What's New in Building Energy Research

Office of Building Technologies

Desiccant Cooling Program

DOE works with industry to make desiccant cooling systems more marketable

Desiccant cooling systems are energy efficient, cost effective, and environmentally safe. They are used as stand-alone systems or with conventional air-conditioning to improve the indoor air quality of all types of buildings. In these systems, a desiccant removes moisture from the air, which releases heat and increases the air temperature. The dry air is cooled using either evaporative cooling or the cooling coils of a conventional air conditioner. The absorbed moisture in the desiccant is then removed (the desiccant is regenerated, or brought back to its original dry state) using thermal energy supplied by natural gas, electricity, waste heat, or the sun. Commercially available desiccants include silica gel, activated alumina, natural and synthetic zeolites, lithium chloride, and synthetic polymers.

Currently, desiccant cooling and dehumidification are being used successfully in industrial and some commercial applications. The Office of Building Technologies in the U.S. Department of Energy (DOE) is working with industry to broaden the market for desiccant cooling so its full energy savings and indoor air quality improvement potential can be realized.

The main goals of the Desiccant Cooling Program are to

- Reduce carbon dioxide emissions by 5 million tons (4.5 million metric tons) annually by 2005 and 18 million tons (16.3 million metric tons) annually by 2010
- Reduce energy consumption by 0.1 quad (105.5 petajoules) annually by 2005 and 0.3 quad (316.5 petajoules) annually by 2010
- Capture 5% of the air-conditioning market by 2005 and 15% by 2010.

Meeting DOE Goals

An industry-led program is critical to the success of the technology. In response, DOE is collaborating with the U.S. Air Quality (USAQ) consortium and industry to

- Benchmark current performance
- Develop generic design tools
- Support technology transfer
- Develop and demonstrate new hardware
- Support industry efforts in developing and implementing rating and certification methods
- Educate industry users.

Near-term goals focus on developing the next generation of desiccant equipment for broader commercial applications. Long-term goals focus on developing second-generation, advanced desiccant systems for broad commercial and residential applications.

Expanding the Market

Technology advancements have improved the performance, reliability, and cost-effectiveness of desiccant equipment. However, further cost reductions and improvements are needed before these systems can compete successfully in the broader

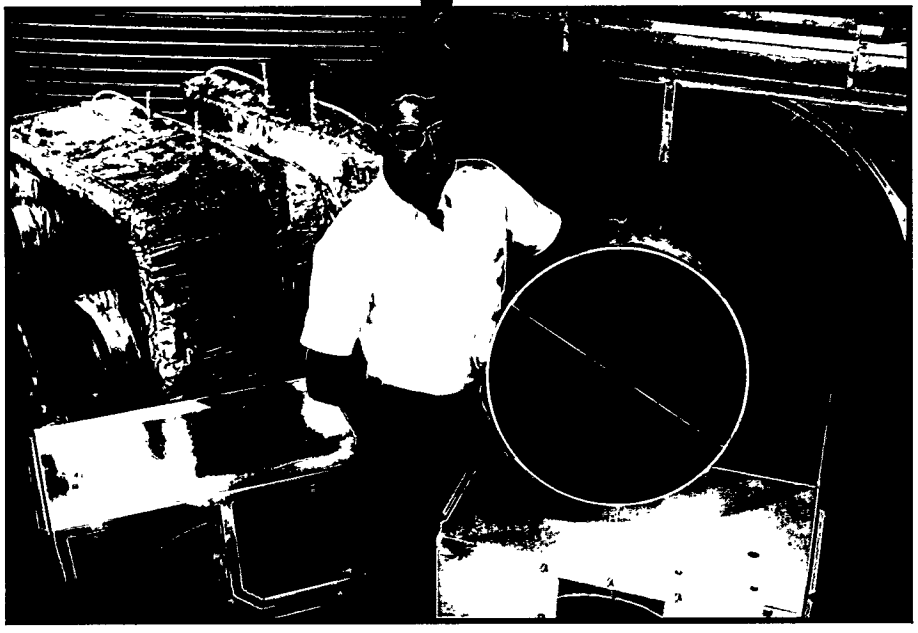

Photo courtesy of Warren Gretz, NREL/PIX03554

Desiccant wheels such as these are being tested at the National Renewable Energy Laboratory.

residential and commercial buildings market. The USAQ consortium will identify barriers to wider acceptance and propose solutions to these market barriers.

Desiccant technologies are being used to great advantage, although thus far only in small numbers, in various markets throughout the United States and are the best choice in many applications. Supermarkets use them to reduce frost buildup on refrigerated cases and frozen products, extending product shelf life as well as the intervals between expensive, energy-consuming defrost cycles. Desiccants contribute to a drier, cleaner, more comfortable environment in stores of all kinds.

Conventional vapor-compression cooling systems are not designed to handle temperature and humidity loads separately. Consequently, oversized compressors are installed to dehumidify the incoming air. And to meet humidity requirements, vapor-compression systems are often operated for long cycles and at low temperatures, which reduces their efficiency and requires reheating the dry, cold air to achieve some degree of comfort. Both consequences are costly.

Desiccant systems, however, can supplement conventional air conditioners. By working together, they tackle the temperature and humidity loads separately and more efficiently. Heating, ventilating, and air-conditioning (HVAC) engineers can then reduce compressor size and eliminate excess chiller capacity.

Improving Marketability

To make desiccant systems more marketable, the federal government is working with industry partners to

- Develop advanced desiccant materials, components, and systems with lower costs and improved performance
- Develop a uniform method for testing desiccant materials and dehumidifiers, adsorption sections, and whole systems in the laboratory
- Demonstrate desiccant systems in real-world environments
- Develop performance benchmarks to establish consumer confidence in manufacturers' claims
- Develop markets for desiccant systems that will improve indoor air quality and reduce environmental pollution.

Because desiccant systems perform differently from vapor-compression systems, performance-rating procedures, test methods, and standards are being developed to permit HVAC-system designers to compare various desiccant systems with competing technologies. Separate procedures are being developed by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. and the Air-Conditioning and Refrigeration Institute. Conventional comfort standards based primarily on temperature must be revised to include humidity and indoor air quality.

Saving Energy and the Environment

Desiccant cooling systems are energy efficient and environmentally benign. According to one estimate, desiccant dehumidification could reduce total residential electricity demand by as much as 25% in humid regions, providing a drier, more comfortable, and cleaner indoor environment with a lower energy bill. Desiccant systems allow more fresh air into buildings, thus improving indoor air quality without using more energy.

Desiccant systems also displace chlorofluorocarbon-based cooling equipment, the emissions from which contribute to the depletion of the Earth's ozone layer.

Partnering with Industry

Collaboration between government and industry is necessary to develop a cost-effective, marketable system that is energy efficient and environmentally safe. The National Renewable Energy Laboratory (NREL) and Oak Ridge National Laboratory (ORNL) are managing the program jointly for DOE and offering technical support to industry. The laboratories are working with Carrier Corporation, The Trane Company, Air Technology Systems, Engelhard/ICC, LaRoche Air Systems, Munters Cargocaire, and SEMCO. USAQ partners include desiccant manufacturers, HVAC equipment manufacturers, and gas utilities.

The information and data generated through this collaboration will be disseminated to the HVAC industry, the desiccant community, architects, engineers, builders, utilities, and other end users through industry and professional society meetings, conferences, and workshops.

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