Practical realities of environmental noise control.

Over the past years many rather dry articles have appeared in the technical press dealing with the Environmental Protection Act (1) as it relates to noise pollution. Even more articles have been written about BS4142 (2). This present article assumes some knowledge of those documents but rather than concentrating on the documents themselves it shows how one particular company dealt with a serious noise pollution problem. A number of the practical noise control solutions are discussed in some detail and a methodology for resolving problems is outlined.

For most companies the advent of an environmental noise pollution problem is both shocking and traumatic. Most people who fall foul of the Environmental Protection Act regarding noise problems are usually shocked not only be how seriously the affected people view this form of pollution but also by how draconian the legislation is. The trauma sets in when they try to resolve the problem.

Reaction

Environmental noise pollution problems are rarely anticipated and when faced with them for the first time all companies seem to go through the same seven basic phases, which are:

1. The dawning
2. The piecemeal approach
3. Recognition of severity
4. The search for help
5. The commitment and resolve to implement the necessary solutions
6. Resolution of the problem
7. Eventual acceptance by the affected people that the problem has been solved permanently

In order to illustrate the sequence of events more clearly let us look specifically at the problems of a typical industrial concern, in this case the Stainland Works of Hoechst (UK) Ltd (3).

Hoechst as a company is extremely environmentally aware. Indeed, it is one of the

committed signatories of the Chemical Industries association's 'Responsible Care' programme (4). Responsible Care is about improved performance for the UK chemical industries in all areas of health, safety and environmental protection.

The dawning

The company gradually became aware that all was not well as the number of complaints about environmental noise from local residents began to rise. Being a responsible company, it sought the advice of the local Environmental Health Department which confirmed its worst fears that it was indeed creating an environmental noise nuisance.

Piecemeal Approach

At first it tried the piecemeal approach. This is an easy philosophy to follow. Basically it means that you identify the item of plant which you think is causing the problem and apply noise control treatment. When this proves not to be a total solution you move on to the next most obvious noise source.

Recognition of severity

The flaw with the piecemeal approach is the time factor. When people complain about environmental noise they are usually at the end of their tether and can stand no more. The piecemeal approach has a cycle time of two to three months per source. All the while the local discontent with the 'apparent' lack of progress becomes rapidly enhanced.

In our example the severity of the situation was exacerbated and the company became rapidly aware that the problem had become severe.

Search for help

The company recognised that it faced a problem which it did not have the in-house skills to resolve and it started to search for outside help. This is not as easy as it seems, but eventually with the aid of various directories it contacted the author's consultancy (5). Acoustic consultants are a rather rare species. If you have a problem finding one, the Association of Noise Consultants (6) will provide a UK-wide list of such companies free of charge.

It takes a great deal of courage for any company, even one of the size of Hoechst, to admit that it needs outside help. It takes even greater courage to agree to pay for that help, knowing that this is just the beginning of the cost of resolving the problem.

Methodology

Most consultants adopt very similar methods for resolving environmental noise problems.

The following programme outlines the principal steps employed in this instance.

(1) The first step is to establish exactly what the existing natural background noise levels are, with the offending plant inoperative. This normally means making measurements in the early hours of the morning if the plant runs for twenty four hours a day. At this time the background noise will be at its lowest and people's sensitivity to sleep disturbance at its highest.

BS 4142 defines the natural background in terms of dB(A) L90, which is the dB(A) level exceeded for 90% of the measurement time. Unfortunately this is totally inadequate for noise control design purposes. If the most cost-effective solutions are to be designed the background noise level should be established as an L90 octave band spectrum.

Figure 1 shows the octave band background noise spectrum applicable to our example, measured at the nearest affected property.

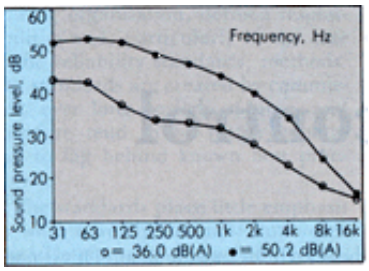

Figure 1.

(2) The noise level survey is then repeated with the plant running to confirm the severity of the problem. Again all measurements are made in octave bands as well as in dB(A). The results for the nearest affected property in this case are shown in Figure 1.

The following table shows the BS 4142 assessment for the nearest affected property:

Hoechst site in full production	50.2 dB(A)
Background noise level	36.0 dB(A) L90
Rating level	14.2 dB(A)

Conclusion: Strong complaints are justified.

Having confirmed that the complaints were totally justified, we then begin the process of designing appropriate noise control measures.

(3) The noise levels of every source on the Stainland site were measured separately and a computer model was constructed to predict the noise level that should result at the nearest affected property and at other locations around the site. The results of the model were compared with the plant-running noise level, again

in octave bands, to verify that the model was accurate and complete.

(4) The computer model was used in an iterative fashion by examining each source in turn. A series of comprehensive noise control measures was then designed which would exactly resolve the problem. This approach leads by default to the most cost effective solutions.

(5) The noise control designs were translated into engineering specifications so that tenders could be placed for the supply of the equipment. The results for Hoechst was a cost of about £200K to treat a total of some fifty or so potential noise sources. At this point many companies would have baulked at the cost, but fortunately Hoescht is a responsible company and it gritted its teeth and took the plunge.

Engineering Solutions

What then did the noise control engineering solutions look like? In fact, they were as diverse as the sources and the illustrations show just how diverse.

Figure 2 shows the two large circular pod type silencers used to control the noise of one of several cooling towers. The basic principal here is that all the noise is generated mainly by the fan. Consequently, traditional ventilation silencers can be used. It must be remembered that the noise will travel equally from both the inlet and the discharge sides of the fan and hence two silencers are required.

Figure 2, cooling tower before relocation.

Cooling tower after the installation of two pod type silencers.

Figure 3 shows the specially ventilated acoustic enclosure around a dust extraction plant. In this case the fan discharge was silenced by means of the large rectangular bend attenuator seen on top of the unit. The noise radiating off the fan casing was controlled by an acoustic enclosure. Once the fan was enclosed the motor would have produced an unacceptable heat gain in the enclosure and consequently it had to be force ventilated using silenced inlet and discharge vents, which can be seen on the right side of the enclosure.

Figure 3, Dust extract plant before . . . . . .

and after silencing and a ventilated enclosure.

Figure 4 shows what came to be know colloquially as the ‘Brick out-house’. This was a specially designed, ventilated acoustic enclosure to control the pure tones emitted by a large centrifugal pump. Figure 5 shows a narrow band spectrum of the noise emitted by this pump. Pure tones of this nature sound like screams or whistles and are very penetrating and annoying. The rather extreme measures taken in this case simply reflect the severity of this particular problem.

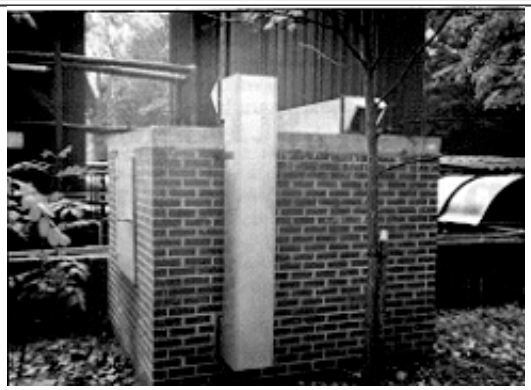

Figure 4, The ' Brick out-house', a ventilated acoustic enclosure for a centrifugal pump.

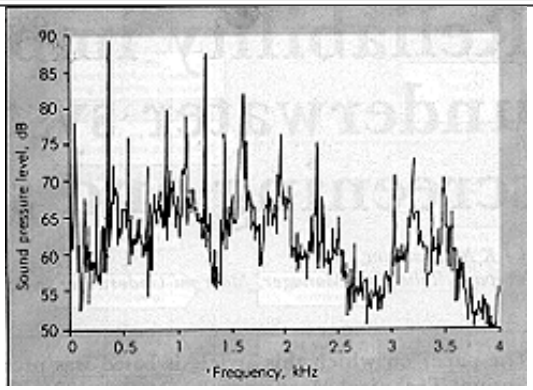

Figure 5, Narrow band spectrum of the centrifugal pump noise.

These examples are just a few of the many noise control solutions that were required.

Problem resolved

All of the noise control equipment was fabricated over a fourteen-week period and installed during a two week annual shutdown. As soon as the plant was restarted a fresh environmental survey was undertaken, the results of which showed spectacular agreement with the predictions. At the nearest affected property the running of the plant raised the background noise levels by just 1 dB(A) from 36 dB(A) to 37 dB(A). This was a complete resolution of the problem.

As in all problems involving people, the local residents held their collective breath to see if the problem stayed resolved. Some twelve months later they have grown used to the quiet and are now satisfied that the problem had been resolved permanently.

Continued control

Having once fallen foul of the problem of environmental noise pollution, the company was determined to ensure that the problem would never recur, even by accident. It therefore established an ongoing three-pronged approach to monitor and continually control its noise emissions.

(1) It invested in a good-quality sound level meter with which the boundary noise levels are measured at night once a week. This enables it to pick up on housekeeping items such as noise from steam and compressed air leaks before they become a serious problem.

(2) Once a year a completely independent check on the noise emissions is undertaken by the PDA Ltd. This is essentially an annual environmental noise emission audit.

(3) The most powerful benefit of the method of approach described above is hidden in the computer models. Before making any changes to existing equipment or installing any new plant, the appropriate noise data are fed into the computer models to check on their environmental impact. Should noise control measures be required these are designed and put in place before the plant is put into operation. This ensures that all plant changes and new additions never cause an environmental noise problem.

Conclusions

The noise problem in this particular example involved over fifty different sources, but the same approach is applicable whether the problem involves two hundred and fifty sources or five, or even just one source. What does change is the total value of the cost equation. Regrettably the greater the number of sources, the higher the total cost is likely to be. However, the more sources there are, the more essential it is to adopt a total design philosophy sooner rather than later.

It is hoped that this article has removed some of the aura of mystery surrounding the problem of environmental noise pollution. In the words of Mr Graham Walker, the Site Director at the Stainland Works:

‘The first step is to recognise that you have a real problem. The second is to seek help and simply the knowledge that help is available is the starting point. The final stage is to summon up the courage and to "bite the bullet". Overall there has to be a determination to act responsibly towards the local community and eliminate the problem’.

The author wishes to express his gratitude to Hoechst UK Ltd for permission to publish this article and for the pleasure of having worked with such an environmentally enlightened organisation.

References

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3. Hoechst UK Ltd, Stainland Works, Holywell Green, Halifax, HX4 9DL.
4. Responsible Care Programme, Chemical Industries Association, Smith Square, London SW1P 3JJ.
5. Philip Dunbavin Acoustics Ltd, Beech farm, Lymm Road, Thelwall, Warrington, WA4 2TG
6. The Association of Noise Consultants, 105 St Peters Street, St Albans, AL1 3EJ.

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