

## About COST Action FP1407: ModWoodLife

The forest-based sector can become a leader in achieving the European Commission's ambitious target of reducing CO<sub>2</sub> emissions with innovative production technologies, reduced energy consumption, increased wood products recycling, and reuse. Apart from these environmental benefits, the use of forest products in long life products, such as built environment applications, allows for the possibility of extended storage of atmospheric carbon dioxide.

### ModWoodLife Facts

Type: COST Action FP1407: ModWoodLife

Duration: 4 years (2015-2019)

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### Participants

4 working groups

96 research partners

33 countries

### MC Chair

Dr Andreja Kutnar

University of Primorska

Muzejski trg 2, 6000 Koper, Slovenia

## Short Term Scientific Mission (STSM) completed during Year 2:

During the second grant period, 1 June 2016 - 30 April 2017, 11 STSMs were completed. The participants and hosts were from 15 countries on 4 continents! Research topics ranged from wood modification treatments, degradation from insects and fungi, mechanical properties, and more. These exchanges provided invaluable opportunities to collaborate with colleagues across the globe.

### René Herrera

René Herrera, PhD student from the University of the Basque Country UPV-EHU, Chemical and Environmental Engineering Department, has completed a short-term scientific mission at the University of Bío-Bío in Concepción, Chile. The title of his STSM was "Thermal modification of radiata pine wood grown in Chile".

The main goals of this STSM were to thermally modify radiata pine wood of different quality at pilot scale, and to measure several physical-mechanical properties of wood after modification in order to know the feasibility of implementing this modification method in the Chilean market, and to obtain possible finished wood products.

The materials and methods to achieve the goals of this Short Term Scientific Mission were supported, supplied and monitored by the research group of Wood Drying and Thermal Treatments of the University of Bío-Bío in cooperation with their industrial partners of 'Bioforest' research group from Arauco Company (Chile).

During his visit, the applicant acquired training about wood drying methods and the parameters taken into account during the thermal modification in addition to preparation of loads, measurement of physical properties in large samples and discussion of the results.



René preparing samples before TM



Load inside the pilot Kiln

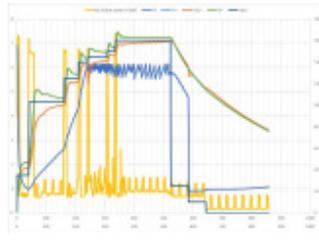


Measurement of properties after TM.

## Dennis Jones

Dr. Dennis Jones undertook a short-term scientific mission to Slovenia, which linked visits to both the Biotechnical Faculty, University of Ljubljana, and the Andrej Marušič Institute, University of Primorska (host) in September 2016. The mission, under the title "The development and evaluation of a possible combined thermal/chemical wood modification" aimed to look at the use of a pre-treatment prior to thermal modification. The concept of the work was that the use of the chemical pre-treatment would help bind hemicellulose fragments usually volatilised during the thermal modification process. The combination of methods should also allow for reduced temperature during the thermal process. During the two week stay several series of Norway spruce and beech were treated and thermally modified. Work continues to analyse the results from this work, along with determination of the energy requirements, as part of an LCA inventory into the processes involved. Part of the work included the development of a total energy use method for the thermal modification phase.

Work continues to finalise the results from this work, and to identify if beneficial effects resulted from the combined treatment. In addition, discussions were held with both universities into further expansion of the work in this STSM, which will be considered for future collaborative work and publications.



Photos from left to right:

- Dennis Jones with Prof. Franc Pohleven (university of Ljubljana).

- Total energy use graph for the thermal modification process.

- Norway spruce samples about to undergo thermal modification.

## Gaye Kose Demirel

Gaye Kose Demirel is a Ph.D. student and working as a Research Assistant in the Discipline of Wood Protection, the Department of Forest Industry Engineering, at Karadeniz Technical University in Trabzon/ Turkey. She successfully completed a Short Term Scientific Mission (STSM) in the period from 26 May to 17 April 2017 at CNR-IVALSA Biodegradation and Preservation Laboratory in Florence, Italy. Her host supervisor was Dr. Sabrina PALANTI.

The title of STSM was "Usability of Epoxidized Vegetable Oils as a Wood Preservative and Its Effect on Leachability of Boron". Epoxidizing vegetable oil in order to reactivate oils and improving the bonding ability between oil and wood components were targeted. Thus, less oil retention (80-270 kg/m<sup>3</sup>) was used. Additionally, in this study, leaching of boron compounds in wood were targeted to be stopped because boron compounds are the rare wood protection chemicals which are environmentally friendly and show both insecticide and fungicide character. One of key factors for understanding of modified wood with oils is the performance of treated wood with oils against biotic factors including insect and decay fungi. In this duration time in IVALSA, she initiated insect and decay test on previously impregnated pine samples according to standards of EN (113) and EN (47), respectively. Basically, 504 kolla flaks were prepared, and two types of fungi (*Coriolus versicolor* and *Coniophora puteana*) were inoculated into them. Finally, impregnated pine samples and control groups were placed into the kolla flaks. Beside decay test, the larvae of *Hylotrupes bajulus* were inserted into 220 impregnated pine samples, by inserting 6 larvae into each single pine samples for insect test.



Gaye Kose Demirel started sample preparation for insect test



Dr. Sabrina Palanti and Gaye Kose Demirel during the STSM visit



Inoculating fungi



*Hylotrupes bajulus*

The first results will be available after 12 weeks. She is very grateful to Dr. Sabrina PALANTI and CNR-IVALSA's staff for completing this part of study in IVALSA. This work in the STSM will also contribute to the Ph.D. thesis of Gaye Kose Demirel.

## Báder Mátyás

As a PhD student at the University of West Hungary, Sopron, Báder Mátyás completed a STSM with Dr. Johannes Konnerth at the University of Natural Resources and Life Sciences, Vienna (BOKU). The aim of the research was the investigating of the induced changes of the wood cell wall in terms of mechanical properties of combined hydrothermal and mechanically modified wood.

Analyzing of the micromechanical properties of the longitudinally compressed wood samples proposed by means of nanoindentation (NI) in Vienna, Austria and investigated the morphological and structural changes also on the sub-micrometer level by means of advanced atomic force microscopy (AFM) in Tulln, Austria. The earlier examined macromechanical changes (Báder and Németh 2017, in press) indicated some changes in the microstructure, and with the help of this short term scientific mission the above featured investigations could made. The results are promising, now many micromechanical data known about this modified wood material. These investigations will also be appended to the doctoral thesis of the applicant.



Báder Mátyás



Nanoindenter



The examined samples

## Miguel Redón

Dr. Miguel Redón, Associate Professor from the Universitat Politècnica de València, Department of Rural and Agrifood Engineering, completed his STSM "Analysis of fracture toughness in Mode II on Modified Wood" with Dr. Vaclav Sebera, Mendel University in Brno, Faculty of Forestry and Wood Technology, Department of Wood Science. The main purpose of the STSM was directed to provide fundamental data about fracture behavior of thermally modified wood in Mode II.

The testing of thermally modified beech wood at two different temperatures has been tested against reference non-treated samples. The test was based on 3-point bending end-notched setup in the mode II (Figure 1). Also, the measurement was accompanied by 3-D digital image correlation (DIC) providing additional data such as displacement and strains enabling the evaluation of the crack development (Figure 2b).

The preliminary findings of this STSM showed that the resistance curve of the non-treated wood samples is greater than the thermally modified specimens (Figure 2a). From that, it could be concluded that the strain energy release rate (GII) of thermally modified wood would be lower than the reference or non-treated wood which confirms that thermal modification influences fracture toughness properties of wood.

During his visit, he has acquired valuable training about thermally modified wood in addition to practical performance of fracture toughness that has been strengthened by using and interpreting non-contact mechanical measurement systems such as the DIC technique.

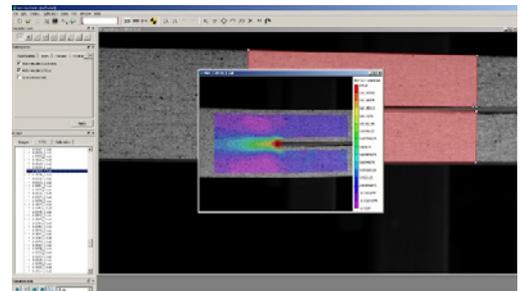


Fig 1.

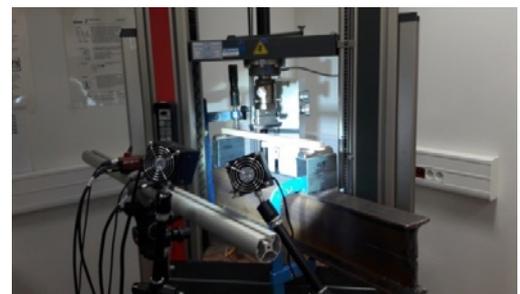


Fig 2a.

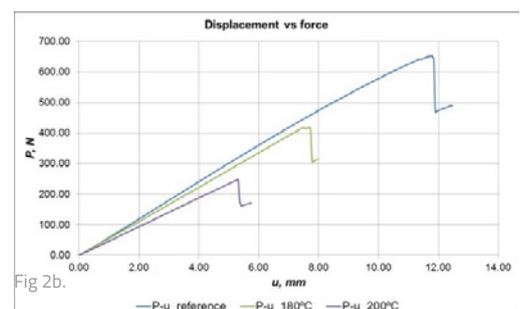


Fig 2b.

## Anna Sandak

Dr. Anna Sandak, researcher from CNR-IVALSA completed her STSM "Alternative trials for end-of-life bio-materials transformation" with Dr Magdalena Kutnik (FCBA, Bordeaux, France).

Construction and demolition sector generate one of the highest volumes of waste in Europe. Extensive research is conducted nowadays to promote cascade use of resources, their reuse and recycling. Bio-based building materials are considered as interesting alternative in modern building manufacturing. However, it must be demonstrated that they are significantly more favourable than the corresponding mineral and fossil-based alternatives. This STSM was focused on laboratory and in-field tests with selected fungi and insects used for bio-based building material transformation. It was expected, that certain organisms will speed-up degradation process of investigated building materials.

Experimental samples (112 bio-based facades materials) were cut into thin strips (150x20x5mm) on the circular saw and calibrated to 5mm thickness on the sanding machine. From each material several specimens were prepared and used for following experiments: in-field degradation in three different locations: FCBA (Oléron island, France), La Rose test site - Guadeloupe Island (Goyave, Antilles, France) IVALSA (San Michele, Italy), laboratory test with termites and microbiological tests in two types of soil (FCBA, Bordeaux, France).

First results demonstrated difference in degradation speed and proved termites' preferences regarding selected biomaterials. All experimental tests provided encouraging results and thank to availability of the FCBA staff the experiments will be carried on for the next 12 weeks.



Start of test



Termites in action



Samples after 3 months of termite exposure

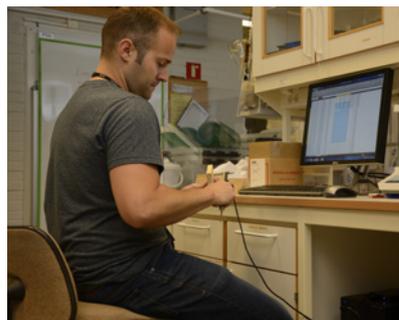
## Matthew Schwarzkopf

Dr. Matthew Schwarzkopf traveled to the Norwegian Institute of Bioeconomy Research (NIBIO) located in Ås, Norway as part of a short term scientific mission (STSM) funded through the COST Action FP1407. The title of Schwarzkopf's STSM was "Chemically modified lampante oil as a wood preservation treatment". The objective of the STSM was to develop a wood preservative treatment methodology using previously prepared modified lampante oil.

During his week-long visit, Dr. Andreas Treu and others at NIBIO shared wood preservation expertise with Schwarzkopf and helped produce treated test specimens for further investigations into the preservative efficacy against fungal degradation, weathering, and leaching. In addition to just preparing treated test specimens, this STSM strengthened the University of Primorska's collaboration with NIBIO for future work together.



Dr. Andreas Treu and Dr. Matthew Schwarzkopf during the STSM to NIBIO;



Dr. Matthew Schwarzkopf testing wood samples



Wood samples treated with chemically modified lampante oil (left) and untreated wood samples (right).

## Ivan Sopushynskyy

Ivan Sopushynskyy working Prof., Dr. hab. at the Ukrainian National Forestry University completed the Short Term Scientific Mission in the period from 10.03. until 20.03.2017 at the Department of Wood Biology and Wood Products of Georg-August-University in Göttingen, Germany. The main purpose of the STSM was directed to study engineering properties of Laminated veneer lumber (LVL) products and their quality control as well as the relationship between wood modification processing, product properties, and the associated environmental impacts.

LVL products are of great structural use due to their high engineering properties dealing with the testing on the mechanical properties like tension, shear, compression etc. The precise sorting on quality includes (a) pre-sanding for perfect quality control, (b) pre-grading for less waste, (c) more efficient machining cycles for lower labour costs and (d) fixed widths on request. The quality control of LVL is directed to check technical properties (density, strength and stiffness values) for every application of boards and beams. Germany has the most specific national legislation on the management of waste wood 'Ordinance on the Management of Waste Wood'.



Vladimir and Ivan preparing the samples for testing



LVL products produced at the Department of Wood Biology



Wood Products of Georg-August-University.

## Mohamed Tahar Elaieb

Dr. Mohamed Tahar Elaieb, researcher from the Tunisian National Research Institute of Rural Engineering, Water and Forests (INRGREF), Laboratory of Management and Valorization of Forest Resources (LGVRF), is hosted by Kevin Candelier, CIRAD\_ UR BioWooEB, Montpellier (FR).

This STSM is focused on the "Understanding of the effect of natural salt water treatment on durability, fiber densification and chemical modification of palm wood". The main goals of this work is to evaluate and understand the durability improvement of Palm wood after undergone an ancestral preservative treatment by saltwater immersion in the Lake Jerid (ChotDjérid), in Southern Tunisia. The treatment consists in removing of the freshly felled palm trunk for a period of 1 to 2 years (depending on species) in the Lake. After this stay, the material changes its appearance, color, properties and becomes a dense, durable and resistant material. This natural treatment is long gone and the treatment process of this wood remains unclear. So, the STSM work is to determine the main properties of this local species with many advantages: intrinsic characteristics of palm stems and their variability (anatomy, chemical composition, physical properties, mechanical properties, natural durability, etc.), in order to understand the wood material modification process and to in order to know the feasibility of implementing this modification method in the Tunisian market, with optimized industrial processes and to obtain possible finished Palm wood products. The materials and methods to achieve the goals of this Short Term Scientific Mission were supported, supplied and monitored by the research group of BioWooeb of the CIRAD Laboratory (Photo 1). During my visit, I was formed on wood decay and termite resistance tests according to European standards (Photo 2-3), wood chemical and mineral compositions analyses by MP-AES (Microwave Plasma-Atomic Emission Spectrometer).

Link: <http://ur-biowoeb.cirad.fr/actualites/accueil-mohamed-tahar-elaieb>



Mohamed TaharElaieb and Kévin Candelier during the STSM visit. Photo credit - Sébastien Paradis.



Preparation of termite resistance screening tests. Photo credit - Kévin Candelier



Preparation of fungal resistance screening tests. Photo credit - Kévin Candelier

## Lars Tellnes

Lars Tellnes, researcher at Norwegian Institute of Wood Technology completed a STSM with Dr. Sc., Christelle Ganne-Chédeville of Bern University of Applied Science, Institute of Material and Wood Technology.

The purpose of the visit was to complete a review of biogenic carbon accounting methods for calculating climate change impacts in life cycle assessment (LCA). The output of the STSM was a manuscript that was submitted to the FP1407 special issue in iForest, which was also co-written by Ana Dias, Franz Dolezal, Callum Hill and Edwin Zea Escamilla.



Lars Tellnes and Christelle Ganne-Chédeville during the STSM visit

## Jure Žigon

Jure Žigon, a PhD student of the interdisciplinary doctoral study programme of Biosciences at the Biotechnical Faculty (University of Ljubljana), successfully completed a short term scientific mission (STSM) in the frame of COST FP1407 project. Between 4th and 21st of February 2017, he was a guest at Clausthal University of Technology in Clausthal-Zellerfeld, Germany. His host supervisor Dr. rer. nat. Sebastian Dahle from Institute of Energy Research and Physical Technologies, gave him some basic training on wood plasma treatment.

The title of his STSM was "Enhancement of coatings for wooden claddings via plasma pre-treatments and environmental impact". As a practical example for application in construction and exterior usage, Norway spruce (*Picea abies* (L.) Karst.) wood coated with water-based two-step acrylic lacquer stain was used in the present research. Prior to application of coatings, wood was treated with dielectric barrier discharge (DBD) plasma treatment technique in air at atmospheric pressure. Plasma pre-treatment process was optimized, considering the hydrophilization and the best wettability of substrate after application of different liquids. Furthermore, morphological and chemical properties of untreated and plasma treated surfaces were studied, using ATR-FTIR and CLSM technique. Finally, mechanical properties of coating systems were evaluated with standard pull-off strength and cross cut tests. Environmental impact of substrate preparation using plasma treatment was evaluated basic on energy consumption. It was shown that DBD plasma treatment evidently increase wettability of wood. Mechanical properties of coatings were improved with additional plasma pre-treatment of the substrate. Plasma treatment is environmentally friendly technique, without energy-intensive drying processes or chemical waste.

Experimental work and results conducted during this STSM present a good foundation for future work on his PhD.

Fig 1



Fig 2

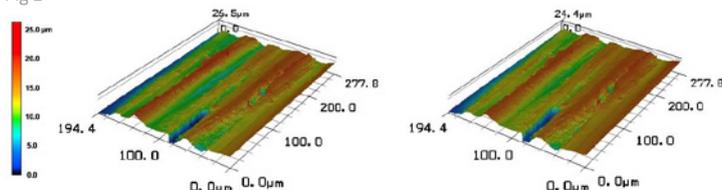


Fig 3.

Type of surface	Time after coloured liquid deposition				
	0 s*	1 s*	2 s*	3 s*	24 h
Untreated					
Treated					

\*Pictures taken by microscope under 8-fold magnification.

Fig 4



Figure 1: Created plasma between ceramic barrier and samples surface

Figure 2: Time-dependent evolutions of red and green-coloured water droplets areas on different plasma treated surfaces

Figure 3: 3D profile of the sample surface segment before (left) and after (right) plasma treatment

Figure 4: Jure Žigon completing experimental work in Clausthal University of Technology, Institute of Energy Research and Physical Technologies

## STSM Scheduled for Year 3

10 STSMs are available for funding in the current round covering the period 1st May 2017 to 30th April 2018. Everyone is encouraged to apply, but especially PhD students and Early Stage Researchers. The maximum amount of funding per STSM is €2400. Please consider taking advantage of the opportunity.

STSMs can be from any Group/University/Institute from a country that has joined the Action to another Group/University/Institute in another member country in the Action.

## PAST EVENTS

### ▪ Think outside of the wooden box! PhD Workshop in Hamburg

In the beginning of July 2017, COST Action FP1407 and University Hamburg / Thünen Institute brought together young researchers, students, wood and non-wood professors, and industry experts from all over Europe. For three intense days, they worked on the advanced understanding of bio-based lignocellulosic materials - thinking outside of the wooden box.



The participants were warmly welcomed by the Center for Wood Science General Director Prof. Dr. Jörg B. Ressel and the Thünen (HF) Acting Director Dr. Johannes Welling. The workshop was then kicked off with recent developments in technology, chemistry, and biology of wood and lignocellulosics presented by Dr. Dr. h.c. Uwe Schmitt (Thünen predecessor), Prof. Dr. Bodo Saake (University Hamburg), and Prof. Dr. Andreas Krause (University Hamburg). Our prestigious speakers and participants then discussed optimistic scenarios for the future industrial applications of high added value wood modification products in four technical sessions.

During our network breaks, numerous future cooperation synergies were explored and interesting new pan-European connections were established. The creative atmosphere brought up new ideas of European network and cooperation modes in wood science and adjacent fields, for instance the establishment of a European virtual wood science institute. The surprisingly high number of applicants and the very positive feedback from the participants and speakers shows that this format is ideally to be held regularly.

The event was funded by COST Action FP1407, the [University Hamburg MIN Graduate School](#) (BMBF/DAAD) and logistically supported by [Innovawood](#), [University Hamburg](#), and the [Thünen-Institute](#). Special thanks to all speakers, contributors and helpers.

A full write up is [available](#).



## UPCOMING EVENTS

### 1. STSM & ITC conference grants

Visit the FP1407 ModWood Life [website](#) for information on how to apply for a STSM.

Inclusiveness target countries (ITC) conference grants are available for young researchers from Inclusiveness Countries to attend a meeting or conference. For details visit <http://costfp1407.iam.upr.si/en/news>.

### 2. Conference

We kindly invite you to participate in the **COST Action FP1407 3rd Conference: "Wood modification research and applications"** at the Salzburg University of Applied Sciences in Kuchl/Salzburg, Austria.

The conference will focus on presenting innovative materials and process developments for various wood modification technologies, ecologic solutions and further related challenges with the focus of improving the properties of timber to guarantee a more sustainable usage of wood. Special emphasis will be given to innovative bio-friendly wood protection techniques and preservatives. The conference committee is also open to accept a variety of contributions with the target objective in line with the "green" principles and with particular interest for studies that deals with timber quality enhancements.

**When:** 14-15th of September, 2017

**Where:** Kuchl/Salzburg, Austria

Additional information available on <http://costfp1407.iam.upr.si/en/events/cost-fp1407-3rd-conference>

### 3. Meetings

Two meetings are scheduled for the year:

- **Core group meeting** in Lisbon, Portugal on 08.02.2018
- **Working group WP1 & WP4 meeting** in Firenze, Italy on 15.11.2017

## Social Media

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## Project Funding

