

HONEYCOMBE® WHEELS

HoneyCombe® Wheels

Desiccant and VOC Abatement Options

 **Munters**
Your Perfect Climate

Pioneers of Desiccant HoneyCombe® Technology


Today, high performance commercial and industrial dehumidifiers employ desiccant wheel technology. This simple and effective technology was first pioneered by Munters more than 60 years ago by Swedish scientist, Carl Munters in conjunction with the American founder of Cargocaire, Commander Oliver Colvin. At that time, desiccant HoneyCombe rotors had been developed for dehumidifiers on cargo ships to keep goods dry. After decades of research and development, HoneyCombe rotors have been greatly advanced. Today, thousands of applications benefit from this technology. Working closely with Munters engineers, customers optimize performance of their humidity control units while minimizing operating expenses in a broad range of applications.

Munters' dehumidifiers in everyday life:

- Speed blasting and coating times of submarines in dry-dock
- Prevent ceiling condensation from forming and dripping onto food products
- Keep ice hard and fast at NHL arenas
- Keep floors dry and saves energy in supermarkets' frozen food storage
- Help keep snack foods fresh and chocolate bars tasting better
- Reduce the risk of infection and increase comfort control for surgical staff in operating rooms
- Preserve famous artifacts and historic motion pictures
- Prevent moisture from entering the tablet manufacturing process of critical medications
- Protect the structural integrity of school buildings and prevent harmful mold and bacteria

Munters Seven HoneyCombe® Rotor Options

Providing the widest range of dehumidification and VOC abatement available today




Titanium Silica Gel*

Titanium silica gel is an adsorbent. Water is attracted and held to the walls of many fine pores within the material. Munters' patented method for manufacturing titanium silica gel in HoneyCombe® wheel form, results in a strong and stable structure yielding ideal drying performance in a wide range of applications.

ADVANTAGES

- **Moisture removal capacity** – Titanium silica gel can hold up to 40% of its dry weight in water when in equilibrium with air at saturation.
- **Non-overloading desiccant** – Because titanium silica gel is a solid, insoluble desiccant, it is not possible to “wash out” the desiccant from the wheel. This means no special precautions are required even when it is exposed to air at 100% relative humidity.
- **Stability** – Silica gel does not undergo any chemical or physical change during the adsorption process. It is inert, stable, and non-toxic.
- **Washability** – The permanent nature of the desiccant makes it possible to literally wash a wheel in water if dust or other particulate block the air passageways.
- **Chemical resistance** – Titanium silica gel is a stable material and is resistant to most chemicals. In particular, it is resistant to acids and sulfur products which may be found in the combustion products of a direct-fired gas burner.

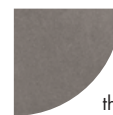


Lithium Chloride*

Lithium chloride is an extremely powerful adsorbent that takes full advantage of the HoneyCombe®, resulting in the most economical system on an operating cost basis.

ADVANTAGES

- **Moisture removal capacity** – Lithium chloride can attract and hold over ten times its weight in water and is one of the most hygroscopic compounds in existence. It has the best moisture removal capacity over the broadest range of inlet air conditions.
- **Bacteriostatic** – The bacteriostatic properties of lithium chloride can significantly reduce the number of organisms which may be carried in the air stream.
- **Stability** – As a salt having very stable chemical qualities, lithium chloride is not dependent on a pore system for its water absorption capability. Lithium chloride is unaffected by most air stream pollutants and resistant to many contaminants like petroleum vapor, solvents and phenols.
- **Efficiency** – The ability of lithium chloride to both absorb and release large amounts of water from a small amount of desiccant creates tremendous drying capacity. Thus, for each unit of energy input, a greater percentage goes to the useful work of removing water rather than heating and cooling the structure.




GTR*

Munters proprietary GTR wheel is an adsorbent that outperforms standard desiccants by as much as 60%. The GTR is especially effective in applications that utilize 100% outside air.

ADVANTAGES

- **Unique structure** – The GTR desiccant is specially formulated to achieve performance on warm, moist airstreams that is not achievable with other desiccant formulas.
- **Moisture removal capacity** – The GTR desiccant provides exceptional moisture removal without the requirement of pre-cooling. The GTR desiccant wheel can remove as much as 100 gr/lb of moisture from an untreated airstream.
- **Non-overloading desiccant** – Because GTR is a solid, insoluble desiccant, it is not possible to “wash out” the desiccant from the wheel. This means no special precautions are required even when it is exposed to air at 100% relative humidity.
- **Stability** – The GTR desiccant does not undergo any chemical or physical change during the adsorption process.
- **Washability** – The permanent nature of the desiccant makes it possible to literally wash a wheel in water if dust or other particulate block the air passageways.



HPX*

Munters unique HPX wheel is an adsorbent that provides very low dew points (-70°F and lower). This desiccant is used under the advice of a Munters engineer for specialty applications.

ADVANTAGES

- **Application** – The HPX desiccant is used for manufacturing spaces and processes that require extremely low humidity levels. For example, HPX desiccant rotors are used to maintain manufacturing environments between 1% and 2% relative humidity at 70°F for the production of lithium batteries.
- **Unique structure** – The HPX desiccant provides high performance drying under specific conditions that cannot be reached with standard desiccant formulas.
- **Moisture removal capacity** – The HPX desiccant was designed for low dew point applications by engineering the desiccant pore system to maximize water pick-up and efficiency.
- **Stability** – The HPX desiccant does not undergo any chemical or physical change during the adsorption process.
- **Washability** – The permanent nature of the desiccant makes it possible to literally wash the wheel in water if dry dust or other particulate block the air passageways.

*Wheels are backed by a five-year warranty

** Hydrophobic zeolites are a non-desiccant Honeycombe® rotor

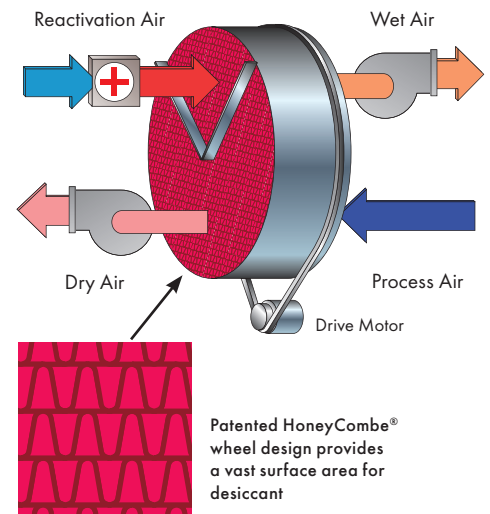
How Does it Work?

The operation of a HoneyCombe dehumidifier is based on the principle of sorption. Sorption is the adsorption or the absorption process by which a desiccant removes water vapor directly from the air. When the air to be dried passes through the HoneyCombe rotor, the desiccant removes the water vapor directly from the air and holds it while the wheel rotates. As the moisture-laden desiccant passes through the reactivation sector, the water vapor is transferred to a heated air stream, which is exhausted to the outside. The process is continuous, allowing for uninterrupted dehumidification. See *Figure 1*.

Zeol Systems

Solvent laden air is drawn through the Honeycombe rotor where VOCs are removed from the airstream by adsorption onto the hydrophobic zeolite. After passing through the rotor, the cleaned air is discharged into the atmosphere. The rotor turns continuously (1-6 rotations per hour) transporting adsorbed VOCs into a regeneration sector. There, the VOCs are removed by a small heated airstream. The regenerated zeolite is then rotated back into the process airstream. The concentrate is typically sent to a small oxidizer where the VOCs are converted to water vapor and CO₂. Heat exchangers are used to pre-heat the concentrate and provide the required heat needed to desorb the rotor and create additional fuel efficiency.

Figure 1: HoneyCombe® Rotor Principle



HCR*

Munters proprietary HCR wheel is an adsorbent wheel that is designed to use low temperature air for reactivation.

The wheel is standard in Munters HCU dehumidifiers. HCU dehumidifiers use refrigeration waste heat for desiccant reactivation.

ADVANTAGES

- **Application** – The HCR desiccant is specially formulated to use low temperature reactivation air. It is typically partnered with a refrigeration system that provides cooling, dehumidification and the heat required to reactivate the desiccant.
- **Moisture removal capacity** – When combined with refrigeration, the HCR rotor can remove as much as 120 gr/lb of moisture from an airstream. Use of refrigeration waste heat for reactivation results in an extremely energy efficient desiccant system.
- **Non-overloading desiccant** – Because HCR is a solid, insoluble desiccant, it is not possible to “wash out” the desiccant from the wheel. This means no special precautions are required even when it is exposed to air at 100% relative humidity.
- **Stability** – The HCR desiccant does not undergo any physical or chemical change during the adsorption process.
- **Washability** – The permanent nature of the desiccant makes it possible to literally wash the wheel in water if dry dust or other particulate block the air passageways.

Molecular Sieve*

Molecular sieve is a solid adsorbent for reaching extremely low dew points (-40°F to -80°F). It is efficient at high temperatures and is not sensitive to microporic clogging by pollutants.

ADVANTAGES

- **Zeolitic structure** – A zeolitic molecular sieve is a crystalline material of aluminum silicate which is capable of separating molecules of different sizes. Small molecules, such as water molecules, are adsorbed, while large molecules pass through the wheel.
- **Moisture removal capacity** – Because water molecules are polar and molecular sieve has a high surface energy, water molecules adsorb at low water vapor pressures. As a result, molecular sieve materials are suitable for applications that require a very low level of humidity. For the same reason, molecular sieve has a better sorption capacity at higher temperatures than other sorbents.
- **Stability** – Molecular sieve does not undergo any chemical or physical change during the adsorption process. Molecular sieve is inert, stable and non-toxic.
- **Washability** – The permanent nature of the desiccant makes it possible to literally wash the wheel in water if dry dust or other particulate block the air passageways.

Hydrophobic

Zeolites**

Munters proprietary zeolite provides several characteristics that are ideal for VOC abatement.

ADVANTAGES

- **Hydrophobic properties** – Munters' zeolite is made hydrophobic using a chemical process that replaces the aluminum in the crystal with silicon atoms. Since it repels water, it is unlike any other zeolite, synthetic or natural. The zeolite can use all of its pores to attract and hold VOC molecules from an air stream.
- **Stability** – The hydrophobic zeolite does not react with organic materials, exhibit catalytic properties or undergo any chemical or physical change during the adsorption process.
- **Non-flammable** – As an inert and stable inorganic crystal, it allows the use of high temperatures for desorption of high boiling compounds and eliminates the safety risk associated with carbon adsorbents.
- **Pore sizes** – Zeolite pore size determines which molecules the zeolite will attract. Munters uses a proprietary mixture of zeolites with pore sizes to cover a wide range of organic solvents (VOCs).
- **Adsorptive capacity** – At low inlet VOC concentrations, zeolite has a higher capacity to adsorb VOCs than comparative technologies. At high relative humidities, zeolite adsorbs less water than carbon leaving more sites for adsorption of organic molecules

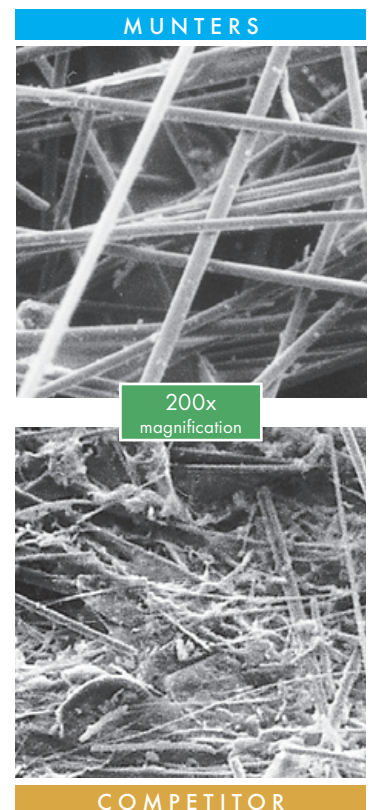


Figure 2: Electron microscope photography shows Munters' uniform diameter extruded glass fibers versus a competitor's structure using random diameter, spun Kaolin fiber. These fibers, of greater than five microns in size, preclude breathability and associated health hazards.

Pioneers of Desiccant HoneyCombe® Technology

Munters' nationwide service organization of factory-trained technicians can provide the most current technical information, complete maintenance recommendations and comprehensive troubleshooting if required. They are supported by a full line of in-stock replacement parts.

Regardless of industry or business type, Munters' customers need a service solution that keeps their operation running as required at all times and at the lowest operating cost. That is why Munters offers a range of services and maintenance programs designed to meet the diverse needs of all customers.

Comprehensive Warranties

Munters provides a five-year performance warranty on every desiccant wheel sold and will repair or replace the rotor at no cost, should structural defects occur within five years. Service agreements provide for regular factory maintenance and inspection of wheels and other dehumidifier components.

Customers on a contracted service program receive discounted parts and labor, along with performance evaluations to ensure their Munters equipment is achieving maximum performance.

Cleaning and Maintenance

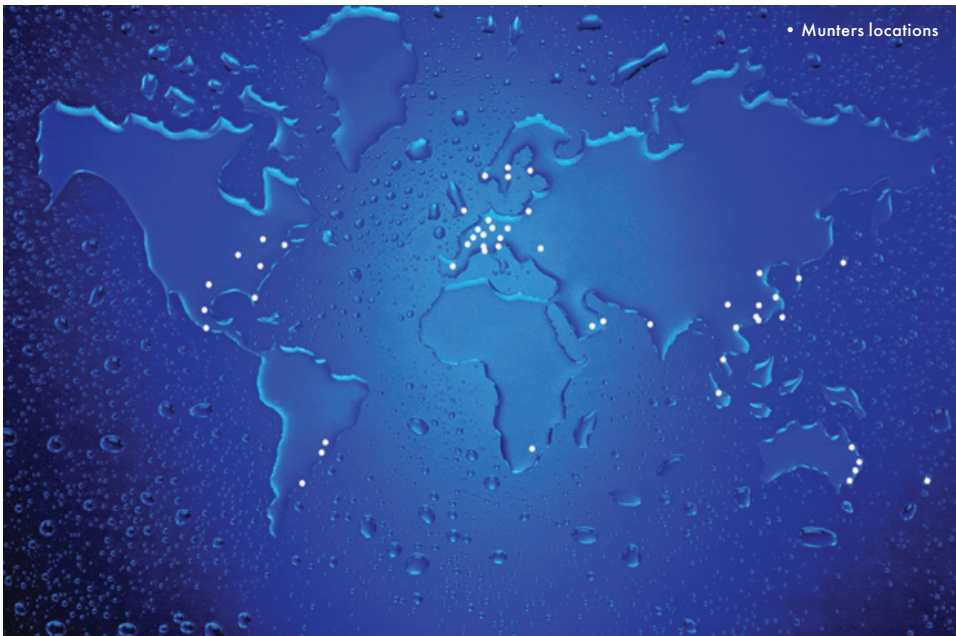
Munters rotors may be readily cleaned when they are installed in an application producing high concentrations of dust or other contaminants. However, the counterflow operation of the wheel in many cases provides self-cleaning. All Munters dehumidifiers are offered with filters, further limiting the effect of airborne particles. Should dust collect on the face of the wheel, it may be simply vacuumed away. In extreme cases where sticky particles such as soot, oil or fertilizer do attach to the media, the wheels are commonly cleaned by washing with water. However, before washing a wheel, it is strongly advised that operators discuss with Munters' Service how to best preserve the desiccant for long life and maximum benefit.



American Made Under ISO 9001:2015 Certification

Munters produces rotors at manufacturing facilities in Sweden and U.S. under ISO 9001:2015 certification. Munters sets the world's standards for rotor production and is the only producer of both desiccant wheels and dehumidification systems in America.

All Munters rotors are made of a non-metallic, ceramic composite. They are engineered to provide superior strength and durability, and to be impervious to water. Munters wheels are characterized by smooth, regular surfaces with even desiccant dispersion throughout the HoneyCombe structure and strong, accurately machined wheel casings. Munters' unique manufacturing processes ensure that the desiccant is an integral part of the HoneyCombe structure. Unlike some competitive rotors, all structural fibers are at least five microns in diameter and therefore, not breathable. See Figure 2. For added safety, HoneyCombe wheels are designed to not emit smoke or support fire if accidentally exposed to high temperatures or flame.



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