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Forest and Wood Products Research and Development Corporation

Conveyor Belt Treatment of Wood - Summary Report

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CONVEYOR BELT TREATMENT OF WOOD

SUMMARY REPORT

Prepared for the

**Forest & Wood Products
Research & Development Corporation**

by

B.M. Ahmed, P. Vinden, J.A. Hann, S.R. Przewloka, J.R.J. French, B.N. Bellingham and P.A. Blackwell

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SUMMARY REPORT

Traditional preservative treatment technologies for wood are an issue and a focal point for the general public, environmental and occupational health and safety administrators. The use of toxic chemicals to protect timber from insect attack and decay is being scrutinised for its life cycle impact on the environment, in particular for the potential contamination of sites and nearby waterways during treatment. The general public is demanding that less toxic preservatives are used for wood protection. This research report is presented in two parts. In Part 1 the Vinden process is evaluated as a method for improving the environmental performance of existing preservatives such as chromated copper arsenate (CCA). This process has the potential to replace traditional batch processing typical of Bethel, Lowry and Rueping treatments with conveyor belt technology. Part 2 of the report details the laboratory and field testing protocols used in the evaluation of the candidate wood preservatives.

Part 1: Treatment technology

In 1999 a new treatment process, the Vinden process, was developed. It developed from a need to impregnate specific quantities of resin into microwave modified wood for *Vintorg* manufacture (Vinden and Torgovnikov 2000). This rapid process was designed to minimise potential resin contamination through the exchange of moisture or wood sugars present in the wood. The process is adaptable to conveyor application. Thus the Vinden process provides conveyor belt or “on-line” impregnation of timber, posts and composite products using very rapid pressure / vacuum treatment techniques. It differs from conventional treatments in that impregnation with (oil, light organic solvent or water) preservative carriers is metered into wood or commodity to the desired loading, rather than saturation and removal of excess. There is no contamination of the parent treatment solution with wood sugars. The treatment can be be completed within seconds or minutes rather an hours. This report describes the scale up of the process to a pilot plant and demonstrates the technology applied in an industrial situation.

An online treatment vessel was designed and constructed. The treatment plant is capable of extremely rapid liquid flow to allow for fast treatment of the timber. Treatment schedules tested included trial runs that had a turnaround time of less than two minutes. The design of the plant and construction material selected allow for the use of polar and non-polar carriers as well as flammable solvents used in light organic solvent preservative treatments. A special schedule comprising evacuation, low pressure impregnation to a predetermined gross uptake, vessel emptying whilst maintaining pressure and then pressure release was designed. A 2.5 metre length plastic pilot plant was constructed to test the feasibility of the proposed treatment schedule for pressures less than 150 kPa.

Analysis of uptakes, penetration and residual surface chemical confirmed the success of the treatments. A second 2.5 metre pilot plant was subsequently constructed from stainless steel to test water based preservatives at higher pressures. The results confirmed the previous work at lower pressures. Using higher pressures little improvement in preservative penetration was achieved but increased residual surface chemical and preservative kickback occurs.

A number of options have been examined for conveyor belt treatment of wood. These include microwave heating (to assist evacuation) followed by conveyor belt dipping in preservative solution. This method has achieved a high standard of sapwood treatment in radiata pine with non-polar preservative solutions. Soaking for up to 15 minutes in oil based preservatives was found to provide acceptable standards of treatment (total cross section impregnation) in eucalyptus posts that had been modified using microwave technology. The schedule providing the best control involved evacuation of the timber or round wood prior to pressure impregnation with the preservative metered into the wood to predetermined retentions.

Outcomes

The Vinden process facilitates the following advantages over conventional treatments:

- Very fast treatment of framing timber in which total sapwood treatment can be achieved in 1 - 2 minutes.
- Timber completely free of preservative dripping following preservative treatment.
- Commercially proven fast fixation of chromated copper arsenate type preservatives, during and after treatment.
- Retention of high quality preservative solution in the store tank with no contamination.
- Suitable for the application of preservatives sensitive to wood moisture, eg. organic boron compounds.
- Suitable for conveyor/automated treatment.

Part 2: Laboratory and field testing of new candidate wood preservatives

The dilemma of finding and introducing effective substitutes for hazard class (H1, H2, H3 and H4) commodities, with the same broad spectrum fungicidal and insecticidal activity as CCA, is approached in this conveyor belt project by focusing on the phenol pyrazole, fipronil. This insecticide is environmentally acceptable and has a proven record of efficacy against termites.
A new formulation of both fipronil and trimethyl borate (TMB) was also evaluated against both decay fungi and insects. Five common species of decay fungi were used in laboratory trials.

Outcomes

- All retentions of fipronil were either repellent and/or toxic to *Coptotermes acinaciformis* (Froggatt).
- The majority of the termite populations in the tests acquired lethal dose of fipronil and permethrin from the treated specimens, with a termite mortality rate of between 70 and 100%.
- The percent mortality indicated that all fipronil retentions had achieved 100% termite mortality within 30 to 56 days.
- The data obtained from this laboratory efficacy study of fipronil was used to evaluate the wood preservative under H2 field conditions.
- Fipronil demonstrated termiticidal activity.
- Timber treated with fipronil alone, as expected, was ineffective against decay fungi.
- The test formulation incorporating both boron and fipronil as the active components was shown to have fungicidal activity due to boron.
- In the new formulation, fipronil neither detracted nor enhanced the fungicidal effectiveness of boron in the treated timber.

Field testing of candidate preservatives was based on the hazard class methods described in the "Protocols for assessment of wood preservatives" as published by the Australian Wood Preservation Committee in 2000. The objectives were:

- To expose fipronil treated wood blocks to a field population of termites and to examine the resistance of the treated timber to attack and damage by *C. acinaciformis* and decay fungi.
- To assess graveyard stakes treated with new preservative formulations against both termites and decay fungi and to examine the resistance of the treated timber to attack and damage in tropical field conditions after one year of exposure.

Conclusions

Field test results suggest that fipronil at the 0.002% m/m mean retention will protect timber from termite attack and damage. It is interesting to note that all fipronil retentions exhibited the same response with increasing retentions with respect to termite mortality in both field and laboratory testing.

The H2 field study concluded that the percent mass loss of wood depends on the retentions of fipronil in treated timber, i.e. percent mass loss decreases with increasing retention of fipronil. Significant weight loss was recorded for the solvent controls.

- Fipronil acted as a slow acting stomach poison. Unlike permethrin, fipronil acted as a strong repellent.
- Fipronil had a termiticidal mode of action, both as a contact and stomach poison.
- There were four termite species found attacking, visiting, muddying, and foraging, on the graveyard (inground) stakes. Although other termite

species are known to be present in this field site, the four major economic termite species were found attacking field stakes.

The results indicated that stakes treated with the mix of fipronil and borate were not attacked by either fungi or termites. Stakes treated only with the solvent carriers failed against both fungi and termites, whilst stakes treated with fipronil only, failed to prevent fungal decay. This difference can be attributed to the synergistic effect of both active ingredients. The synergistic attributes arise from the failure of fipronil (on its own) to decay fungi and TMB to some termite attack when used on its own. In combination the mixture provided protection from both decay and insect attack. The toxic threshold of fipronil against termites was lower when used in combination with TMB.

The graveyard decay and termite field test outlined in the report is well established and will generate useful field data over the coming years. The field data will be useful to the softwood industry in marketing treated timber for hazard classes H2, H3, H4 and H5.