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INDUSTRIAL NOISE CONTROL IN THE TRANSMISSION PATH: A REAL CASE

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1. SUMMARY

This work describes a cost-effective approach to the minimization of noise levels found in the glass factory *CEBRACE (Caçapava, SP, Brasil)* during emergency situations. It included three main tasks:

. problem identification, with local acoustical measurements;
. measurements analysis and noise control design;
. implementation of acoustical treatment and final measurement to evaluate the resulting noise reduction.

2. INTRODUCTION

During emergency situations the noise levels produced in the control room of the *Companhia Brasileira de Cristal - CEBRACE* were very high; this condition prevented verbal communication and alarm signs comprehension. An emergency situation is characterized by the lack of electrical energy, which implies in the simultaneous operation of the following equipments:

. three generators Cummins - 543 cv / 400 kva
. one generator Cummins - 543 cv / 300 kva (stand-by)
. six compressors Atlas Copco - 300 cv (three of them stand-by)
. four pumps KSB - 200 cv (two of them stand-by)

All equipments were located in two rooms contiguous to the control room, and none of these places had acoustical treatment. So, there was noise transmission from the source rooms (generators and compressors) to the receiver room (control), establishing noise levels of 102 dB(A) in the last one.

3. INITIAL NOISE MEASUREMENTS

Global values in dB(A) as well as noise spectra in octave frequency band, between 63 Hz and 8,000 Hz, were measured in equivalent noise level, by means of a noise level meter model CEL 328 by Lucas Instruments. Three points were analysed, each one in a specific room:

. point P01 - control room
. point P02 - compressors room
. point P03 - generators room

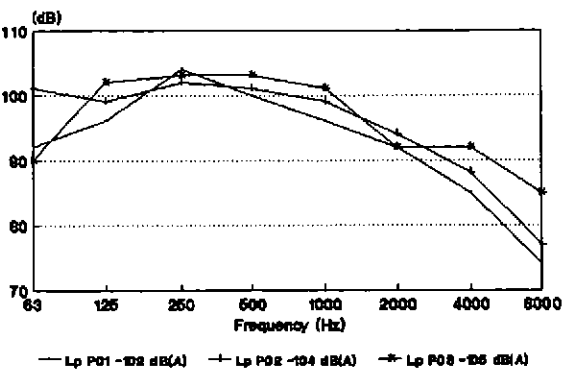
Table 1. shows the resulting noise levels and Fig.1 shows the corresponding spectra, with major contributions in the middle frequency range, from 250 Hz to 2,000 Hz.

Table 1. Initial Noise Measurements

Freq. (Hz)	63	125	250	500	1k	2k	4k	8k	A
Point P01	92	96	104	100	96	92	85	74	102
Point P02	101	99	102	101	99	94	88	77	104
Point P03	90	102	103	103	101	92	92	85	105

Even in normal conditions (with no generators in operation), the sound pressure level in the control room reached 92 dB(A), a strong indicative of noise transmission paths between rooms.

Fig.1
Noise Spectra



4. NOISE DESIGN

A detailed analysis of the rooms' construction quality showed many problems: noise transmission paths were so evident that it was unnecessary to use a mathematical model to forecast noise transmission levels. The main problems were:

. the common wall between the control room and the compressors room did not reach the roof level, leaving an open space of 3.50 m above the ceiling level;

. the control room ceiling material was light, non- acoustical;

. the boundary between the generators room and the control room was open to the common stair access;

. there was noise propagation from the motor's ventilation exhausts through the Venetian blinds;

. the access door between the compressors room and the control room was non-acoustical, plenty of air gaps.

One factor constrained the choice of acoustical systems and materials: the constrict structural dimensioning of the building which did not allow a heavy overloading. So, the design included the following acoustical specifications:

Control room. Closing of the common wall with a double panel 40 mm each one, made of agglomerated wood density 800 kg/m^3, with an air space of 25 mm between them, external lining with a low density carpet fabric (the constructed wall surface reached 105 m^2); application of a 50 mm glass wool blanket density 60 kg/m^3 over a mineral wool acoustical ceiling, covering a surface of 290 m^2; closing of the stair access to the generators room through an acoustical door of aproximately 4 m^2, with the same specifications of the common wall.

Generators room. Internal wall lining of 25 m^2 with a 50 mm glass wool panel, density 40 kg/m^3 , protected by a #18 perforated steel sheet, 42% open area; installation of a dissipative atenuator close to the ventilation exhausts: the atenuator is a duct with dimensions (7.00 x 3.70) m^2, 1.0 m long, of #14 plain steel sheet, with 50 mm glass wool panels, density 40 kg/m3 protected with a porous cotton fabric, separated by an air space of 50 mm.

5. FINAL MEASUREMENTS

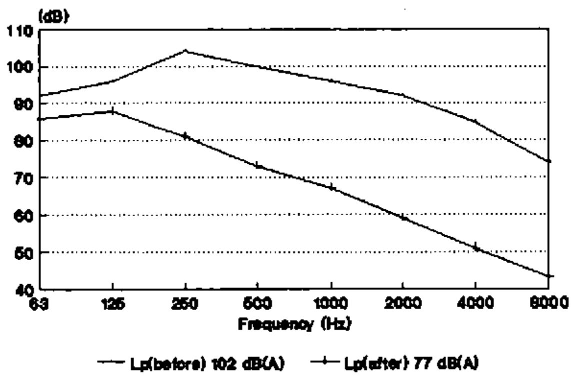
Noise measurements after design implementation were made with the same instruments previously described. Noise measurements took place exclusively in the control room, since this is the only room where operators are under occupational noise exposure. The results overcame the predicted reduction of 20 dB(A), reaching 25 dB(A). Table 2. shows the final and the previous spectra measured there on point P01. Fig.2 shows a comparison between both conditions (before and after acoustical treatment).

Table 2. Final Measurements - Control Room

Freq. (Hz)	63	125	250	500	1k	2k	4k	8k	A
P01 before	92	96	104	100	96	92	85	74	102
P01 after	86	88	81	73	67	59	51	43	77
Differ. dB	6	8	23	27	29	33	34	31	25

To evaluate the noise reduction produced by the acoustical treatment in the generators room, a global measurement there indicated 93 dB(A), or 12 dB(A) less than the initial value of 105 dB(A).

Fig.2
Noise Spectra P01



6. CONCLUSIONS

An overall industrial noise reduction of 25 dB(A) is meaningful and unusual. The main aspects that contribute to these results are:

Measurements. The accurate evaluation of noise levels, showing an acoustical energy concentration in the middle - high frequency range.

Materials. The excellent performance of acoustical materials (particularly the absorbents) in that frequency range.

Design. An efficient design solution associating isolating and absorbing materials in order to get an air-tight condition in the transmission paths partitions.

The actual noise level of 77 dB(A) in the control room is above the reccomended criteria of 65 dB(A), but it surely represents a very cost-effective approach to the problem, since the whole acoustical treatment of 450 m^2 required a financial investment of +/- US$ 40,000.