**Special Report: On HVAC Technology
It' s Not the Heat. .**

**Facilities step up humidity control efforts**

*by James Piper*

Maintenance and engineering managers are increasingly aware of the important role that proper humidity control plays in indoor air quality (IAQ). In the past, humidity control was limited to special applications, such as computer rooms in which high levels of moisture in the air could corrode electrical contacts and low levels of moisture would lead to a static electricity buildup.

Today, recognizing the effect humidity has on people's health and comfort, more manufacturers are designing HVAC systems with humidity controls.
Without proper humidity controls, a typical office facility has summer humidity levels and winter humidity levels that can vary as much as 10- 15 percent.

The ideal summer range for humidity in most applications is 40-60 percent. Higher levels can cause building occupants to feel uncomfortable and can have other effects, such as increasing the number of paper jams in office printers and fax machines. Lower levels can lead to respiratory problems and skin irritation.

During the winter, the ideal humidity range is 20-30 percent. Higher levels can cause condensation to form on windows and other cold surfaces, while lower levels can increase the susceptibility of occupants to colds and viral infections and result in the buildup of static electricity that can damage computers and other office equipment.

The good news for managers is that both summer and winter humidity levels can be easily controlled. A range of options is available - including those that use hot water, steam or electricity - to add moisture to building air systems. Similarly, building dehumidification systems can use either mechanical refrigeration or a desiccant to remove moisture from the building air system.

While the methods of maintaining building humidity levels within the desired range are not new, advances in system technology have made them more reliable, easier to control and less expensive to maintain.

**Humidification Systems**
Managers have five major types of building humidification systems to select from today: water spray systems; boiler-supplied-steam systems, packaged electric or steam systems; centrifugal atomizing systems; and pressurized- air systems.

Water spray systems are the lowest cost and simplest of the major building humidification systems. They operate by injecting a fine mist of water into the building's air supply, where it evaporates. Since the water is not heated, no energy is required to operate the system, resulting in low operating costs.

The systems, however, can have high maintenance costs, particularly if the mineral content of the water is high enough to lead to clogging of the nozzles. The systems also must be frequently inspected to ensure that water does not pond in the duct downstream of the spray nozzles, a condition that can lead to fungi and bacteria growth.

Boiler-supplied steam systems are the simplest and least expensive type of system to install, provided the facility has a central steam plant and a steam distribution line is located close to the building's air supply. This system draws steam from the central boiler system and injects it into the air stream. Although these systems once were very common in facilities with large central steam plants, concerns over the impact of the boiler feedwater treatment chemicals on indoor air quality has led to their decline.

Packaged electric and steam systems use a small, dedicated boiler to generate steam that is free of contaminants. These systems, as with central boiler systems, inject steam directly into the air stream. Since the steam is generated in a dedicated system, there is no boiler- feed-water chemical-treatment system to contaminate the humidified air. Both packaged electric and steam systems offer the advantages of low first cost and low maintenance costs, although both require energy to generate the steam.

Centrifugal atomizing systems, unlike electric and steam systems, do not heat the water before injecting it into the air stream. Instead, water is sprayed onto a large rotating disk. Centrifugal force forces the water off the disk into an atomizing screen in the building's HVAC supply duct. There, it is broken into droplets that are 5- 1 0 microns in size. Air flows across the screen and dislodges the droplets, which evaporate into the supply air.

Centrifugal atomizing systems offer the advantages of low operating and maintenance costs and require no energy for steam generation. Depending on the mineral content of the water supply, however, it may be necessary to use treated water to prevent the clogging of the atomizing screen.

Pressurized-air systems operate by forcing high-pressure air through a nozzle. The pressure drop in the nozzle creates a vacuum that draws water into the nozzle, where it is broken into micron-sized particles and injected into the building's HVAC system air supply. Pressurized-air systems do not require energy to generate steam, but they do require the use of pressurized air. Their chief draw- back is the need for frequent cleaning of the nozzle, particularly when the mineral content of the water is high.

**Selecting a System**
Managers and specifiers must weigh a number of factors when evaluating building humidification options, including the climate in which the building is located, energy costs and maintenance costs.

Geographic areas with long heating seasons probably will benefit more from a centralized approach to humidification than those with short heating systems. Managers of facilities in climates with limited heating requirements should consider installing small, localized units to serve specific areas of the facility.

Systems that inject steam into the air supply have much higher energy requirements than those that inject water at supply-water temperatures. If an inexpensive source of energy is readily available, such as natural gas, steam or waste heat, managers should consider using a steam- based system. If not, centrifugal atomizing or pressurized-air systems will be less expensive to operate.

Building humidification systems can be high-maintenance items, particularly if a facility's water quality is poor. Minerals dissolved or suspended in the water tend to clog discharge nozzles, foul atomization screens and coat boiler heat-transfer surfaces. All systems will re- quire some maintenance to minimize damage from mineral deposits.

**Technology Improvements**
All of the current types of systems for regulating the humidity levels in buildings have been in use for years. What makes today's systems so successful is recent developments in the technology used to control those systems.

One of the most significant improvements that has been made is in the way the systems sense humidity levels. In the past, humidity sensors have been made from a range of organic and inorganic materials. Most ofthese sensors were inaccurate and prone to failure, due to contaminants in the air supply. Today's generation of sensors is electronic, using thin capacitance film or bulk polymer resistance to measure changes in the moisture content of the building's supply air.

Both types are accurate to within 3 percent, operate over a range of humidity levels and provide fast response to changes in relative humidity. These sensors have given system designers the accuracy needed to provide the humidity control required in today's IAQ-conscious environment.

Changes in sensing technology have resulted in the way systems are controlled. Most system operations had used on-off controls, resulting in swings in building humidity levels as conditions changed. Today's systems - due, in part, to the rapid response of humidity sensors - are proportional. Sensors rapidly detect changes in building moisture levels and vary the output of humidification and dehumidification systems to keep a facility within the desired range.

Today's systems also use multiple sensing locations to provide a more accurate picture of humidity levels through- out the facility. The result of these developments in sensing and control technologies is that today's humidification and dehumidification systems finally give engineering and maintenance personnel the tools they need to meet the needs of building occupants in making the building environment as comfortable and healthy as possible.

**Dehumidification Technology**
Humidification systems are only half of the story when it comes to regulating humidity levels in buildings. During air-conditioning months, humidity levels often are too high, which reduces occupant comfort, accelerates corrosion of electrical contacts in sensitive electronic equipment, causes condensation on cold surfaces, and creates conditions in the building that promote the growth of mold and bacteria.

Two major types of systems are used for dehumidification - mechanical refrigeration and desiccant-based systems. The majority of the installed dehumidification systems are based on mechanical refrigeration, but desiccant-based systems are growing in use due to their low energy requirements.

Mechanical-refrigeration-based systems operate by cooling a building's supply air below the dew point, causing moisture to condense out of the air. Since the air leaving the coils is at nearly 100 percent relative humidity, it must be mixed with warmer supply air or reheated before being introduced into the building space.

By increasing or decreasing the temperature of the dehumidifying coil, the system can vary the amount of moisture left in the air supplied to the space, thus regulating the humidity of the building space. The primary drawback of mechanical refrigeration-based dehumidification systems is their energy cost.

Desiccant-based dehumidification systems require much less energy than mechanical refrigeration systems. A wheel or drum coated or filled with a material that absorbs moisture, such as silica gel, slowly rotates in the duct of the building's air supply. As air passes across a portion of the wheel, the desiccant absorbs moisture, lowering the air supply's humidity level. As the wheel rotates, it passes through a second air stream, one that is heated. Moisture absorbed by the desiccant is released, thus regenerating the desiccant for another cycle. The primary drawbacks of desiccant- based systems are their size and the need for a second, heated air stream.

*James Piper is a consultant based in Bowie, Md., with more than 20 years of facilities management experience. This article appeared previously in the May issue of Maintenance Solutions*