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FACTORY NOISE IN URBAN AND INDUSTRIAL AREAS

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ABSTRACT

This paper is about a recent study on acoustic contamination caused by industrial sources. A surveys methodology has been specially developed for this kind of sound source, and results include day and night noise levels, study of sound sources, and low frequency noise components. Noise levels are usually higher than the maximum allowed by local noise regulations, specially at night, when noise caused by traffic decreases. Noise sources are different and depend on the typology of industrial estate. In those surrounded by households noise usually comes from inside factories, but in the case of peripheric industrial estates, noise tends to be generated by external machinery.

1 - INTRODUCTION

Industrial noise is not the main cause of annoyance for citizens [1], perhaps because it is one of the easiest controllable sources [2], but there is a lack of information about noise levels caused by industries, in part because noise maps are usually receptor-oriented rather than source oriented. Results collected in this way can contribute to choose the best action to reduce urban noise [3].

Terrassa is a town near Barcelona, in the northeast of Spain, with a population of 160.000 inhabitants and a rich industrial history. However, the growth of the city has not been properly regulated, therefore some industrial areas are found in the city centre, surrounded by households. This situation can cause complaints of the neighbourhood [4].

According to the figures provided by the Town Hall, in Terrassa there are 12.381 factories placed in different industrial areas, which can be classified as urban and peripheric industrial estates, depending on their location. Up to six urban areas and seven peripheric industrial estates can be distinguished (see fig. 1).

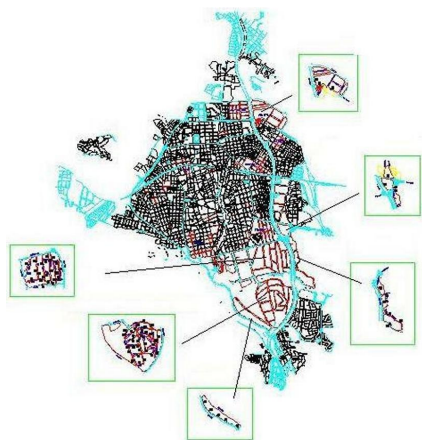


Figure 1(a): Urban industrial estates.

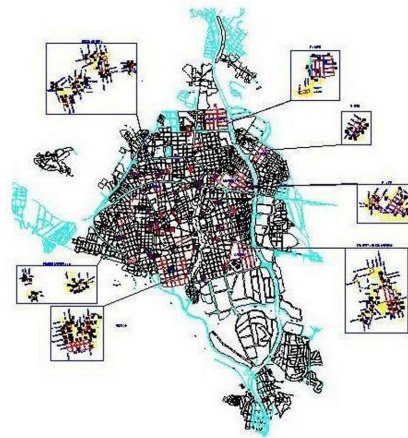


Figure 1(b): Peripheric industrial estates.

2 - METHODOLOGY

Generally, noise from industries is totally or partly distinguished by traffic noise. Under these circumstances the use of L_{Aeq} is not feasible because noise is measured on the whole. When noise is measured in the street, noise from industries turns out to be a background murmur and traffic noise tends to be more variable and louder. The use of the statistic level L_{90} which determines the background noise level was suggested, but it requires longtime measurements, of at least fifteen minutes, depending on the traffic flow.

The final decision was to use L_{pA} to measure industry noise, when traffic noise decreased and noise from the different activities was detectable. For constant noise – for instance fans – three instantaneous measures were taken for each case. Results obtained using this procedure were very similar to results obtained using L_{90} in an interval of ± 1 dBA, but they were obtained much faster.

For discontinuous or impulse noise (a hammer or material unloading) the measure parameter was L_{max} , which was easy to relate with the source.

3 - RESULTS

3.1 - Urban states

Results from urban industrial estates measurements are summarized in the following tables.

L_P dBA (day)	40 < L_P < 50	50 < L_P < 55	55 < L_P < 60	60 < L_P < 65	65 < L_P < 70	L_P > 70
% points (106)	15%	37%	31%	15%	4%	3%
L_P dBA (night)	L_P < 45	45 < L_P < 50	50 < L_P < 55	55 < L_P < 60	60 < L_P < 65	L_P > 65
% points (69)	26%	29%	22%	16%	4%	1%

Table 1: Measurements near households, take in the limits between factories and houses.

L_P dBA (day)	40 < L_P < 50	50 < L_P < 55	55 < L_P < 60	60 < L_P < 65	65 < L_P < 70	L_P > 70
% points (69)	7%	13%	35%	23%	10%	12%
L_P dBA (night)	L_P < 45	45 < L_P < 50	50 < L_P < 55	55 < L_P < 60	60 < L_P < 65	L_P > 65
% points (52)	8%	13%	15%	42%	8%	13%

Table 2: Measurements inside industrial estates, taken in points where no households can be seen.

Town regulations for noise and vibration in Terrassa fixes the following maximum emission levels (outside):

		Day	Night
Area A,	Households:	50 dBA	45 dBA
Area B,	Combination of households and industries:	55 dBA	45 dBA
Area C,	Industrial area with households near to it:	55 dBA	50 dBA
Industrial estates		65 dBA	60 dBA

Table 3.

During the day (7 –22h), the maximum allowed level does not depend on the location of the factories with regard to the households, and the level of nonfulfillment is higher inside the industrial estates rather than near the households.

As far as night measurements are concerned, the maximum level in bordering areas is 45 dBA, whereas in places far from households it is 50 dBA. Under these circumstances the nonfulfillment level is higher next to the households.

Industrial estates which present the highest noise levels are the largest, have high occupancy and large limits with household. Hence they are the most ostentiously annoying. Usually noise comes from inside the factories, such as workshops (hammer, metal cutting, steel work and marble cutting, among others), textile industries, air extractors, furnaces, reactors, car washers, warning or alarm noise and noise from compressed air devices. There are also external sources such as non-insulated compressors or fan exits. At night, industrial activities decrease and, for example, a typically noisy activity such as steelworks stop working. Factories which work at night present constant processes where noise is mainly caused by equipment such as extractors, compressors, cooling towers and so on. These elements could be silenced, but usually they are not.

For all the activities it would be advisable to work with closed windows and doors. Besides, they should be properly insulated depending on their interior noise. When factories have equipment in the open air, it should be equipped with the necessary acoustic conditions, which include enclosures for compressors, silencers for extractors, fans and cooling towers and so on.

In spite of these results, complaints from the population in Terrassa about industrial noise are only 8% of the total amount of complaints related to noise. For instance, 50% of noise complaints come from noise in the street, but due to people, not traffic.

3.2 - External states

For peripheral industrial estates, results were as follows:

L_P dBA	$L_P < 55$	$55 < L_P < 60$	$60 < L_P < 65$	$65 < L_P < 70$	$L_P > 70$
% points (74)	22%	26%	28%	11%	13%

Table 4: Results from the total amount of day measurements.

L_P dBA	$L_P < 45$	$45 < L_P < 50$	$50 < L_P < 55$	$55 < L_P < 60$	$L_P > 60$
% points (57)	16%	33%	19%	7%	12%

Table 5: Results from the total amount of night measurements.

Generally activities which take place in peripheral industrial estates are noisier than those inside the urban areas. However only a low percentage of industries do not comply with the town regulations because allowed levels are higher in peripheric industrial estates. The conditions in peripheric industrial estates (wide streets, low building density) contribute to a relatively low level.

The source of noise in this case, is more related to open air activities such as concrete plants, or factories with partial open air activities, such as warehousing or container-washing. There are also an important amount of machinery components placed outside the factories without acoustic treatment. Comparing to urban industries, only in few cases noise come from inside the factories.

In order to decrease noise in open air activities barriers could be arranged in the activity perimeter, or efforts could be focussed on the components which cause noise: using electric lifting trucks instead of diesel motorized, non-metallic containers, optimum maintenance of installations and so on.

Equipment in the open air should have the necessary acoustic treatment, similar to those of urban industries, but in this case, solutions should be of great dimensions due to larger equipment placed outside factories.

The comparison between measurements taken in dBA and dBC is quite interesting. The difference between these levels for the same source have been always higher than 10 dB. After talking with neighbours and taking measures inside the households, it is shown that noise caused by industrial components tends to invade homes as annoying sound, the level of which is usually lower than 35 dBA, which mean it is

legal in most of cases. In these measures it would be convenient to propose a penalty for low frequency noise [5].

4 - CONCLUSIONS

In urban industrial estates sound levels are rather high in areas next to households, which means they can be the source of annoyance, especially at night. Besides since it is usually low frequency noise, it can be more easily perceived from inside households. In peripheric industrial estates, noise levels are higher than in urban industrial estates, but since they are far from households the chance of being annoying is relatively low.

In urban industrial estates the source of noise tends to be noise itself inside the factories which goes out through different ways. In peripheric industrial estates noise is more related to open air activities, and there are a great amount of machinery components outside factories without any kind of acoustic treatment.

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