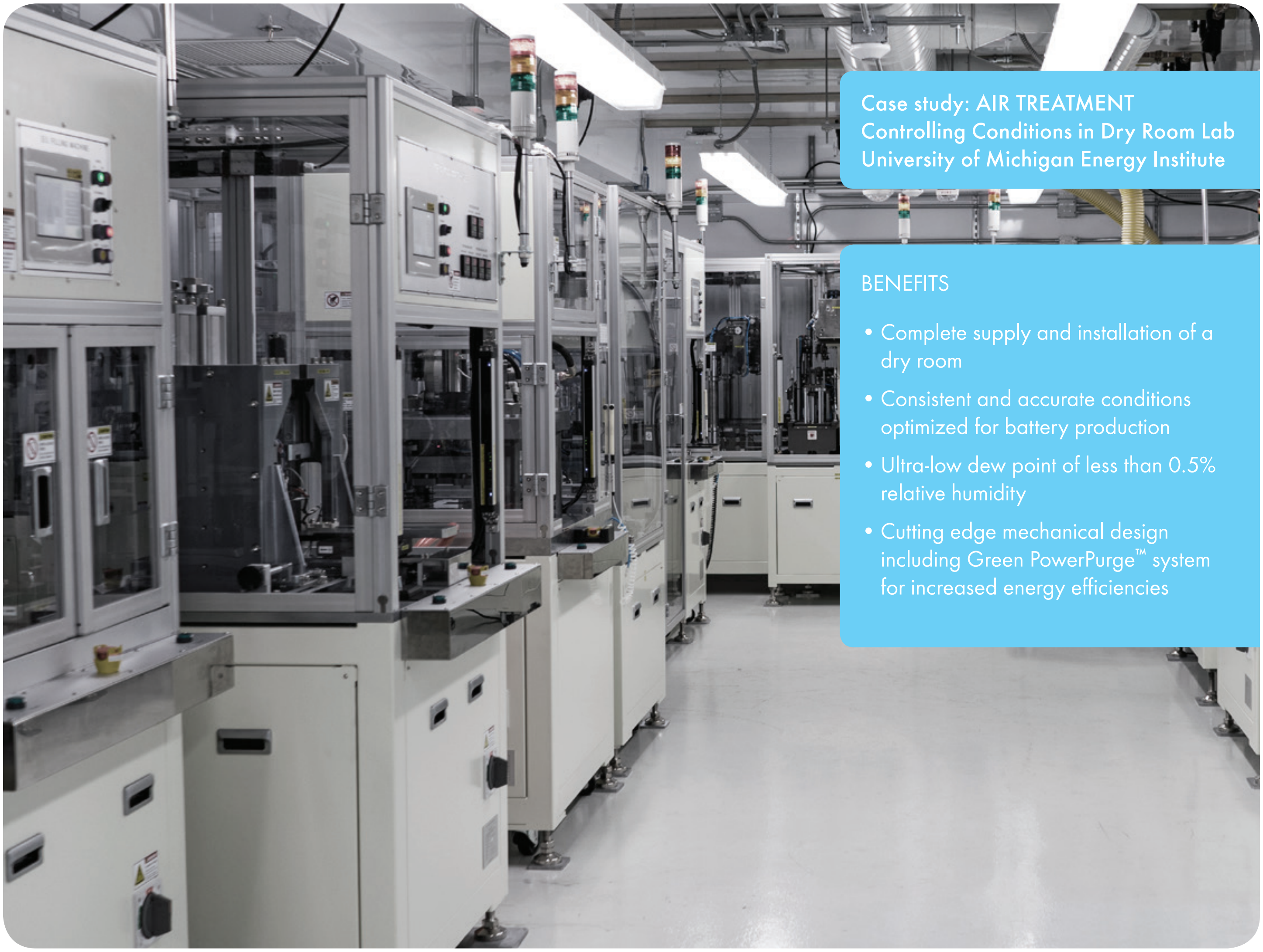

Case study: AIR TREATMENT
Controlling Conditions in Dry Room Lab
University of Michigan Energy Institute

BENEFITS

- Complete supply and installation of a dry room
- Consistent and accurate conditions optimized for battery production
- Ultra-low dew point of less than 0.5% relative humidity
- Cutting edge mechanical design including Green PowerPurge™ system for increased energy efficiencies

Innovative Solutions Supercharge Design of World-Class Battery Research Lab

Developing a dry room for an advanced lithium-ion battery production lab is a precise task requiring ultra-low dew point levels. The task becomes monumental when that lab project also required renovating an existing space, isolating it from the rest of an occupied building and placing needed mechanical equipment two floors above.

Working together, the teams from Scientific Climate Systems (SCS), Munters and Innovative Air Systems provided the expertise needed to design and develop a world-class lab and ensure consistent and accurate conditions were met.

The setting for this complex assignment – the University of Michigan Energy Institute's Battery Lab in Ann Arbor, Mich. The facility offers university researchers, materials scientists and engineers, as well as suppliers and manufacturers, state-of-the-art equipment to develop less expensive and longer lasting energy-storage devices for grid storage, transportation and consumer products.

"Our primary focus in the dry room is electrolyte filling and final cell assembly for lithium-ion batteries," said Greg Less, Ph.D., senior laboratory manager with the University of Michigan Energy Institute. "Having a moisture-free environment is essential for longevity and safety in lithium-ion batteries."

Houston-based SCS, specializes in designing and installing precise low humidity environmental conditions for dry rooms, with more than 200 installations worldwide, was selected to design and build the dry room. The work encompassed a complete integration, mechanical systems, controls for monitoring and adapting to ambient conditions and all the equipment needed to achieve design requirements.

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Munters


Roof mounted dehumidifier system with air-cooled condensing units.

Developing the 700-square foot lab presented several unique challenges. For one, the project required converting an existing, second story space in a three-story building into a dry room.

"The building functions as a multi-purpose research and study facility, and the laboratory was to be installed in a space that was used for study work areas," said David Parkman, senior project engineer with Scientific Climate Systems. "Installing this lab meant totally isolating the area from the surrounding adjacent spaces and hallway."

Second, the mechanical equipment had to be located on the roof and connected to the second floor of the building without disturbing occupants on the third floor.

In addition, all of the equipment had to be specified to fit on the available roof space and designed to operate with minimal sound and visual impact.

The design of the lab took more than a year with several meetings to review design concepts and details to the installation schedule and coordination with a local contractor to arrange space on the roof and use of an industrial crane to lift the mechanical equipment in place.

Based on the size and activity within the room, design conditions were set at 70°F and ≤ -40°C dew point or ≤ 0.5% relative humidity. Holding these conditions was essential as high energy lithium-ion batteries must be produced in environments with less than one percent relative humidity to prevent hydrolysis of the electrolyte salt.

Lab staff also wanted the benefit of windows in the dry room to correspond with the building windows for natural light. With the separation of mechanical equipment on the roof and the dry room two levels below, the supply air conditions from the dehumidification system must be maintained to provide the drying capacity needed to control the space at 70°F, ≤ -40°C dew point or ≤ 0.5% relative humidity.

"We had to accommodate the needs of the lab but also work around other areas between the mechanical equipment location and the dry room site," said Parkman. "Therefore, the supply air ductwork needed to be equally vapor tight, as well as the return air.

"We have to hold a lab that's surrounded by rooms at 75°F and 60% relative humidity at a half of percent relative humidity," added Parkman. "That differential makes the integrity of that dry room critical, and we had to ensure every seam was precisely sealed."

Where there were other functional areas within the building, multiple small access hatches were required in the dry room to adjust utilities associated with these rooms and other labs. These had to be gasket sealed along with the room enclosure to maintain conditions.

"Because this space wasn't ever really meant to be a dry room, let alone a lab, there were several panels needed inside of the room to allow access to control valves and shut off switches for building services that had to be incorporated into the design," said Less.

SCS utilized its extensive experience to incorporate quality insulated panels and sealed all joints to provide a vapor tight enclosure. In addition, all penetrations for sprinklers, electrical power and compressed air were sealed with the same quality control as the room. Lab staff gain access to the dry room by entering and exiting through an airlock to prevent moisture infiltration from outside sources.

With proper sealing in place, the dry room requires only 200 CFM of positive pressure to avoid moisture infiltration that would affect conditions inside. To achieve this level of control required a large amount of mechanical equipment, including an advanced dehumidification system, all strategically placed on the building's rooftop.


Scientific Climate Systems crew installing dry room enclosure.

Munters Dehumidification System Delivers

The design criteria and expected activity within a dry room determine the equipment performance requirements. For the University of Michigan Battery Lab, the supply air temperature and moisture needed to be lower than the design set point to accommodate three sets of conditions: the internal sensible and latent loads from the number of people working in the space, any exhaust air from workstations, and the heat load from people, processing equipment and lights.

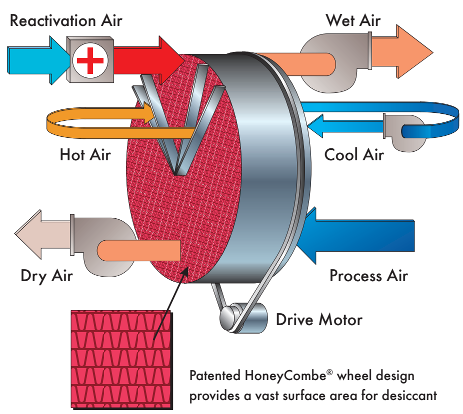
"The Munters Green PowerPurge desiccant system was chosen as the central component of the mechanical system because it's specifically designed to meet the needs of advanced battery manufacturers requiring low dew point control, while at the same time consuming less energy than other systems," said Jeff Siemasko, Munters director of sales, North America.

"The Green PowerPurge high performance desiccant system uses the least amount of energy possible, and was precisely developed for the low dew point application required by the lithium-ion battery dry room industry," said Curtis Musall, president of Innovative Air Systems and SCS OEM account manager for Munters.

The Green PowerPurge is energy efficient because the unit acts as an energy recovery system, collecting waste heat off of the hottest section of the desiccant wheel and using it to help with the regeneration. This process reduces the energy required for reactivation, while lowering the discharge temperature of the process air, decreasing energy costs for post cooling the air being delivered to the dry room.

"Green PowerPurge easily can supply dew points at -70°F/-56°C supply air while saving between 25% and 45% of the dry room cooling cost and 35% to 50% of desiccant reactivation energy cost," said Musall.

The Munters dehumidification system effectively and efficiently controls the dew point and the unit's refrigeration provides the initial stage of temperature and moisture removal before the final drying through the dehumidifier for the supply air to the dry room.



Results: Lab Conditions Exceeding Expectations

According to Less, conditions in the facility have actually exceeded expectations.

"Our humidity is usually lower than the spec by quite a bit," said Less. "We are easily able to monitor conditions via a digital readout outside the room that also is connected into the University building monitoring system."

"The support provided by Curtis and the Munters team in confirming the design features and performance was essential to the success of the project," said Parkman. "Munters has been providing energy-efficient dehumidification systems for this application for nearly 40 years and has been our source for these dry room design specifications.

"Munters quality and performance are consistent with our requirements in designing the facility to control these extreme conditions," added Parkman. "Where the installation requires total integration, Munters supplied the dehumidification system and Innovative Air Systems provided the refrigeration equipment needed to match the dry room/dehumidification system requirements."

"Scientific Climate Systems worked with us to make sure we received the exact type of lab that we wanted and made sure we understood all of the parameters," said Less. "Working together we developed a fantastic, world-class space for our customers to produce batteries."


University of Michigan process equipment layout in dry room.

Project Quick Facts:

- Design - 70°Fdb, ≤ -40°C dew point or ≤ 0.5% relative humidity
- People – Five (5) maximum in the dry room
- Personnel Entry/Exit – 5 per hour
- Exhaust – 1000 CFM
- Panel Enclosure (fire retardant) – 4" walls and ceiling with Unistrut mounting system
- Personnel Access – Airlock 6' x 8'
- Access Hatches – Nine (9) 24" x 24" gasketed hatches to access building utilities
- Emergency Exit – Fire rated door sealed to University fire rate hallway walls
- Penetrations and Sealing for Automatic Fire Suppression Systems heads
- Floor – Vapor barrier seal and ESD epoxy final finish
- Windows – Eight (8) triple pane viewing windows inline with building windows
- Dehumidification - Munters IDS-4500 GPP with gas reactivation, DX refrigeration cooling coils, HEPA filtration and electric post heat
- Additional Features – Heated snow and mist louvers for winter
- Controller (Munters) – Siemens Integrated control system with HMI display
- Dry Room Controller – nCompass controller/HMI with graphical display of room temperature and dew point
- Room Sensors – Vaisala DMT 342 temperature and dew point sensor
- Ductwork – Welded seam supply and return ducts with 2" insulation from roof mounted dehumidification system above building 4th floor down to 2nd floor dry room
- DX Condensing Units – One (1) 25 HP and One (1) 15 HP

Munters Green PowerPurge™ system with gas reactivation.

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