HYGRO DRY ROOMS

QUALITY SYSTEM CERTIFICATION
DNV·GL
ISO 9001:2015

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DRY ROOMS FOR LITHIUM BATTERY MANF.

Low Dew Point Humidity Control for Battery Production to Ensure high quality and consistency for manufacturing and R&D of the latest battery technologies. Most battery manufacturers require that a room's humidity/average moisture level be maintained as low as -40°C dew point (0.5% Relative Humidity at 71.6°F) and sometimes even lower.

Battery Processes Requiring the Low Dew Point Conditions

- Slurry Mixing
- Electrode Coating/Drying
- Electrode Stamping/Punching
- Electrode Stacking/Winding
- Cell Assembly
- Laser Welding
- Vacuum Drying
- Electrolyte Filling
- Battery Sealing
- Aging and Formation

MAJOR CHALLENGES

The major Challenges in Lithium battery Manufacturing process in terms of maintaining the low dew point conditions

i. To maintain ultra-low dew point conditions (-40° to -60°C dew point) in the dry room

i. To maintain consistent conditions through out the year irrespective of ambient conditions

i. To maintain consistent conditions through personnel activities

i. To maintain consistent conditions while equipment operates and its heat loads fluctuations

i. To maintain positive pressure inside the Dry room to avoid infiltration air

i. To Minimize the equipment footprint and energy consumption

HYGRO SOLUTION

Hygro desiccant dehumidification systems for low dew points are specifically designed to meet the exact needs and requirements for precise and low dew point control, Hygro low dew point units are designed with innovative energy recovery to minimize operating costs for the customer.

A typical Hygro Dehumidification system for low dew point control incorporates cooling, heating, chillers, ducting and controls. The system uses an energy recovery purge design to recover waste heat off the hottest section of the desiccant wheel (the dehumidification process produces heat) and uses it to help with regeneration. This process reduces the reactivation heater power required. The purge design creates a more energy efficient system with 30 to 35% reduction in energy costs. Other options include night and weekend setbacks, variable flows, and waste heat recovery off integrated DX cooling units. Each project is unique and has its own set of challenges.

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BENEFITS OF HYGRO DRY ROOM SYSTEMS

BENEFITS OF HYGRO Dehumidification System for Low dew point.

- Increases the operational time frame by meeting performance 24/7, during all seasons, all production modes and varying numbers of occupancy
- Precisely controls the humidity and temperature / Dew points inside the Dry room
- So Consistent low dew point improves cycle life, product yield and storage capacity.
- Hygro Specialised low dew point desiccant and purge design saves 30 to 35% on energy requirements and minimizes operational costs
- Hygro will build energy-efficient system
- Hygro custom built Dehumidification system as per the site conditions which reduces the footprint

DEHUMIDIFICATION DESIGN FACTORS

- Local climate conditions / data as per ISHRAE / ASHRAE
- Dry room size including Change room & ante room
- Type of chemistry and process
- Moisture infiltration
- Personnel activity in the dry room
- Airlocks for material and personnel movement
- Other Sensible / latent loads if any
- Make up air
- Clean room Classification & Filtrations levels etc..

However each dry room and its design requirements demand a custom design approach, since the variables which define the moisture load can be measured, and the selection of available mechanical systems available is finite, the decisions from an equipment selection standpoint for dehumidification, refrigeration, heating, and total airflow follow a similar pattern for each project. Prior to discussing energy saving opportunities and new technologies, some of the basics of dry rooms must be defined

CLEAN ROOM DESIGN PARAMETERS

Clean rooms are defined as a room in which the concentration of airborne particles is maintained within established parameters and where other factors are controlled within specified limits. The clean room designs includes utilization of fan/filter modules to ducted HEPA filters, to plenum systems, all with unique mechanical systems precise levels of temperature and humidity control.

These rooms are designed to provide control of environmental factors like

- Viable and non viable airborne particles
- Air flow patterns
- Temperature and Humidity / Dew Point
- Air pressure Differential
- Containment of Hazardous aerosols.

- ❖Filter Calculation based on Class and Air change rate
- ❖Air flow Pattern : Unidirectional / Laminar

As per ISO and Federal Air Change Rates for Clean rooms

Clean room Class	ISO Equivalent Class	Air Change Rate
100	ISO 5	240-480
1,000	ISO 6	150-240
10,000	ISO 7	60-90
100,000	ISO 8	5-48

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CLEAN ROOM / DRY ROOM STRUCTURES

Metal PUF / Mineral wool Insulated modular panel dry rooms are suggested for low dew point applications to limit dry room moisture infiltration. Air locks for dry rooms should be of adequate size to allow easy egress by occupants without both doors being open at the same time.

The advantage sof Modular panels are

- ❖Zero vapor transmission is attainable
- ❖Panels can be cut to fit any size space
- ❖Adding space is simplified
- ❖Possible to expand room without changing mechanical system
- ❖Easy to move dry room to a new facility

The Hygro turnkey clean room Systems provides customizes the room size, cleanliness needs, mechanical systems, and logistical issues, Hygro works for cost effective architectural, mechanical, and control system for a complete turnkey solution.

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DRY ROOM SETUP KEY COMPONENTS / REQUIREMENTS

- Double skin modular panel construction with vapor tight construction ensuring with zero leakages
- Metal Constructed Insulated Clean Room Panels and fire retardant modular panels
- Air tight self supporting rooms with HEPA filter terminals inside the room
- Anti static flooring
- Entrance door with Change room and ante room / air lock
- Additional Emergency door to be provided
- Ducting work as per SMACNA standards with decent aesthetic look
- RH & Temp Controller, dew point meter with dew point sensor, Pressure controls.
- PLC / HMI Controlled digital display panels
- Provision of LAN, DATA LOGGING, BMS Compact ability, USB Ports.
- lighting arrangement and power points at necessary locations as per the client requirements
- Low Dew Point Dehumidification system with necessary Refrigeration system includes Chiller, Ducting work, Steam Piping Insulation, Refrigeration piping & Insulation,
- Fire safety systems
- Validation, Training , IQ-OQ-DQ Documents.

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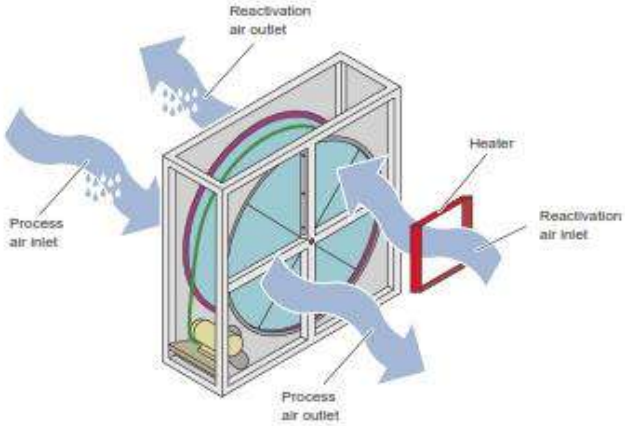
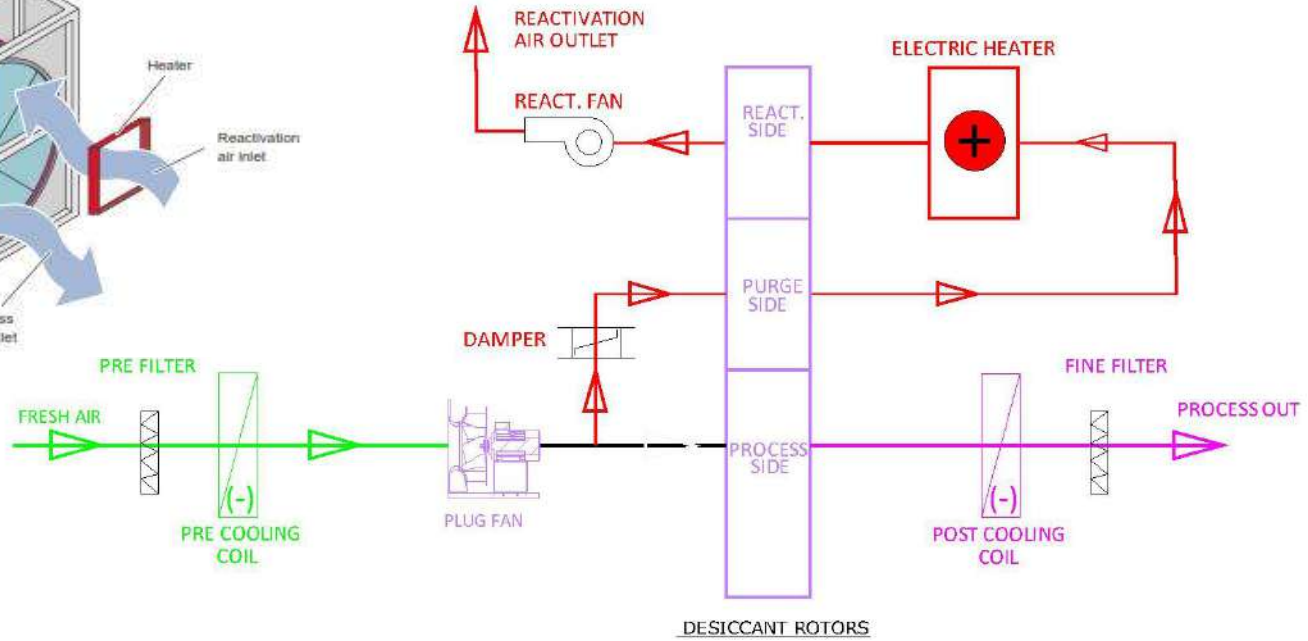
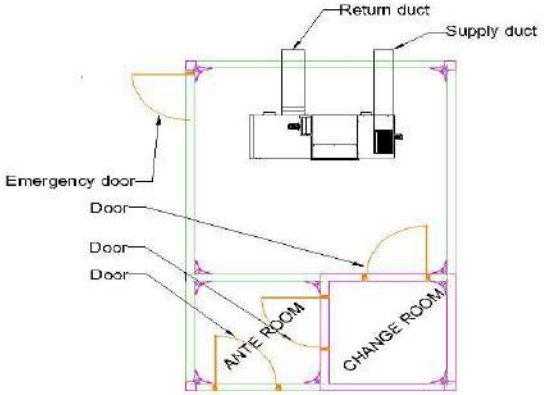
SCHEMATIC DEH SYSTEM AIR FLOW (PILOT PLANT)



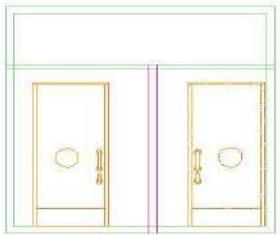
Typical Schematic Flow Diagram Of Dehumidification system



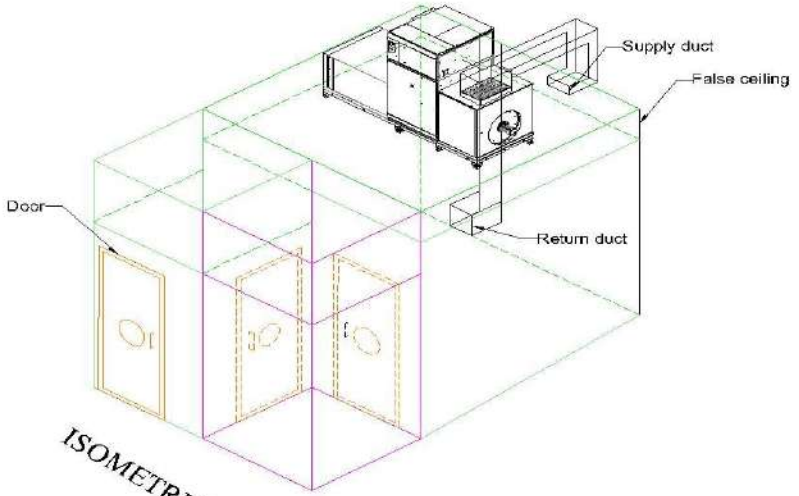
SCHEMATIC LAYOUT OF DRY ROOM (PILOT PLANT)



PLAN



FRONT VIEW



ISOMETRIC VIEW

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CUBICAL DRY ROOMS

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CLEAN ROOMS

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LOW DEW POINT DEHUMIDIFICATION UNITS

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Hygro experts work in close partnership with our customers to ensure the most optimum design for each individual project. Hygro solution provides the lowest energy consumption while meeting the highest performance requirements for advanced battery manufacturing.