



18-MONTHS POSTDOCTORAL POSITION

“SELECTIVE SORPTION OF MIXED SOLVENTS IN LIGNO-CELLULOSIC SUBSTRATES”

Modelling the interactions between wood and mixed solvents is a pre-requirement for advances in fundamental and applied fields. The physical chemistry of selective sorption of different solvents on the mechanical properties of lignocellulosic materials with different structures can lead to general models of composite behaviour and open the perspective of new processes for the growing industry of renewable materials.

The industry of structural materials increasingly relies on renewable lignocellulosic resources, spanning from wood to bamboo and fast-growing species. Their use as materials is a more effective strategy than burning in the perspective of circular economy, provided their performances and life-cycle are improved. The deconstruction-reassembly of lignocellulosic substrates as well as the improvement of their life-time, mechanical strength, resistance towards bio-damage or flammability are currently achieved by chemical treatments, often performed in severe conditions. More advanced treatments, based on the use of mixed solvents and specific interactions with lignocellulosic biomass, are promising less energy-intensive alternatives. The expected technological fallouts on treatments of wood-based materials and organosolv treatments of biomass require a deeper understanding of the sorption and swelling mechanisms occurring between complex solvent systems and wood hierarchical structures made of biopolymer assemblies.

The post-doctoral research program, under the supervision of Francesco Di Renzo in Institut Charles Gerhardt (ICGM) and Nicolas Le Moigne in IMT Mines Alès, will be focused on the development of experimental methodologies that will allow to analyse selective sorption processes (DVS Thermogravimetric analysis, swelling measurements by microscopy) in relation with viscoelastic behaviour (Dynamic Mechanical Analysis) of wood substrates in the presence of mixed solvents and will exploit earlier advances already supported by LabEx ChemiSyst (Wood Sci. Technol. 2018, 52, 987). Model wood materials with various biochemical compositions as well as pure substrates will be selected to better depict the contribution of microstructural features and different biopolymers, i.e. cellulose, lignin and hemicelluloses.

The experimental data will be the basis for a better understanding of phenomena related to selective sorption of mixed solvents in lignocellulosic substrates. Planned collaborations with renowned labs in the field of wood science will support these investigations and help in the development of mechano-chemical models describing the synergic effect of the components of mixed solvents on the swelling and viscoelastic behaviour of wood materials. Ongoing molecular modelling studies (PhD of Sonia Aguilera at ICGM/MACS) on the interactions of mixed solvents with individual components of wood will contribute to the understanding of specific interactions and organization of mixed solvents at the molecular level. The use of solid state NMR and large instruments for radiation-matter interaction are envisaged in the second part of the project for a deeper understanding of solvents-substrate interactions and selective sorption of mixed solvents within the cell wall structure of wood.

Experimental activities will be carried out at ICGM in Montpellier and IMT Mines Alès. The candidate is expected to deal with handling of wood specimens, the characterisation of their behaviour under solvent treatments and the modelisation of the underlying physico-chemical interactions and mechanical response. Eligible candidates should present either a PhD or a first postdoc with accepted papers related to the field of the proposed research topic. Previous international experience or activity in network of laboratories will be highly appreciated. Candidates can contact Francesco Di Renzo (direnzo@enscm.fr, +33 607508148) and Nicolas Le Moigne (nicolas.le-moigne@mines-ales.fr, +33 466785302) and submit their candidature by sending their CV and a motivation letter targeted at this specific call.