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L_{Aeq} vs L_{A90} AS A BASELINE NOISE DESCRIPTOR IN ENVIRONMENTAL NOISE ASSESSMENT

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INTRODUCTION

This paper aims to promote discussion on the parameters presently used for the purposes of environmental noise assessment, namely L_{Aeq} and L_{A90}. Should the measured or predicted new source levels be compared with the existing levels in terms of background L_{A90} or ambient L_{Aeq} levels?

CURRENT PRACTICE

Most assessments are based on BS 4142 "Method of Rating Industrial Noise Affecting Mixed Residential and Industrial Areas" 1990 (1). This method determines the likelihood of complaints arising on the basis of the extent to which the intruding noise exceeds the existing background noise level. The intruding noise is assessed in terms of L_{Aeq} and the background noise in terms of L_{A90}. This approach is also adopted, along with the use of set absolute limits, in the Draft MPG 11 "Control of Noise at Surface Mineral Workings" 1991, (2). The Draft Planning and Noise Guidance Note PPG XX 1992, (3) also refers to BS 4142 for assessing the likelihood of complaints from new industrial developments.

How valid is the comparison of L_{A90} with L_{Aeq} levels? This question has been asked so often that it is presently included in research being carried out by NPL into the application of BS 4142, (4). The aim of this paper is to increase awareness of possible misrepresentation of "background noise levels" in environmental assessment, it is not restricted to the application of BS 4142.

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L_{Aeq}

There is no need to validate the use of L_{Aeq} as a general purpose index for environmental noise. Reference to research papers to support its use could easily occupy a significant proportion of this paper. However, the validation of L_{A90} as a baseline descriptor requires further consideration.

L_{A90}

A cumulative distribution is a standard method of describing a time varying sound. There would appear to be no real scientific basis for the adoption of L_{A90} as a baseline noise descriptor. It is, however, fair to assume that given an ambient noise which is broad band and continuous in nature, the L_{A90} is a reasonable representation of the background noise i.e., the normal noise level without the very occasional uncharacteristic events.

SITE MEASUREMENT

An example of misrepresentation of background levels is where an environmental assessment is carried out near a road with very intermittent traffic. It should be noted at this point that the choice of intermittent traffic was used as a convenient means of illustration, the argument could equally apply to any other noise source. In Figure 1 the results of a measurement carried out in the garden of a dwelling house 20m from a fairly quiet road are illustrated in the form of an amplitude density plot. The measurement was to enable BS 4142 to be used to assess the likelihood of complaints arising from the operation of a workshop proposed at the opposite side of the road. There was also very audible distant road traffic.

The results given in Figure 1 show a 15 dB(A) difference between the L_{Aeq} and the L_{A90}. In terms of BS 4142 these results would indicate that complaints are likely to occur as a result of the distant traffic noise without even considering the introduction of the new source. It is obvious that it is the intermittent nature of the existing ambient noise which has led to the large disparity between the two parameters. In the calculation of the L_{Aeq} the relatively high levels of intermittent vehicle pass-bys are spread throughout the lulls occurring in the sample period. Whereas in the calculation of the L_{A90} levels the intermittent pass-bys are completely lost.

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CALCULATION OF L_{A90} VALUES

A typical pass-bytakes approximately 15 seconds and the maximum levels within the pass-by account for approximately 5 seconds. Therefore, in any fifteen minute measurement period with 30 pass-bys the maximum levels will account for only 16% of the sample period and the actual pass-bys 50% of the sample period. To be a bit more precise the nature of the calculation of the L_{A90} can be clarified by reference to the amplitude density plot given as Figure 1. To produce an amplitude density plot the SLM divides the dynamic measurement range into equal class interval of width, usually 0.5 dB. The incoming signal is then sampled 32 times per second and the percentage of time the signal spends in each of the amplitude intervals is calculated. By reading along the amplitude density plot from right to left the probability that any particular level is exceeded can be obtained.

In effect, the L_{A90} is not only taking out the occasional uncharacteristic noise it is prohibiting an important constituent of the ambient noise from evaluation. While it is accepted that the lulls between the 'events' are important in the subjective evaluation of background noise there comes a point where the frequency of occurrence of the significantly higher levels significantly affects the determination of the subjective evaluation of what can be considered background noise.

This then leads on to the proposal of L_{Aeq} as a baseline descriptor. There is a plethora of evidence supporting the correlation of A-weighted L_{Aeq} levels and community reactions. However, before leaping to the conclusion that this is the answer, consideration has to be given to the possibility of acceptance of L_{Aeq} levels as a baseline noise descriptor leading to a creeping growth of background noise levels. This would occur as a result of the spreading of the short bursts of high-level noise into the quieter parts.

ADEQUACY OF L_{A90}

The adequacy of L_{A90} as a general baseline descriptor for environmental noise has been questioned in the Institute of Acoustic's response, (5), to the Draft MPG 11, (2). The response document pointed out that if setting noise limits by the use of comparison with background noise levels then the existing levels of noise should be considered in terms of both background L_{A90} values and ambient L_{Aeq} values. This would appear to be a recognition of the fact that the blind acceptance of L_{A90} as a baseline descriptor can lead to misrepresentation.

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It is interesting to make the comparison of the L_{A90} and rating levels as defined in BS 4142. In the determination of the rating level section 7.2 of BS 4142 states that "if the noise is irregular enough in character to attract attention, add 5 dB to the specific noise level to obtain a rating level". There is no analogous correction for the characteristics of the pre-existing ambient noise levels.

Alternatively, the correction of background noise could be based on the ratio of the maximum A-weighted rms level recorded to the measured L_{A90} level. This does not take the number of occurrences into account. The baseline noise corrected by means of the following;

$$L_{A90true} = L_{A90\ measured} + 10 \log L_{Amax}/L_{A90\ measured}$$

where $L_{A90\ true}$ is the actual true background level to be used for the purposes of assessment

$L_{A90\ measured}$ is the actual measured background noise

L_{Amax} is the maximum A-weighted rms level recorded

SUMMARY AND CONCLUSION

This paper has discussed the suitability of L_{A90} as a baseline noise descriptor in environmental assessment. An example of a situation where the measured background level in terms of L_{A90} is likely to lead to a misrepresentation of the subjective evaluation of background noise has been given. The general conclusion at this stage is that where possible the L_{A90} value should be used as a baseline descriptor. However, the limitations of its application must be realised and suggestions as to how the limitations may be dealt with are tentatively given.

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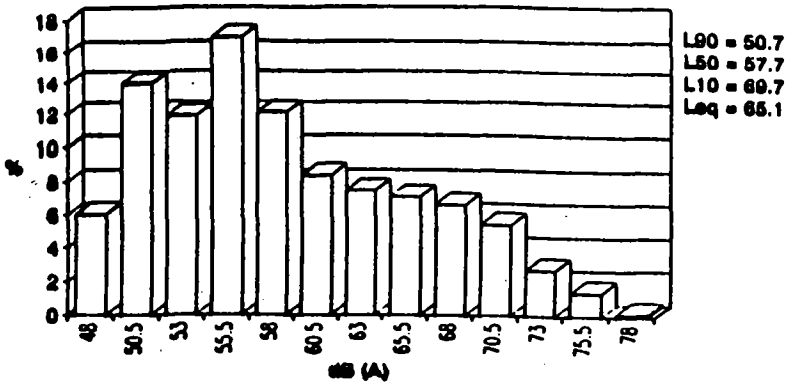
Figure 1 **level distribution histogram intermittent traffic noise**



REFERENCES

(1) *BS 4142:1990 "Noise affecting mixed residential and industrial areas" – HMSO*

(2) *Consultation Draft "Control of Noise at Surface Mineral Workings", MPG11, 1991, DoE, HMSO*

(3) *Consultation Draft "Planning and Noise", PPGXX, 1992, DoE, Welsh Office, HMSO*

(4) *Potter, N. "Study of the application of the revised BS 4142 1990; Method for rating industrial noise affecting mixed residential and industrial areas".*

(5) *I.O.A. Response to Consultation Draft "Planning and Noise" PPGXX Acoustic Bulletin Vol 17 No 2 March/April 1992*