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THE ENVIRONMENTAL NOISE BUYING STANDARD

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1. INTRODUCTION

Despite, lately, being over-shadowed by domestic noise complaints, the number of noise complaints from industry have risen at a large and concerning rate over the last few years [1].

One simple, long term solution to all industrial noise problems is for companies to buy machines and equipment that conform to a strict environmental noise buying standard or 'buy quiet'. The concept seems so simple and obvious that it is, perhaps, surprising that very few companies operate such a buying standard. Why is this?

The Industrial Noise and Vibration Centre developed the 'de facto' occupational noise buying standard to enable companies to provide a long term solution to hearing damage for their employees. This standard has been carried out successfully for many years by a large number of companies. Although, a fair degree of time and effort is involved in the establishment of the standard - once 'up and running' the system operates with little effort and results in a large degree of time and cost savings compared to the retrofit solutions for difficult noise problems.

The environmental noise buying standard is more complex than the occupational standard due to the inevitable larger and acoustical more variable, distances between the source and the receiver. However, the benefits of installing a strict standard can lead to large, long term, costs savings.

2. DEVELOPMENT OF THE STANDARD

Manufacturers of noisy equipment will not take responsibility for environmental noise problems, even if they know that the equipment is to be located outdoors. This is because they will usually be unaware of the two greatest factors affecting the noise level at the receiver i.e.:-

(i) location of the equipment is to be sited relative to local residents and

(ii) whether there are any barriers between the source and receiver.

First approximations to noise level prediction, due to distance attenuation is relatively easy to calculate. However, barriers such as natural hills, existing buildings, earth bunds, walls and fences make the prediction of distant noise levels complicated for anybody without, at least, a basic training in acoustics. This is because of the fact that the sound attenuation of barriers is frequency dependant (giving a better attenuation at higher frequencies that lower frequencies), thus octave band measurements and calculations are required.

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In many cases octave band analysis is not required, either because there are no barriers or because the distance attenuation is large enough in its own right to predict no problems. In other cases the barrier could be the critical factor.

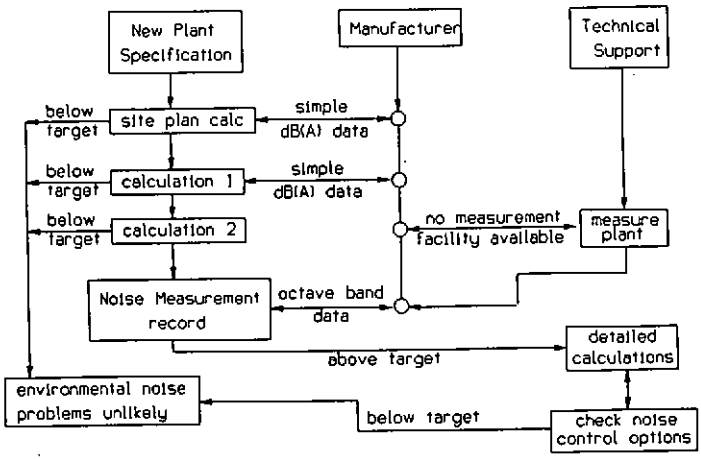
The standard could, therefore be:-

(i) very simple, incorporating only the distance attenuation prediction based on the inverse square law (6 dB per doubling of distance) plotted on a site plan;

(ii) a much more complicated method could be used, incorporating octave band analysis together with ground and air absorption effects, the effects of reflections from buildings or other large structures, the effects of directivity, the effects of duration (on-time), the effects of meterological conditions, noise character effects; or

(iii) a compromise somewhere between (i) and (ii).

The simple method is attractive, using the 'K.I.S.S.' philosophy (Keep It Simple Stupid). However, this could lead to a drastic over design, requiring large, unnecessary costs. The second method gives accurate results but requires long and involved calculations, even for cases where it is blatantly obvious that the noise will not be a problem (e.g. where the plant it situated at a great distance from the nearest residential buildings and/or is behind a tall and wide building). The compromise often results in the worst of both worlds, taking a long time to calculate inaccurate results. So the answer is to use all three methods in a 'filter' type system as shown in the flow chart given below:-



2.1 Stage 1.

The site plan' estimation involves making use of noise level contours on a site plan. These represent the maximum noise levels at one metre (dB(A)) that are permissable to avoid complaint. Only distance attenuation is assumed. No account is taken of any barriers or other noise attenuators. The noise is assumed to have a 'character' (i.e. tonal, impulsive, etc). If the manufacturer can guarantee no that such character exists a 5 dB correction can be added to the contours. If the noise from the plant is below the figure for the nearest interpolated contour passing through the proposed location, then complaints will be unlikely. If the figure is above, then a more accurate assessment is required - move on to stage 2.

2.2 Stage 2.

This procedure allows a quick estimation to be made of the allowable noise level at a set position from the new plant such that complaints will be unlikely. The calculation should be repeated in the direction of each factory boundary that may be of concern. Octave band data is NOT required as it is assumed that the frequency is mid to high in nature and that there is no significant low frequency noise at 125 Hz or below. The company can calculate a overall target noise level using simple charts or software provided by the INVC. This includes distance attenuation, barrier attenuation (based on barrier performance at 250 Hz), character corrections, multiple sources and building reflections. If the noise from the plant is below the calculated figure, then complaints will be unlikely. If the figure is above, then a more accurate assessment is required - move on to stage 3.

2.3 Stage 3.

This procedure generates an approximate target octave band spectrum at a set distance from the new plant that will ensure that complaints will be unlikely. The calculation should be repeated in the direction of each factory boundary that may be of concern. The company can calculate a overall target octave band level using simple charts or software provide by the INVC. This includes distance attenuation, barrier attenuation (based on each octave band), character corrections, multiple sources and building reflections. If the noise from the plant is below the calculated figure, then complaints will be unlikely. If the figure is above, then a more accurate assessment is required, this would usually be outside of the scope of the company engineer and a specialist acoustical consultancy would be required to carry out a detailed assessment.

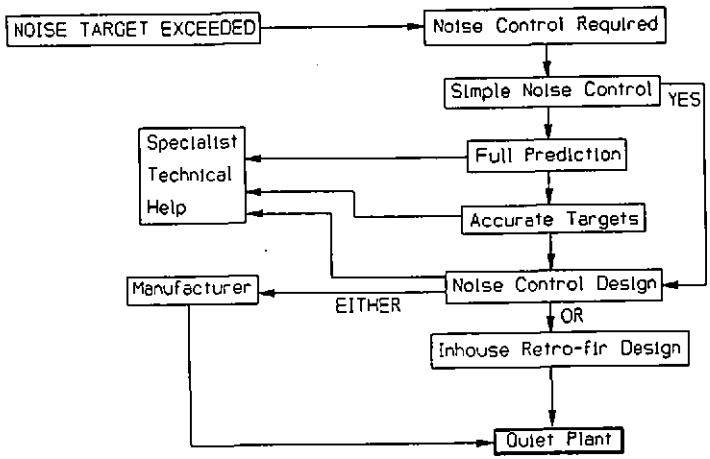
2.4 Stage 4.

If the consultancy reports that complaints are likely then some form of noise control must be implemented. It is usually far more cost effective to carry out noise control at this stage, i.e. before the equipment has been installed, than to retrofit noise control when complaints have been received.

3. NOISE CONTROL

As stated above, in circumstances where the calculations reveal that the target noise level is likely to be exceeded, then noise control must be implemented.

However, in cases where noise control may involve substantial costs, technical support should be sought. The calculation procedures given in the standard contain assumptions to simplify the process. A more complete prediction without assumptions will prove whether there is a problem and will also provide an accurate objective target for noise control. This avoids the common problem of unnecessary expenditure on over-specified noise control. The procedure is outlined below:-



3.1 Simple Noise Control.
In some cases noise at neighbouring properties can be reduced simply. The following outline some examples:-

(i) Orientation
For directional noise sources, the orientation of the plant should be considered prior to installation. It is sometimes possible to avoid potential problems in this way - for instance bringing a duct out from the side of a roof pointing away from sensitive premises.

(ii) Positioning
Advanced planning can sometimes be used to minimise the noise radiated by a new item of plant. Can the plant be positioned behind an existing construction to make an effective barrier? Does the fan have to be positioned on the side of the flat roof overlooking the boundary?

(iii) Local screens
Low cost local screens can be used to reduce the noise from small pieces of plant. For example, a process pump mounted at ground level may only require a

galvanised acoustic absorbent lined steel screen one metre high by two metres long to reduce the noise radiated towards the boundary by circa 8 dB(A).

(iv) Attenuators (silencers)
The noise from fan inlets/outlets or duct terminations can often be greatly reduced by fitting with a small acoustic lined cowl that both directs the noise downwards and acts as an attenuator.

(v) Operational features
The way that plant (and processes) are operated can have a significant effect on noise levels. It is some times possible to reduce the running speed of cooling fans at night when the cooling requirement (or operational load) is reduced. A 50% reduction in fan speed reduces the noise level by circa 16 dB.

Another example involves scheduling intermittent noisy operations for 'daytime only' when there is less likelihood of causing complaints.

3.2 Design of Noise Control Measures.

In cases where significant noise control measures are likely to be needed, then the first step is to carry out a full prediction of the expected noise at the residential facade position. This requires yet more detailed calculations than those used in the standard to ensure that the required noise reduction can be accurately determined (to avoid over design of modifications). Once this is complete, the next steps are to carry out accurate diagnostic measurements and then to consider all the noise control options.

(i) Diagnosis
Diagnosis involves listing all the potential noise sources and then determine the contribution from each source. The sources can then be ranked and the information used to predict the effect of each noise control option. This will usually require tests at the manufacturer's premises or at a similar installation elsewhere. The following examples illustrate the need for diagnosis to avoid very costly guesswork.

Exemple 1
Diagnosis is often required even on relatively simple pieces of plant such as a dehumidifying system. A detailed noise buying standard would have avoided one organisation being found guilty of a statutory nuisance and over £20,000 in costs, when all that was required was internal modifications to a centrifugal fan and an adjustment to a burner tube. They had installed an expensive enclosure to try to retain the noise but this had had little effect on the low frequency noise which was the main cause of the problem.

(ii) Noise Control Options
Once accurate diagnosis and ranking has been carried out, then the best noise control option may become obvious. If there is a dominant source that can be treated there is often an opportunity for cost effective noise control at source rather the relying on the purchase of enclosures and silencers. The techniques that should be considered are:-

(a) Noise Control at Source
(b) Vibration Isolation
(c) Vibration Damping

followed by

(d) Attenuators (silencers)
(e) Enclosures (including lagging and screening)

Unfortunately, manufacturers are often loath to implement noise control modifications other than the purchase of high cost enclosures (and silencers). It is commonly necessary to develop a package of noise control measures with expert help (designed to meet the target facade noise levels) and to purchase the plant on the condition that the recommendations are implemented.

Approximately 30% of all complaints about noise from industrial or commercial premises involve fans [2]. They are by far the most common single type of environmental noise problem from industry. The reasons are:-

(i) they are often fitted outside of buildings and in most cases, either the inlet or exhaust (or both) will be outside;

(ii) they often generate tonal noise (at blade pass frequency and multiples) which is highly annoying and more likely to cause complaint even at relatively low sound pressure levels.

Example 2
Both occupational and environmental noise problems from a brick oven were solved by fitting a single INVC developed internal modification inside the casing of a 3.5 m diameter fan. The work was carried out during a four hour shutdown at a cost of £1200 which compares with circa £15000 for conventional technology (silencers and enclosures). The low frequency (63 Hz) tonal noise was reduced by 22 dB and the occupational noise from 90 dB(A) to 79 dB(A). This type of low cost modification has been successfully applied to a wide range of fan types and sizes. Other examples are shown by Scannell [3]

4. THE ROLE OF THE LOCAL AUTHORITY

The local authorities have a statutory duty, under the Environmental Protection Act 1990 [4] to investigate complaints and to inspect their areas from time to time to check for noise problems. However, with increasing work loads and limited resources, the strain on many local authorities has almost reached breaking point. Perhaps the time has come for a change of approach, to a pro-active approach. If all local authorities could, educate, persuade, encourage and motivate local commercial and industrial businesses to adopt a strict environmental noise buying standard, the work load concerning industrial noise problems would start to diminish.

This would require a deal of extra work in the short term, i.e. carrying out training sessions, seminars, short talks, printing and distributing leaflets. However, it might just be possible that some of this work could be funded by Central Government of the European Council. The long term benefits would be to increase the quality of life for local residents, reduce costs for industry and to reduce the work load for local authorities.

5. REFERENCES

[1] Environmental Health Reports 1991 - 1992 published by the Chartered Institution of Environmental Health Officers.

[2] Porter, N., 'Study of the Application of the Revised BS 4142 : 1990 'Method for rating Industrial Noise Affecting Mixed Residential and Industrial Areas'' Proc. I.O.A. Vol 13 Part 8 (1991) 31 - 42.

[3] Scannell, K., 'The British Standard BS 4142 : 1990 - Cases Studies and A Consultant's View' Proc. I.O.A. Vol 13 Part 8 (1991) 43 - 50.

[4] The Environmental Protection Act (1990), DoE, HMSO Books, London.