TIMBER DRYING AT KAWERAU

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BACKGROUND

Traditional methods of drying timber in New Zealand were largely reliant on stacking the sawn timber in layers with spacing pieces outdoors, and letting the sun and wind do the work over a period of a few weeks in summer and much longer, if ever in winter. Some timber was pre-dried in the open air and then "topped-off:, i.e. brought down to the required moisture content in the controlled atmosphere of a drying kiln. Older types of drying kilns in the USA were of the "wigwam" or conical type.

This procedure had certain limitations: (1) variability of moisture content from top to bottom and side to side depending upon the exposure, (2) the temperature in the kiln and the final moisture content of the lumber could not be well controlled in the older type drying kilns, (3) sun checking would occur at the top of the stack in the open air, and wide boards would curl or twist, and (4) increased handling cost and prolonged drying period requiring material to be held longer in inventory.

About 40 years ago, a number of the larger sawmills began building timber drying kilns. These were typically enclosures constructed from brick, concrete and concrete masonry and would accommodate 20 to 50 m^3 of stacked timber. The enclosures or chambers were heated by steam and heat exchangers. Operating temperatures were low by today's standards typically 60 to 70°C (80°C maximum) which resulted in timber taking up to 2-3 weeks to dry from green sawn state.

At that time, the timber resources was mostly Native species and the slow drying process was ideally suited as it allowed the moisture to be extracted without subjecting the timber to cell damage and stress. About 20 years ago the technology developed with the introduction of "dehumidifying" drying processes which basically used reverse cycle refrigeration techniques similar to air conditioning to removed the moisture from the timber.

The percentage of timber dried from the total sawn was relatively small and demand for the dried project was such that a premium could be charged which made the drying process a very profitable business. It was obviously the quickest and simplest way to add value to the timber, and still is today.

RADIATA PINE

With the rapid decline in the availability of Native timber species and a large plantation grown Radiata Pine resource becoming available, the drying process needed to change. Radiata Pine has quite different characteristics to the native species being lower density full of knots and in particular having a very high moisture content (up to 130% by weight). New Zealand's timber industry is now dependent on this new resource.

The Radiata Pine, however, has some serious disadvantages compared to most other timbers used in similar situations: (1) it is of low density and variable in density through the log, (2) it has very high moisture content when harvested, (3) it is of relatively low strength, and (4) it is subject to fungal and insect attack if not treated.

The Forest Research Institute have developed techniques and processes which solve many of the problems listed above, and are list in order as follows: (1) grading of sawn timber, (b) kiln drying schedules, (c) measuring and being able to guarantee strength, and (4) a number of preventative treatment processes. The most important single factor is kiln drying the timber in order to be able to supply a completely predictable product.

KILN DETAILS

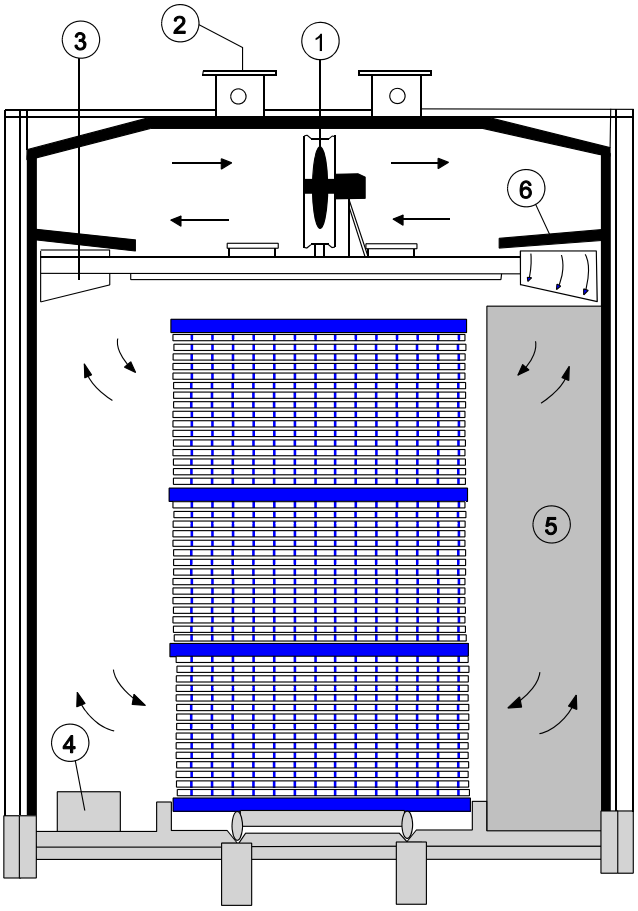
The two main reason for drying lumber is to set the sap and prevent warping. The sap usually sets at 57 to 60°C and warping is prevented by establishing uniform moisture content through the thickness of the wood, which is best achieved in a kiln. The drying rate varies with the species of wood and decreases (time increases) with thicker sizes.

Kiln drying techniques have developed to the extent that different drying regimes are followed depending on the end use of the timber. For timber used in structural applications the appearance is not important provided that the timber is strong straight and stable. These parameters can be achieved by firstly grading the timber correctly then drying at elevated temperatures which allow drying in 24 hours or less. Often some form of timber treatment process will follow drying.

For timber that is required to further processing into products such as flooring, cladding joinery and furniture the timber must be dried in a way that precludes apparent defects which detract from appearance. For finger jointing and laminating to produce building components it is of critical importance to have timber dried accurately with moisture content varying between pieces by no more than ±1%.

In basic terms a timber drying kiln is simply a large oven which can be heated up and have the enclosed heated air

circulated to draw the moisture from the timber and exhaust it to the atmosphere. By far the most popular method of providing the energy in recent times has been to supply hot water at high pressure and temperature to an enclosed system with heat exchangers in the kilns and fans distributing the air at velocities ranging from 5 m/s to 8 m/s and with kiln temperatures ranging from 80 to 140°C. The operation of the kilns can be completely automatic. Steam can also be used as a heat source. Using geothermal energy, the cost is estimated to be between NZ$2.00 to NZ$4.00 per m^3 (US$1.00 to 2.00). This is usually less than half the cost of other fuel sources, however, geothermal energy is not available everywhere.



1. Adjustable Pitch Aluminium Fan
2. Aluminium Ventilator
3. Aluminium Side Air Baffle
4. Water Trough for Humidification
5. Adjustable Aluminium Vertical End Air Baffle
6. Bi-Metallic Estruded Aluminium Finned Heat Exchanger Tubes

Figure 1. Typical New Zealand drying kiln (courtesy of Tekwood Ltd.).

KAWERAU DRYING KILN

The geothermal drying kiln associated with the Tasman Pulp and Paper Plant at Kawerau is operated by Fletcher Challenge Forest. This kiln uses 10 bar geothermal steam at inlet temperature of 180°C which produces 150°C temperature in the kiln. Radiata Pine in batches of 80 to 100

Figure 2. Stacked lumber ready to be dried.

Figure 3. Reconditioning of the dried lumber.

m^3 is moved into the kiln on three rail-mounted trucks. Each layer of lumber is separated by spacing pieces about 2 cm thick. In the kiln the moisture is reduced from 150 to 10% in 20 hours. Two-meter diameter fans produce 9 m/s air across pipe heat exchangers. The circulation direction is reversed by computer every 1.5 hours. The lumber is then put through a cool-down period for two hours and finally reconditioned for six to eight hours at 90 to 100°C , which changes the moisture content from 10 to 20%. This creates a uniform moisture content throughout each piece of lumber. A bacteria mat is used to clean the hydrogen sulfide from the geothermal steam after it has been run through the heat exchangers and before disposal.

The typical lumber dried is rough 2 x 4 (5 x 10 cm) in dimension, however, wider material requires a lower temperature of 120°C and longer time. The dried product is stained by sap on the surface, which is removed in the finish planing operation. Prior to using geothermal energy, lumber was dried at 70°C for four days - a much more costly operation. The entire procedure is monitored and controlled by computer. The final product sells in New Zealand for US$ 150 to 200 per m^3 - adding 50 to 100% to the price of green lumber. Kiln drying costs about US$20 per m^3 of which the geothermal energy is about 5 to 10% of this cost. About 80% of the product goes to the domestic market.