DRY KILN HUMIDIFICATION SYSTEMS
"A Cool Water Spray System"

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Abstract

An improved cool water humidification system has been developed for use in lumber dry kilns. The system uses a high pressure pump and specialized nozzles to break the water stream into droplets seven times smaller than previously achieved with other cool water sprays. Trial shows that the system attains equalizing and conditioning atmospheres in the kiln in the same or less time than conventional steam sprays. The use of the new cool water spray system eliminates the problem of dry bulb override during equalizing/conditioning. The system should be useful to operators of dehumidification kilns and those using conventional kilns with marginal boiler capacity.

Introduction

Approximately three years ago I received a phone call from Dr. Bob Little of the University of Tennessee. The call was in reference to a cool water humidification system being used in another application at the University. Dr. Little wanted to know what I thought of the potential of it's use in a dry kiln. We discussed that my only experience with a water spray system had been back in 1978 or 1979 with an Italian dehumidification manufacturer and that their system did not work. We then decided to try to modified a system to work in the dry kiln environment and installed it in our small kiln for testing purposes. It only took one equalizing and conditioning cycle for us to be very ex-cited about the unit's potential for the Lumber Drying Industry. As we continued to test the cool water spray system in our kiln, other potential advantages began to appear.

System Performance & Drying Trials

Regardless of the drying method used, stresses may build during drying. "Drying stresses are the main cause of nonstain-related drying defects. Failure to adequately relieve these stresses at the conclusion of drying can result in severe warping of boards during subsequent processing." At the end of the drying cycle stresses are relieved by subjecting the lumber to high relative humidity for a short period; this process...
is called conditioning. It has been generally accepted that steam must be used to obtain proper conditioning in a reasonable period of time.

A common problem experienced by those who use live steam to relieve drying stresses is an uncontrollable rise in the kiln dry bulb temperature. This rise in temperature decreases the relative humidity in the kiln, thus reducing the effectiveness of the conditioning process and lengthening the time required for conditioning. Dr. Hart theorized that this temperature rise is due largely to an enthalpy decrease when high temperature, high pressure steam is released into the kiln interior. A smaller heating effect results from the temperature change undergone by the steam as it leaves the spray line. He estimates that the combined effect of these two factors results in a release of 1270 BTUs for each pound of water vapor absorbed into the lumber. He further theorizes that if a cool water spray were to be used in place of live steam, 1,112 BTU/lb would be used in raising the temperature of the water droplets to the kiln interior temperature. This would largely offset the 1270 BTU/lb released when the vapor entered the wood surfaces thereby reducing or eliminating the overheat problem. As a caution, he states that the water droplets must be sufficiently small to readily vaporize before striking the lumber. Preliminary tests of the high-pressure cool water spray system seem to verify Hart's position in that we have noted a decrease in the dry bulb temperature when the spray system was activated.

In the past, cool water sprays have done little to relieve drying stresses and, in some instances, have even been reported to rewet the lumber. To be successful, any new conditioning system must be as effective as the presently used live steam method. Conditioning of lumber with cool water would eliminate the need to produce steam for conditioning and would address the kiln overheat problem as well as allow this excess steam to be used for extra drying capacity.

This new system starts with an ultra-fine filter through which city water (drinking quality) is passed. After filtering, the water is pumped at approximately 1000 psi into piping which delivers it to a stainless steel header fitted with specially designed high diffusion nozzles. After exiting the nozzles, virtually all of the spray droplets are shattered to an extremely small diameter. This allows for uniform moisture dispersal within the kiln chamber without rewetting the lumber. The average low pressure spray system produces droplets that are over seven times larger in diameter while using 25 times more water per time period.

Results & Conclusions

To date, over 45 charges have been dried, equalized, and conditioned successfully with no dry bulb override or lumber wetting in our 10,000 bd. ft. kiln using the new cool water spray system. In addition, there are now over twenty five E.M.C. Mistifyers in operation in commercial kilns varying in size.
from 45,000 BF to 140,000 BF. Lumber species have varied from white oak to yellow pine in thicknesses of 4/4 through 8/4.

Conclusions:

1. The kiln reaches wet bulb setpoint more quickly with the new spray system and there is no corresponding increase in dry bulb temperature.

2. The new spray system uses 25 times less water than standard lower pressure spray systems. Average droplet size is seven times larger in a conventional spray system.

3. Boiler treatment chemicals are conserved and any corrosive effect of the boiler water on the kiln chamber is reduced.

4. The new system can be used with any thickness or species of lumber and in either steam or dehumidification dry kilns.

References
