

Factors affecting distribution of borate to protect building envelope components from biodegradation

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2012

Abstract

Wood preservatives have been effectively used in poles and railway ties for centuries. However, they are not very common in the construction industries as the heavy duty preservatives are not cost-effective in regard to the required performance on building envelope components. Furthermore, most of these preservatives are not registered for this application. In this regard, borate can be a potential candidate as it has low toxicity and can penetrate wood without pressure treatment, even in the refractory species commonly used in construction industries as structural components. In this research, wood moisture content, grain direction, formulation and species that affect the diffusion of borate in refractory species were investigated. Two highly concentrated formulations were applied to understand the diffusion process in refractory species and a novel approach (borate bandage) was used to keep the preservative on the surface and enhance the diffusion by reducing surface drying. It was observed from the concentration gradient that moisture content is an important factor in the diffusion process and diffusion extent increases substantially with increase of moisture content. Likewise, diffusion extent is clearly higher in the longitudinal direction than radial and tangential directions. The radial direction shows comparatively higher penetration depth than the tangential direction. For formulations, a copper borate formulation shows slightly better treatment than a glycerol borate formulation. Regarding species, spruce shows trivially higher diffusion extent than Douglas-fir. From the ANOVA (analysis of variance) test for different diffusion periods and depth of penetration it was found that grain directions and moisture content are significant factors. A mould test was performed with spruce to determine the efficacy of the formulations and necessity of co-biocides. Finally, the diffusion co-efficients were calculated to compare the results quantitatively; some recommendations were made about the quantity required to protect a specific volume of wood considering the distance moved by diffusion and volume treated in different directions.