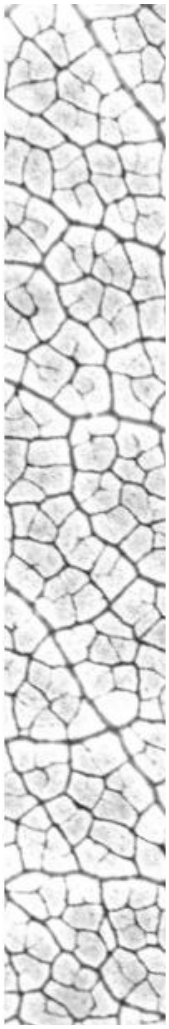

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Noise levels of pollution during processing of maple wood (Albania)

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Abstract
The acoustic pollution is an environmental contaminant, which is known as a real threat to people's health and quality of life. The noise is one the main professional noxious in woodworking industries. The wood processing employees are exposed to work hazards starting from various accidents at work, to the risks of contaminations by wood dusts, noise pollution, chemical agents etc. This study consists in analyzing the noise levels during the processing of maple timber samples in planner and spindle moulder which are available in woodworking facility of the Faculty of Forest Sciences of Tirana. From all the measurements, it resulted that during the maple samples processing in planner machine, the noise levels don't exceed the permissive noise level of 85 dB(A), while during the maple samples processing in Spindle moulder the levels of noise are higher, exceeding the permissive noise level of 85 dB(A) in both feeding rates. By increasing of feeding speed from V1 to V2, the Equivalent Noise Level (dB) is increased too.

Keywords: noise pollution, maple, noise level, planner machine, spindle moulder

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INTRODUCTION

In a transitional economy people are exposed to various noises of hard work such as construction works, stone and marble quarries, road works, and heavy equipments. Further to that the wood processing industry is a very important industry with a considerable number of employees. The woodworking industry is one of the noisiest working environments. Noise levels can vary widely between machines depending on their use. Every day, thousands of employees in Europe and worldwide are exposed to noise pollution and to hazards that this noise causes in the work environment (EASHW, 2004; Serin et al. 2017; Jianu and Rosen, 2017) About one third of employees are surrendered to high level noise more than one fourth of their work time (EASHW,2004; EC, 2008; John et al. 2018). Noise may be defined as unwanted sound. There are data that a noise may at least weaken the effectiveness at work; affects health and increases the rate of incidents. At much higher levels, noise can damage hearing immediately, but even lower levels can have gradual hearing damage. Influence of noise to health of employees expresses as more frequent breathing, loss of concentration and too high blood pressure. Noise can cause hearing impairment, interfere with communication, disturb sleep, cause cardiovascular and psycho-physiological effects, reduce performance, and provoke annoyance response and changes in social behavior and it also increases the rate of incidents (WHO, 1999). The Occupational Health and Safety Administration (OSHA, 1983) determined the Noise exposure limits to be 85 dB and 87 dB. While continuous working time is 16 hours in 80 dB, 8 hours in 85 dB, 15 min in 100 dB and 0.9 s in 130 dB. Many studies were carrying out all over the world to determine the effects of noise on the human health and actually the industry is governed by noise regulations adopted by OSHA (Occupational Safety and Health Administration) and also many studies are carried out to see the factors that affect in noise levels in wood processing factories.

Machinery noise emission is dependent on a lot of factors as stated by D'Angelo et al. 1985, and among these factors are the cutting tool, wood species, length, width, thickness of material, feeding rate, cutting speed, cutting depth, sharpness of cutter, cutter design, vibration of machine parts etc. Staša et al (2008) stated that as the result of wearing out of woodworking cutting instruments, the noise of level is increased. Kvietková et al. (2015) stated the number of circular saw blade in the cutting process affected the noise level and it was found

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that for the saw blades with fewer teeth, the noise values were greater, while Krilek et al. (2016) studied the effect of the circular saw blade tooth spacing on the Equivalent noise process Laeq in the process of cross cutting wood and it was found that the circular saw blade with uniform tooth spacing has lower equivalent noise level at smaller feeding speed and cutting soft wood species. The circular saw blade with non-uniform tooth spacing has lower equivalent noise level at higher feeding speed. Svorenet al. (2010) studied the effect of the shape of compensating slots in the body of a circular saw blade on noise level in the cutting process and they stated that the circular saw blades with compensating slots emitted high cutting noise level but their noise level was different. The circular saw blade with sigmoid compensation slots had the lowest noise levels in the range of (2-5) dB(A) as compared with the others saw blades. Planning, boring, auxiliary and top surface machine groups, which exceed 90 dB(A) noise level, should be running maximum 4 hours according to OSHA (1983) while the machines are running with loading.

Durcan and Burdurlu (2018); Melamed et al. 1995 studied the effects of type of wood, number of blades and depth and width of cutting in the noise level during machining of wooden materials in a spindle moulder. There were used three type of materials: Lombardy poplar, Oriental beech and MDF at the different thickness of material, that were planned for 20 min at the same feeding rate and at the cutting depth of 1 mm, 2 mm, 3 mm or 3 mm with one or four blades. According to the data obtained the highest noise level connected to the type of materials was measured in the machining of poplar wood, followed by that of of beech wood and MDF. As the thicknesses of the materials were increased, increases up to 9 dBA of the noise level were measured. Moreover, machining the materials with one blade instead of four and with a cutting width of 1 mm instead of 3 mm increased the noise level by 2 dBA and 6 dBA, respectively.

This approach consists in analyzing the noise levels during the use of maple samples in planner machine and spindle moulder. The objective of this study is evaluating the noise levels during the mechanical processing of maple in function of feeding speed and the used machines. According to the European Directive 2003/10/EO, the upper limit for a workplace noise exposure based on the eight-hour working day is determined to be $L_{EX, 8h}$ = 85 dB(A) (EU, 2003).

MATERIAL AND METHODS

The tests were performed using the maple timber from the hardwoods as one of the most widespread species in Albanian forest and among the most useful types of wood in Albanian wood industry. The samples dimensions were 36 x 36 x 800 mm. The maple density is 680 kg/m^3. For all samples were taken moisture measurements, which resulted an average moisture of 12.89 % to 13.20 %.The samples were processed in a universal woodworking machine, consisting in planner and spindle moulders, which is available at the woodworking lab of the Faculty of Forest Sciences in Tirana. The planner knives dimensions 300 x 30 x3 mm. The spindle moulder cutter head has four exchangeable HWM (Solid tungsten carbide) straight knives. The technical data of Spindle Moulder and Planner machine are presented in **Table 1**.

Table 1. Technical details of Spindle Moulder and planner machine

Machine	Technical data	
Spindle Moulder	Spindle saw blade Diameter d (mm)	30
	Cutterhead diameter D (mm)	180
	Spindle rotation speed (RPM)	3600
	Motor Power (KW)	2.2
	Straight Knives dimensions (mm)	50 x 12 x 1.5
	Number of knives Z	4
Planner machine	Cutterhead diameter D (mm)	124
	Spindle rotation speed (RPM)	3600
	Motor Power (KW)	2.2
	Straight Knives dimensions (mm)	300 x 30 x 3
	Number of knives Z	3

Fig. 1. A. General view of woodworking machine; B. Cutter head of Spindle Moulder and automatic feeding device

During the tests, two feeding rates were used V1 = 3m/min and V2 = 7m/min, which differ considerably among them. The method for such measurements are those approved by the WHO (World Health Organization) and used by the PHI (Public Health Institute of Albania), which is officially responsible for these kinds of measurements. PHI is referred as reference authority for Albania by EU as well. The tests were done in collaboration with the Public Health Institute of Albania and their experts provided the Noise measurement device and were responsible for its calibration. For noise measurements, the Sound Level Metter EXTECH 407764 RS-232/Datalogger equipment was used. This instrument enables to perform measurements every 3 seconds, i.e. about 20 readings per minute. The measurements were in dB (A) (**Fig. 1** and **2**). The measurement from the noise source at a distance about 1.5 m, were according the European Union (EU) Directive 86/188/EEC. The device was placed near the employee's ear performing the work.

Initially it was preceded by passing the samples into the planner machine for two minutes without

Fig. 2. A. Sound Level Meter EXTECH 407764; B) Measurements of Noise levels (dB)

Table 2. The Average Noise Levels Laeq

Average value of Equivalent Noise Level Laeq				
Feeding rate	**Material**	**Machine**	**Thickness (mm)**	**Laeq**
V1	Maple	Planner	36	81.44
V1	Maple	Planner	36	80.13
V1	Maple	Planner	36	80.323
V1	Maple	Planner	36	79.95
V1	Maple	Router	36	88.24
V1	Maple	Router	36	87.942
V1	Maple	Router	36	87.56
V1	Maple	Router	36	88.014
V2	Maple	Planner	36	81.78
V2	Maple	Planner	36	82.01
V2	Maple	Planner	36	82.54
V2	Maple	Planner	36	81.98
V2	Maple	Router	36	89.82
V2	Maple	Router	36	90.15
V2	Maple	Router	36	89.01
V2	Maple	Router	36	90.23

interruption. Every measurement lasts 2 minutes and Sound Level Metter read every 3 seconds the Equivalent Noise Level Laeq. The measurements for each group were carried out for two feeding rates. The thickness of the processing is 1 mm for each case. After the measurements in the planner machine, it was proceeded with the measurements in the Spindle moulder for each feeding rate. (it means nearly 40 measurements of noise levels in one series). Four series of measurements were performed in planner machine and spindle moulders for each feeding rate. All the data obtained the measurements were subject to statistical processing.

RESULTS

The Average Noise Levels Laeq for the different work regimes are given in **Table 2**.

Following the data presented in **Table 2**, the average values of Noise Levels Laeq oscillates from 79.95 to 90.23 dB.

The Equivalent Noise Levels results from the maple samples processed with two feeding rates in planner machine

The maple samples were processed with two feed speed in planner machine. In **Table 3** are given the Equivalent Noise levels Laeq (dB) resulting from the

Table 3. Average Equivalent Noise Levels Laeq (dB)

Feeding Rate	Thickness h (mm)	Mean	Test No.	Stand. Dev.
V1	36	80.461	4	0.6703
	Mean	80.461	4	0.6703
V2	36	82.078	4	0.3247
	Mean	82.078	4	0.3247
Mean	36	81.269	8	0.8146
	Mean	81.269	4	0.8146

Table 4. Average Equivalent Noise Levels Laeq (dB)

Feeding Rate	Thickness h (mm)	Mean	Test No.	Stand. Dev.
V1	36	87.939	4	0.2828
	Mean	87.939	4	0.2828
V2	36	89.8025	4	0.5573
	Mean	89.8025	4	0.5573
Mean	36	88.8708	8	0.4307
	Mean	88.8708	8	0.4307

maplesamples worked in planner machine for the two feeding rates.

From **Table 3** and chart datas it is noticed that the Equivalent Noise Level (dB) during the maple samples proceesing in planner machine for the two feeding speed, doesn't exceed the Permissible Level Noise Limit of 85 dB and by increasing the feeding speed from V1 to V2, the Equivalent Noise Level is increased (**Table 3** and **Fig. 3**).

The maple samples were processed with two feeding rates in Spindle moulder

The maple samples were processed with two feed speed in planner machine. In the following table are given the Eqivalent Noise levels Laeq (dB) resulting from the maple worked in Spindle moulderfor the two feeding rates.

From **Table 4** and **Fig. 3**, it is noticed that the Equivalent Noise Level (dB) during the maple samples proceesing in Spindle moulder for the two feeding speed, exceeds the Permissible Level Noise Limit of 85 dB (EU, 2003)., reaching the max value of 89.8025 dB and by increasing the feeding speed from V1 to V2, the Equivalent Noise Level is increased.

CONCLUSION

According to all the measurements of maple samples processed in Planner machine and Spindle moulder with two different speed feeds: (i) The spindle moulder results in higher levels of noise by exceeding considerably the permissive noise level of 85 dB; (ii) The level of noise resulting from the processing of maple in planner machine doesn't exceed the permissive noise level of 85 dB for both feeding speed and (iii) By increasing the feeding rate from V1 to V2 increases the noise levels, for all the work regimes carried out, because the cutting forces are larger working with V2 feeding speed.

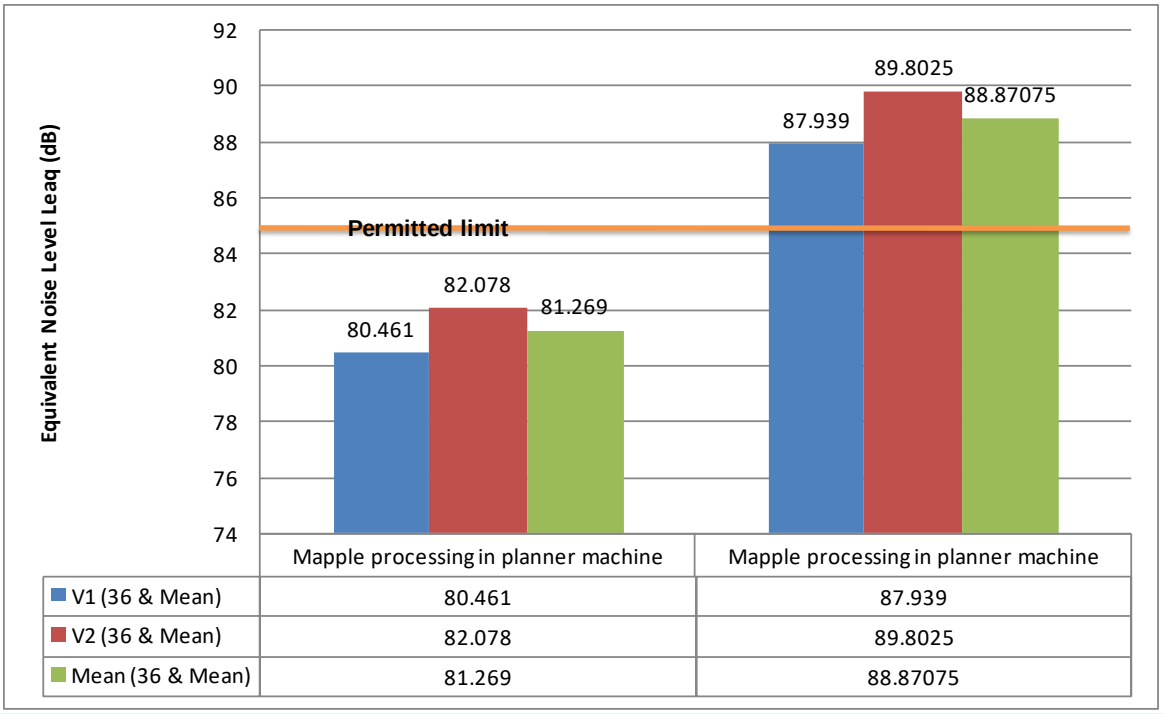

Fig. 3. Equivalent Noise Level (dB) during the processing of maple in planner machine and during the processing of Maple in router machine

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