FUTURE OF DEHUMIDIFICATION DRYING ON THE WEST COAST

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The introduction of heat pumps dehumidifiers came about in the mid 70's during the energy crisis. Since, the process has progressed enormously. Small kilns, low energy cost, low capital investment and the quality of the finished product were appealing to the hardwood producers. But now, with the development of large heat pumps dehumidifiers, the fast drying softwood producers have the opportunity to share the benefits. So much has been published on the subject of dehumidifiers that we will only review the principle.

There are two basic methods to dry the air that will be used to dry the lumber. The first is to increase the holding capacity of air by heating it. This is used for drying with a clothes dryer, a hair dryer, etc. In a conventional kiln, outside air is warmed up, which decreases its relative humidity, then passed through the lumber where it picks up moisture and then is vented to the outside. As it leaves the kiln, the air leaves with the energy it was heated with, and with the energy the water needed to evaporate (970 BTU/lb).

In the dehumidifier, instead of venting the humid air, it is processed through a cold radiator (evaporator) which condensates the water in the air. The heat absorbed from the water is used to vaporize a refrigerant. Compressed to a higher pressure by a compressor, this refrigerant has now a higher than room temperature boiling point, and thus, condensates, realizing its energy to the hot coil (condensor). The air passing through this hot coil is rewarmed and is now relatively dryer than when it entered the unit.

What makes the process so economical is that only 1 BTU has to be purchased from the utility company in order to extract 3 BTU from the moist air. Thus, condensating 1 pound of water requires the use of only 320 BTU to transfer 970 BTU of latent heat. This 320 BTU is rejected inside the kiln with the latent heat. So, 3 BTU of latent heat is transferred by 1 BTU of purchased energy and we get 4 BTU back in the kiln for the price of one.

Besides its lower energy consumption what is the advantage of such a system? Since it does not have to heat the air to lower its relative humidity, we can now obtain dry air at much lower temperatures.

Low temperatures (below 150°F) have great benefits on the quality of the lumber. Because of its composition, lumber shrinks appreciably less at 130°F than at 200°F for the same M.C. Since most drying defects come from the effect of shrinkage, warping and checking are greatly reduced.

In a conventional vs dehumidification kiln, study done by B.C.F.P. on SPF lumber, trimming was reduced by 25%, boards degraded by crook and bow were reduced by 66%. The dehumidifier

produced 22% more construction grade lumber and 33% less utility and economy grades. Drying costs were reduced by nearly half compared to natural gas.

Since lower temperatures are used, a concern is drying time. With the proper amount of horsepower, dehumidifiers are as fast as conventional kilns down to 15%. But purchasing the H.P. to match a conventional drying time is not economical. Unfortunately, when working at low relative humidity, the dehumidifier does not extract the maximum amount of water. So increasing the horsepower by 20% only decreases drying time by 8% while increasing cost by 20%. So a balance dictated by the best return on investment is necessary. With today's equipment cost, 1.5 HP per 1,000 fbm in SPF will produce a drying time of 55 to 60 hours for below 19% M.C. lumber and this, with using less than 100 KW/Mfbm. Investment cost for a turn key operation will run $2.25 to $2.50 per board foot.

This compares favorably to a direct fired natural gas kiln of equal annual production and is, on larger installations 2.5 to 3 times less expensive than a wood waste system. Some people consider a wood waste system to be free energy. Unfortunately, often almost as much electrical energy is used for hoggers, conveyors, blowers, storage bins, etc., than in a dehumidifier and with a closer look, the interest saved on capital investment by purchasing a dehumidifier usually can pay for the total annual electric bill of a dehumidifier.

In the past years, large units capable of handling well over 100,000 fbm in SPF have been installed. The drying method is now used by a number of companies on the West Coast to dry SPF, ponderosa pine, cedar and hemlock. For the kiln building most have decided to use a wood structure with plywood on the inside. Since temperatures over 130°F are not necessary, this building method is acceptable. The most critical factor for the building is to keep the insulation dry. To assure this, a fiberglass coating on the plywood inside the kiln is desirable. Also, a metal structure as "ARMCO" or "BUTLER" can be used with some modification for the inside sheeting. Conventional prefab kiln buildings often cannot be used because of their low insulation values. For proper operation, walls with "R" values of 16 to 18 and ceiling of 25 to 27 are necessary on the coast and somewhat higher R values in the interior mountain chains are required. In the last few months, a totally automatic scheduled system has been used. All the operator has to do is start the system and return toward the end of the schedule to check the lumber M.C. Since temperatures do not exceed 130°F it is simple to bring the moisture meter inside the kiln and make on the spot checks.

As you see, dehumidification has many advantages and few drawbacks. Although the kilns must be larger because the drying time is longer, capital cost is equal or lower than a conventional kiln, the quality of the finished material is superior, the energy cost is low and maintenance is minimal.

With today's technology, fast drying softwood are being dried by heat pumps dehumidifiers very economically and with high quality. Dehumidification drying on the West Coast will have a great impact, probably greater than in the eastern hardwood industry.