# The Effect of pH on Thermal Treatment of Wood

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Thermal treatment of wood has received much academic attention and commercial interest. Various reports have indicated that thermal treatment could improve dimensional stability, hygroscopic properties, and biological resistance. A major drawback of this technology is the reduction of mechanical strength. Although different processing conditions have been investigated in order to mitigate the strength loss, there have been no major breakthroughs.

The mechanism of strength loss has been extensively discussed. It is generally agreed that heat-induced chemical changes are responsible for the mechanical strength reduction. Hemicellulose is the most thermal labile component of wood and its degradation is responsible for bending strength loss. Decomposition of hemicelluloses releases acetic acid which could catalyze the degradation of cellulose.

In this study, the effect of pre-treating wood with different buffer systems on chemical changes and strength properties was investigated. Cathay poplar (*Populus cathayana* Rehd.) wood samples were impregnated with solutions of different pH values, which included disodium octoborate tetrahydrate (DOT, pH=8.3), monoethanolamine (MEA, pH=12) and four solutions of boric acid adjusted to pH 6, 7, 8, and 9 with sodium hydroxide. After drying, the pre-treated wood samples were heated for 4h at 180℃, 200℃ and 220℃, respectively.

When the treatment solution has a pH < 7, wood pH did not change appreciably after heat treatment. For wood treated with solutions of pH > 7, wood pH decreased significantly after thermal treatment, suggesting that acids released during the heating process reacted with the buffers.

After 4 hours at 220 $^{o}$C, untreated samples showed hemicelluloses loss of 55%. In comparison, samples treated with pH 9 boric acid/sodium hydroxide solution had a hemicelluloses loss of just over 30%. Wood treated with MEA had the highest mass loss of about 8% after heating at 220 $^{o}$C for 4 hours. Under the same conditions, wood without pre-treatment had a mass loss of 7.3%, and wood pre-treated with pH 7 sodium borate buffer had a mass loss of 4.2%.

MOR loss for wood without pre-treatment was 45% after 4 hours at 220 $^{o}$C. For wood treated with pH 8 buffer, the MOR loss was 30%. MOE loss did not have a good correlation with the pH of the treating solution.

In summary, pre-treatment with borate solutions reduced mass loss and mechanical strength loss as a result of thermal treatment. The decomposition of hemicelluloses was also inhibited. In the next phases of this work, the impact of pre-treatment on dimensional stability and durability will be examined.