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ANALYSIS OF NOISE LEVEL AT MDF AND PARTICLEBOARD PROCESSING WITH DIFFERENT FEEDING SPEED

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Abstract:

The wood processing employees are exposed to work hazards starting from various accidents at work, to the risks of contaminations by wood dusts, acoustic pollution, chemical agents etc. The noise pollution is an environmental contaminant, which is known as a real threat to people's health and quality of life.

This study consists in analyzing of noise levels during the processing of wood base panels such as MDF and Particleboard with two different feeding speeds and two different thickness of material.

MDF is processed in spindle moulder and circular saw, particleboard material is processed only in circular saw, which are available in woodworking facility of the Faculty of Forest Sciences of Tirana. The measurement method of noise levels are those approved by WHO (World Health Organization) and used by the PHI – Public Health Institute of Albania. All measurements are done using the Sound Level Metter EXTECH 40 7764 RS-232/Data logger equipment.

The Spindle moulder machine results in higher levels of noise, exceeding considerably the permissive noise level of 85 dB. The level of noise resulting from circular saw machine by processing MDF is much smaller than the noise level resulting from circular saw machines during operation of particleboard samples.

In general, by increasing the feeding rate from V1 to V2 increases the noise level, for all the work regimes carried out.

Key words*: acoustic pollution; feeding speed; MDF; particleboard; circular saw.*

INTRODUCTION

The acoustic pollution is an environmental contaminant, which is known as a real threat to people's health and quality of life. (Lawrence *et al*. 2005).

Every day, millions of employees in Europe and worldwide are exposed to noise pollution and hazards that this noise causes in the work environment* (European Agency for Safety and Health at Work, 2005, Reducing the risks from occupational noise). The noise is one of the main professional noxious in woodworking industries (Godan 2009).

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 (Factsheet 258, 'Occupational and community noise', World Health Organization, revised 2001).

The Ocupational Health and Safety Administration (OSHA) determined the Noise exposure limits to be 85 dB and 87 dB. While the continouos 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.

The woodworking industry has experienced noise level increase as a result of modern, higher speed, and more compact machines (Samir *et al*. 2013).

The noise levels from the machining wood operations are affected by many factors as wood species, length, width, thickness of the material, feeding rate, cutting speed, cutting depth, sharpness of cutter, cutter design, vibration of machine parts etc.

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Many studies are carried out to see the factors that affect in noise levels in wood processing factories.

Kvietková *et al.* (2015) statied the number of circular saw blade in the cutting process affected the noise level and it was found that for the saw blades with fewer teeth, the noise values were greater.

Krilek *et al.* (2016) studied the effect of the circular saw blade tooth spacing on the Eqiuvalent noise process Laeq in the process of cross cutting wood. There were used three wood species Spruce, pine and beech, two feeding speeds were set up with the same revolutions of circular saw blades. There 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 eqiuvalent noise level at higher feeding speed.

Svoren *et 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 statied that the circular saw blades with compensating slots emited high cutting noise level but their noise level was different. The circular saw blade with sigmoid compensationg slots had the lowest noise levels in the range of (2-5) dB(A) as compared with the others saw blades.

Durcan and Burdurlu (2018) studied the effects of the types 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 20min at the same feeding rate and at the cutting depth of 1mm, 2mm, 3mm or 3mm 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, increses 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 3mm increased the noise level by 2 dBA and 6 dBA, respectively.

Other studies are done in wood processing factories, measuring noise concentration exposure by the workers of this industry and the audiometric hearing tests showed that the wood industry is among the industries with highest level of noise exposure. Some sectors as the rough milling sections of the wooden furniture factories are exposed to noise levels higher than the permissable one, comparing to other sectors. (Fairfax *et al*. 1996)

Ratnasingam *et al*. (2010) studied noise concentration exposure by the workers working in the machines of tenoner, multi borer, mortiser, moulder, thicknesser and narrow bandsaw in different sectors of 30 factories in the Southeast Asian region. They showed that the noise concentration level changed between 40 dBA and 150 dBA according to the machine type. The noise levels were 130 dBA in the rough milling department. The noise concentration levels of five machines were above the standard noise concentration level (85 dBA).

As the industrial noise pollution can present health and social problems to the workers, the concerns about reducing noise pollution are multiplying. Noise control methods are effective when all the factors related to the nature of noise, device which produces noise, the propagation pathways and environment in which it propogates are studied. Owoyemi *et al*. (2016) after analyzing the sources of the noise pollution in the wood processing industry, the effects of industrial noise pollution at the health of the workers they give the noise control techniques as sound insulation, sound absorption, vibration damping and vibration isolation.

Currently, the Albanian furniture manufacturing industry uses wood-based panels as raw material, which has considerably reduced the solid wood consumption.

The study consists in analyzing noise levels during the processing of MDF and particleboard in Spindle moulder and circular saw machines.

The objective of this study is to estimate the noise level during the mechanical processing of wood based panels in function of feeding rates and used machines.

MATERIAL AND METHODS

The tests were performed using MDF and Particleboard samples, which are commonly used as raw materials in the wood processing industry.

The MDF density is 650 kg/m^3 and the particleboard density is 620kg/m^3.

MDF samples were 36 x 36/18 x 800mm.

Particleboard samples were 36 x 36/18 x 800mm.

The samples were processed in a universal woodworking machine, consisting in circular saw and spindle moulder, which is available at the woodworking lab of the Faculty of Forest Sciences in Tirana. The circular saw blade is a heavy duty laser cut HRC44 plate with industrial Micro-grain carbide for long life. The spindle moulder cutter head has four exchangeable HWM (Solid tungsten carbide) straight knives.

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Fig. 1.
General view of woodworking machine and automatic feeding device.

Fig. 2.
Cutter head of Spindle Moulder.

Fig. 3.
MDF and particleboard samples.

Fig. 4.
Measurements of Noise levels.

During the tests, two feeding rates, which differ considerably among them, were used:

- V1 = 3 m/min;
- V2 = 7 m/min.

The technical datas about the Spindle moulder and circular saw are presented in Table 1.

Table 1

Technical details of Spindle Moulder and circular saw

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
Circular saw	Disk Diameter D (mm)	250
	Kerf Thickness (mm)	3.2
	Number of teeth z	80
	Pitch p (mm)	8.2
	γ the clearance angle °	15
	α the rake angle °	10
	Rotation speed (RPM)	3600
	Motor Power (KW)	2.2

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. 5.
Sound Level Meter EXTECH 407764.

The noise level measurements were in accordance with ISO 9612 (2009). The device was placed near the employee's ear performing the work.

The measurements were performed by passing without interruption the samples into the machine for two minutes. The measurements for each group were carried out for the two feeding rates.

Four series of measurements were performed in the Spindle moulder and circular saw for each feeding rate by using samples of 18 and 36mm thickness, (it means nearly 40 measurements of noise levels in one series).

For the Particleboard samples, the measurements were carried out in the circular saw machine with two-feeding rates by using samples of both thickness of 18 and 36mm. All the measurement datas were subject to statistical processing.

Table 2

Measurements for the two materials

MACHINES / MATERIALS / Feeding speed		MDF		PARTICLE BOARD	
		Thickness		Thickness	
		18mm	36mm	18mm	36mm
SPINDLE MOULDER	V1	+	+	-	-
	V2	+	+	-	-
CIRCULAR SAW	V1	+	+	+	+
	V2	+	+	+	+

RESULTS AND DISCUSSION

The tests for measuring of the noise amount were carried out with MDF and particleboard samples in Spindle moulder and Circular-saw machine.

a - MDF measurements results in Spindle moulder

MDF samples were processed with two feed speed in Spindle moulder.

In the following table are given the Equivalent Noise Levels Laeq (dB) resulting from the MDF samples processed in Spindle moulder with two feeding rates, for the 18mm e 36mm thickness of samples.

Table 3

Average Equivalent Noise Levels - Laeq (dB) for MDF

Feed Speed	Thickness h (mm)	Laeq (dB)	Tests Nr	Standard Dev
V1	18	89.6100	4	.59655
	36	89.1750	4	.10599
	Mean	89.3925	8	.45977
V2	18	89.4450	4	.40121
	36	89.5900	4	.37727
	Mean	89.5175	8	.36877
Mean	18	89.5275	8	.47883
	36	89.3825	8	.33915
	Mean	89.4550	16	.40777

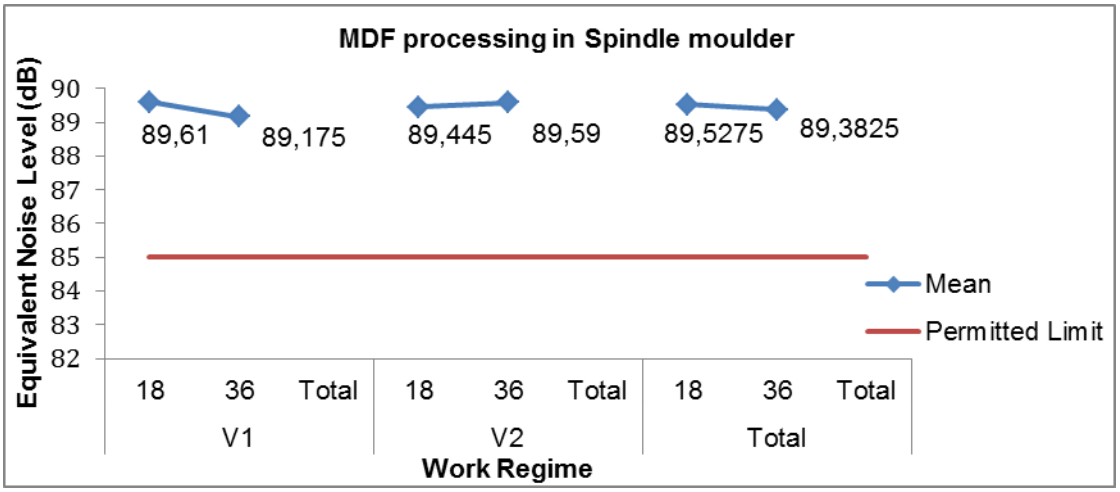

Fig. 6.
Average Equivalent Noise Level (dB) during the MDF processing in Spindle moulder.

From the table and chart datas it is noticed:

- The Equivalent Noise Level (dB) during the MDF samples processing in Spindle moulder in all the works regimes, exceeds the Permissible Level Noise Exposure of 85 dB.
- By increasing the Feed speed from V1 to V2, no increase is noticed of Equivalent Noise Level.
- The noise level for the V1 Feed speed is decreased with the increase of samples thickness, while for the V2 Feed Speed the Noise level is increased with the increase of samples thickness.

b - MDF measurements results in Circular Saw Machine

MDF samples were processed with two feed speeds in circular saw machine.

In the following table are given the Equivalent Noise Levels Laeq (dB) resulting from the MDF samples processed in circular saw machine with two feeding rates, for the 18mm e 36mm thickness of samples.

Table 4

Average Equivalent Noise Levels - Laeq (dB) for MDF

Feed Speed	Thickness h (mm)	Laeq (dB)	Tests Nr	Standard Dev
V1	18	83.1800	4	1.01751
	36	81.1450	4	.16980
	Mean	82.1625	8	1.28034
V2	18	85.2875	4	.35781
	36	83.4700	4	.23777
	Mean	84.3788	8	1.01138
Mean	18	84.2338	8	1.32951
	36	82.3075	8	1.25740
	Mean	83.2706	16	1.59755

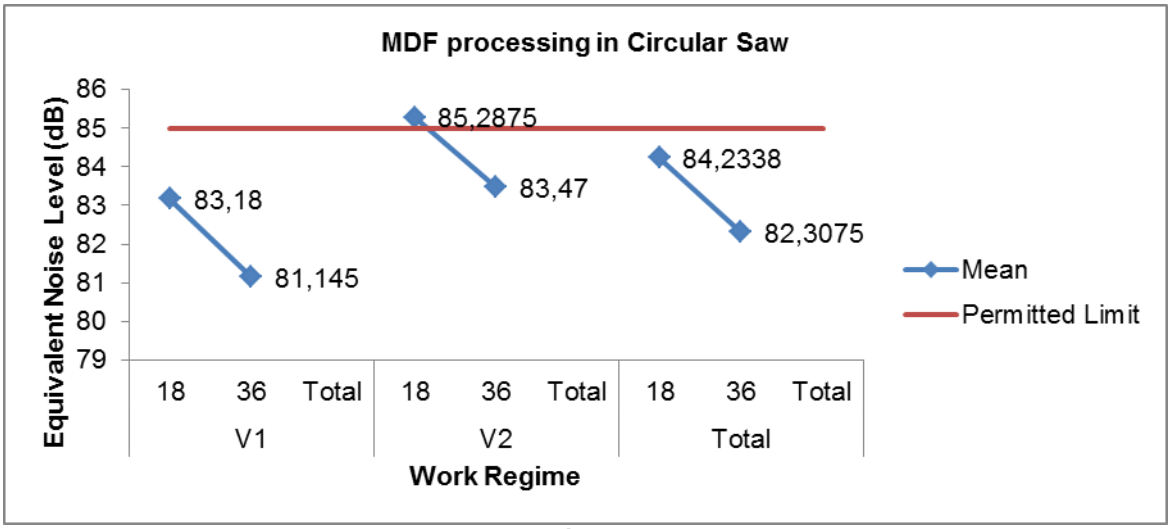

Fig. 7.
Average Equivalent Noise Level (dB) during the MDF processing in Spindle moulder.

The results of the measurements done in circular saw machine during the MDF processing showed:

- The Equivalent Noise Level (dB) during the MDF samples processing in Spindle moulder in all the works regimes, doesn't exceed the Permissible Level Noise Exposure of 85 dB, except the work regime with V2 feed speed, for 18 mm material thickness that goes 85.28 dB.
- By increasing the Feed speed from V1 to V2, the Equivalent Noise Level of the circular saw increases.
- The average noise level, for the two Feed speeds, is decreased with the increase of samples thickness.

c - Particleboard measurements in Circular Saw Machine

Particleboard samples were processed with two feed speeds, for two thicknesses of samples in circular saw machine.

In the following table are given the Equivalent Noise Levels Laeq (dB) resulting from the Particleboard samples processed in circular saw machine with two feeding rates, for the 18mm e 36mm thickness of samples.

Table 5

Average Equivalent Noise Levels for Particleboard

Feed Speed	Thickness h (mm)	Laeq (dB)	Tests Nr	Standard Dev
V1	18	85.4250	4	.49088
	36	83.2700	4	1.40487
	Mean	84.3475	8	1.50864
V2	18	86.2500	4	.41336
	36	85.6800	4	.34380
	Mean	86.4750	8	.42631
Mean	18	85.8375	8	.60907
	36	84.7550	8	2.06347
	Mean	85.4113	16	1.53426

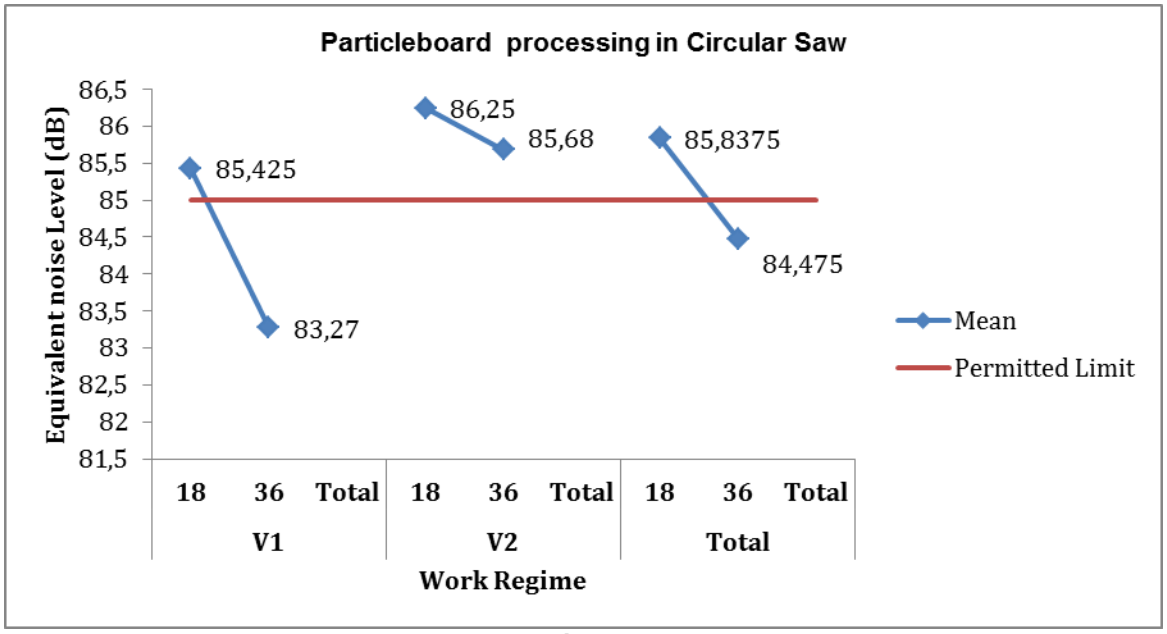

Fig. 8.
Average Equivalent Noise Level (dB) during the Particleboard processing in Circular saw machine.

The results of the measurements done in circular saw machine during the Partibleboard processing showed:

- The Equivalent Noise Level (dB) during the Particleboard samples processing in Spindle moulder in all the works regimes, exceeds the Permissible Level Noise Exposure of 85 dB, except the work regime with V2 feed speed, for 36mm material thickness.
- By increasing the Feed speed from V1 to V2, increases the Equivalent Noise Level for both thickness of material.
- By increasing the thickness of material from 18mm to 36mm, the noise level is decreased.

CONCLUSIONS

According to all the results of the measurements to the MDF and Particleboard processed in Spindle moulder and circular saw machine, with two different speed feed and two thickness of materials:

- The Spindle moulder results in higher levels of noise, exceeding considerably the permissive noise level of 85 dB.
- The level of noise resulting from circular saw machines by MDF processing is much smaller than the noise level resulting from circular saw machines during operation of particleboard samples.
- In general, by increasing the feeding rate from V1 to V2, the noise level increases, for all the work regimes carried out.
- In general, by increasing the thickness of material from 18mm to 36mm, the noise level decreases.

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