DER
DISTRIBUTED ENERGY RESOURCES

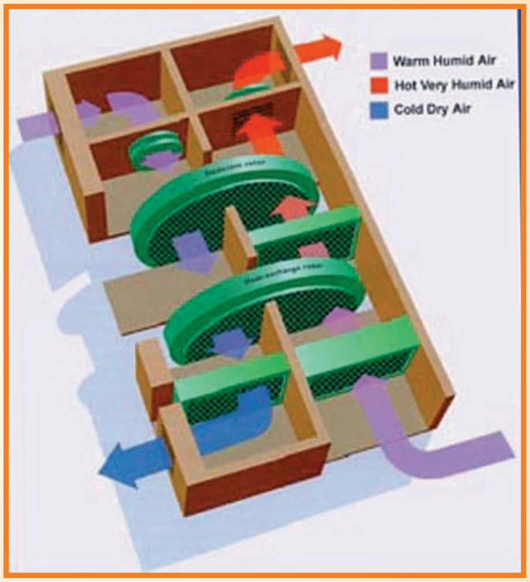
Thermally Activated Technology: Desiccant Dehumidifiers

Tech Brief

Distributed Energy Resources (DER) are a suite of onsite, grid-connected or stand-alone technology systems that can be integrated into residential, commercial, or institutional buildings and/or industrial facilities. These energy systems include distributed generation, renewable energy, and hybrid generation technologies; energy storage; thermally activated technologies that use recoverable heat for cooling, heating, or power; transmission and delivery mechanisms; control and communication technologies; and demand-side energy management tools. Such decentralized resources offer advantages over conventional grid electricity by offering end users a diversified fuel supply; higher power reliability, quality, and efficiency; lower emissions; and greater flexibility to respond to changing energy needs.

A desiccant dehumidifier uses a drying agent to remove water from the air being used to condition building space. Desiccants can work in concert with chillers or conventional air conditioning systems to significantly increase energy system efficiency by allowing chillers to cool low-moisture air. Desiccants can run off the "waste" heat from distributed generation technologies, with system efficiency approaching 80 percent in cooling, heating, and power (CHP) mode.

The desiccant process involves exposing the desiccant material (such as silica gel, activated alumina, lithium chloride salt, and molecular sieves) to a high relative humidity air stream—allowing it to attract and retain some of the water vapor—and then to a lower relative humidity air stream, which draws the retained moisture from the desiccant. In some applications, desiccants can cut cooling loads and peak demand by as much as 50 percent, with significant cost savings.



Two-Wheel Desiccant System

In stand-alone operations, a solid (dry) desiccant removes moisture from the air; a heat exchanger and evaporative cooler then chill the air. A desiccant dehumidifier wheel, composed of lightweight honeycomb or corrugated matrix material, dries the air as the wheel rotates through the supply air before reaching the building. Once the desiccant material reaches its saturation point, heat must be added, or the material must be replaced to regenerate the moisture-absorbing capability. Natural gas, waste heat, or solar energy can be used to dry moisture that is either absorbed or collected on the surface to regenerate the material.

Liquid absorption dehumidifiers spray the air with a desiccant solution that has a lower vapor pressure than that of the entering air stream. The liquid has a vapor pressure lower than water at the same temperature, and the air passing over the solution approaches this reduced vapor pressure. The conditioner can be adjusted so that it delivers air at the desired relative humidity. Liquid desiccant materials include lithium chloride, lithium bromide, calcium, chloride, and triethylene glycol solutions.

Market Potential

- Schools, hospitals, and grocery stores have stringent IAQ needs, representing large potential markets for clean air technologies.
- Desiccants enable the downsizing of chillers in new construction.
- Desiccants can stretch the capacity of existing chillers by increasing system efficiency, potentially eliminating the need to replace a functioning chiller with a larger unit.

Environmental Benefits

- Can reduce fossil fuel consumption through increased CHP system efficiency
- Operate without CFCs and HCFCs
- Improve IAQ through better ventilation
- Reduce condensation on equipment and humidity levels in air ducts, eliminating growth of mold, mildew, and bacteria

Applications

Most Americans spend a majority of their lives in buildings; the dehumidification benefit that desiccants provide can improve the quality of life, comfort, and safety.of the typical American In fact, liquid desiccant systems can literally save lives; their liquid solution can kill deadly germs, including the Anthrax bacteria, as it is sprayed onto air being conditioned.

Early adopters of desiccants include schools, hospitals, grocery stores, and other facilities concerned about healthier indoor air quality (IAQ). Others may include:

- **Pharmaceutical Manufacturing** — Dryer air extends the shelf life of pharmaceutical products.
- **Refrigerated Warehouses** — Desiccants prevent water vapor from forming on the walls, floors, and ceilings of refrigerated warehouses.
- **Operating Rooms** — Desiccants remove moisture from the air, keeping duct work and sterile surfaces dry.
- **Hotels** — Desiccants prevent the build-up of mold and mildew common in hotel guestrooms and bathrooms.

Kathabar liquid desiccant dehumidifier from the University of Maryland's CHP for Buildings Integration Test Center

Program Goals and Activities

The Advanced Desiccant Dehumidifier and Chiller Program is working with industry, including the U.S. Air Quality (USAQ) Consortium, the Gas Technology Institute (GTI), the American Gas Cooling Center (AGCC), and gas utilities to identify and remove barriers to commercialization of advanced desiccants. The program will also investigate desiccant systems that use recuperated waste heat from distributed generation technologies, such as turbines, microturbines, and fuel cells; refrigeration processes; and solar heat.

The National Renewable Energy Laboratory and Oak Ridge National Laboratory are assisting industry in developing desiccant wheels, as well as testing emerging designs and materials. Diagnostic techniques, such as infrared thermal performance mapping and advanced tracer gas leak detection, will be used to assess equipment designs and concepts.

The program is also working with York International in the development, testing, and commercialization of an advanced Double Condenser Coupled (DCC) commercial chiller, which is expected to be 50 percent more efficient than imported chillers. This DOE-patented DCC technology, which uses a LiBr/H_20 refrigerant solution, is being pursued rapidly given its potential for near-term commercialization.

For further information:

Office of Power Technologies
www.eren.doe.gov/power/

Distributed Energy Resources
www.eren.doe.gov/der/

FEMP
www.energy.wsu.edu/cfdocs/tg/10.htm

Partners:

American Gas Cooling Center (AGCC)

Gas Technology Institute (GTI)

Georgia Tech Research Institute (GTRI)

National Renewable Energy Laboratory (NREL)

Oak Ridge National Laboratory (ORNL)

U.S. Air Quality (USAQ) Consortium

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