



MicroCool[®]

A Division of Nortec Industries Incorporated

72-128 B Adelaide Street Thousand Palms CA 92276-2309 USA

Choosing and selecting a high-pressure fog system

Understanding how a high-pressure fog system operates and performs

Fog systems are used for two distinct applications in horticulture: humidification and cooling. The action of the fog is the same in both applications, but controlled by different methods.

All air in a greenhouse contains a certain amount of moisture that is available to plant material at all times. Environmental conditions change the available water by heating, ventilation and solar effect.

Plants (like humans) normally thrive within a “comfort zone” of humidity and temperature. Stomata on the leaves open and close depending on the ambient conditions, and will become more active when in their particular “comfort zone”.

Generally, plant material below 40% humidity tends to transmit excessive water (the pressure in the air is less than the pressure in the leaf) and it is unable to receive enough from the roots. Therefore, the plant's natural defenses come into play, slowing (or halting) the growth process in order to accommodate for the excess loss.

At high humidities (generally over 90%), the pressure differential is so slim that little or no transpiration takes place. As there is no transpiration, there is no movement of nutrients through the plant; the fruit is therefore starved.

By providing environmental conditions around the plant that maintain its comfort zone, plant growth and quality is maximized to produce superior crops and higher yields. However, a plant that lives and thrives in a constant environmental “cocoon” is far more susceptible to atmospheric changes around it. When removed from the “cocoon”, or when the system is inoperative, plant health suffers at an alarming rate.

Creating the right environment

MicroCool® high-pressure fog systems produce billions of small droplets of water from each nozzle to evaporate into the air. The nature and structure of these droplets is crucial to the operation of the system and the performance of the unit. The evaporation action absorbs energy from the surrounding air and water vapor is added.

Droplets of fog from a MicroCool® system have been independently tested to ensure a median diameter of less than 10 microns. As a comparison, a human hair is between 40 and 200 microns; MicroCool® fog droplets are 10% of the diameter of a human hair.

Why is the droplet size important? By reducing the droplet size to 10 microns, we achieve two things. Firstly, at 10 microns in diameter, the surface area of the droplet in relation to the volume of water is greatly increased. Remember that water evaporates only from the surface. The faster the water evaporates, the faster the ambient conditions are changed.

The secondary action of a small droplet of water is that it will stay airborne for a longer period before falling. The longer the droplet is airborne, the more potential is extracted from the fog droplet.

This 'flash evaporation' process is defined as adiabatic cooling and humidification. A psychometric chart can be used to determine the amount of cooling that can be obtained from the evaporation of water and the amount of water required for the process.

If we imagine the air as a sponge, a better idea of the process can be seen. When a sponge is dry (low humidity), a large amount of water can be poured onto the sponge and absorbed before it seeps from the bottom. This amount of water can be utilized in the adiabatic process for cooling and humidification.

If the sponge is squeezed and left damp (high humidity), much less water can be added. Therefore, less water can be "used" in the adiabatic process. Consequently, more cooling is possible in arid conditions than in the humid Southeast of the United States.

With all this in consideration, the cooling process also proves to be a dynamic event that requires continuous air exchange to facilitate maximum cooling. Once the fog has evaporated and saturation is achieved, no further cooling is possible. However, an influx of warmer, dryer air allows the process to continue.

Creating the right environment

Humidification does not require air exchange, as the object is only to add water vapor to the air and change the properties of the air to the desired level. As the humidification level rises, the rate of “flash evaporation” slows, and accurate control of the MicroCool® system becomes more critical.

Selection and Design of a MicroCool® fog system for Horticulture

The primary decision for the design of a system is to determine the need of the individual grower and his/her needs. Is the primary requirement for cooling or humidification? If cooling – what is the desired level and the maximum humidity that the plants can stand?

If only humidification is required, other factors need to be considered. Will humidification be required when the vents are open? As the heating system operates, the rise in temperature will reduce the amount of available water (reducing the humidity).

Once the requirements of the system are known, then the atmospheric conditions have to be studied. Your MicroCool® specialist will need to know the outside air conditions to calculate the potential cooling possibilities of a MicroCool® system.

The most important data required is the ambient temperature and humidity when the cooling (or humidification) is required. One of the biggest mistakes people make in submitting this information is to offer the maximum day temperature and the maximum day humidity for the period. These two comparisons are useless to the engineer, as both “maximums” never occur at the same time. Of critical importance is the humidity level **at** the maximum temperature.

Averages can also be reported by meteorological offices and stations. These are of little use to the MicroCool® engineer, because extreme reports can distort an average reading. If in doubt, your specialist can consult ASHRAE charts to determine sample data from your area.

The type of ventilation and positioning of the vents and/or fans are also of critical importance to the design and layout of the system. Knowing how the air moves within the greenhouse can dictate positioning and layout of the system.

Creating the right environment

Other factors affecting the design are the installation of a thermal/shade screen. Insufficient space to “move” and evaporate the fog can lead to problems later on. Crop height is important for the same reason. Generally, a clear space of approximately 30-36” (750-1,000mm) is required for successful evaporation of the MicroCool® fog.

Using this data, a MicroCool® engineer will calculate the amount of water (usually expressed as “pounds” or “kg”) required for the desired function. Using his experience and knowledge of the airflow in the greenhouse, he then designs a grid or nozzle pattern for optimal fog distribution.

Once designed, a high-pressure pump unit is selected and the hydraulic distribution mains are designed. Correct pipe sizing and lengths by MicroCool® engineers ensure correct drainage and operation when the system is commissioned.

In the design stage, the potential user is asked how many different sections or zones of fog they need. Special “sectioning controllers” are used to divide the greenhouse into different climate zones. On a cautionary note, too many zones and sections add considerably to the overall price per square area. Fewer zones are preferred and are more cost-effective.

Control of the MicroCool® fog system is as important as the design. With an inefficient / non-integrated controller, wetting saturation and dripping occurs from any system. Economizing on a controller at this stage is a false savings.

Modern controllers will measure temperature and humidity together with electronic sensors. For optimal air exchange and control, some controllers are able to integrate the opening of ventilators and fan operation with the fog system. The larger computer driven systems are able to predict situations and change the operating frequency of the fog system to accommodate.

For cooling, the humidity level is generally the guiding point. Required temperature and the maximum humidity level are entered into the controller. Over the maximum humidity level, either plant damage is foreseen (disease and petritis), or no further cooling will take place as the air is saturated.

Creating the right environment

In operation, cooling only takes place when the humidity is below the set point. Therefore, the maximum cooling is available within a constantly changing ambient in the greenhouse and outside.

Humidification is controlled using the same unit. However, when trying to achieve maximum levels of 90 – 95% humidity (for propagation) care must be taken that the system does not “overshoot” and saturate the air. Careful design by your specialist generally avoids this.

Conclusion

By following some simple guidelines and practices, your MicroCool® system will perform to give you the climate conditions that you require. Like all machinery, maintenance is paramount, and regular maintenance of the filters and nozzles is essential for trouble-free operation. Your specialist can advise you of known problems and help alleviate others with regular service visits.

Mark Stanley
Export Sales Manager
© MicroCool® (A Division of Nortec Industries Inc.) 2002

Creating the right environment

Phone +1(760) 322-1111 Fax +1(760) 322-4341 E-mail: info@microcool.com Web Site: www.microcool.com