The Museum of Contemporary Art, Los Angeles installs MeeFog System to improve the Museum’s humidity control

THE BENEFITS OF MEEFOG™ TECHNOLOGY
- Humidification controlled to within less than 1% compared to plus or minus 5% before
- Relative humidity stably maintained at 50%
- Significant savings in electricity

CHALLENGE
Upgrading the existing air handling units (AHUs) and humidification system at the museum without having to close the facility to engage in major demolition and extensive renovations.

SOLUTION
The facility kept the outer casing of the existing AHUs but changed out the AHU motors, cooling coils, heating coils and upgraded the casing interior and exterior. A new building automation system was also installed, which made it possible to manage energy usage throughout the building.

Premier Attraction
The Museum of Contemporary Art, Los Angeles (“MOCA”) on downtown LA’s Grand Avenue was established in 1979. MOCA is the only artist-founded museum in LA. Over 250,000 visitors enter its doors each year. It houses a compelling collection of contemporary art. This comprises roughly 7000 art objects created after 1940. These exist in a variety of media, all of which have to be preserved for future generations.

Museum environments must be strictly monitored and controlled to prevent the deterioration of historic artifacts and art collections. Temperature, relative humidity (RH) and light levels all must be optimized. While temperature and light are typically well cared for, humidity can be a wild card. If left to drift out of the desired range, it can exert dramatic changes on paintings and other objects.
The MeeFog system has provided the technology for us to properly control our humidification on a daily basis.

— Woodburn T. Schofield Jr., Director of Operations

**Humidification the Main Driver**

A major upgrade to the humidification system was the primary driver for the retrofit. MOCA turned to ACCO Engineered Systems of Southern California as the contractor for the project. The contractors retained the shell of the AHUs, but changed out the motors, cooling coils, heating coils, and installed a new MeeFog humidification system. A new building automation system by Sunbelt Controls was also installed, which made it possible to manage energy usage throughout MOCA.

“The software from Sunbelt Controls has environmental sensors and valves tied into it so we can maintain tight control of our environment,” said Schofield.

As part of the retrofit, the AHUs were switched from older pneumatic controls to digital distributed controls that interface with the building automation system and the MeeFog humidification system.

Schofield reported that MOCA selected a fog humidification system from Mee Industries after seeing a demonstration of the technology. He said MOCA looked at other systems. Ultrasonic humidification was considered too expensive and might introduce air quality issues. Steam humidification was found to use far too much energy and water. Schofield said the lower electrical and water usage of fog were key factors in its favor, along with cost, efficiency and control.

“The old system used too much water and led to rusting of equipment. Being a museum, we needed to ensure air quality excellence and stringent humidification control.”

For MOCA, that meant temperatures of 70°F and 50% relative humidity – ideal conditions for the museum. The MeeFog system uses an adiabatic humidification (pure water) process. The system continuously monitors and controls the amount of humidity introduced into the air while helping maintain the overall temperature. High-pressure pumps, control systems, piping, water softening and a reverse osmosis (RO) water system are located in MOCA’s mechanical room.

Pure water is transmitted to the AHUs where a series of fog nozzles atomize it into micro-fine droplets. He likened the old system to a household cooler. Water goes in at the top, drips down through a convoluted series of cardboard media and into a pond at the bottom of the AHU. That water in them recirculated from the base to the top of the unit. This functionality accepted for MOCA when the outside air was dry. But during periods of higher ambient humidity, this was a greater challenge for building management personnel.

**The Importance of Droplet Size**

Mee Industries utilizes impaction-pin type fog nozzles as droplet size is the single most important factor governing performance. Smaller droplets mean faster and more efficient humidification, minimal wetting of duct surfaces and greatly reduced water usage. Each MeeFog impaction-pin nozzle is made from high-grade stainless steel. It features a 0.006-inch (150 micron) diameter opening which produces billions of ultra-fine droplets per second. At an operating pressure of 1000 psi, the resulting average droplet size is far below 10 microns, or one tenth the diameter of a single strand of human hair. The resulting fog cools and evaporates rapidly.

At MOCA, the nozzle arrays are arranged within the AHUs. The fog system can be controlled granularly from the building automation system to ensure conditions are optimized for the art objects. Schofield reports tighter control with the new system, as well as lower maintenance, clearer air, lower electricity costs and water usage. Such savings typically mean that a MeeFog system can pay for itself within one year.

**Aging Humidification System**

It is vital, therefore, to control humidity levels. This involves the reduction of sharp fluctuations, and maintaining RH within acceptable limits. However, this must be done in such a way as to maximize energy efficiency. Standard practice is to hold RH between narrow limits. But achieving that goal proved far from easy at MOCA’s main site on Grand Avenue, one of the premier attractions of downtown Los Angeles. Existing air handlers had reached end of life. And after more than thirty years of operation, the evaporative media-type humidification system was no longer enough to provide the level of control required.

Closing the facility for structural renovations wasn’t an option. Yet replacing the aging AHUs would have entailed the demolition of many walls, which was not practical and would have been cost prohibitive. One of the unique aspects of this project, therefore, is that the old air handling units (AHUs) were used.

“We decided to keep the AHU’s casings which were in good shape, to maintain the integrity of the structure, but to replace or upgrade all internal parts.” said Woodburn T. Schofield Jr. Director of Operations at MOCA who oversaw the retrofit of the new humidification system as part of an overall environmental upgrade program.

But it isn’t only the condition of the inside air that can impact art. Ambient air pulled in from the outside environment has its own level of humidity which can change significantly. This is due to the fact that warm air can hold more moisture than cold air. When air is warm and too dry, moisture is absorbed from the items that can hold more moisture than cold air. When air is warm, RH can rise when saturated outside air is brought in, when water leaks are present, floors are being washed, wet coats and umbrellas enter the building or because of lack of ventilation.

Factors such as building heating, solar gain, and electric lights can raise temperature and drop the overall level of RH. On the other side of the coin, RH can sink below 40% when RH sinks below 40%, organic materials may contract and might introduce air quality issues. Steam humidification was considered too expensive and might introduce air quality issues. Steam humidification was found to use far too much energy and water. Schofield said the lower electrical and water usage of fog were key factors in its favor, along with cost, efficiency and control.

If RH sinks below 40%, organic materials may contract and shrink, textiles can become brittle, wood may break, and veneers, glues and adhesives can crack, lift or break. If RH moves above 65%, organic materials swell, painting canvases will sag, mold can flourish, and chemical reactions such as rusting can accelerate.
**ENERGY COST COMPARISON CHART (ANNUAL)**

<table>
<thead>
<tr>
<th>System</th>
<th>Cost</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>MeeFog™ System</td>
<td>$706</td>
<td>1%</td>
</tr>
<tr>
<td>Ultrasonic</td>
<td>$8,467</td>
<td>6%</td>
</tr>
<tr>
<td>Compressed Air</td>
<td>$13,054</td>
<td>9%</td>
</tr>
<tr>
<td>Steam to Steam</td>
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<td>74%</td>
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<tr>
<td>Gas to Steam</td>
<td>$74,966</td>
<td>49%</td>
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<tr>
<td>Electric Steam</td>
<td>$153,931</td>
<td>100%</td>
</tr>
</tbody>
</table>

Assumptions: $.10 per kWh, $1.20 per therm, 3500 hours operation, 1000 lbs. per hour moisture output.

A typical fog system uses one horsepower for every 600 lbs. of water, which is 3% of the energy usage of compressed air-type systems and about 1% of the energy usage of electric steam systems.

**About Mee Industries Inc.**

For over 45 years Mee Industries has led the world with innovative water fog technology. MeeFog systems are used to humidify and cool many industrial, commercial and agricultural processes and to create interesting and dynamic special effects. Today there are over ten thousand MeeFog systems in use around the world. The MeeFog team looks forward to helping you with your fogging project.

**The Mee Advantage: Experience, Innovation, Performance**

In 1969, Thomas Mee Jr. a former Cornell University research scientist, founded Mee Industries. The company originally manufactured high-tech electro-optical, meteorological instrumentation, but by the early 1980’s, high-pressure water fogging had become the main focus of the company. Today, Mee Industries provides innovative, highly effective, economical fog solutions for many industrial applications including gas turbine inlet-air fogging, commercial and industrial building humidification and cooling, data center humidification, outdoor air conditioning, greenhouse climate control, wine barrel storage humidification, as well as dynamic special effects for the entertainment industry and theme parks.

**Industry Leaders — Focused on Fog Technology**

Mee specializes in providing custom-engineered, turn-key high-pressure fog solutions. We are committed to researching, developing, marketing and supporting the most innovative and reliable fog systems available anywhere in the world.