THE ANNALS OF "DUNAREA DE JOS" UNIVERSITY OF GALATI
FASCICLE XIV MECHANICAL ENGINEERING, ISSN 1224 – 5615
2008

ACOUSTIC ABSORPTION COEFFICIENT VARIATION OF SOUND ABSORBING STRUCTURES AND MATERIALS

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ABSTRACT

The task of this work is the acoustic absorption coefficient variation study of sound absorbing structures and materials. Three construction equipments have been considered according to their different cabin design. Different sound frequencies and different layers of diverse sound absorbing treatment lead to different absorption average coefficient values.

KEYWORDS: Sound, Frequency, Absorption, Coefficient, Cabin .

1. Introduction

The cabin is exposed to the noise generated by sources which are parts of the construction equipment.

$$\Delta L = 10\lg\frac{A}{A_0}\ [dB] \tag{1}$$

A_0 - equivalent acoustic absorbing surface of the cabin before insulating, treatment (m2AU); A - equivalent acoustic absorbing surface of the cabin after insulating treatment (m2AU)

The following relation is considered for the equivalent absorbing surface:

$$A = \sum_{i=1}^{n} \alpha_i S_i \tag{2}$$

S_i - the surface corresponding to "i" partial cabin area; α_i - acoustic absorbing coefficient corresponding to "i" area.

The average acoustic absorbing coefficient is calculated as shown below:

$$\alpha_m = \frac{\sum \alpha_i S_i}{S} \tag{3}$$

Acoustic absorbing inside the cabin it is also characterized by the absorption constant "R"[2], [3]:

$$R = \frac{\alpha_m S}{1-\alpha_m} \tag{4}$$

2. Case study

2.1. MMT 45 equipment

The following values have been considered for MMT 45 equipment cabin:

$S_1 = 4.7m^2$, $S_2 = 1.7m^2$, $S_3 = 3.8m^2$.

Table no. 1
Four layers

f	α	α_{med}	ΔL	R
250	0,1	0,071	0,61	0,775
500	0,4	0,209	5,318	2,692
1000	0,8	0,393	8,066	0,502
1600	0,88	0,43	8,455	2,031
2500	0,92	0,448	8,637	0,408

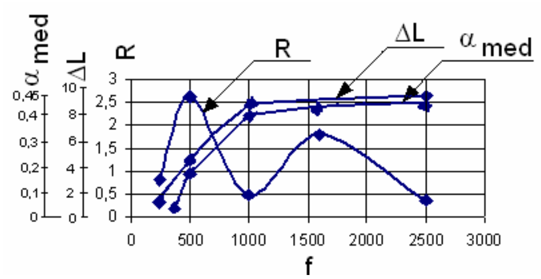

Figure 1- Plotting $R, \Delta L, \alpha_{med}$ function f for four layers for MMT 45 equipment

Table no. 2
Three layers

f	α	α_{med}	ΔL	R
250	0,06	0,052	0,71	0,561
500	0,28	0,154	3,982	1,85
1000	0,54	0,273	6,487	0,211
1600	0,83	0,407	8,216	1,27
2500	0,99	0,481	8,939	0,195

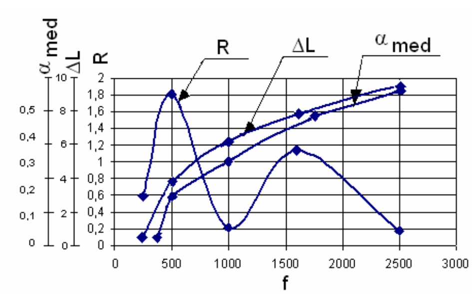

Figure 2 - Plotting $R, \Delta L, \alpha_{med}$ function f for three layers for MMT 45 equipment

Table no. 3
Two layers

f	α	α_{med}	ΔL	R
250	0,03	0,038	2,04	0,407
500	0,17	0,103	2,242	1,169
1000	0,29	0,158	4,111	0,076
1600	0,56	0,283	6,631	0,46
2500	1	0,485	8,98	0,072

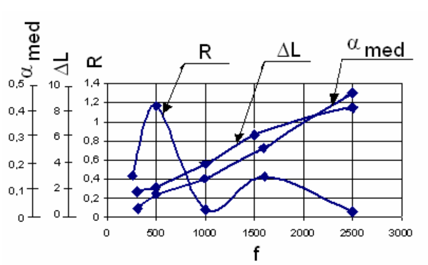

Figure 3 - Plotting $R, \Delta L, \alpha_{med}$ function f for two layers for MMT 45 equipment

Table no. 4
One layer

f	α	α_{med}	ΔL	R
250	0,08	0,061	0	0,667
500	0,11	0,075	0,882	0,829
1000	0,26	0,144	3,713	0,112
1600	0,21	0,121	2,958	0,114
2500	0,31	0,167	4,357	0,023

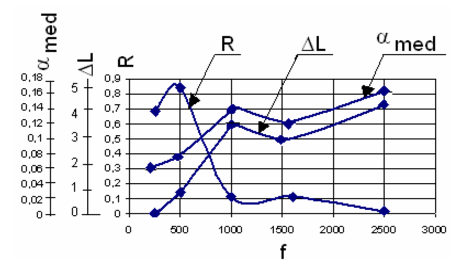

Figure 4 - Plotting $R, \Delta L, \alpha_{med}$ function f for one layer for MMT 45 equipment

2.2. S 1201 excavator

For S 1201 excavator the following values cabin: $S_1 = 3.8m^2$; $S_2 = 1.2m^2$; $S_3 = 511m^2$.

Table no. 5
Four layers

f	α	α_{med}	ΔL	R
250	0,1	0,062	0,56	0,673
500	0,4	0,174	5,037	2,145
1000	0,8	0,323	7,728	0,322
1600	0,88	0,353	8,111	1,171
2500	0,92	0,368	8,291	0,187

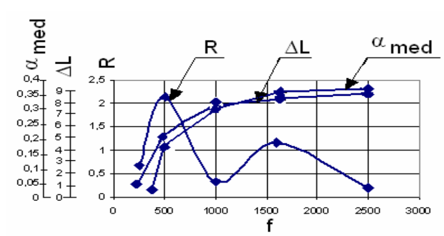

Figure 5 - Plotting $R, \Delta L, \alpha_{med}$ function f for four layers for S 1201 excavator

Table no. 6
Three layers

f	α	α_{med}	ΔL	R
250	0,06	0,047	0,64	0,503
500	0,28	0,129	3,745	1,511
1000	0,54	0,226	6,178	0,147
1600	0,83	0,335	7,876	0,759
2500	0,99	0,394	8,589	0,096

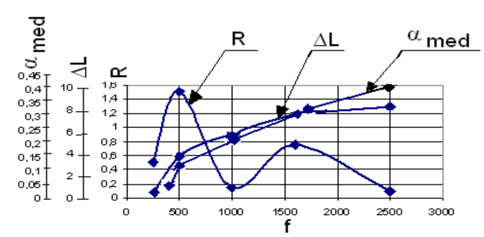

Figure 6 - Plotting $R, \Delta L, \alpha_{med}$ function f for three layers for S 1201 excavator

Table no. 7
Two layers

f	α	α_{med}	ΔL	R
250	0,03	0,036	1,82	0,379
500	0,17	0,088	2,084	0,984
1000	0,29	0,133	3,868	0,058
1600	0,56	0,234	6,319	0,3
2500	1	0,398	8,63	0,038

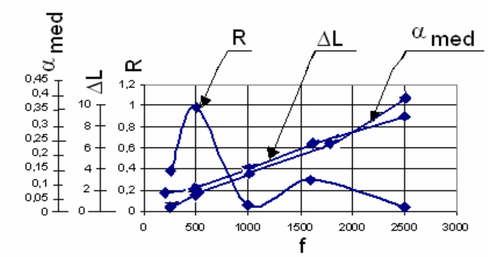

Figure 7 Plotting $R, \Delta L, \alpha_{med}$ function f for two layers for S 1201 excavator

Table no. 8
One layer

f	α	α_{med}	ΔL	R
250	0,08	0,055	0	0,587
500	0,11	0,066	0,811	0,717
1000	0,26	0,122	3,486	0,081
1600	0,21	0,103	2,763	0,082
2500	0,31	0,14	4,105	0,013

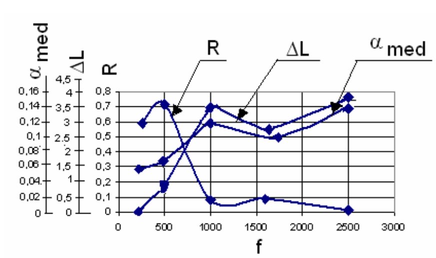

Figure 8 Plotting $R, \Delta L, \alpha_{med}$ function f for one layer for S 1201 excavator

2.3 CVA 10 vibrating compactor

Consideredvalue: $S_1 = 4{,}5m^2; S_2 = 2{,}1m^2$ $S_3 = 2{,}2m^2$.

Table no. 9
Four layers

f	α	α_{med}	ΔL	R
250	0,1	0,07	0,57	0,787
500	0,4	0,2	5,109	2,603
1000	0,8	0,373	7,815	0,469
1600	0,88	0,408	8,2	1,793
2500	0,92	0,425	8,381	0,347

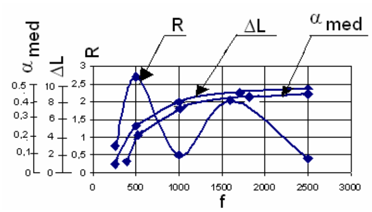

Figure 9 - Plotting $R, \Delta L, \alpha_{med}$ function f for four layers for CVA 10 vibrating compactor

Table no. 10
Three layers

f	α	α_{med}	ΔL	R
250	0,06	0,053	0,66	0,583
500	0,28	0,148	3,805	1,81
1000	0,54	0,261	6,258	0,206
1600	0,83	0,386	7,964	1,139
2500	0,99	0,455	8,68	0,172

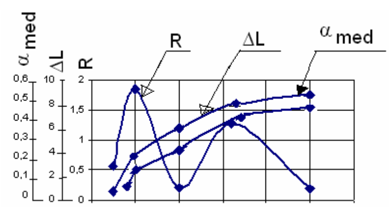

Figure 10 - Plotting $R, \Delta L, \alpha_{med}$ function f

Table no. 11
Two layers

f	α	α_{med}	ΔL	R
250	0,03	0,04	1,87	0,434
500	0,17	0,101	2,124	1,164
1000	0,29	0,153	3,93	0,078
1600	0,56	0,269	6,399	0,429
2500	1	0,46	8,721	0,067

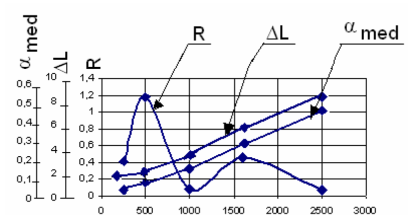

Figure 11 - Plotting $R, \Delta L, \alpha_{med}$ function f for two layers for CVA 10 vibrating compactor

Table no. 12
One layer

f	α	α_{med}	ΔL	R
250	0,08	0,062	0	0,684
500	0,11	0,075	0,829	0,84
1000	0,26	0,14	3,544	0,111
1600	0,21	0,118	2,813	0,112
2500	0,31	0,161	4,17	0,021

S_1 - sound absorbing treated geometric surface; S_2 - sound absorbing untreated metallic surface; S_3 - glass surface.

3.Conclusions

A study of acoustic absorption coefficient variation for sound absorbing structures and materials considering three construction equipments has been performed. The sound material has been considered from one to four layers [1]. Different values have been determined for: R-absorption constant, ΔL - global noise reducing, α_{med} -sound absorbing average coefficient. Different frequencies have been considered. The results can be compared considering the tables below[4]. Notations in the tables above: FB – very good, C – onstant, B – good, S–low.

Table no. 13

Equip ment	Para- metes	Frequency				
		250	500	1000	1600	2500
MMT 40	R	FB	S	B	FB	B
	ΔL	FB	B	C	C	C
	α_{med}	FB	B	C	C	C
S 1201	R	FB	B	B	FB	B
	ΔL	FB	FB	B	C	C
	α_{med}	B	FB	FB	C	C
CVA 10	R	FB	S	B	FB	B
	ΔL	FB	B	C	C	C
	α_{med}	FB	B	C	C	C

Table no. 14

Equip ment	Para- metes	Frequency				
		250	500	1000	1600	2500
MMT 40	R	FB	S	B	FB	B
	ΔL	C	B	C	C	C
	α_{med}	C	B	C	C	C
S 1201	R	FB	S	B	FB	B
	ΔL	FB	FB	B	C	C
	α_{med}	FB	FB	B	B	B
CVA 10	R	FB	S	B	FB	B
	ΔL	FB	FB	B	B	B
	α_{med}	FB	FB	B	B	B

Table no. 15

Equip ment	Para- metes	Frequency				
		250	500	100 0	160 0	250 0
MMT 40	**R**	B	S	B	S	B
	ΔL	FB	B	B	S	S
	α_{med}	FB	B	B	S	B
S 1201	**R**	B	S	B	S	B
	ΔL	FB	B	C	C	C
	α_{med}	FB	B	C	C	C
CVA 10	**R**	FB	S	B	FB	B
	ΔL	FB	B	C	C	C
	α_{med}	FB	B	C	C	C

Table no. 16

Equip ment	**Para- metes**	**Frequency**				
		250	500	1000	1600	2500
MMT 40	R	B	B	S	B	S
	ΔL	S	B	S	S	B
	α_{med}	S	B	S	S	B
S 1201	R	B	B	S	B	S
	ΔL	S	B	S	S	FB
	α_{med}	S	B	S	S	B
CVA 10	R	B	B	S	B	S
	ΔL	S	B	B	FB	B
	α_{med}	B	B	B	FB	B

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