POSITIVE HUMIDITY CONTROL FOR DIRECT FIRED KILNS

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In recent years, there have been two predominate methods of heating kilns in the western United States -- namely, steam heating and direct firing. Steam heating, the most widely used, can be categorized into low pressure systems (15 psi or less) and high pressure systems (100 to 150 psi). Direct firing, on the other hand, traditionally has been with natural gas as a fuel, primarily because of its convenience, low cost, and ready availability -- up to now. "Up to now," we say because the picture of natural gas availability is quickly changing in most of the country.

We'll quickly abandon steam heating from this talk, because a good steam heating system is pretty hard to build a case against.

The purpose of this presentation is to discuss humidification systems to be used in direct fired kilns. Please keep in mind the difference between humidification and humidity control. Humidification would be the process of adding moisture to the kiln atmosphere or environment. Humidity control, on the other hand, would be adding or subtracting moisture to maintain a desired humidity level, or what we call a wet bulb temperature set point. So, while humidification concerns itself with a steam spray or some other device, humidity control involves the control and operation of ventilators, as well as steam sprays.

Let's sidetrack here a moment, to preface this talk a little further, let's put to rest a few superstitions that are commonly held in the industry regarding wet bulb control and high temperature drying (schedules in which the dry bulb temperatures are over the boiling point of water). We have found that high temperature drying requires no humidification source, other than the lumber itself. There are some minor exceptions, but a kiln used only for high temperature schedules would need no humidification system ; and we can further state that it needs no humidity controls whatever only a dry bulb control. This is because, whether you like it or not, you have absolutely no control over the wet bulb temperature if the dry bulb temperature is over the boiling point. The kiln, the lumber inside, and the dry bulb temperature, all in combination, produce a situation which will dictate the wet bulb temperature at any one moment and there's nothing you can do to alter this condition, except make it worse (or more severe, to use a milder term). In other words, you're best to leave it alone to take care of itself. But let's argue about it some other day, because it's an entirely different subject.

Now, having removed high temperature drying from this discussion, let's get back to what we were talking about. We can now state that humidification in direct fired kilns is a matter of concern in schedules utilizing dry bulb temperatures of less than 210°F to pick a round number, or what we refer to as conventional temperature schedules. Up until recently, the only practical means of humidification was through the use of a steam spray system. Scads of other methods were tried where the mill had no steam generation facilities. There was even the water spray line; much the same as a steam spray line, but with atomizers spaced along the pipe, in hopes of facilitating the vaporization of the water in the 230° temperatures of the kiln (even Moore Oregon was

guilty of this one). To add to the confusion, some operators even tried to spray water into the flame of the direct firing burner. Needless to say, they came up with resounding failures. The result, a flood wherever the water was applied enough to make old Noah wish he were around to build a bigger ark, was the wet bulb just keeps on dropping.

Why did these attempts not work? Basically because we were ignoring the laws of physics that we should have learned in high school.

A few minutes ago, we began heating exactly one pound of water on a hotplate which is transferring an average of about 38 BTU's per minute to the water. If I've not read this paper too fast, it had better be boiling by now. We know from the laws of physics that it takes one BTU to heat a pound of water 1°F. higher in temperature. So, in this case, starting with water at approximately 70°, it took 142 BTU's to bring this pound of water to 212°F.

Now that the water is at 212° and boiling, we also know from the laws of physics that it'll require another 970 BTU's to completely convert this pound of boiling water to steam, or nearly 7 times as much as it did just to come from room temperature to boiling. By the way, the burner on this hotplate is well over the 500° maximum exit temperature we allow on our direct fired burner controls. What we're trying to say here is that even with a very hot heat source, it's taking almost 7 times as much effort to take the water from 212°, to steam at the same temperature, as it did to bring that water from room temperature to 212°. If it takes that much effort and BTU's to boil out a pound of steam on this hotplate, why have we been trying to blow a bunch of water into a direct fired burner?

This cannot be done successfully in one pass through the flame because of the lack of time required to transfer the necessary BTU's to the droplets of water injected. So, why not spray water into the heated exit air and recirculate it over and over again inside the burner until enough BTU's have been absorbed to convert the water to steam -- and then release it to the kiln? Well, this is exactly what we are now doing with the Moore Oregon Vapoaire Heating/Vaporizing Unit. Granted, it's a lot more expensive than putting a spray pipe in to shoot water on the burner, but it works! It humidifies as well or better than a steam spray line, or two steam spray lines.

If you had a supplementary boiler and steam sprays for your direct fired kilns, you'd have the usual operational and maintenance duties associated with a boiler and steam lines. You would be saddled with water treatment and would receive only 80 cents or less out of every dollar spent on fuel for the steam generated.

With Moore Oregon's Vapoaire, steam generation is almost 100% efficient, and no water treatment is needed. Add to this its easy adaptation to light oil firing, as well as natural gas (or even LP gases) and you have the most versatile heating system available for kilns. Also, we found that the large recirculation blower in the unit could successfully be utilized to take care of all venting needs, eliminating the necessity of roof vents. This is not to be confused with past attempts with "pressure venting." Lastly, we are anticipating using the Vapoaire concept in direct firing kilns with wood wastes in the near future.

Moore Oregon's Vapoaire is available in 8 sizes, ranging from approximately 350,000 BTU's per hour to 10,000,000 BTU's per hour. (A 10,000,000 BTU size would nicely handle the requirements of a 104' double track kiln for conventional temperature operation). So if you've got a kiln, or are going to buy one soon, we've got the King of Direct Fired Burners to fit your drying requirements.