Curing and degradation processes of cement-bonded particleboard by supercritical CO_2 treatment

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Cement-bonded particleboard (CBP) and its application in the building industry have been rapidly accepted in many countries because of its excellent exterior properties. In the development of CBP, many studies have focused on understanding the utilization of carbon dioxide (CO_2) in the manufacturing process. Using of gaseous or supercritical CO_2 accelerated the curing process rapidly and enhanced the mechanical properties of board [1]. On the other hand, it has often been reported that CO_2 degrades the cement or concrete because of carbonation, however, it has not yet been revealed whether the supercritical CO_2 treatment has a positive or negative effect on the performance of CBP over a longer time span. We aim to clarify the curing and degradation processes of CBP under the supercritical CO_2 treatment.

We have manufactured CBP using Japanese cypress (*Chamaecyparis obtusa* Endl) and Japanese cedar (*Cryptomeria japonica* D.Don) with a target density of 1.2 g/cm^3 at a cement/wood particle/water weight ratio of 2.5:1.0:1.25. As references, we have manufactured neat cement board (NC) and $Ca(OH)_2$ board. Hand-formed mat of 230 x 230 mm was cold-pressed to a targeted thickness of 12 mm and kept in an oven set at 60^{o}C for 24 h. Four specimens of 50 x 210 mm prepared from these boards were then used for curing treatment. The three curing treatments were (1) supercritical CO_2 treatments, 10 min to 10 days; (2) conventional curing treatment for 28 days (Conventional); and (3) neither curing nor supercritical CO_2 treatment as the control. Figure 1 shows the effect of supercritical CO_2 treatment on bending properties at various curing time of the CBP, neat cement boards (NC) and $Ca(OH)_2$ boards. We conclude that supercritical CO_2 treatment accelerates the curing process rapidly and enhances the mechanical properties of CBP. However, with a longer time span of treatment, the MOR and MOE values decreased and had a negative effect on board performance. It was considered that supercritical CO_2 treatment over a longer time span leads to degradation of CBP [2].

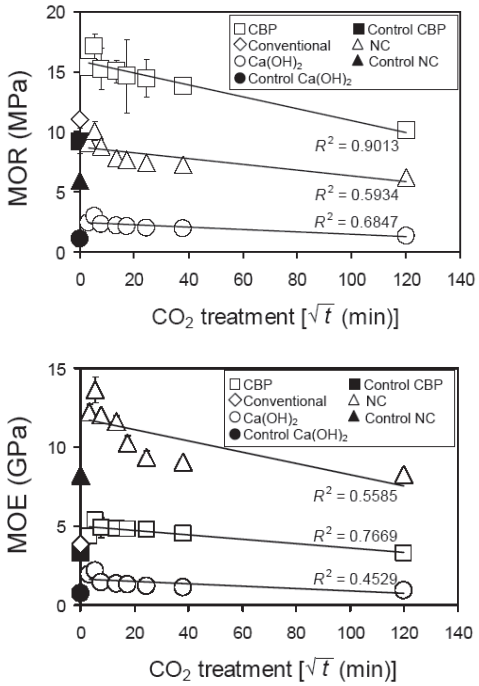

Figure 1. Effect of supercritical CO_2 treatment on bending properties at various curing time of the CBP, neat cement boards (NC) and $Ca(OH)_2$ boards.

We are expanding this research to *clarify* some factors which affect the properties of CBP using supercritical CO_2 treatment, and to estimate long term degradation of CBP in natural condition based on treatment of CO_2 to conventional cured CBP.

References

[1] Hermawan, D., Hata. T., Umemura. K., Kawai, S., Nagadomi, W., Kuroki, Y. "Rapid production of high-strength cement-bonded particleboard using gaseous or supercritical carbon dioxide", *J Wood Sci* 47:294-300, 2001

[2] Maail, R.S., Umemura, K., Aizawa, H., Kawai, S. "Curing and degradation processes of cement-bonded particleboard by supercritical CO_2 treatment", *J Wood Sci* 57:302-307, 2011