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CONFLICT, COST AND REALITY OF INDUSTRIAL NOISE DESIGN

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1 INTRODUCTION

When a major industrial development is being considered all environmental aspects must be quantitatively estimated at an early stage. The setting of noise control limits by rigidly imposed sound level requirements is causing expense and inconvenience to the point of ruling out development in an otherwise ideal area. These limits require detailed noise control from the very earliest stage and many technical arguments of interpretation and measurement arise. The design and hardware costs are such that a main consideration is to limit expenditure to give just the amount of noise control required. This paper draws from experience in the heavy chemical industry, particularly with regard to the Greenfield development of a multiplant complex, but the main considerations apply to all industries which operate 24 hrs/day, are very sensitive to the problems of pollution and safety, and have a high level of capital intensity. It summarises a comprehensive dissertation already published(7).

2 SOUND OUTPUT AT SOURCE AND DISTANCE ATTENUATION

In assessing the sound level contribution at a distant point the sound output from what is perhaps a very large source must be known and a method of distance attenuation adopted. The output can be defined in conflicting ways and estimates of "excess attenuation" (ie in excess of the inverse square law) must be considered in relation to a very large measurement scatter which will occur (fig 1) at large distances. Excess attenuation is well documented elsewhere (eg 3,4) and is hence not discussed further except to emphasise that there can be a large excess attenuation indicated from close to the ground measurements (2) which often means that measurements at heights up to 10 m must be made.

3 THE NOISE CLIMATE

The design of a noise climate considers the background and the eventual effect on it of the new development, regulations (and standards), and above all true annoyance to local inhabitants.

3.1 The Existing (Background) Climate

Background measurements in very quiet country areas has main problems of traffic, wind and weather. Traffic problems are straightforward but wind generates high background levels as well as severe microphonic interference. Typical nightime variations in a country area could easily vary from 20 dBA to 40 dBA and at these levels a wind speed of greater than 1 metre/sec creates appreciable microphonic noise even with a wind shield. Wet weather of course completely eliminates the use of the ordinary condenser microphone.

A study of weather conditions near a large proposed site indicated that suitable measuring conditions were only possible during 3 or 4 nights every year and thus special methods of measurement have to be devised to alleviate the situation.

3.2 Measurements

Measurement of the background is bad enough. Measurement of a contribution from a large complex 2000-4000 metres away is even worse particularly if that contribution has to be limited to 35 dBA. Invariably a measurement has to be made closer to the source and extrapolated to the so called measurement point, which leads to complex technical debate.

3.3 Regulations and Standards

Appreciating that background and eventual industrial sound levels vary widely, the difficulty of relating one to the other is next to impossible. Yet the most severe regulations in Europe (5), and the most severe standard anywhere (6), define levels which should be achieved (tables 1 and 2) without any idea of existing background levels or the difficulties of establishing whether their standards had been met. Circular 10/73 recommends much more realistic sound levels (table 3).

3.4 Annoyance

Environmental noise has been "measured" in many ways. Units of Sound Level, Equivalent Level, Percentage Level, Perceived Levels, Pollution Level and many hybrid units are all used to define the "Noise Level". However "Noise Level" can not be defined by any simple measurement of sound level. BS 661 certainly makes no attempt at definition. In fact people rarely complain of sound levels but only of fairly dramatic short term changes of level or of characteristics which are audible within the level. The majority of cases of noise annoyance coming to court are brought by persons who do not even understand what a decibel is let alone have the means to measure it. This point is further illustrated by a survey of complaints carried out at a large chemical works bounded by a densely populated area. Nine noise complaints were received in 1977 all of which were identified and action taken without recourse to a sound level measurement of any kind.

4 COST OF NOISE CONTROL

The first design stage is to ensure that on-plant sound levels are safe. This will usually reduce the sound emission by 5-10 dB and cost 0.5% of total capital. For modern plant layouts the boundary level will be approaching 60 dBA and if this has to be reduced the cost of achieving more than 5 dB can easily rise to 2% of capital. Beyond this "current state of the art" costs can rise very rapidly (fig 2). At the planning stage of a development of a Greenfield site, where firm data was limited, the author has considered site costs at the rate of £10 million/dB to meet a requirement which had been rigidly enforced without any knowledge of what is acceptable. Fortunately this rate eventually proved excessive but the point should be noted.

For a "current state of art" design, direct hardware costs could be 0.5-1% of capital and indirect hardware costs also in this range. Design work could cost between 0.25% and 0.5% including the cost of a specialist noise control engineer integrated into the project team and justified in savings from cost optimisation. For a large multiplant site the cost could easily exceed £1000 million and noise control account for £20 million. The difference between doing too much noise control and the optimum amount could be £5 million. The optimisation process often results in hardware costs of tens of thousands of pounds being necessary to improve a plant output but which may mean only 0.1 dB improvement at a particular distant location - a really ludicrous situation brought about by having to meet rigid standards.

5 CONCLUSION

The main consideration of this paper must be cost. Vast sums of money are being spent on noise control of large chemical complexes simply to reduce sound level without the authorities having much idea as to what sound levels are really acceptable. If sound levels are specified by authorities it is essential that they be related to local circumstances and applied flexibly as site knowledge improves. However the author considers that better methods of controlling noise could include a direct noise measurement in the form of a complaints monitoring system and/or a method of defining in general terms the "best practical means" or the "current state of the art" as a standard which equipment must meet in particularly sensitive areas. If a scientific unit must be specified then consideration should be given to defining the desirable "sound power density" of a site - dBA SWL per square metre.

Thus in reviewing the "Cost, Conflict and Reality" of industrial noise design the author believes that "conflict" will always occur when technicalities are unnecessarily indulged in. The "cost" so incurred will result in futile expenditure and the "reality" of the situation is that the regulation makers must realise the folly of current trends and develop standards which are not only more effective than the present in achieving an acceptable climate but also are possibly less costly.

6 REFERENCES

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7. G R JONES University of Salford, Sept 1978, Conflict, Cost and Reality of Industrial Noise Design.

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7 FIGURES AND TABLES

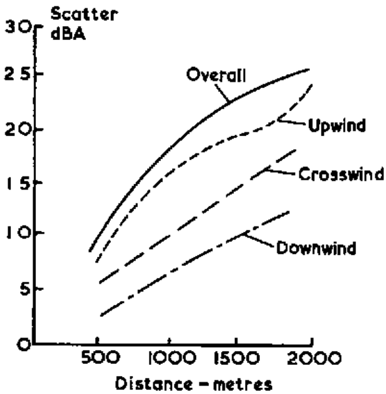

Fig 1 : Measurement Scatter (illustrative only - guided by Michelsen (1))

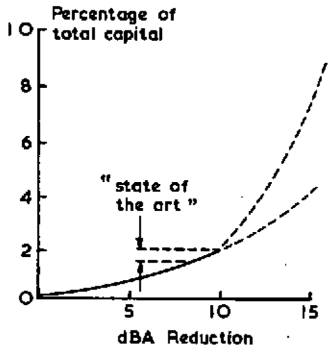

Fig 2 : Cost of reducing plant sound output (illustrative only)

Category/Area	Day	Night
A Trade/Industry only	70	70
B Trade/Industry predominant	65	50
C Trade and private housing	60	45
D Private housing predominant	50	50
E Private housing only	50	35

Table 1 - West German Regulations (5)

(dBA - L10 index - outside houses)

Type of Area	Day	Night
Busy Urban	55	50
Suburban	50	45
Country	45	35

Table 2 - Cheshire Planning Standard (6) (dBA - L10 index - at works boundary)

		Day	Night
Near Houses		75	65
In houses - windows shut	Maximum	55	45
	Good Standard	45	35

Table 3 - Circular 10/73 (sound level - dBA)