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Aging of Wood - Elucidation of color changes as comparison between natural aging and accelerated aging -

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The deterioration of wood as a material is due to biodegradation, weathering, and aging. In conditions under which biodegradation and weathering can be avoided by careful maintenance, the service life of wood can exceed a thousand years as proven by Horyuji temple, which is the oldest wooden building in the world. The elucidation of the wood aging mechanism is important not only for the preservation and restoration of wooden historical buildings but also for purposes of basic wood research.

Previous researches have observed that the changes of wood properties during natural aging seem similar to that during heat treatment under dry conditions. Based on the empirical data, they suggested that wood aging is a mild thermal oxidation at ambient temperature and can be accelerated by heat treatment. We aim to theoretically evaluate the mechanism of wood aging by kinetic analysis, to predict the changes of wood properties at room temperature, and to compare the predicted changes with the properties obtained from naturally aged wood.

While we have evaluated some properties of naturally aged wood samples from Japanese historical buildings [1], the color of wood is a typical index of the properties which sufficiently changes during natural aging and is measured in non-destructive process. We measured the color of naturally aged wood and heat-treated wood. Then, the data obtained were analyzed kinetically to determine whether they could be explained as the result of a mild thermal oxidation at ambient temperature. Sample preparations were as follows; samples collected from Japanese historical buildings were cut into specimens; recently felled down hinoki (*Chamaecyparis obtusa* Endl.) wood were cut into samples, completely dried, and then heated at 90, 120, 150, 180°C for the durations ranging from 0.5 hour to approx. 2 years. Figure 1 shows some of specimens. Based on the successful kinetic analysis [2], we conclude that the color change of wood during natural aging is almost explained as thermal oxidation while somewhat accelerated possibly by the hydrolysis due to the moisture in air. Furthermore, the result allows to predict the color changes at any time and temperature. Compared with the predicted color changes, the internal color variation of recently felled wood was relatively small. This implies that the color changes accompanied with natural aging begin with tree harvesting and wood processing [3].

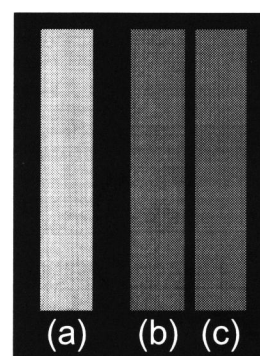


Figure 1. Untreated specimen as control (a), colored specimens during natural aging for approx. 1600 years (b) and heated at 180°C for 12 hours (c).

We are expanding these results to other wood properties and species which will lead a further understanding of the wood aging mechanism.

References

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