Infection control via RH level

Airtec Hydrosens high pressure water humidifier providing humidity control and adiabatic cooling

Managing humidity levels can have a significant impact on the effectiveness of infection control. John Barker of Humidity Solutions explains

There is growing awareness of the relationship between relative humidity (RH) and pathogens such as bacteria and viruses. This has important implications for the role of RH management in infection control – especially in healthcare and pharmaceutical facilities.

To understand this, it's worth considering the interactions that can occur between RH and both airborne pathogens and those on surfaces.

Neptronic SKE Resistive steam humidifiers installed into air handling units

Airborne pathogens

One of the key causes of infection from viruses is inhalation of contaminated air. For example, speaking, coughing or sneezing can all expel large numbers of 'aerosols', which are suspensions of solid or liquid particles in air, potentially including viruses. The smaller the particles, the longer they remain airborne and the further they travel.

When these aerosols are exposed to dry air, much of the moisture in the aerosol evaporates almost instantly, so the suspended particles become smaller and lighter and remain in the air for longer. This means the viruses can travel further in dry air, increasing infection risk across a wider area.

In more humid air the hygroscopic nature of these particles causes them to group into larger particles that fall to a surface more quickly, making regular cleaning of surfaces more effective.

Viruses such as influenza and norovirus (the 'vomiting bug') survive longer at an RH of 20-30%, whilst a mid-range RH between 40% and 70% will minimise their survival rate. Also, tests indicate the infectivity of the influenza virus is increased by both low and very high RH, with minimum infectivity at 50% RH. RH has been shown to have a similar effect on airborne bacteria, with a high mortality rate of airborne pneumococci, streptococci and staphylococci at intermediate RH levels.

Surface-borne infections

When RH is very low, static electricity can be an issue and raising the RH above 35% allows surfaces to become covered in a thin film of moisture that dissipates the static charge. This thin film of moisture facilitates more effective surface cleaning.

Also, it has been found that survival of MRSA (Methicillin Resistant Staphylococcus Aureus) was significantly reduced when contaminated surfaces were stored at 45-55% RH, compared to 16% RH.

Further, it is well known that some bacteria will form protective spores at an RH of less than 40%, making them more resistant to the actions of surface disinfectant.

Infection resistance

When RH is persistently below 40% it causes moist tissues in the nose, throat and lungs to dry out, leaving the body susceptible to infections. Therefore, maintaining mid-range RH not only reduces survival rates of viruses and bacteria, it also supports the body's infection resistance.

In an operating theatre, dry air will increase the rate of evaporation from tissues, thereby exacerbating problems of dehydration.

Controlling RH

An RH range of 40-70% is considered acceptable for most workplaces and will also be suitable for most healthcare facilities – though it's important to check specific regulations relating to particular areas in hospitals and other facilities.

For example, the Health Technical Memoranda (HTM) Guidelines 7.48 and 7.50 define the acceptable range of humidity as between 35% and 60% saturation. The Scottish Health Facilities Note 30 – "Infection Control in The Built Environment" notes that control and physical monitoring of humidity can help ensure that environmental conditions do not contribute to the spread of infection.

Problems relating to RH in the UK tend to be because of low humidity. During the winter months buildings are usually heated to around 20°C and as the temperature rises the RH falls dramatically. For example, outdoor air at -5°C and 100% RH has a moisture content of 0.0025kg moisture per kg of dry air. When raised to 21°C dry bulb, with no humidification control, the resultant RH is a mere 18%.

Where comfort air conditioning is used in the summer months to reduce the temperature, the cold surfaces within the air conditioning system also remove moisture from the air, again leading to low RH.

Thus, humidity control usually requires the introduction of moisture using a humidifier to raise the RH. To that end, HTM 03-01 Part A Guidelines 3.55, 3.56 3.59 and 3.60 prefer clean, dry (central plant) steam for humidification. However, if that is not available a steam generator should be provided locally. It also states (Guidelines 4.91 to 4.115 and 4.91 to 4.114) that only steam injection systems are permissible for humidification, and that water curtain, spray or mist humidifiers should not be used.

At this stage, it's important to stress that specifiers and installers need to acquaint themselves with the specific regulations that apply to the project with which they are involved. It also makes sense to engage with specialists in the field of humidity control as steam for humidification can be generated in a number of different ways, using either electricity or gas to provide heat. Arriving at the best solution with the right balance of performance and cost of ownership means taking a look at a number of important criteria.

John Barker of Humidity Solutions