

Evaporation of Spray

The spray delivered by a humidifier must be fog-like, consisting of particles small enough to be evaporated while they still float in the air. The weight of coarse particles and their relatively small surface, would cause them to sink and be deposited upon any object which they happened to touch before evaporation could take place. As the relative humidity rises and the space approaches saturation, the rapidity of the evaporation of the spray decreases. The higher the humidity, the greater the necessity that the spray be fine and be widely and rapidly distributed to avoid precipitation.

Evaporation requires an appreciable amount of time. The particles must be discharged with considerable velocity, and over the widest possible area to stimulate rapid evaporation. The actual evaporative capacity of a humidifier depends upon (1) uniformly fine quality of the spray, (2) effective distribution of spray, and (3) quantity of spray successfully delivered and actually evaporated under typical working conditions. The ability of a direct humidifier to generate a large quantity of spray is of little value unless accompanied by the ability to distribute the spray so widely as to assure successful evaporation.

Spray Generation and Distribution

The methods for generating spray are by atomization, by impact, by centrifugal-hydraulic separation and by centrifugal-mechanical separation.

Atomization: This is commonly accomplished by utilizing a jet of compressed air to tear water into particles of spray and distribute it similar to the familiar method used in ordinary nasal atomizers.

Impact: In an early type of humidifier two small streams of water under pressure were directly opposed, one slightly smaller than the other. The impact caused the water to fly into a jet of spray of conical form. This method has been superseded by a simpler equivalent in which a single fine jet of water under pressure impinges directly upon the opposed end of a small round wire. It is this type of nozzle which is widely used in so-called *spray humidifiers* and *high duty humidifiers*.

Centrifugal-hydraulic separation: A jet of water enters a small cylindrical chamber through a tangential port and escapes through an axial port with a rapid rotation which causes it immediately to separate into a cone of spray. This device is most commonly used in the spray chamber of saturated air humidifiers for central station purposes.

Centrifugal-mechanical separation: Water thrown by centrifugal force from the surface of a rapidly revolving disc or brush separates into particles sufficiently small to be utilized in some forms of mechanical humidifiers.

After generating the spray, distribution is effected by (1) air blast, (2) induction or (3) fan propulsion.

Air Blast. In atomizers, the same jet of air which generates the spray propels it through a space sufficient for its diffusion and evaporation.

Induction. The aspirating effect of an impact or centrifugal spray jet is utilized to induce the flow of a current of air through a duct or casing, and the air current is utilized to effect the distribution of the entrained particles of spray in the outer air.

Fan Propulsion. Currents of air generated by fans are utilized to entrain and convey the spray with great force.

Effective Area of Distribution

The size, shape, and direction—the spread—of the jet of spray leaving a humidifier, have an important bearing upon the effective area of dis-

tribution. The greater the spread, the greater the evaporative capacity of the unit.

Small Jet, One Direction Only. The spray discharged by an atomizer issues from a single small opening, forming a cone of spray of very small diameter, delivered in one direction only.

Large Jet, One Direction Only. Some types of humidifiers discharge a large cylindrical jet of spray horizontally and in one direction only. This jet being larger than that of the atomizer results in a larger area of distribution and makes possible a correspondingly larger capacity.

Large Jet, All Directions. High duty humidifiers have a large annular outlet from which the spray issues horizontally to all points of the compass at high velocity. This results in the maximum possible area of distribution and thus greatly increases the allowable capacity of the unit.

Because of these differences in the effective area of distribution the atomizer is installed in a relatively large number of units of relatively small capacity, whereas the high duty humidifier is installed in a relatively small number of units of relatively high capacity.

Cooling Effect of Humidifiers

Every pound of water evaporated at 70 F absorbs about 1053 Btu—more than seven times the amount of heat required to melt one pound of ice (144 Btu). Modern humidifiers evaporate several gallons of water in each hour. The heat required to evaporate the spray is withdrawn from the surrounding air which is thereby lowered in temperature. This explains the comfortable and moderate room temperatures found in well-humidified factories in hot weather. The cooling effect of a humidifier is directly proportional to the weight of water which it evaporates.

Effect of Heating the Supply Water

In winter, the cooling effect just described increases the demand for heat. By heating the water supplied to the humidifiers, the desired temperature may be more readily maintained in the building. This practice also increases the rate of evaporation. By thus simultaneously increasing the capacity of the humidifying and the heating systems, a distinct advantage is secured in severe weather, especially on cold mornings.

Atomizing Humidifiers

Atomizing humidifiers are in common use. They are of several different types, all of which rely upon compressed air as the atomizing and distributing agency.

Air is supplied under pressure (ordinarily about 30 lb per square inch) from a centrally located air compressor through main and branch pipe lines to the atomizing units. The air lines on which the units are located are usually horizontal and parallel to water lines which supply water by gravity from a float tank located in the neighborhood of the humidifiers.

Water is maintained at a constant level slightly lower than the outlets of the atomizers themselves. It is drawn constantly to the atomizer by aspiration while compressed air is supplied. When the air supply is cut off by closing a valve, aspiration ceases and the flow of water stops. Supplying water under pressure to atomizers should be avoided because