ANNALS of the ORADEA UNIVERSITY.
Fascicle of Management and Technological Engineering, Volume VII (XVII), 2008

ENVIRONMENT NOISE IN INDUSTRIAL ZONES

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Keywords: noise level, industrial acoustic, inhabitant noise protection

Abstract: It is well known that the human been is affected by environment noise. The ordinary noise sources are the road vehicles, rail vehicles, plains etc. The purpose of paper was to evaluate the environment noise in an industrial zone and in the adjacent inhabited aerie. With this aim it was effected a series of measurements at the boundaries of both residential and industrial zone.

1. INTRODUCTION.

The manner in which the human been is affected by the noise produced by a single source, like road vehicles, rail vehicles, plains etc. leaded to different indexes to characterize the noise sources. Passing from an index to another one leads to the apparition of important uncertainties.

If the environment would be affected by a single kind of noise, the confusion, provoked by the existence of different indexes, would be not so grave. Usually, the environment noise represents a sum of sounds from all sources, and the distribution of different noise sources could change from a moment to another.

In order to evaluate the environment noise in an industrial zone, it was effected a series of measurements at the boundaries of the residential zone. The aim of data processing by the automatic equipment was to determine following noise parameters:

- equivalent A weighted sound pressure level, LAeq;
- equivalent C weighted sound pressure level, Lceq;
- noise frequency spectrum;
- probability of apparition of over specified level noises;
- noise curve on different time intervals, during the industrial activity.

The measurements were effected in accordance to the following Romanian standards, equivalent to some international standards (ISO):

- SR ISO 1996-1 Description and measurement of environment noise. Part 1: Base quantities and methods.
- SR ISO 1996-2 Description and measurement of environment noise, Part 2: Obtaining the corresponding data for the ground utilization.
- SR ISO 1996-3 Description and measurement of environment noise, Part 3: Application to noise limits

The methods applied within the frame of the paper are dedicated to measurements of noises generated by all sources which contribute, by composing, to the environment noise. Actually technology recommends adopting, as base quantity to cover the above condition, the equivalent sound pressure level, in accordance with A curve, LAeq. The results must be express as functions of this quantity, even if there are other quantities which allow appreciating the noise level [2].

2. GENERAL CONSIDERATIONS

The human ear is characterized by a very week auditory acuity at very low or high frequencies in auditory spectrum 20 Hz-20 kHz. To reproduce and simulate this phenomenon, in order to realize objective acoustic measurements, in measuring devices there are used weight integration filters. The most used frequency weighting is the one that corresponds to the ear frequency response, in accordance to the A weighting curve. When noises of very large amplitude and low frequency are measured, usually it is used the C weighting curve. In figure 1, the two curves [5] are shown.

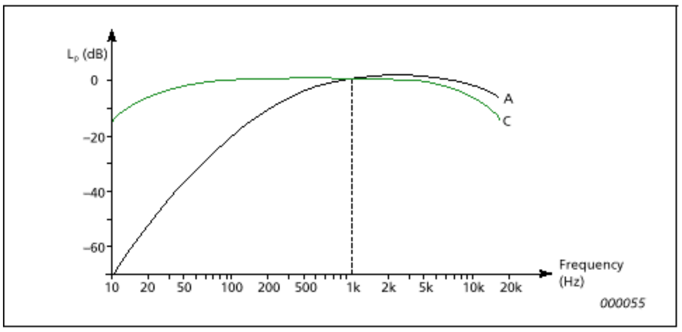


Fig.* 1. *Frequency weighting curve

Equivalent A weighted sound pressure level, LAeq, represents the level of a stable continuous sound which, along a T time interval, has its pressure equal to the squared average of the sound whose acoustic pressure varies in time.

$$L_{eq} = 10\log_{10}\frac{1}{T}\int_0^T\left(\frac{p(t)}{p_0}\right)^2 dt$$

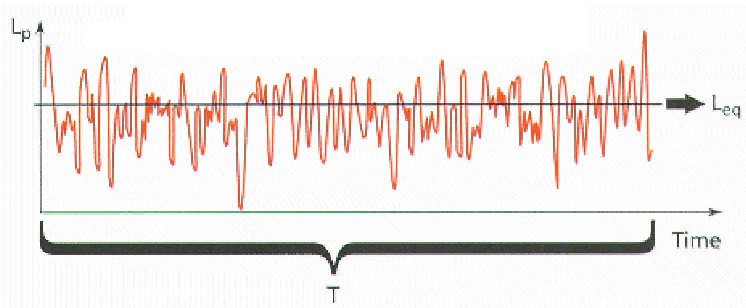


Fig.* 2. *Equivalent A weighted sound pressure level

The inconvenience produced by the noise is a subjective phenomenon, i.e. a complex one. That is why the individual psychological reaction, relative to the same noise source, are added in industrial zone neighbor life. This is the reason for which, another quantity – evaluation acoustic level (Lr)– is introduced [3].

Evaluation acoustic level, Lr, is defined by SR ISO 1996-2/1995, as some correction applied to the equivalent A weighted sound pressure level LAeq:

$$Lr = LAeq + K_1 + K_2$$

The first correction term, K_1, specifies that for a time interval, the tonal components must represent essential characteristics of the noise. The value of this correction must be declared and its value can be from 2 dB until 5 dB.

The second correction term, K_2, is taken into account when the impulse represents an essential characteristic of the noise, in a specified time interval. The correction must be specified and it varies until 7 dB, from a country to another.

The most part of countries defined absolute limit values to be compared to the evaluation acoustic level, Lr, as a function of the type of the zone, day time or night time, etc. This values are obligatory taken into account in urbanism developing projects [1].

3. MEASUREMENTS AND RESULTS

3.1. MICROPHONE LOCATION

Usually the norms specify the paces where measurements must be effected, for example at the boundary of industrial zones or, even in the interior of the zone, exposed to noises. The acoustic level varies as a function of the microphone height in relation to the ground level (due to the variation of air density with the temperature), the distance to the walls and other material obstacles (due to their properties of reflection and absorption). SR ISO 1996-2-1995 makes the following recommendations concerning the parameters of measurements:

- ❖ Distance to building walls
- ❖ Distance to material obstacles
- ❖ The direction of microphone (to coincide to wind direction)
- ❖ Velocity of the wind (under 5 m/s)
- ❖ Air humidity (dry air, not rainy time)
- ❖ Microphone high (at 1.2m to the ground)

3.2. MEASUREMENT RESULTS

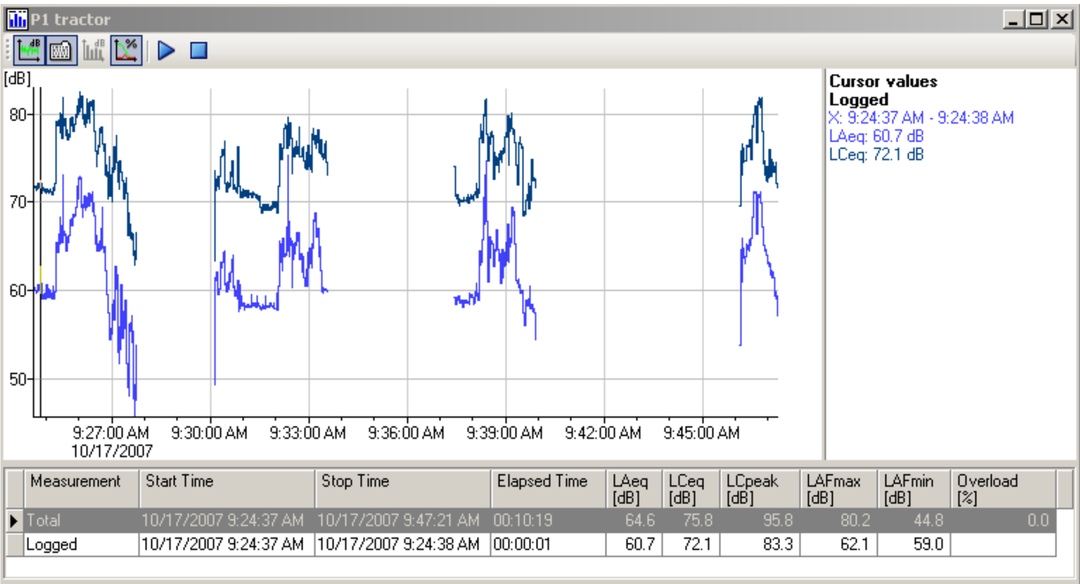


Fig. 3. Measurements corresponding to a tractor working

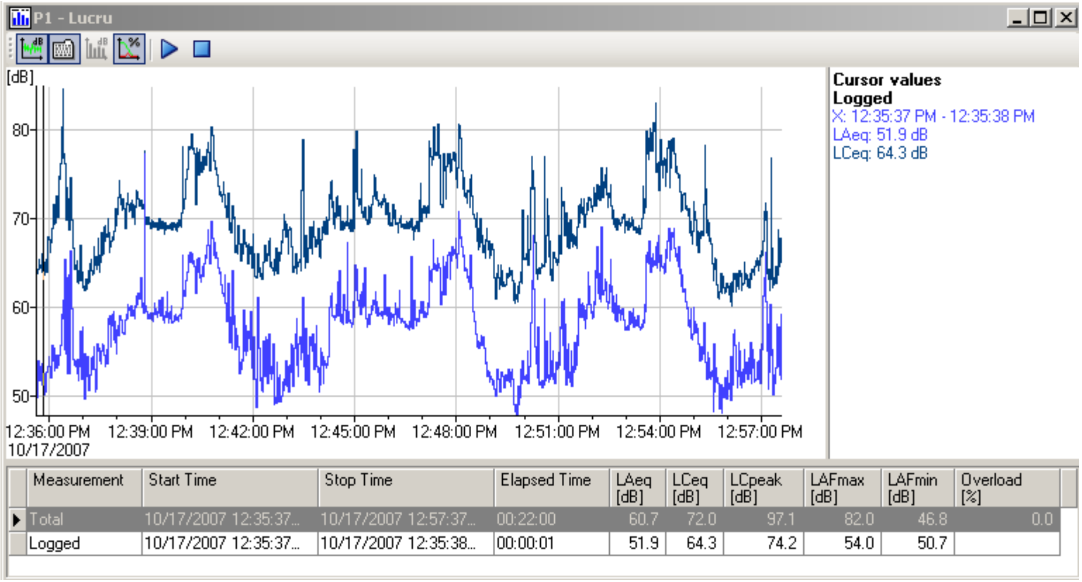


Fig. 4. Measurements corresponding to a tractor working (with background noise)

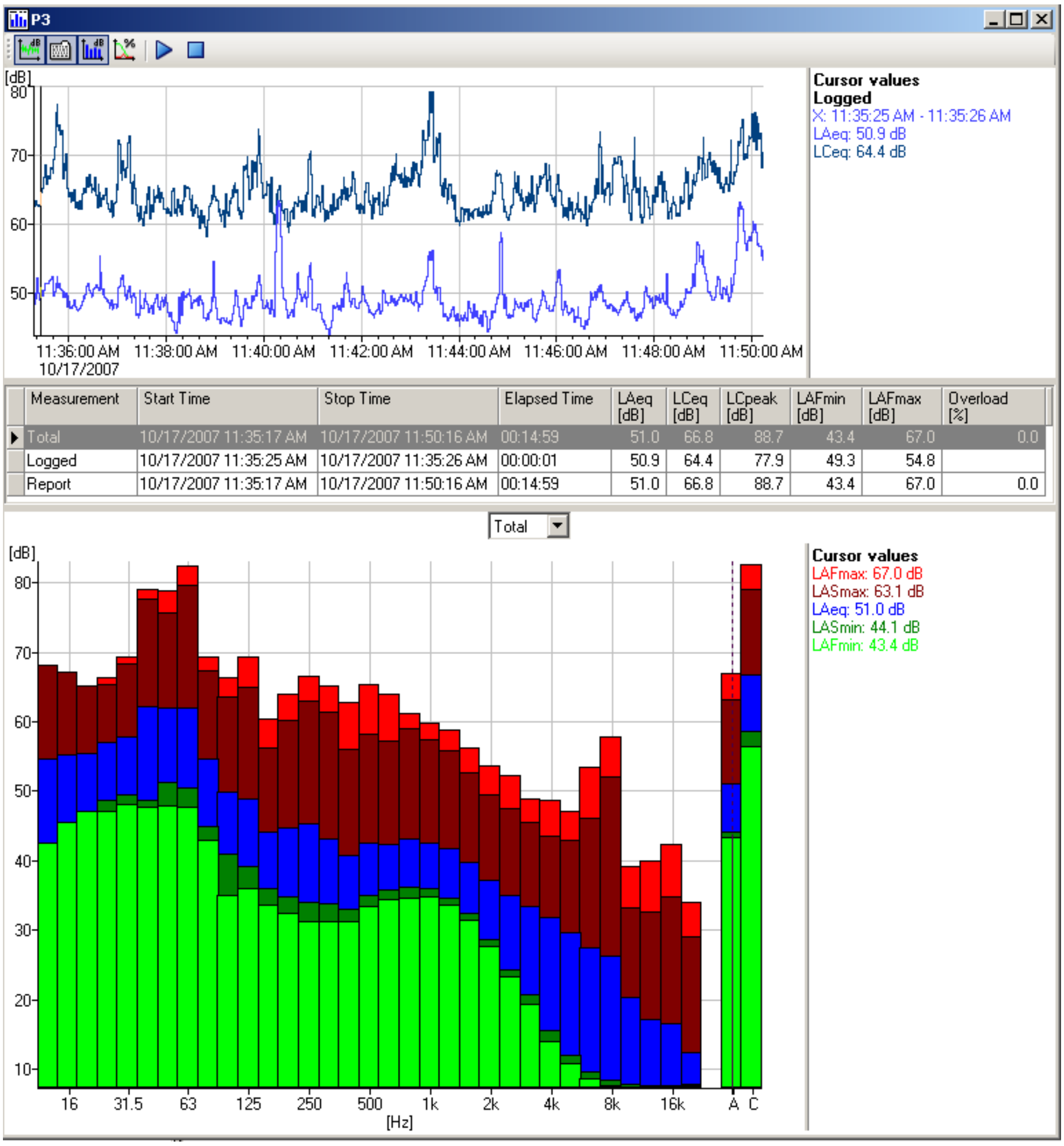
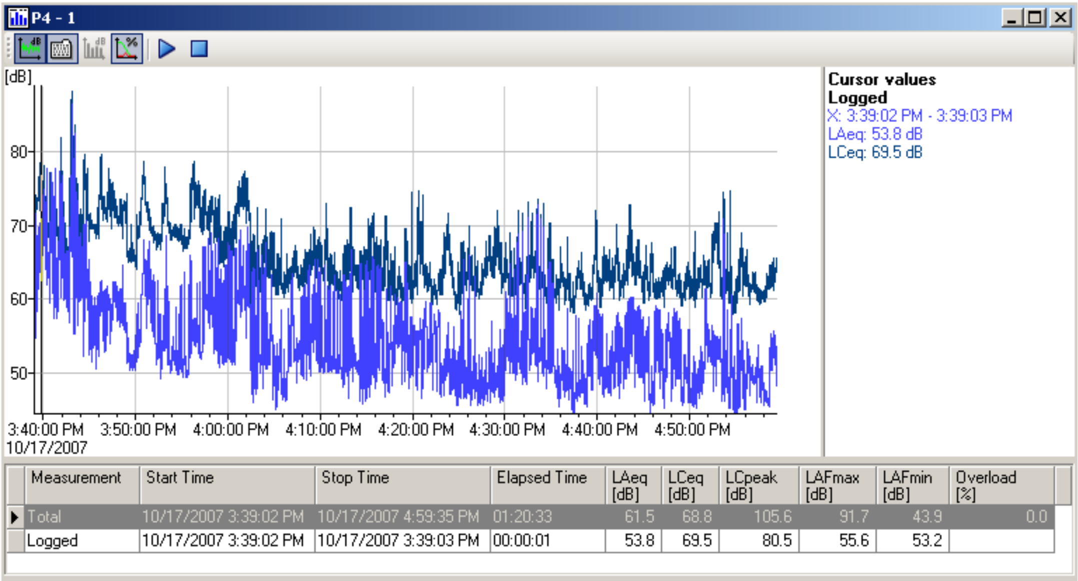
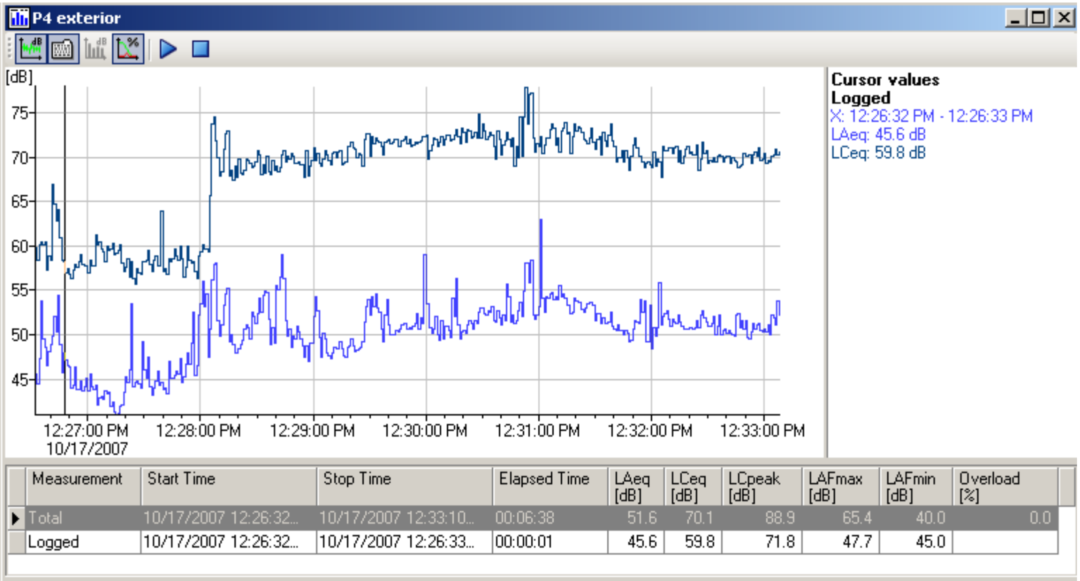


Fig. 5. Measurements next to the industrial building, during the mechanical processing



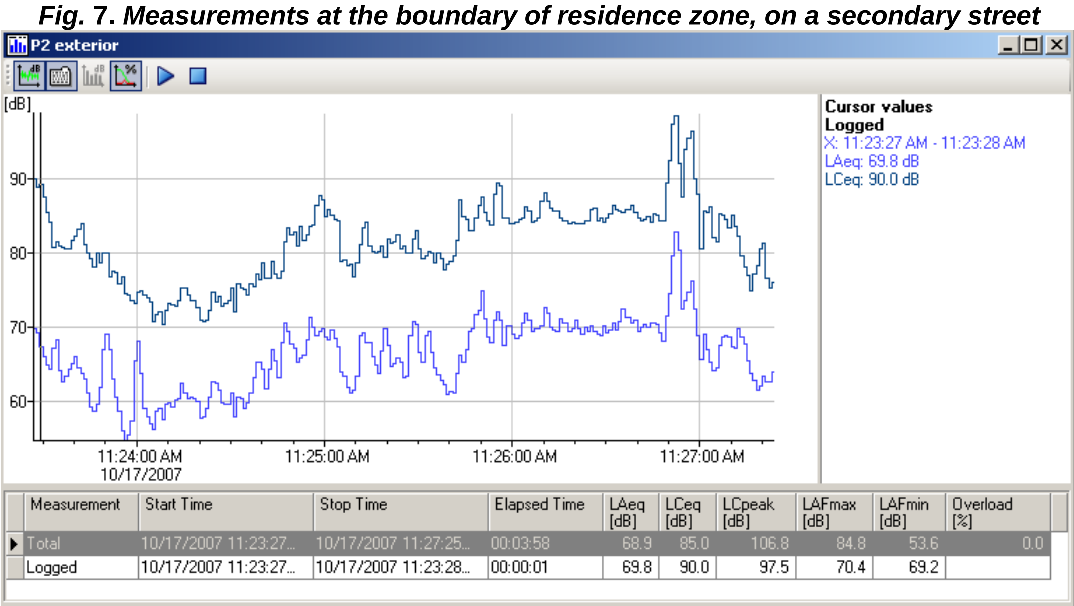
Measurement	Start Time	Stop Time	Elapsed Time	LAeq [dB]	LCeq [dB]	LCpeak [dB]	LAFmax [dB]	LAFmin [dB]	Overload [%]
Total	10/17/2007 3:39:02 PM	10/17/2007 4:59:35 PM	01:20:33	61.5	68.8	105.6	91.7	43.9	0.0
Logged	10/17/2007 3:39:02 PM	10/17/2007 3:39:03 PM	00:00:01	53.8	69.5	80.5	55.6	53.2	

Fig. 6. Measurements next to the industrial building, during the mechanical processing (at the opposite side of the building)



Measurement	Start Time	Stop Time	Elapsed Time	LAeq [dB]	LCeq [dB]	LCpeak [dB]	LAFmax [dB]	LAFmin [dB]	Overload [%]
Total	10/17/2007 12:26:32...	10/17/2007 12:33:10...	00:06:38	51.6	70.1	88.9	65.4	40.0	0.0
Logged	10/17/2007 12:26:32...	10/17/2007 12:26:33...	00:00:01	45.6	59.8	71.8	47.7	45.0	

Fig. 7. Measurements at the boundary of residence zone, on a secondary street



Measurement	Start Time	Stop Time	Elapsed Time	LAeq [dB]	LCeq [dB]	LCpeak [dB]	LAFmax [dB]	LAFmin [dB]	Overload [%]
Total	10/17/2007 11:23:27...	10/17/2007 11:27:25...	00:03:58	68.9	85.0	106.8	84.8	53.6	0.0
Logged	10/17/2007 11:23:27...	10/17/2007 11:23:28...	00:00:01	69.8	90.0	97.5	70.4	69.2	

Fig. 8. Measurements of road traffic noise

For the measurement it was used a 2250 Bruel&Kjaer sonometer, for signal processing, the BZ 7222 program of acoustic level measurement, and for frequency analysis, the BZ 7223 program.

The 2250 Bruel&Kjaer measure device consists in the following components parts: microphone, preamplifier, and processor. The microphone transforms the acoustic signal in an electric signal of very low value which must be amplified before processing. Because the human ear presents different sensibilities as a function of sound frequencies, there are used different frequency weightings. The most used weighting is in accordance to A curve, which correspond to the best ear frequency response. The sonometer allows the F, S and I weightings, i.e. for weighting noise level for fast (F), slow (S) and impulsive (I) evolutions.

4. CONCLUSIONS AND REMARKS

To formulate conclusions on the measurement results, a few remarks must be made:

– international standards (ISO) and Romanian standards too describe only the way to effect the noise measurements in order to determine the evaluation level [2],[3],[4].

– due to the important difference of life level, traditions and culture there are not established limits of acoustic levels, valid for all countries members of ISO, i.e. these limits have a national validity.

The effected measurements permit to formulate the following conclusions:

– at the industrial zone boundary the maximum noise level was of 64.6 dB, corresponding to the noise produced by a tractor working.

– the noise level in the adjacent aerie to the industrial zone increased to 69.8 dB, due to the presence of a main road with heavy traffic, which created a supplementary discomfort to the inhabitants.

REFERENCES

[1] Hand-held Analyzer Type 2250, (2004),*Technical Documentation*, Bruel & Kjaer.

[2] SR ISO 1996-1 CARACTERIZAREA ŞI MĂSURAREA ZGOMOTULUI DIN MEDIUL ÎNCONJURĂTOR. (1995), *Partea 1: Mărimi şi procedee de bază*.

[3] SR ISO 1996-2 CARACTERIZAREA ŞI MĂSURAREA ZGOMOTULUI DIN MEDIUL ÎNCONJURĂTOR, (1995), *Partea 2: Obținerea de date corespunzătoare pentru utilizarea terenurilor*.

[4] SR ISO 1996-3 CARACTERIZAREA ŞI MĂSURAREA ZGOMOTULUI DIN MEDIUL ÎNCONJURĂTOR, (1995), *Partea 3: Aplicații la limite de zgomote.*

[5] http://www.nonoise.org/library/envnoise/index.htm