Steaming ahead – the designer’s choice
by Ray Carr

The penny is dropping with many system designers that the key to controlling the occupied space is not so much getting the temperature under control, but solving the humidity problem.

And now, with more products available to control humidity in an air conditioned or ventilated space than ever before, the designer faces a bewildering array of choices. Firstly a decision has to be made concerning the effect of adding moisture. Should it be added isothermally using steam, or adiabatically using water sprays, atomisers, nebulizers (ultra-sonic) or evaporative panels?

The designer may have to allow for a re-circulating system servicing a space where sensible heat gains occur due to production machines or computers. A water based system can provide some temperature control as well as humidity control, thus reducing the refrigeration load or providing additional humidity at little cost. If this is not the case, then the cost of running the system has to take into account heating of air flows for evaporation of the water.

For large water loads, atomisers are recommended and the running cost of compressed air equipment has to be included in the overall calculations. Whatever the water system, ultra-violet lamps are recommended to ensure a sterile water supply.

Supplying steam to an air handling system incurs no significant change in temperature. There are a wide variety of methods of raising steam. Use of boiler steam directly into the air stream is often not considered desirable, but when it is possible, direct injection humidifiers are a low cost, efficient method. Well designed models are stainless steel with appropriate control valves having a good range of capacities and a wide turn down ratio. Specially designed units with dispersion tubes as close as 75 mm can reduce absorption distances to as little as 200 mm. These units do not have jacketed tubes so the radiation gain is quite low.

If the use of boiler steam is not acceptable, a number of options are available:

Purpose made steam generators for humidification are essentially low pressure generators, they are not classified as pressure containing equipment.

It is possible to use electricity, gas, medium or high pressure hot water, or, of course, boiler steam as the primary heat source.

If steam is produced for other purposes, it provides an efficient and low cost means of raising clean, low pressure secondary steam using a steam to steam heat exchanger humidifier. Medium pressure hot water, heating secondary water in a similar unit.
can also be used economically. Proportional control of the primary steam or hot water in this type of unit is achieved with a good quality two port valve for steam on the supply, or a three port valve on the return for the MPHW unit. Controlling the primary in this way ensures excellent secondary steam output control.

Electric humidifiers supplying low pressure steam are available as electrode or resistance types. Electrode humidifiers are usually inexpensive on first cost and have disposable cylinders or electrodes, or both. They require some water conductivity to operate. Solids can build up and cause a problem, and electrode humidifiers have various methods of trying to deal with this problem with varying degrees of success. Some have a self-cleaning system to change the nature of the solids from scale to crumbs to enable easy removal through the drainage which occurs regularly with electrode type humidifiers.

Electric resistance humidifiers can be supplied to operate with softened, de-ionized or reverse osmosis water, which helps to reduce or almost eliminate maintenance. Single elements for each phase help keep running costs down.

The use of almost pure water removes the requirement for drain and flush programs. On particular installations, such as clean rooms or hospital operating theatres, the improvement in control and the almost total absence of down time make this option very desirable. While resistance humidifiers tend to be relatively expensive, this benefit is often worth the extra cost.

Pure water is very hungry water and care must be taken in the selection of transmission materials.

Resistance humidifiers should be built of stainless steel and have a high quality microprocessor with thyristor control of heating for output. Units should drain automatically when shutdown for long periods due to zero demand.

If gas is available, the low running cost for humidification is very attractive. Compared to an equivalent quality electric humidifier of similar size, the capital cost of a gas unit is a little less than double the cost of an electric unit (based on 100 kW). However, the running cost can be a ratio of 1:4 gas compared to electricity. Again, all stainless steel construction allows the optional use of reverse osmosis or D.I. water to provide the benefits of low maintenance and high quality control. An added benefit is the use of a float valve for inlet water, so that no blast discharge occurs on the water supply to “kill” the boil which could affect control in clean rooms.

When a heat exchanger humidifier is used a further choice needs to be made concerning dispersion of steam in the airway. It is not uncommon for supply air to be at temperatures as low as 13 or 14 degrees C. This imposes a high RH off the humidifiers and requires particular attention to the vapor trail which could condense on surfaces in the airway or on fans etc.
Particular systems have been designed in stainless steel with tubes as close as 75 mm. Orifices on both sides at 40 mm centres with steam output at 90 degrees C to airflow ensure very short absorption distances. It is essential that the orifices are sized correctly and have “tubelets” (nozzles in the holes of the tube) to prevent condensate carry over. Absorption distance can be as short as 200 mm the most important point is that the actual distance is predictable.

This reduction of space required for the humidifier section in an air handling unit has a knock-on benefit. The air handler will obviously be shorter, the foundation work will be less, the space required in the plant room is also less.

In conclusion, there is a wide range of methods and equipment; the designer is spoilt for choice.

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