B5b: INNOVATIVE WOOD PROTECTION AND DURABILITY STRATEGIES TO MITIGATE CLIMATE CHANGE IN THE TROPICS AND WARM TEMPERATE CLIMES

From fungal detoxification systems to wood durability

Eric Gelhaye[1], Melanie Rouhier[2], Rodnay Sormani[2], Thomas Perrot[2]
[1]Institut National de la Recherche Agronomique, Nancy, France; [2]Université de Lorraine, Nancy, France (eric.gelhaye@univ-lorraine.fr; melanie.morel@univ-lorraine.fr; rodnay.sormani@univ-lorraine.fr; thomas.perrot@univ-lorraine.fr)

Organisms and in particular static (no-motile) organisms have to be adapted to their environment to cope with biotic and abiotic stresses. In the case of wood-decaying fungi, these latter have developed an efficient detoxification system with expended multigenic families, such as cytochrome P450 monooxygenases and glutathione transferases (GSTs), involved in the catabolism/detoxification of wood extractives. Concerning GSTs, their activity or even their expression are widely used to evaluate physiological and environmental stress of diverse organisms. In this context, we postulated that fungal GSTs could be used as tools to identify wood extracts that possess interesting biological properties and could also give some clues on the ecological traits of the corresponding trees. We have therefore developed biochemical tests quantifying the interactions between fungal GSTs and wood extracts from subtropical and temperate forests. The obtained results that validate the initial hypothesis and demonstrate a correlation between these interactions and the natural durability of the tested woods as well as the growth strategy (heliophilic/sciaphilic continuum) of the considered species, will be discussed. Related articles: - Deroy et al.(2015) The GSTome Reflects the Chemical Environment of White-Rot Fungi. PLOS ONE. DOI: 10.1371/journal.pone.0137083 - Schwartz et al. (2018) Molecular recognition of wood polyphenols by phase II detoxification enzymes of the white rot Trametes versicolor. Scientific reports. DOI: 10.1038/s41598-018-26601-3 - Perrot et al., (2018) Fungal glutathione transferases as tools to explore the chemical diversity of Amazonian wood extractives. ACS sustainable chemistry and engineering. DOI: 10.1021/acssuschemeng.8b02636.

Exemplary kempas hardwood protection with two proprietary microemulsion termiticides based on permethrin and cypermethrin against *Coptotermes termite* attack under tropical aboveground indoor and weathered conditions

Daouia Messaoudi[1], Andrew H. H. Wong[2], Carlson A. D. Tawi[2], Nebil Bourguiba[1], Olivier Fahy[3]
[1]Adkalis, Blanquefort, France; [2]Universiti Malaysia Sarawak, Kota Samarahan, Malaysia; [3]Adkalis, Blanquefort, France (daouia.messaoudi@berkem.com; awong.unimas@gmail.com; carlson.tawi@gmail.com; nebil.bourguiba@berkem.com; olivier.fahy@berkem.com)

Patented proprietary SARPECO® and AXIL® environmentally acceptable microemulsion wood-protecting chemicals are water-based wood preservatives approved for dipping and pressure treatment providing 25 years of termite protection for solid wood and wood-based products in Europe and for more than 10 years in Indonesia. Field trials conducted in Malaysia confirmed the efficacy of SARPECO® and AXIL® solutions at three product concentrations on short dip-treated kempas (Koompassia malaccensis) heartwood, a major hardwood species used in Malaysian wood construction, against the Southeast Asian subterranean termite Coptotermes curvignathus exposed to aboveground H2 (indoor, non-wetting conditions) hazard class targeting termites compared to CCA-treated kempas and radiata pine (*Pinus radiata*) sapwood. Prior to the H2 hazard class termite field test exposure, treated wood blocks were conditioned to either a non-leaching volatilization (H2 hazard class weathered wood) or to a leaching with volatilization (aboveground H3 hazard class weathered wood) as well as non-leaching non-volatilization and leaching non-volatilization reference treatments. After 6 months field exposure, untreated kempas was severely (AWPA termite ratings: 0, mean mass loss: 97.4%) or moderately attacked (mean ratings: 7.7, mean mass loss: 17.5%), while none of the leached-volatilized (H3 hazard class) or non-leached-volatilized (H2 hazard class) test blocks treated with SARPECO® and AXIL® at both target retentions were regarded as attacked (mean ratings: 9.7-10, negligible mean mass loss) at low applied termiticide concentrations, leached or non-leached wood, volatilized or non-volatilized wood treatments. Concluding, due to their unique compositions, both patented formulations conferred excellent protection against Coptotermes curvignathus, at far lower termiticide concentrations where conventional agro-insecticides will fail, for tropical aboveground indoor-outdoor wood construction.

Tropical indoor wood floorings and outdoor deckings are in dire need of wood protection

Andrew H. H. Wong[1], Malcolm Farmer[2]
[1]Universiti Malaysia Sarawak, Kota Samarahan, Malaysia; [2]Koppers Performance Chemicals, Manila, Philippines (awong.unimas@gmail.com; farmerm@koppers.eu)

In many tropical regions indoor timber floorings and sometimes outdoor deckings have become popular features of buildings and parks, which when installed without naturally durable woods, are readily predisposed to the biological hazards of termites and rot fungi that are destructive to wood materials. Such premature failure of unprotected structural materials incurs considerable monetary losses as well as carbon loss from wood biodeterioration that is detrimental to climate change mitigation plans. Brief illustrations of wood being climate-friendly material, that wood must be treated in the tropics, variable natural durability of Malaysian woods, their tropical wood degraders, options for biocidal and non-biocidal wood protection strategies of wood floorings and deckings, and case studies of biocidal wood protection of tropical woods in aboveground conditions, are presented.

Evaluation of furfural/urea complexes to improve properties of commercial birch wood (*Betula* sp.)

Davood Efhamisisi[1], Marie-France Thevenon[2,3], Marzieh Sharifat[1], Asghar Taromian[1], Mehdi Jonoobi[1]
[1]Department of Wood and Paper Sciences and Technology, Faculty of Natural Resources, University of Tehran , Tehran, Islamic Republic of Iran; [2]Wood Preservation Laboratory, CIRAD, UR BIOWooEB, Montpellier, France; [3]BIOWooEB, Univ. Montpellier, CIRAD Mont (efhami@ut.ac.ir; marie-france.thevenon@cirad.fr; marzieh.sharifat@ut.ac.ir; asghar.taromian@ut.ac.ir; mehdi.jonoobi@ut.ac.ir)

Due to recent national forestry policy banning logging from the Northern parts of the country, Iranian wood industry must mostly rely on wood importation. Birch (*Betula* sp.) from Russia is a commonly imported wood, but has a low durability and therefore must be protected for long-term uses. Protection systems based on wood impregnation with different monomers and their conversion to un-leachable reacted polymers were developed to create new wooden products with improved properties. Furan compounds such as Furfuryl Alcohol (FA) can be commercially used for wood modification.Wood is impregnated with FA, which is converted to polyFA by heating. Furfural is, in fact, the primary raw material in the production of FA, and is extensively manufactured in Iran from residues of sugar cane. Furfural can not be easily polymerized alone like FA; however it is an aldehyde able to react with urea to make polymer network. In this study, the possibility of creating furfural/urea polymer along with acidic catalyzer (maleic anhydride) was evaluated for the improvement of physico-mechanical properties, as well as the durability of birch wood.