

CASE STUDY

Optical Fiber Manufacturing Facility

Humidity Control and Pressure Management in Optical Fiber Draw Tower

OVERVIEW

A four-story optical fiber draw tower was experiencing significant environmental control issues. The tower room, critical for maintaining precise conditions for optical fiber production, was served by a roof-mounted dehumidification unit for moisture removal, as well as conventional heating and cooling systems. The dehumidification unit utilized a pre-cool coil, desiccant wheel, and post-cooling coil to provide dehumidification as needed, and space heating via gas-fired furnace. Heating or cooling was supplied when necessary to satisfy the required space sensible temperature.



PROBLEM STATEMENT

During humid summer months and on rainy days, the humidity in the fiber draw tower consistently rose above the maximum permitted limit of 30% relative humidity (RH). Additionally, the room was operating at negative pressure relative to the outdoors and surrounding spaces, drawing in unconditioned and unfiltered air. These conditions were potentially compromising the quality of optical fiber production and the overall efficiency of the facility.

OBJECTIVES

- Investigate the causes of humidity control failure in the optical fiber draw tower room.
- Determine the reasons for negative pressure in the space.
- Propose corrective measures to achieve and maintain the desired environmental conditions.

COMPREHENSIVE INVESTIGATION PROCESS

- Examination of the HVAC system, focusing on the dehumidification unit.
- Assessment of airflow patterns and pressure differentials throughout the facility.
- Inspection of building construction, identifying air infiltration points.
- Analysis of exhaust systems and their impact on room pressure.
- Review of control systems and programming.

KEY FINDINGS

HVAC Limitations:

- The dehumidification unit was designed to use only about 40% outside air, lacking the capacity to condition 100% outside air during warm and humid periods.
- Once outside air temperatures exceeded 78°F and 50% RH, the unit began to use a mixture of outside and return air in order to control the discharge temperature, thus losing the ability to control space pressure.
- The unit lacked sufficient heating capacity during cold weather.



Pressure Imbalance:

- The fiber tower room was operating at negative pressure to adjacent areas and outside due to higher exhaust rates compared to supply rates.
- The pressure cascade from outside through all spaces was consistently negative, pulling unconditioned air into the facility.

Building Construction Issues:

- Numerous unsealed penetrations, expansion joints, cracks, gaps, and openings throughout the space facilitated excessive air infiltration.
- Air moved between rooms unimpeded via numerous transfer ducts.
- Multiple conventional doors lacked sweeps and proper sealing.

Control System Problems:

- A programming issue in the unit controller disabled building pressure control when the desiccant dehumidification system was not operating.
- Temperature and humidity sensors were not properly calibrated, leading to inaccurate readings.

Exhaust System Modifications:

- Many of the installed fans were larger than specified in the original design drawings.
- Additional exhaust systems had been added to the room, further contributing to the pressure imbalance.

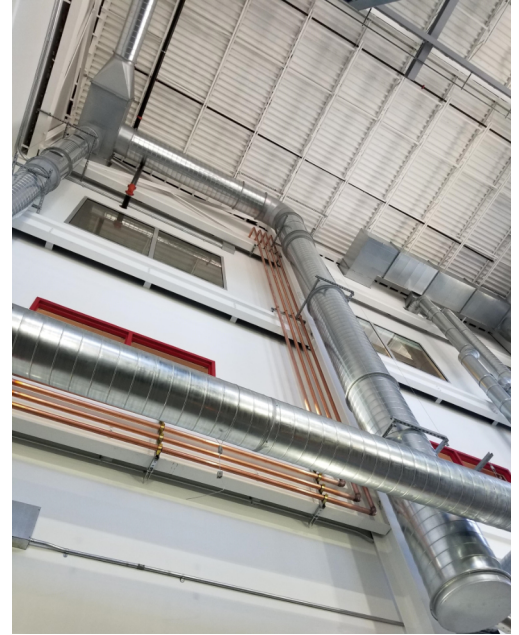
RECOMMENDATIONS

Sealing and Construction:

- Fully seal all penetrations, cracks, and openings from slab to roof deck to minimize infiltration and exfiltration.
- Remove or properly cap unused VAV supplies and returns.
- Eliminate unnecessary transfer ducts between spaces.

HVAC System Upgrades:

- Update the control sequence for the unit to fix the building pressure mode issue.
- Consider installing additional dehumidification capacity to accommodate outside air requirements pending further fiber tower and lathe room supply and exhaust traverses analyses.
- Provide conventionally-conditioned outside air (72°F and 45% RH) in front of fume hoods in fiber tower and lathe rooms to reduce the amount of make-up air required.



Airflow Assessment and Balancing:

- Conduct comprehensive airflow measurements on all supply and exhaust systems to determine actual operating conditions.
- Rebalance the system to achieve positive pressure in critical areas.

Control System Improvements:

- Recalibrate all temperature and humidity sensors.
- Implement proper offsets in the control system to account for any remaining sensor inaccuracies.

CONCLUSION

The optical fiber draw tower facility's environmental control issues stemmed from a combination of factors including HVAC system limitations, building envelope issues, and control system problems. By implementing the recommended corrective measures, the facility achieved and maintained the required humidity levels and positive pressure relationships, ensuring optimal conditions for production. Regular monitoring and maintenance are crucial to sustain these improvements over time.

[View our in-depth nine-page Diagnostic Report detailing our investigation.](#)