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Biological performance of wood-based composites post-treated with preservatives

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The production of wood-based composites (WBC) has increased considerably over the past few decades and they have been utilized under conditions conducive to biological attacks. Unfortunately, these composites are prone to decay fungi and termites if utilized without preservative treatments. The post-manufacturing treatment of WBC with wood preservative chemicals is a mature procedure which does not require any modification in WBC-manufacturing lines.

Alkaline copper quat (ACQ) and copper azole (CA) which have been accepted worldwide as alternatives to chromated copper arsenate (CCA), were evaluated as wood preservatives for post-manufacturing treatment of WBC in the present research.

Specimens were prepared from five commercially available structural-use wood-based composites: softwood plywood (SWP), hardwood plywood (HWP), medium density fiberboard (MDF) produced from hardwood fibers, aspen oriented strand board (OSB) and particleboard (PB) made of both hardwood and softwood particles. The specimen sizes were 210 mm x 30 mm x thickness and 100 mm x 100 mm x thickness for laboratory and filed tests, respectively. ACQ and CA were tested for their effectiveness at three retentions, respectively K1, K2 and K3 classes as designated by JAS. These classes are identical to use classes 1 (interior dry), 2 (interior damp) and 3 (exterior protected and unprotected from weather) of the ISO use class system. Based on laboratory tests even higher than K3 retentions were tested for some laboratory and field tests.

Untreated and treated wood based composite specimens were tested for their changes in mechanical properties due to preservative treatments by the JIS three-point bending method. The same retention groups were also tested for their resistance to decay fungi (brown rot fungus *Fomitopsis palustris* and white rot fungus *Trametes versicolor*) and the subterranean termite *Coptotermes formosanus* by laboratory (JIS K 1571) and field test methods. In addition, untreated and treated sugi sapwood specimens were included in the tests as reference materials for the subsequent discussions. A previously developed system to simulate performance of sill plates (dodai) in traditional Japanese homes was used in the field tests.

Untreated MDF was most resistant to fungi and termites in both laboratory and field tests. PB was second, and needed further protection only against *C. formosanus*. In general, both preservative chemicals did not adequately protect SWP and OSB from fungal and/or termite activity even at the highest retention levels with an exception of end-coated OSB post-treated with CA at 2.01 kg/m^3 retention level against *F. palustris*. As a result, cut-end coating highlighted the importance of remedial treatments of processed building components at construction sites. The biological resistance of HWP was reasonably improved by both chemicals in laboratory and field tests.

The chemical analysis revealed different biocide distribution profiles among WBC types. Both SWP and HWP exhibited a sharp biocide gradient between outer and inner sections, suggesting that core sections were more susceptible to biological activity. Interestingly, the opposite biocide distribution profiles were noticed in MDF, OSB and PB indicating more preservative chemicals were recovered from the core sections. Termite attack is always severer than decay regardless of composite type and retention level based on the field test findings. While SWP, HWP and OSB material treated at higher retention levels showed significantly slower progress in termite attack rating when compared to their untreated controls, none of composites among the highest retentions rated as sound after 36 months exposure.