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Wood Protection Research at UBC

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Background

Currently there are three other faculty members in the Department of Wood Science who conduct research related to wood protection. Dr.'s Stavros Avramidis and Colette Breuil are currently collaborating with F.P. Innovations, in evaluating the usefulness of Radio Frequency heating of wood to control decay fungi, insects and pinewood nematodes (Figure 1).

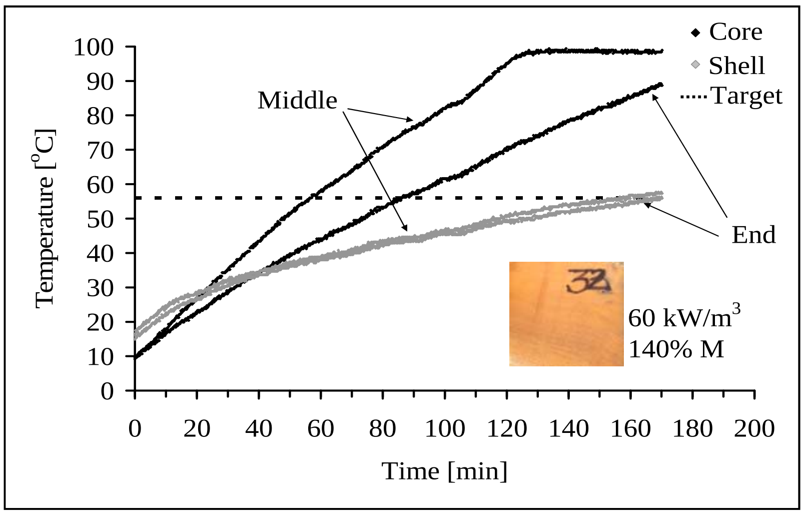


Figure 1 Typical RF heating curves for 90 mm square western hemlock

Dr. Breuil has also studied the potential of albino strains of *Ophiostoma* sp in reducing the effects of blue-stain fungi in on unseasoned wood. Dr. Philip Evans has an active research team which examines the factors resulting in the physical degradation of wood during exposure to weathering, as well as methods of reducing the damage by the application of coatings. This paper will highlight selected research on wood preservation undertaken during the past five years, to provide a broad overview of current research interests.

Overview of Current Wood Preservation Research

Composite products

As the use of composite products continues to increase particularly for structural building components, the need to strategies to protect the wood from decay and termite attack is of high importance. The research at UBC has focused on the potential of glue-line additions of biocide to protect Oriented Strand Board. Selected organic biocides have been evaluated for their compatibility with phenolic and MDI resins and the resultant impact on the strength of the OSB measured. A number of successful combinations of biocide and resin were identified and durability of the boards measured using standard soil block experiments. (Fang, Ruddick and Smith, 2008 and 2009).

XPS and EPR

A major research interest has been the application of advanced instrumental techniques to study the chemical reactions which take place when biocides are impregnated into wood. A considerable body of research has focused on two techniques, Electron Spin Resonance (also known as Electron Paramagnetic Resonance) and X-Ray Photoelectron Spectroscopy. Examples of XPS research are shown in Figure 2. In this research the usefulness of the technique for studying the changes in a triazole (tebuconazole) during reaction with wood and weathering was identified. The two chemical environments of the nitrogen in the triazole with an area ratio in the pure solid of 2:1 were readily observed. Spectra of the chemical in wood also showed that the two nitrogen environments were retained confirming the lack of interaction between the triazole and the wood components.

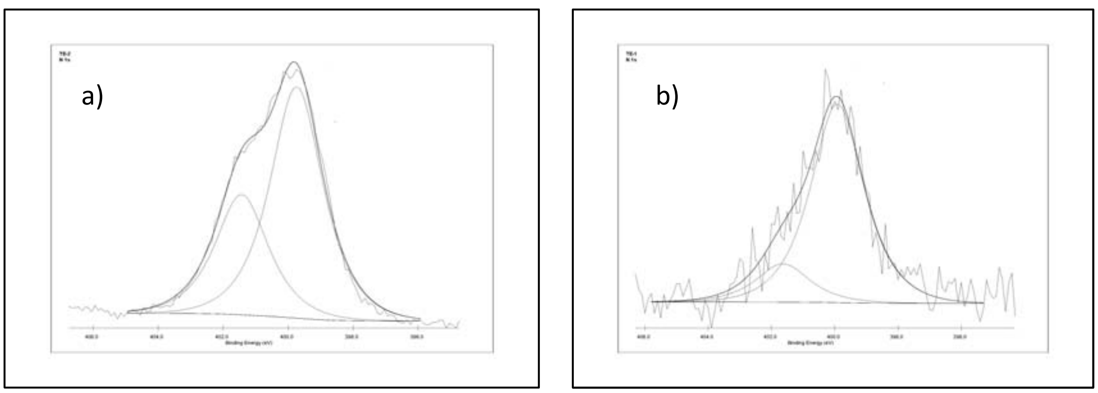
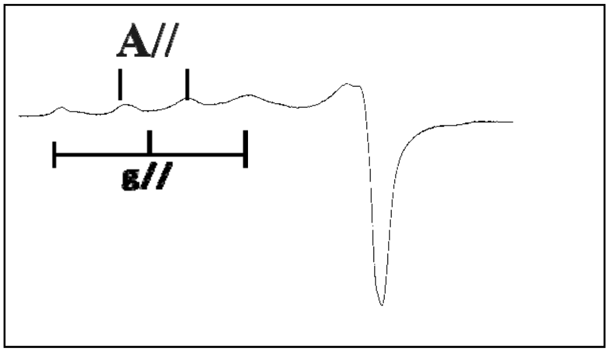
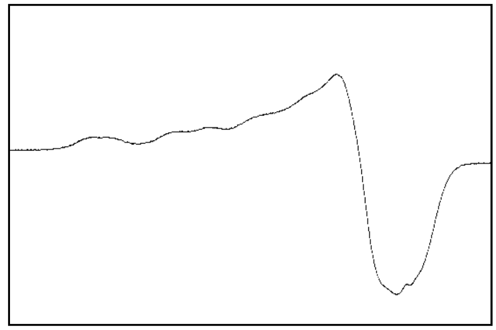


Figure 2 a) XPS spectrum of tebuconazole clearly showing the presence of two types of nitrogen with a 2:1 ratio and b) the spectrum of tebuconazole treated wood with again the two types of nitrogen visible.

One technique which is of particular interest is EPR which enables chemical species which are paramagnetic to be studied. EPR is similar to NMR in that both depend on the magnetic moment associated with a spinning particle. EPR spectra depend on determining the g-values for the unpaired electrons in the sample, which differ from those of the free electrons, and are sensitive to the chemical environment of the paramagnetic atom. EPR spectra are usually observed as plots of the first derivative of absorption intensity against the applied magnetic field. Relative intensities can be approximated by comparing peak to peak separations of the first derivative display when more than one species is present and the spectra are relatively simple. In the case of copper EPR spectrum can show hyperfine splitting. This gives rise to a useful parameter A which is strongly influenced by the geometry and types of atoms bound to the copper. Typical copper

EPR spectra are shown in Figure3 with data of some simple copper compounds presented in Table 1.





Cu(Vanillin)$_2$(H$_2$O)$_2$ crystal   Cu-en treated wood

Figure 3 a) EPR spectrum of crystalline Cu(vanillin)$_2$(H$_2$O)$_2$ and b) (Cu-ethylenediamine treated wood

It can be seen from the data for the copper sulphate and an ammoniacal copper solution, that the presence of the nitrogen bound to the copper causes the A// value to increase from 150 to 177, while that of the complex of copper sulphate in ethylenediamine increases to 190. Thus it is possible to use this technique to study the complexes formed by copper during fixation reactions in wood. Current research is focused on developing and understanding of the chemistry of different copper based wood treatments.

Table 1 ESR spectral parameters for Cu(II) in treated wood

Treatment	g//	A//	g⊥
$CuSO_4$ in water*	2.388	150	2.080
$CuSO_4$ in wood**	2.372	132	2.082
$CuCO_3/NH_4OH$*	2.282	177	2.069
$CuCO_3/NH_4OH$**	2.272	166	2.068
[Cu(en)$_2$]SO_4 in water*	2.204	190	2.064

* Measured at temperature 77K

** Measured at room temperature