THE THEORY OF EVAPORATION ENABLING THE DESIGN OF THE TURBOMISTER

In a natural environment such as a lake, only the top portion of the top layer of water droplets are exposed to the air, this allows natural evaporation to occur to that top layer of water.

Common sense dictates that natural evaporation can be accelerated by:

1.) Exposing more of the water droplets to the air.

2.) That increased evaporation will occur as more air is allowed to surround each individual droplet. It would follow that if a water droplet is exposed to the air, given enough time, that droplet would evaporate entirely, and that natural acceleration can be achieved by placing more water droplets into the air and keeping them suspended long enough for the natural evaporation to occur.

The Slimline theory to accelerate evaporation, is to mechanically expose more water to the air, and maintain those droplets aloft long enough to evaporate them naturally. To achieve this goal, our company designed a machine utilizing our turbine technology to produce airflow sufficient to accomplish this goal. We call our machine a Turbo-mist evaporator; it utilizes known technology to accelerate natural evaporation by doing just that, suspending a large quantity of water droplets into the air, and keeping them aloft long enough to enable nature to work. In our theory, this "hang time", which is our reference to the time the water droplet is suspended in the air, is the essential ingredient in successfully accelerating natural evaporation.

The success of the Turbo-mist evaporator, is based upon its ability to use mechanical means to achieve sufficient "hang time" to let nature work, the simplicity of which allows man to use nature and the environment to clean up man made problems by simple evaporation, naturally, to a point where they became manageable by other means if necessary.

THE FACTS BEHIND THE THEORY

To show why we designed our evaporator as we did, I offer the following assumptions that are based upon tests completed at the Ohio State University and the extension department of Virginia Tech.

Fact #1: It is generally accepted that evaporation is effected by humidity, temperature and wind conditions. The greater the temperature, the less the humidity and the greater the wind conditions (which lengthen hang time), the greater the amount of evaporation. We have accepted these factors as truths.

Fact #2: The smaller the droplet size the faster it will evaporate and the greater the potential is for drift.

This bulletin is a 3-page report, which addresses nozzle orientation and droplet size. I will publish only portions of this report but the entire report is on the internet at:
http://ohioline.ag.ohio-state.edu/b816/b816_8.html

See report results on the next page. Direct quotes from **this report: "Spray droplet size is by far the most important factor affecting drift. Spray droplet diameters are measured in micrometers. A**

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micrometer is 1/25,000 of an inch and is usually referred to as a *micron* (Fig. 3). For reference, the thickness of a human hair or a sheet of paper is roughly 75 microns.

Slimline
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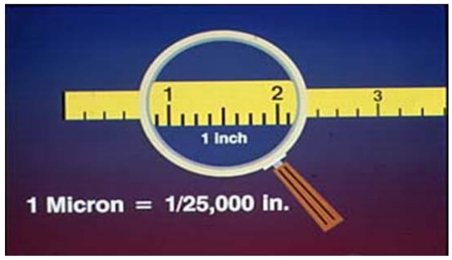

***Fig.3. Spray-droplet diameters are measured in microns*.**

In general the longer the droplets remain airborne, the greater the chances they are going to be carried by wind away from the application site. Small spray droplets are more susceptible to drift than the larger droplets because they tend to remain airborne much longer than the larger droplets. Research shows there is a rapid decrease in the drift potential of droplets greater than about 150 or 200 microns. Droplet size where drift potential becomes insignificant depends on wind speeds, but lies in the range of 150 to 200 microns for wind speeds of 1 to 9 miles per hour (Bode, 1984). Small droplets can drift long distances because of their light weight. For instance, as shown in Fig. 5, the theoretical distances that water droplets would be carried while falling 10 feet in air having a uniform horizontal velocity of 3 miles per hour would be only about 8 feet for 400-micron droplets, but about 1,000 feet for 20-micron droplets.

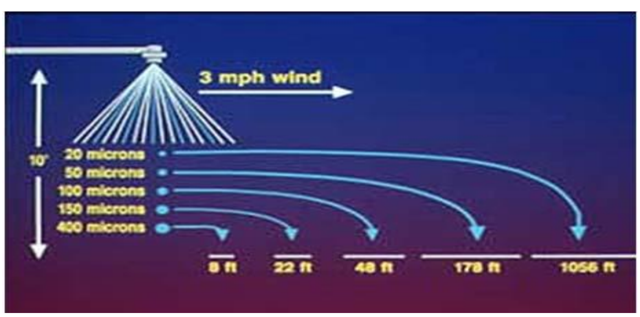

Fig.5. Smaller droplets drift longer distances.

Spray particles under 50 microns in diameter remain suspended in the air definitely or until they evaporate.

Fact #3 Based upon finding by Virginia Tech, we accept the following: A water droplet size of 150 microns will drop at 1.7 ft/sec, and take 16 seconds to evaporate, therefore it must fall 27.2 ft to evaporate. A water droplet of 100 microns will fall .91 ft/sec and take 7 seconds to evaporate, which is a drop of 6.37 ft See chart of finding from their Internet site,
http://www.vtpp.ext.vt.edu/psecenter/drift98vt/sld015.htm

Evaporation and Deceleration of Various Size Droplets*

Droplet Diameter (microns)	Terminal Velocity (ft/sec)	Final Drop diameter (microns)	Time to evaporate (sec)	Deceleration distance (in)
20	.04	7	0.3	<1
50	.25	17	1.8	3
100	.91	33	7	9
150	1.7	50	16	16
200	2.4	67	29	25

*Conditions assumed: 90 F, 36% R.H., 25 psi., 3.75% pesticide solution

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Fact #4 Supported by bulletin #816

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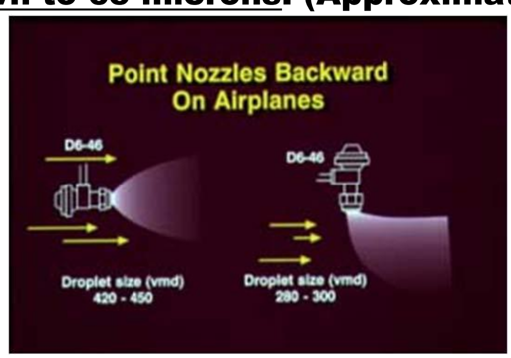
Extension

Nozzle Orientation

Orientation of nozzles is not critical for ground applications, but plays an important role in reducing drift from aircraft applications. When a nozzle is pointed backward toward the tail of the aircraft, larger droplets are produced (Fig. 9). The same nozzle produces medium droplets when pointed downward and smaller droplets when pointed into the air stream.

Fig.9. Nozzle orientation is critical with aircraft applications.

We have assumed that since our application uses an axial flow fan to produce a wind speed of in excess of 100 mph exiting the top of our wind tunnel, the result is the same as an aircraft traveling at 100 mph, therefore by placing our nozzles at an angle, as we do, to the wind, we are shearing our water droplet size from a nozzle calibration using a teejet or Bete spiral jet TF6M nozzle, <u>from a water droplet size average of 95 microns down to 65 microns</u>. (Approximately 1/3 reduction)



CONCLUSIONS BASED UPON THESE FACTS

To successfully build a machine that will accelerate evaporation, we need to achieve a hang time of at least 20 seconds for a water droplet that is 180 microns.

We could achieve smaller water droplet sizes, however the tradeoff is drift, and many customers have the restriction of retaining all drift within a lined area, to comply with the EPA. In addition, our turbine has the capability of generating enough loft to produce an average hang time for water droplets in the range up 180 microns, thereby allowing good average returns on evaporation, of the total water droplets set aloft while restricting drift due to utilization of this droplet size, or larger.

If we wish to increase the overall percentage evaporated of the total pumped aloft, we can easily achieve this by reducing the nozzle size, thus the water droplet size, however, this not only increases the drift potential, but it in fact has diminishing returns, in that it reduces the overall output of a evaporator unit. That is, it is advantageous to evaporator 60 % of 100 gallons per minute rather than 100% of 50 gallons per minute, unless other variables dictate the fall out is problematic.