

## **REPORT OF SHORT TERM SCIENTIFIC MISSION - COST ACTION FP1006**

### **COST MC Chair:**

Prof. Dr. Stefanie Wieland

### **STSM SCIENTIFIC REPORT**

**Action:** COST FP1006

**Date of the visit:** 15th November – 30th November of 2013

**STSM Research Theme:** “Biological durability of thermally and chemically modified wood – Chemical analysis”

**STSM Applicant:** Kamperidou Vasiliki, PhD Candidate, Aristotle University of Thessaloniki, Faculty of Forestry and Natural Environment, Laboratory of Furniture and Wood Products, Thessaloniki, Greece

**Host:** Prof. Bartłomiej Mazela, Poznan University of Life Sciences, Faculty of Wood Technology, Poznan, Poland

### **STSM Scientific Report Contents:**

1. Purpose of the STSM
2. Description of the work carried out during the STSM
3. Description of the main results obtained
4. Future collaboration with host institution (if applicable)
5. Foreseen publications/articles to result from the STSM (if applicable)
6. Confirmation by the host institution of the successful execution of the STSM
7. Other comments (if any)

### **1. Purpose of the STSM**

Under constant attempts to implement enhancing processes, are some of the poor properties of wood, referring mainly to dimensional instability and susceptibility to microorganisms attack. Several preservatives have been proposed and developed so far, in order to provide a solution, which, however, are accompanied by the concern of people about the potential hazard to human health and environment. Modification of wood is a method that came to fill this gap, providing the improvement of some crucial wood properties without carrying the environmental impact of preservatives.

The purpose of this STSM to Poznan University of Life Sciences was to acquire the necessary knowledge background, as well as experience on biological durability test processes. Towards this direction, fungi and micro fungi tests of pine wood were conducted, after the application of thermal treatment and a combination of thermal and superficial chemical treatments with organo-silicon compounds.

Professor Bartłomiej Mazela has a great experience and considerable achievements in the field of biological durability, microfungi and fungi tests, wood modification, especially with silicon compounds and that was the main reason for choosing the specific Department in order to accomplish this scientific mission. I had visited Poznan University of Life Sciences earlier in 2013, in order to prepare the necessary details of the research and make a start in the experiment. In 15<sup>th</sup> of November 2013, I visited again Poznan University in the frame of STSM programme in order to accomplish the basic part of the durability experiment and specifically, the chemical analyses of the research and attempt explaining and interpreting the scientific findings.

## 2. Description of the work carried out during the STSM

Pine wood (*Pinus nigra* L.) of Greek origin and thermally treated at different conditions (temperature, durations) was brought with me from my home institution. Wood was cut in final dimensions for the tests (8 x 20 x 30 mm along fibers) and all the specimens were sanded, while the cross-sectional surfaces were blocked with adhesive.

Except for thermally treated wood, also thermally and chemically treated pine wood with three different silane systems (1/25 w/v) participated in biological durability tests. The chemical treatments were conducted in host University. Each thermally treated specimen was soaked for 1.5 minute in a mixture of Alkyd Resin (FTALAK S-6575 20%), Silane (AE-AP-TMOS 5%), Water-Benzin, while three different solvent ratios were used: 50% water - 50% benzin, 30% water - 70% benzin and finally, only benzin. An electric stirrer was used in order to achieve the homogeneity of the mixture, at room conditions. The wet mass measurement of each specimen was necessary, to calculate the retention percentage value, which was around 9 - 20% of the specimen mass.

For the biological durability tests, two basidiomycetes species (*Coniophora puteana* and *Poria placenta*) were chosen and the tests were implemented according to EN113 and EN839 standards.



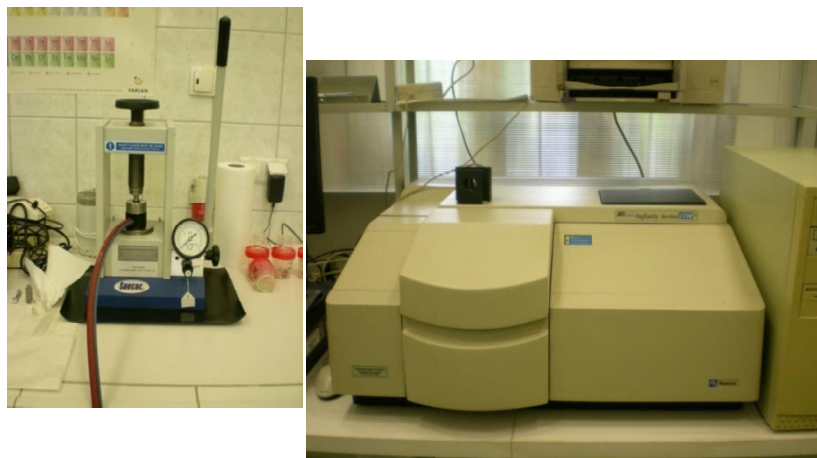
Additionally, a mixture of microfungi species were tested, in order to determine the impact of the treatments on surface durability of the specimens. The spore suspension for the microfungi species was the following: *Aspergillus niger* (An), *Trichoderma viride* (TV), *Penicillium funiculosum* (Pf).



During my stay in the frame of STSM programme, (15-30 November 2013), I accomplished the basic part of fungi tests and the whole microfungi tests and also implemented a chemical analysis (FTIR analysis) of the thermally and chemically treated specimens.

The reactivity of the thermally treated and treated with organosilanes formulations wood was analyzed with the method of infrared spectroscopy - FTIR. Samples of wood powder were mixed with Potassium bromide KBr at a 1/200 mg

ratio and an Infinity Spectrophotometer was used offering spectra at a range of 500 - 4000  $\text{cm}^{-1}$  with 64 scans. In that way, structural analysis of bonds between wood and silicon compounds was accomplished.



Additionally, samples of pine wood thermally treated and also treated with AE-AP TMOS and Resin were mineralized in Mars-express CEM Internal semi-closed microwave mineralization system. For the Atomic Absorption Spectrometry - AAS method, samples of wood powder with silane formulations were prepared at room temperature, by stirring for 2 hours with magnetic bar, then filtered and left to dry. The extraction with deionized water lasted for 2 hours and the silane concentration in cellulose was detected.



The process of FTIR and AAS analysis of the treated material was necessary in order to explain and interpret some of the microfungi/fungi results, elucidate the behavior of the specimens of different treatments, and finally draw safe and useful conclusions about the treatments and their effect on surface durability of wood.

### **3. Description of the main results obtained**

During my stay in Poznan I learned the technique and experience the processes of biological durability tests, fungi and microfungi tests, chemical treatment of wood with organosilicon compounds and additionally I learned the technique of FTIR and AAS method for wood and treatment solution analysis. The great number of my obtained results values, at the moment, needs further processing and interpretation and allow only indicatively presenting the general tendency of the results, as it follows:

- ⊙ Thermally treated specimens revealed a slight improvement of fungi static properties of wood, compared to control specimens.

- ⊙ As the intensity of thermal treatment increases, the specimens seem to be less susceptible to fungal attack and growth.
- ⊙ Thermally treated specimens of pine wood did not seem to be effectively protected against micro fungi growth.
- ⊙ Chemical treatment of wood with organo-silane formulations enhances the problems of hygroscopicity and low resistance of wood against brown rot.
- ⊙ IR and AAS methods showed the reaction of wood components with organosilane formulations components, while the silane concentration during the reaction and after the extraction showed significant changes in bonds and structure of wood.
- ⊙ The reactivity of wood with silicon compounds corresponds to the effectiveness of this agent to enhancing wood hydrophobicity.

#### **4. Future collaboration with host institution**

My personal cooperation and cooperation of my home University (Aristotle University of Thessaloniki) with Poznan University of Life Sciences, as I believe, has been established. Future collaboration has been already discussed during my stay in Poznan and as it was concluded some publications on international journals will be the final result of our research and also collaboration through specific STSM actions in future will be investigated further, for me and for other master and doctoral students from both sides, as well.

#### **5. Foreseen publications/articles resulting or to result from the STSM**

Me and the research team of the host University plan in the very near future to prepare two publications on the basis of the gathered results. The first is almost ready to be sent and published, while I am just under preparation of the detailed results analysis for the second manuscript.

#### **6. Confirmation by the host institution of the successful execution of the STSM**

The document is in a separate file.

#### **7. Other comments**

During the period of my stay in Poznan for the STSM, I visited the laboratories of the whole Faculty, I had the chance to meet and discuss with researchers, professors and students of the Faculty, which was a very interesting experience for me. I also experienced and attended several researches of other doctoral students, seminars and scientific trips around Poznan city. Therefore, the period of STSM was very significant and creative for me personally and allowed me to exchange literature, knowledge, and research experiences.

I would like to thank warmly Professor Bartłomiej Mazela and the PhD Candidate of the laboratory Waldemar Perdoch for the constant help and support during my STSM period. Except for office space, they provided me also with a warm atmosphere during the whole period of my stay. The research team of the laboratory was also very helpful, and made me feel very comfortable and welcome. STSM was a fantastic experience for me and a unique opportunity to accomplish significant tests and obtain the necessary results for my project.

I should like also to express my thanks and appreciation to the MC of COST FP1006 and to the COST Administrative Secretariat for funding my trip, allowing me to carry out this Scientific Mission.

December 25, 2013, Thessaloniki, Greece  
PhD Candidate, Kamperidou Vasiliki