HUMIDIFIRST

Technical Paper – humidifier droplet evaporation

1. **Vapor droplet size:** The droplet size obviously plays an important role in evaporative distance. Both ultrasonic and steam humidifiers provide droplet sizes with volumes of approximately 0.52 cubic microns. High pressure spray nozzles (1000 to 3000 psi) have droplet volumes of approximately 1,767 cubic microns. The droplet size comparison of ultrasonic droplets to spray nozzle droplets is approximately 1:15, similar to a grape versus a basketball.

2. **Evaporative Distance:** Evaporative distances vary depending on field conditions – entering air temperature and relative humidity, air velocity, air volume, humidifier pulse rate, etc. As discussed previously, the droplet size plays an important role in evaporative distance.

3. **Description of Technology:**

   A. Ultrasonic humidifiers use a multiple of transducers (physically similar in size to a nickel) that are mounted under a pan of water. The transducers vibrate 1.65 million times per second, causing a mushroom shaped water finger to form, off of which 0.52 cubic micron droplets are produced (droplet size similar to steam). The droplet size remains constant regardless of the life of the transducer. Heat used to change water to vapor is absorbed from the surrounding air.
   B. Spray nozzle systems typically us either high pressure water (1000 to 3000 psi) or a combination of compressed air and water (30-70 psi air) forced through a machined nozzle. Multiple nozzles are used and droplet sizes will vary depending on the pressure variations and or maintenance of the system. When the spray nozzles are new and set up correctly, droplet sizes will range from 523 to 65,450 cubic microns. Heat used to change water to vapor is absorbed from the surrounding air.
   C. Steam humidifiers use nature fuels (electricity included) to generate steam droplets. They create their own heat through the boiling process to convert water to a vapor – approximately 1000 btu's per pound of water.

4. **Maintaining Relative Humidity Set-point:** Droplet size plays a key role in achieving full evaporation. The smaller the droplet size the faster evaporation occurs. In ducted or AHU applications, large droplets (spray nozzle) may not evaporate and can collect on coils or inside of the ductwork. The spray nozzle's non-evaporated droplets will go to drain and therefore relative humidity set-points may not be achieved. Field experience reveals that 25-50% of spray nozzle water may go to drain.

5. **Power consumption:** There are many factors that are to be considered when calculating total power consumption. When comparing evaporative humidification to electric steam humidification, major operating cost differences are easily noted (93-99% less). When comparing ultrasonic humidification to spray nozzle humidification in ducted or AHU applications, the operating costs can be similar. Spray nozzle systems may use less electricity but in most cases are less efficient in evaporation. The spray nozzle humidifiers may operate longer in order to get the same amount of evaporation as Ultrasonic humidifiers. Also, the un-evaporated water from spray nozzles will go to drain. (This is treated water - RO/DI – and has cost associated with its production)