Longer unit life
- Compatibility with all insulating gases and sealants



The benefits and technical information, which apply to the PHONOSORB® group of products will be dealt with in more depth in the following sections:

The PHONOSORB® molecular sieve is a granular desiccant which is formed from a mixture of zeolite molecular sieve powder and clay containing binders. Whereas the clay builds up the mechanical strength of the granule, the zeolite functions as an adsorbent. Adsorption is the physical attraction of gaseous or liquid molecules to a solid surface. In the adsorption process, gas and fluid molecules are adsorbed by the desiccant. This is possible as zeolites are porous and are comprised of well ordered structures which form a system of channels and cavities. This three-dimensional arrangement is known as pores. The pores of a certain type of molecular sieve all have the pore diameter which is precisely defined. Molecular sieves can have pore openings of roughly 3Å, 4Å and 10Å, and are known as 3A, 4A and 10A type zeolites respectively. Very often 10A type zeolites are also called 13X type zeolites. In each case, these zeolites can adsorb such molecules as long as their diameter is small enough to be adsorbed by the corresponding pores.



PHONOSORB® Beads, Zeolite Crystals, Crystal Structure

Making the right choice

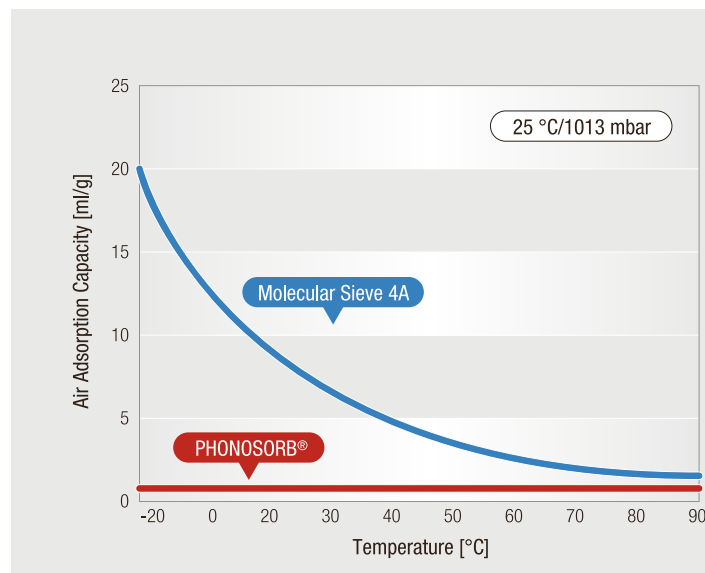
PHONOSORB® desiccants consist of 3A zeolite crystals which allow high adsorption of water on the one hand, yet do not allow the adsorption and/or release of air (nitrogen) or commonly used insulation gases. As such these desiccants meet the specific needs of the insulating glass manufacturing industry.

In their endeavour to find the best technical solution, some manufacturers have mistakenly marketed desiccants such as 10A and 4A molecular sieves, claiming that these have higher

water adsorption capacities than 3A. Strictly speaking this is correct. In practice, however, these zeolites are not suitable for use as desiccants in double glazed windows. Where there are corresponding temperature fluctuations, these zeolites adsorb and/or release a large amount of air/insulating gases and this is something which can lead to the improper function of the insulated glass.

The temperature dependent adsorption and/or release of air/insulating gases leads to negative and positive pressures inside the double pane window with the following consequences:

- Glass deflection
- Glass stress and breakage
- Reduced heat and sound insulation
- Sealant stress resulting in the loss of seal integrity
- Reduced unit life



Air Adsorption/Desorption

High levels of water adsorption – a long-term view

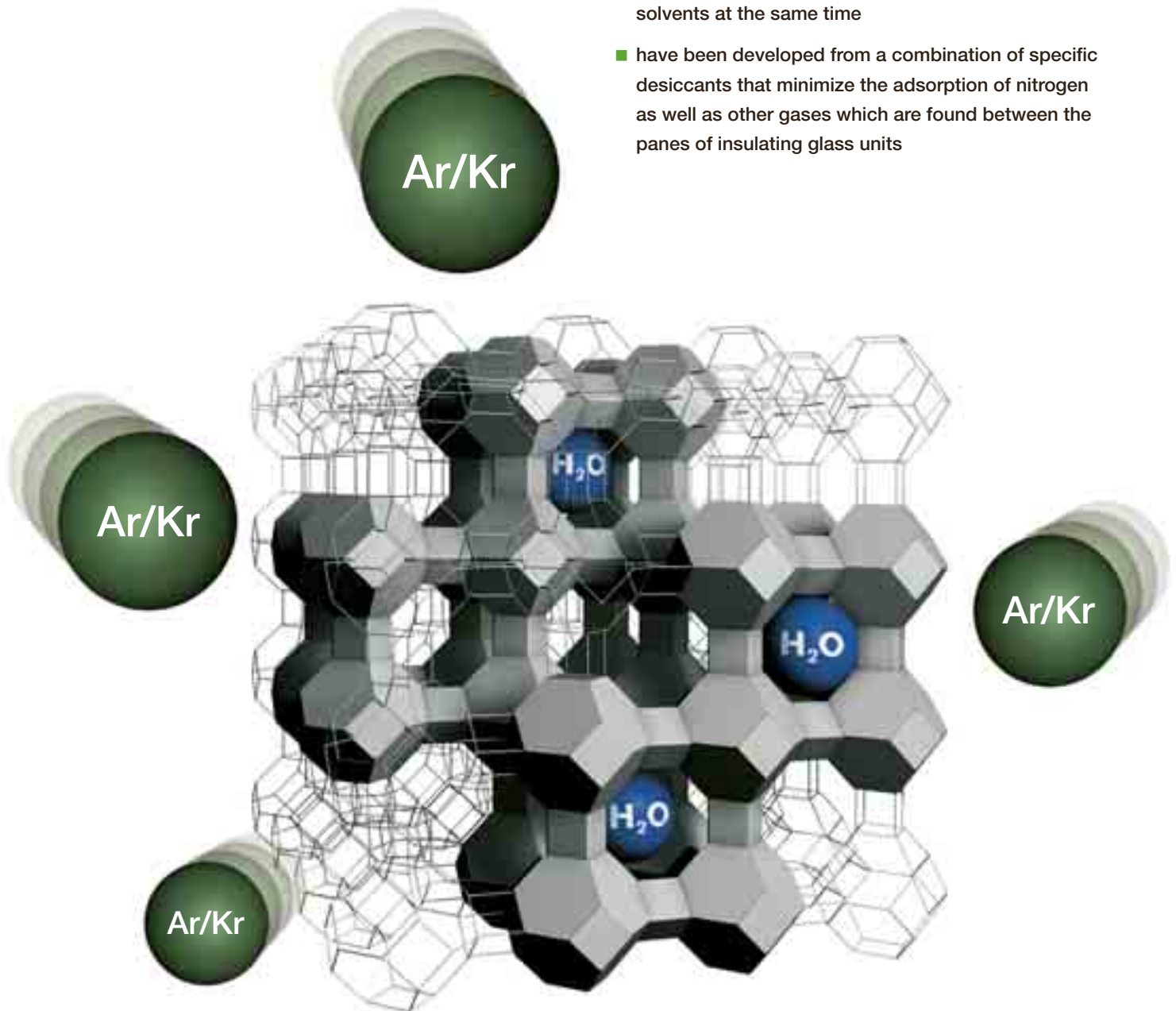
Insulating glass manufacturers have placed a great emphasis on achieving the lowest possible dew points in the space between the double panes of insulating glass units. All adsorbents have the capacity to pick-up water to a greater or lesser extent. PHONOSORB® molecular sieves however, have a superior capacity to adsorb moisture at low water vapour pressures. Through this a low initial dew point is ensured in the insulating glass unit over a long period of time.

The solution for sealants containing solvents

Insulating glass units are sometimes manufactured using solvent-releasing sealants or adhesives. In such cases, Grace recommends the use of a blend consisting of regular PHONOSORB® beads and a small quantity of a desiccant with larger pore openings which is specially suited for adsorbing solvents. Through this, both the moisture and the solvent are adsorbed, preventing condensation between the panes (fogging).

These products:

- have the ability to adsorb both moisture and solvents at the same time
- have been developed from a combination of specific desiccants that minimize the adsorption of nitrogen as well as other gases which are found between the panes of insulating glass units



Molecular Sieve Effect

(Small water molecules are adsorbed, large nitrogen molecules e.g. argon/krypton cannot enter the pores)

Manufacturing at Grace – Quality Guaranteed

In order to ensure quality and consistency, Grace Davison uses state-of-the-art technologies and processes in the manufacturing of adsorbents. Our operations are committed to Total Quality Management and we have set ourselves the target of exceeding environmental and work safety requirements.

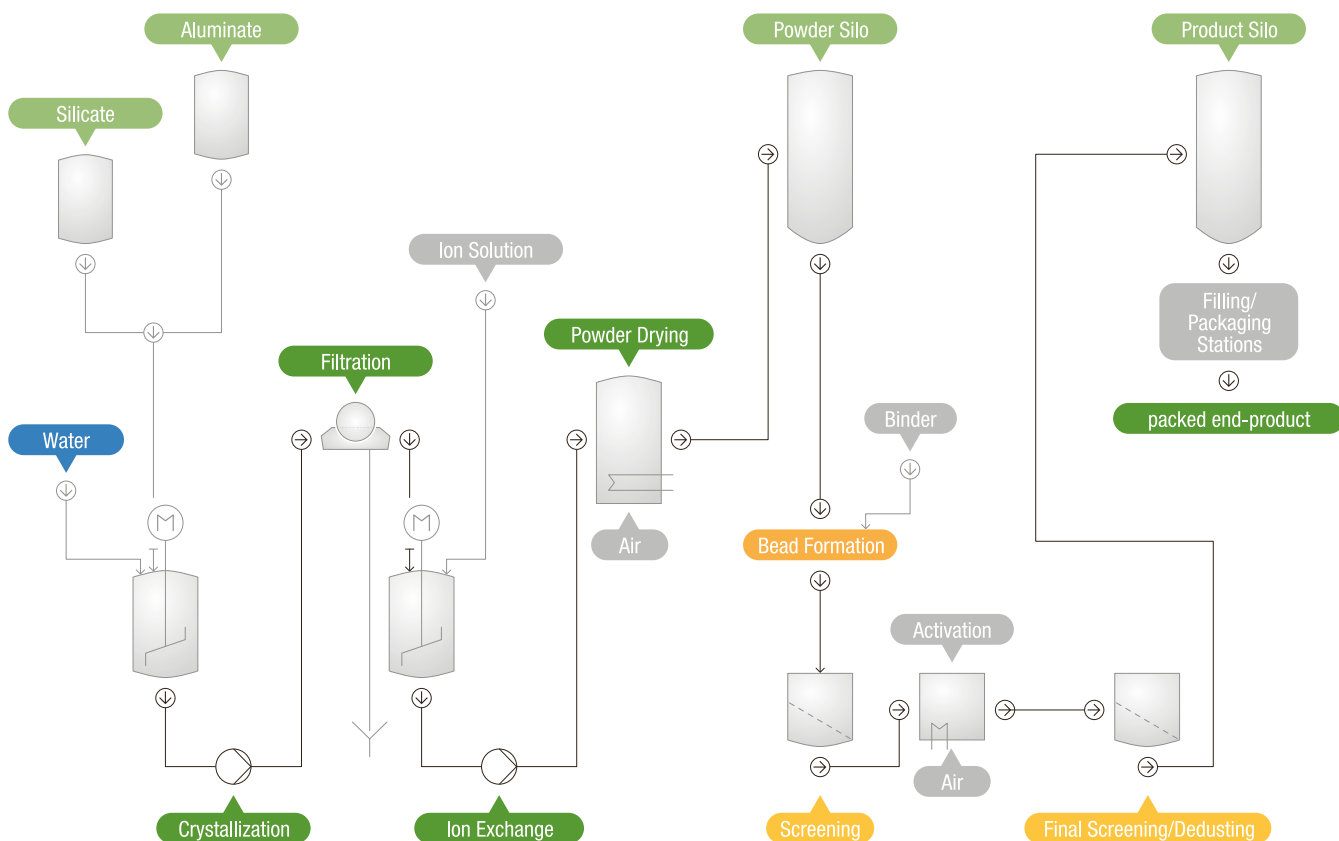
Molecular sieves are manufactured by crystallisation of aluminium hydroxide, sodium hydroxide and sodium silicate. Under carefully controlled conditions, the crystallisation process produces the required sodium aluminium silicate structure. In a subsequent step, the zeolite crystals undergo an ion exchange through which the desired pore dimension is set. After drying the molecular sieve crystals, a small quantity of binder is added, forming the material into beads. These beads are then dried and calcinated and, at a final stage, the dust is removed and they are screened to the required particle size prior to packaging.

Grace's desiccants are permanently subject to the strict control of our quality department, which operates around the clock to ensure a high level of product quality.

In our production operations, we employ the latest statistical process control (SPC) techniques in order to monitor and analyse production and related work processes, as well as strive for continuous process improvement using Grace's Six Sigma® tools. These were designed to investigate process parameters, quantify their effects and to optimize these in order to achieve the best possible results.

Our customers benefit from our endeavours by obtaining products of the highest quality. Quality you can count on. Grace has committed itself to further using these methods in order to continually improve the production processes.

Molecular sieve production



The Standard in the Insulating Glass Industry

PHONOSORB® beads are the most common products, developed for loose-fill insulating glass units. They are characterized by a unique combination of adsorptive and mechanical properties. Apart from excellent water adsorption characteristics they feature optimum particle size distribution, a very low level of dust and attrition and a high level of compression strength.

PHONOSORB® products features & benefits:

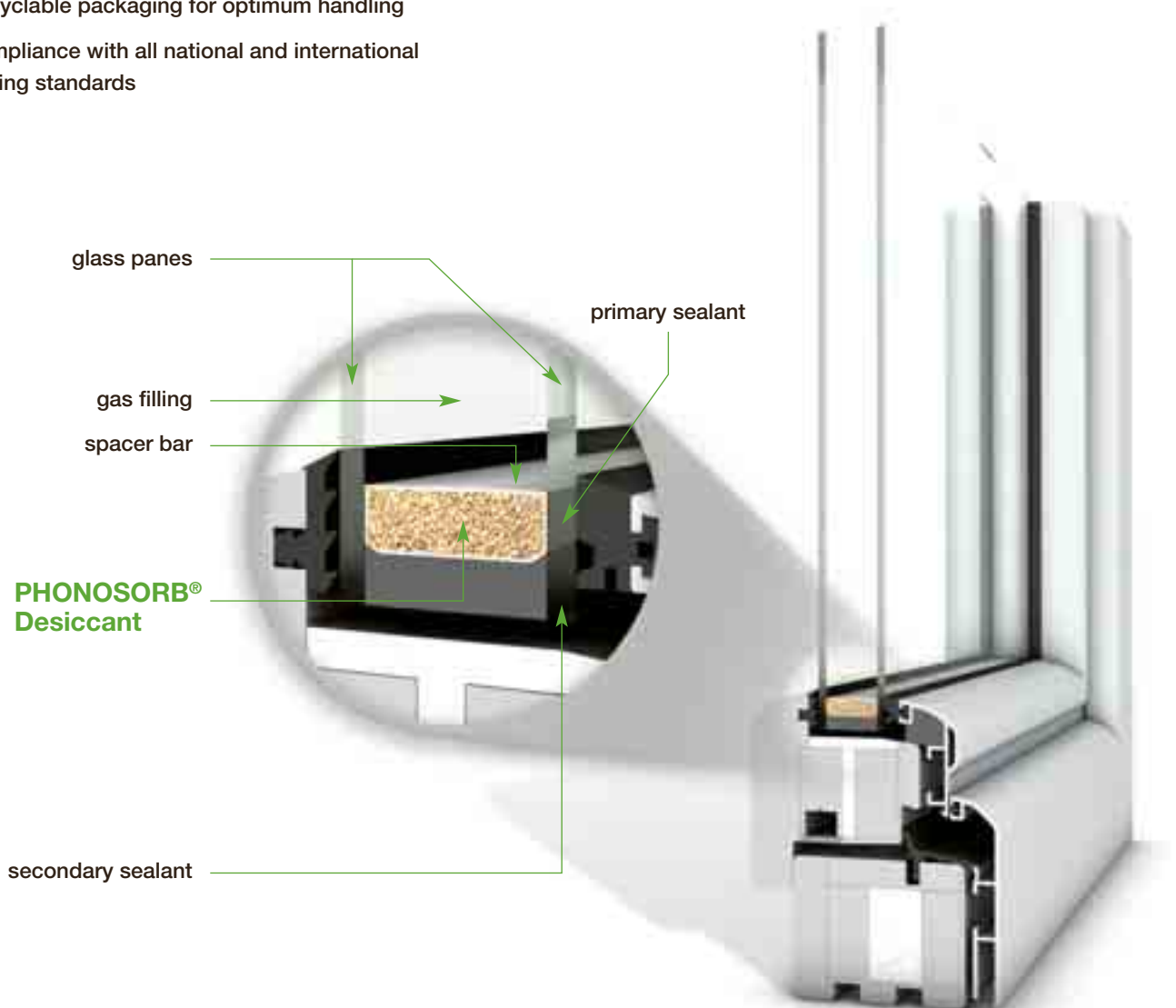
- High water adsorption capacity
- Low dew points
- No adsorption/desorption of air/insulating gases
- Optimum bulk density
- Low dust and attrition
- Longer life of the insulating glass unit
- Compatibility with all gases and sealants
- Compatibility with all filling and flexure systems
- Recyclable packaging for optimum handling
- Compliance with all national and international testing standards

Especially for pneumatic filling systems: Minimized dust and attrition for maximum quality.

Dust particles are highly undesirable in the space between the panes of the insulating glass. These can originate from dust on the outer surface of desiccants or can be caused by attrition of the desiccant beads or during the process of filling the profile.

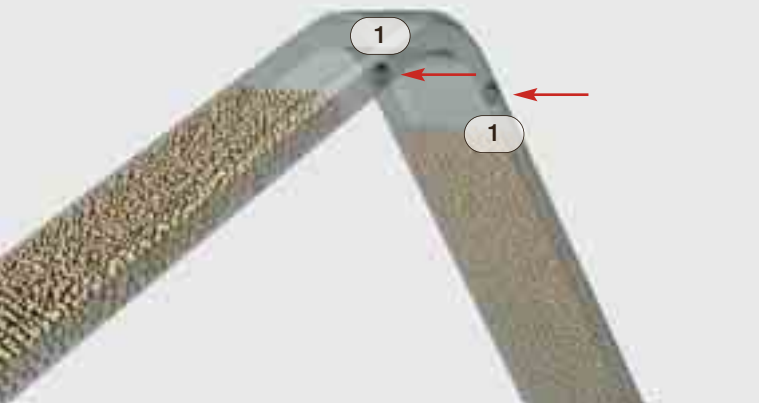
Through special treatment during the course of production, the amount of dust in PHONOSORB® sieves is extremely low and they demonstrate very high resistance to attrition. The dust content is regularly controlled and recorded during production and as a consequence of this, we are able to guarantee our customers very low levels of dust.

Pneumatic filling processes expose the molecular sieve to extreme mechanical stress. Optimized bead strength and a fine-tuned particle size distribution are necessary to facilitate trouble-free filling without dust and attrition.



Structure of a double pane window

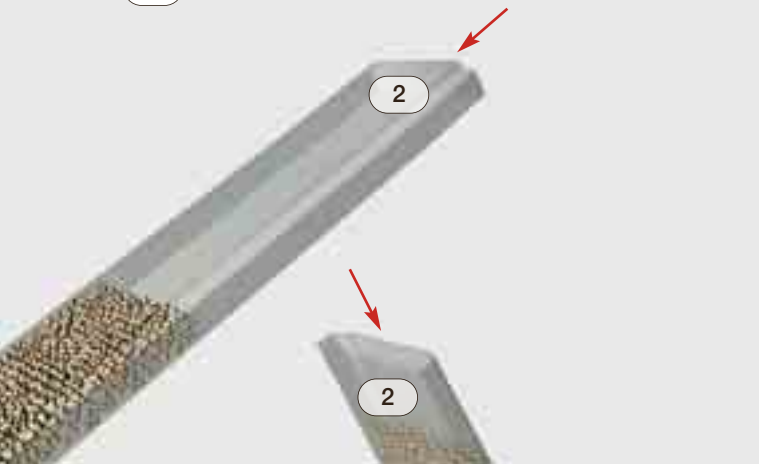
1 Pneumatic filling



Recommended grades:

PHONOSORB® 551

2 Pre-bent pneumatic or gravimetric spacer filling



Recommended grades:

PHONOSORB® 551 PHONOSORB® 555

3 Gravimetric filling before bending



Recommended grades:

PHONOSORB® 551 PHONOSORB® 555
PHONOSORB® 558

Our PHONOSORB® 551 desiccant has been specifically developed for automatic filling systems where the desiccant is pneumatically loaded into the profile through injectors. As such, their dimensional accuracy plays a crucial role. The bead distribution of PHONOSORB® 551 is carefully and repeatedly screened in order to rule out blockage of the injection system in the filling machines.

The exceptionally low dust and attrition levels of the PHONOSORB® molecular sieve help achieve a border area which is virtually dust-free. This enables the sealants that are used to be applied without problems, thus allowing better adhesion. This results in the insulated glass unit achieving a longer service life.



**Especially for automatic bending:
Optimising the compression strength**

If spacer bars are filled before bending, the desiccant should exhibit a suitable level of compression strength. In order to prevent the disintegration of the profile in the corner area, it should not be too strong. On the other hand, the desiccant should not cause the profile to burst during bending by being too rigid. The compression strength of PHONOSORB® beads has been precisely adjusted so that filled spacer bars can be bent without problems. This optimal compression strength is a result of a careful and optimized molecular sieve formulation in combination with the best suited particle size distribution for your specific filling system.

Grace Technical Customer Service: Our Expertise is Your Success

Behind PHONOSORB® desiccants there is a highly trained and experienced technical service team. In order to achieve maximum quality and consistency in the production of their insulating glass, our engineers have made it their job to offer you their advisory services with regard to the entire PHONOSORB® range. On the basis of our many years of experience and expertise, we are able to support you in selecting optimum solutions to meet your specific demands.

It is our goal to make a significant contribution to your success with an effective combination of superior products and outstanding customer service.

Grace Davison technical service offers:

- Customer seminars
- On-site consultancy concerning applications
- Profile performance testing
- Dew point analysis
- Stress deflection assessment
- Innovative product development



Customer seminars

Upon request, we can arrange seminars to train those people directly involved with the handling of our products. This can be carried out as an in house seminar or take place directly at the Worms plant. Our technical customer service team has developed a wide range of customer-related presentations to meet specific needs. Since 1988 more than 2500 experts from the Insulating Glass Industry have been trained in PROQUAL seminars.

Pneumatic filling test

As a market leader in desiccants for the insulating glass industry, it is Grace's philosophy to improve and develop products in line with customer-specific application requirements.

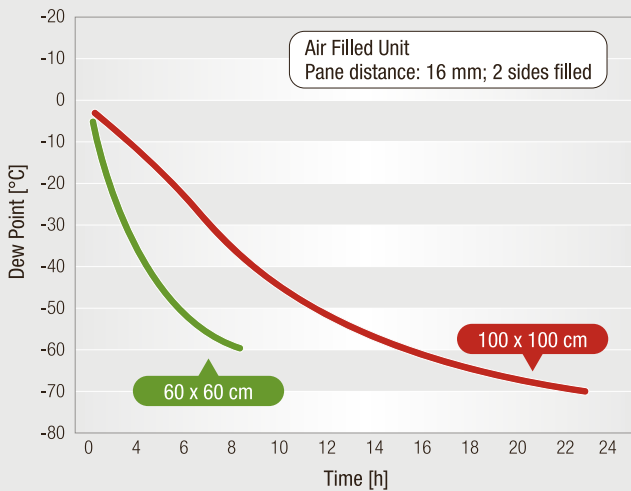
For this reason we use a pneumatic filling machine in our application laboratory with which we can adjust, test and optimize all conditions which are relevant to the production process. We pay special attention to increases in productivity wherein specifically, the flow behaviour of our desiccants is investigated.

Filling pressure represents another important variable with which the desiccant is brought into the space via an injector. In this process, the optimum filling pressure has to be set so that the filling speed and the mechanical integrity of the desiccant are ensured. With an optimum throughput, the aim is to keep dust and attrition as low as possible.

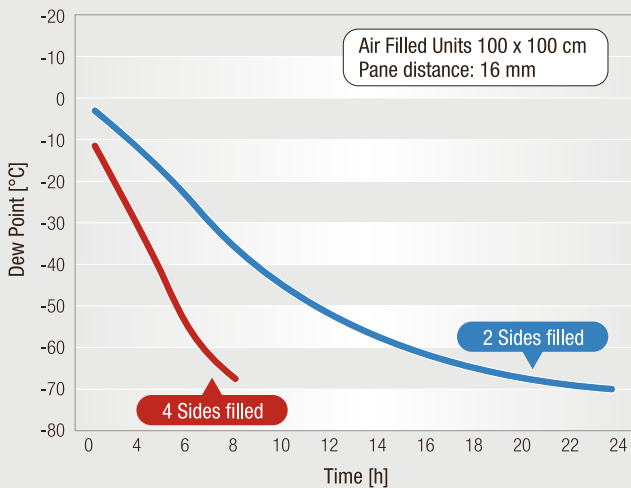


Evaluation of the drying-out rate

During the manufacture of insulating glass units, humid air can be trapped between the panes of glass. After the panes are locked, this humidity is adsorbed by the desiccant in the spacer.



Influence of the Unit Size



Influence of Side Fillings

In order to be able to precisely define the conditions for thorough drying-out without condensation, extensive measurements have been carried out to study the impact of the profile type, the number of profile sides which are filled, unit size, position of the filled profiles as well as the type of filling or desiccant. Our application engineers are happy to present you with technical solutions corresponding to the specific needs of your production systems. In the process, you will be benefiting from our wealth of experience which has built up through a multitude of tests.

"Big Bag" emptying system

Grace has developed an emptying system specifically for customers who require large quantities of PHONOSORB® products. This enables large amounts of desiccants to be processed in a cost-effective and safe manner.

The PHONOSORB® product emptying system offers a number of advantages, especially the easy handling of PHONOSORB® products in 600 kg big bags.

- The discharging system is made of stainless steel and practically maintenance free
- The system can handle an entire 600 kg big bag
- The unit can be adjusted in terms of height and can easily be adapted to the customer's specific requirements e.g. existing profile filling devices.
- An easy-to-handle flap at the container outlet allows for emptying without any problems.
- By means of an inspection window on the lower part of the container, the user is provided with an indication as to when the container has to be filled up again
- The stable system guarantees both secure filling as well as easy operation



Grace "Big Bag" emptying system

A Pioneer in Premium Dual Pane Windows

Grace Davison's involvement in the insulating glass industry goes back over 35 years to the time when such materials were first developed and produced on an industrial scale.

Throughout this time, it has been our philosophy to supply the insulating glass market with both excellent products as well as with detailed technical information in order to ensure optimum usage for our customers.

The Grace brand represents the development of innovative product concepts in order to enable and improve its customers' products and manufacturing processes in a sustainable way.

We are able to attribute our prominent position in the field of adsorption technology to the continual optimization of our products as well as our own production processes and services.



The history of desiccants at Grace Davison

- **1963** Start of production of molecular sieves at Curtis Bay/USA
- **1972** Start of production of silica gel at Worms/Germany
- **1973 Start of production of 4A molecular sieves at Worms/Germany**
- **1976** Start of production of the PHONOSORB® 3A molecular sieve for gas filled units
- **1979 Transition of the insulating glass market to 3A type molecular sieves similar to PHONOSORB® products**
- **1985** Introduction of PHONOSORB® 551 desiccants for pneumatic filling machines
- **1987** Introduction of the Big Bag packaging/emptying device
- **1988 Start of the "PROQUAL" seminars and technical training for our customers**
- **1993** Introduction of fully recyclable PE bags for PHONOSORB® beads
- **1994** 1000th "PROQUAL" seminar participant
- **1994 Introduction of Grace PHONOSORB® MTX products for Intercept lines**
- **1995** New Big Bag emptying systems (container system)
- **1995** New pneumatic conveying system for conveying PHONOSORB® beads into Big Bags
- **1996** Grace PC Window Information System
(information about insulating glass components – mainly desiccants)
- **1998** Big Bag emptying device (funnel system)
- **2000 2000th "PROQUAL" seminar participant**
- **2001** New "PROQUAL" seminar: Quality control of Grace adsorbents
- **2002** The making of "In Touch with Phonosorb" 8 min. video clip
- **2004** Dew point calculation simulation program
- **2006** Technical Information about the role of dessicants under EN 1279
- **2007** Delta-T Evaluation according to EN 1279
- **2008 EN 1279 certification by IFT**

Innovation and Quality

Research & Development

Grace Davison is a firm believer in driving innovation. Our researchers are continuously working to improve the quality of existing products and seeking ways to broaden our product range in order to fulfil the increasing requirements of our customers.

With R&D centres in Columbia/USA and Worms/Germany, Grace has over 80 years of experience and expertise in the development of adsorbents for numerous industries. Modern laboratory facilities enable us to carry out a range of chemical/physical characterisation experiments. In our technical centre we are able to carry out operational application tests e.g. the automatic filling of spacers or dew point measurements in insulating glass units.

Being familiar with all common Insulating Glass technologies, our technical experts can develop sophisticated solutions for bead technologies, such as automatic bead filling systems and bending machines, polymeric desiccants, such as hot melt systems, and speciality molecular sieve powders for use in alternative systems such as TPS, Swiggle Strip® or Super Spacer®.

The collaboration between Grace Davison's research and development department and our technical customer service team as well as ongoing dialogue with our customers has led to the successful development of PHONOSORB® desiccants. It is considered as "the desiccant of choice". PHONOSORB® products are available in a whole variety of bead sizes for all spacer types and filling methods.

Grace Davison offers you fine-tuned adsorbents for narrow and wide profiles, for pneumatic and gravimetric filling as well as for all bending systems.

Our Europe-wide sales and distribution network, ensures that all our customers can benefit from advice and support at short notice. This is a prerequisite for building successful business partnerships both now as well as in the future.

Quality Management

The introduction of EN 1279 parts 1–6, has brought with it significant changes with regard to the certification of insulating glass. Thanks to our high quality products and extensive technical consultation we have made a significant step towards making the changed standards understandable for our customers.

Our Total Quality Management (TQM) program takes a customercentric approach and is based on Grace Davison's philosophy of continuous improvement in every area of the organisation.

- All our facilities are ISO 9001 or ISO 9002 certified and we implement internal and external audits to find ways to improve our services and processes.
- We employ the latest Statistical Process Controls (SPC) to monitor and analyse production and related work processes.
- Our well-equipped Quality Control department works around the clock to ensure constant product quality.
- We continuously collect and assess customer information and feedback as an important factor in our TQM program.

In order to meet the needs and expectations of our customers, the Quality Control program includes the functional divisions of marketing, research and development as well as customer service. Our dedicated work force is our most important asset and customer satisfaction is our most important objective.



The Six Sigma Advantage

At Grace Davison, we are committed to Total Quality Management, including the continuous improvement of our processes. To maintain Grace Davison's high standards, we employ Grace's Six Sigma® tools. These were designed to investigate process parameters, quantify their effects and optimise these in order to achieve the best possible results. Our Six Sigma® initiative aims at improving both product consistency as well as production flexibility using advanced statistical methods and evaluation procedures. Our customers benefit from products of the highest quality.

Grace is a premier specialty chemical and materials company with more than 6000 employees located around the world. Our products are used by millions of people each day. Among many other things, we ensure the integrity of some of the world's major buildings and bridges, enhance the performance of your petroleum products and preserve the safety of your food.

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