

REPORT OF A SHORT TERM SCIENTIFIC MISSION

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COST STSM Reference number	COST-STSM-FP1006-20828
STSM title	Influence of tool wear on morphological characteristics of the machined surfaces
Period	from 22nd of August 2014 to 27th of October 2014
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1. Purpose of the visit

The motivation to apply for the Short Term Scientific Mission (STMS) is to work on problem of influence of drilling tool wear on machined surfaces together with team of prof. dr. Marius-Catalin Barbu from Salzburg University of Applied Sciences, Campus Kuchl. Our department has already good connections with Salzburg University of Applied Sciences in Kuchl and through this STMS I try to acquaint with the methods and equipment for analyzing the surface quality that are used in Kuchl. In machining of parts, surface quality is one of the most specified customer requirements. As a mechanical engineer, responsible for mechanical processing technologies at Department of Wood Science and Technology, I combined in this research the knowledge from different scientific fields in order to explain how geometry of drilling tools affected on the newly formed surface.

2. Description of the work carried out during the visit

During my visit at the Salzburg University of Applied Science, Department for Forest Products Technology and Wood Construction, Kampus Kuchl, my work was divided in three parts:

- exchanging knowledge with students, researchers and professors at the department of Department for Forest Products and Wood Construction, Campus Kuchl;
- supporting the organization of International Conference (PTF BPI 2014);
- working on the project of investigation of the influence of drilling tool wear on quality of machined surface

2.1 Exchanging knowledge with students, researchers and professors at the Department for Forest Products Technology and Wood Construction

- At the beginning of the visit the coworker gave me guided visit of all laboratories in department, getting familiar with the experimental equipment and experimental research projects which are carried out at the Department for Forest Products Technology and Wood Construction.
- During my visit I participated in the defense of diplomas at Master and Bachelor study program.
- I was involved in discussions about the open issues on active project.

- I performed lectures on Master level in English on the field of woodworking machines, wood tooling and processing in the course »Wood-technological Processes & Procedures« for the Study Program »Forest Products Technology & Management«.

2.2 Supporting the organization of International Conference (PTF BPI 2014)

During my stay in Kuchl I became a member of the conference organizing committee and actively participated in the organization of 3rd International Conference on Processing Technologies for the Forest and Biobased Products Industries (PTF BPI 2014) which took place between 24th and 26th September 2014 in Campus Kuchl. The conference was very successful. This was also an opportunity for me to meet the researchers from all over the world and strengthen my personal research network.

2.3 Working on the project of investigation of the influence of drilling tool wear on quality of machined surface

In the furniture industry, furniture is most frequently made from surfaced, composite panels of medium (MDF) and low (PB) density. The drilling of holes through composite panels presents considerable problems in the assurance of a high quality edge on the outlet side of the hole. If the loads involved in drilling the hole through the composite are higher than the delamination value of the composite, the composite delaminates on the outlet side is most frequently unacceptable. Drilling loads depend on the technological parameters of machining, i.e., feed rate, tool rotation speed, tool geometry, and specimen properties. The structure and composition of the composite in particular have a strong influence on the tool wear as well. Today, composite panels can contain a large portion of recycled old furniture, and thus also contain a relatively great amount of particles that are not of a wood and lignocellulose origin. Most frequently, these are ground metal structural elements (screws, door hinges, metal guides, etc.) of the recycled furniture or sand and stones which were introduced into the composite raw material during transport and handling of waste furniture before the recycling process. In the event that during the process of drilling the tool comes in contact with such a foreign body in composite panel, the tool is instantaneously damaged, which considerably changes the tool geometry and increases the thrust force, consequently affecting the composite delamination on the outlet side of the hole.

In this study the proposed model for hole edge quality prediction on the outlet side was tested on an experimental model where the cutting forces and torque in the drilling direction were measured. The project was divided into two stages namely sample

preparation with drilling holes and the measurements of the holes and the analysis of the results to find the correlation between the drilling tool wear and the quality of the holes (surfaces). First part of the project was done in Laboratory of Mechanical Processing Technologies at the Biotechnical Faculty of the University of Ljubljana and the second part at Department for Forest Products Technology and Wood Construction at the Salzburg University of Applied Science in Kampus Kuchl.

In Laboratory of Mechanical Processing Technologies a clockwise rotating tool intended for drilling holes, produced by Leitz, with designation 34077, 8mm in diameter and with maximum drilling depth of 70 mm was used for drilling into a white, 18mm thick, laminated particleboard. A cyclic drilling program was used to drill series of 180 holes into the panels of 500mm x 700mm in size. The distance between holes was 15mm, the tool feed rate was 1800mm/min, and the tool speed was 6000 rpm. After each completed series of drilling, the thrust force was measured in the direction of drilling axis on the previously prepared five specimens, which were subsequently also used to determine the particleboard delamination factor. The measurements were performed in the Laboratory of Mechanical Processing Technologies at the Biotechnical Faculty of the University of Ljubljana. In Kuchl, each specimen was photographed and the area of particleboard delamination was measured using the photo processing program, which is shown below on Figure 1.

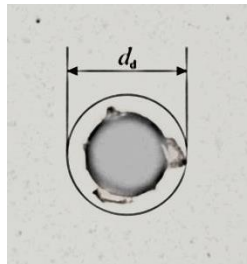


Figure 1: Graphic presentation of determining the delamination factor

Based on all measurements we defined the delamination factor $F_d=d_d/d$; where d_d is diameter of the circle drawn around delamination area in [mm] and d is hole diameter in [mm], Figure 1.

3. Description of the main results

The results of calculated delamination factors of five test specimens (Sp1...Sp5) after N drilled holes are shown in Table 1.

Table 1. The measured delamination factor

N	Delamination factor F_d					
	185	1110	2220	3330	4440	5550
Sp1	1,00	1,21	1,24	1,31	1,44	1,28
Sp2	1,00	1,30	1,36	1,25	1,26	1,33
Sp3	1,00	1,24	1,25	1,45	1,32	1,26
Sp4	1,00	1,00	1,15	1,22	1,22	1,35
Sp5	1,00	1,16	1,43	20	1,35	1,34
Avr.	1,00	1,18	1,29	1,29	1,32	1,31

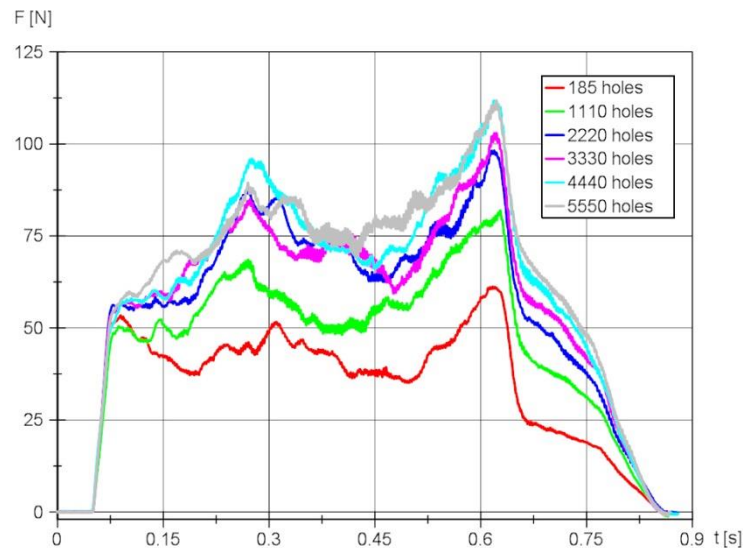


Figure 2: Measured averages of force in the direction of drilling

In the following research in February 2015 we will try to find the dependence of thrust force and the delamination factor on the number of drilled holes.

4. Future cooperation with host institution

This STMS allow me to strengthen my personal research network and the cooperation between my research group (Laboratory of mechanical processing technology at University of Ljubljana, Biotechnical Faculty, Department of Wood Science and Technology), and research group of FH-Prof.Univ.-Prof.Dr.-Eng.Dr. Marius-Catalin

Barbu from Salzburg University of Applied Sciences, Department for Forest Products Technology and Wood Construction in Kuchl.

Cooperation with Department for Forest Products Technology and Wood Construction, Campus Kuchl will continue also in the future. Results of this STSM showed additional topics that would be needed in the future to investigate and we already agreed for my second short stay in Kuchl in February 2015.

As a result of this short term scientific mission and my next visit in February 2014 a common article is planned to be published.

5. Acknowledgments

The financial support, provided by COST organization, to this short term scientific research project presented in the report is gratefully acknowledged. Special thanks go to dr. Stefanie Wieland, a chair of COST Action FP1006 and Ms. Ingrid Seidl a Grant holder Administration of COST Action FP1006, for their help and support through the application process.

Last but not least, special thanks go to FH-Prof. Univ.-Prof.Dr.-Eng.Dr. Marius C. Barbu, Head of the Forest Products Technology at the Department for Forest Products and Wood Construction at the Salzburg University of Applied Sciences, Campus Kuchl, for his availability and all useful advices.

Appendix

1. Confirmation by the host institute of the successful execution of the mission.

Prepared by:



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Ljubljana, 28.10.2014