The Voice of the Networks

energynetworks association

environment briefing03

noise

Introduction

Modern technologies ensure that our lives are more comfortable than at any time in the past. However, the cars, aeroplanes, telephones, radios and many other trappings of modern life also emit a lot of noise. Although complaints about industrial noise have increased substantially, the fastest growing volume of complaints concerned neighbours (particularly their music, dogs and DIY) and aircraft.

What is Noise?

Noise is defined as unwanted sound, but this definition is very subjective. For example, what is one person's favourite piece of music may be noise to another.

Sound arises from small pressure fluctuations or vibrations which travel as waves through the air, or any other medium. When the vibrations arrive at the ear, a series of physiological processes converts them into nerve impulses to the brain, where we perceive them as sound (see Figure 1)

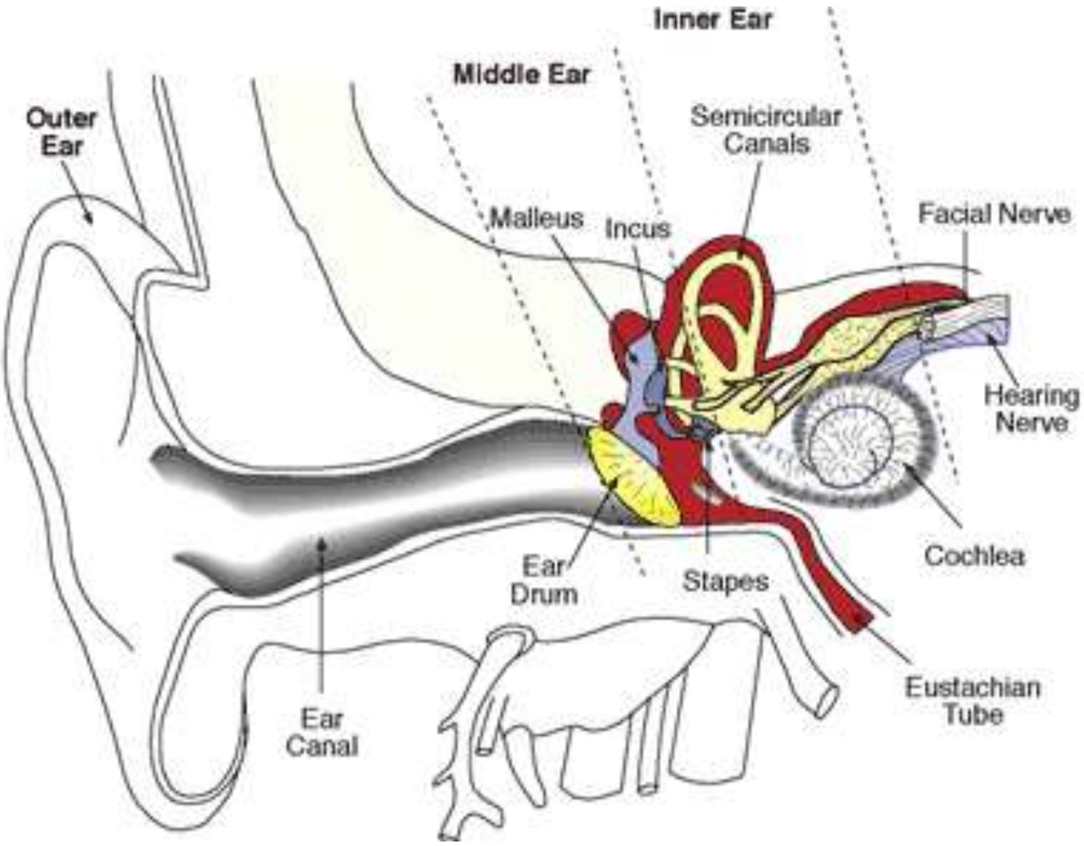

Figure 1 **Anatomy of the Ear**

Sound Units

The two properties of sound detected by the human ear are ‘pitch’ and ‘loudness’.

Pitch describes the frequency of vibration of a sound wave, usually measured in cycles per second or ‘Hertz’ (Hz). Doubling the frequency raises the pitch by one octave. Many sources of sound produce a wide mix of sound frequencies which is often referred to as ‘white’ noise.

Loudness is a very personal, subjective sensation which cannot be measured directly so a compromise is made by measuring the pressure change caused in the air by the passage of sound. This is measured in decibels (dB). The lowest sound pressure that can be detected by an average human ear is 20 micropascals (µPa) which equates to a 0 dB value. At the other end of scale, a pressure of 200 Pa equals 140 dB, which is the threshold above which the ear experiences discomfort and pain.

The perceived loudness of a sound is not directly related to the energy of the sound wave, since the sensitivity of the ear varies with the pitch of the sound. The ear is most sensitive to frequencies around 4000 Hz (4 kHz) and is totally insensitive to frequencies below about 20 Hz or above about 20 kHz, although this varies between individuals. Loudness is therefore determined by both the intensity and frequency of the noise. While an increase of 3 dB in sound level represents a doubling of sound energy, an increase of 10 dB is perceived as a doubling of loudness by the ear.

The annoyance caused by a particular noise depends not only on its loudness and pitch, but also on the background noise level, the duration of the noise, its repetition rate, the time of day it occurs and many more social and physiological factors. The annoyance potential of a single pitch (tonal) noise is greater than that of white noise of the same loudness.

Despite the complexity of loudness and annoyance assessment, there are some generally accepted guidelines. Different scales have been devised which attempt to represent human assessment of different types of noise. The commonest of these is the A-weighted scale, expressed as dB(A). This scale weights the frequency content of noise so as to match the ear’s sensitivity to medium loudness noises. It is incorporated into most commercially available noise meters. The scale does not correspond closely to annoyance values but it does give some guide and is a widely accepted standard. Figure 2 shows some typical noise levels on the dB(A) scale. Other scales, devised for specific purposes, take account of various factors such as the duration, fluctuation or time dependence of noise.

Effects of Noise on People

Environmental noise can affect people both physically and psychologically. Physical damage, such as loss of hearing, is rare outside the work place, since noise is not often concentrated from one source for long enough. However, there is the potential for self-inflicted noise damage from sources such as rock concerts (registering up to 120 dB(A)), gunfire or machinery. In the work place continuous processes make it more likely that physical damage will occur, especially when the noise is experienced over prolonged periods. Continuous exposure to noise levels above 85 dB(A) can result in some permanent loss of hearing.

Outside work, people are mainly affected psychologically. For instance, the seemingly constant low frequency drone present in inner cities is known to make some people feel mildly depressed. High frequency noise has also been claimed to make people irritable and angry.

Controlling Noise Pollution

There are many ways to combat noise pollution. It is generally not possible to cut out the noise entirely, if the process or activity is to continue. Therefore it is necessary to reduce the impact of noise either actively, using quieter machines at the source, or passively, through technology such as double glazing and other forms of noise break.

EU Directives place limits on noise from specific sources such as motor vehicles, aircraft and agricultural machinery. Although no general environmental quality standards for noise exist at EU level, the sixth Environmental Action Programme (Environment 2010 - Our Future, Our Choice) contains an objective to substantially reduce the number of people regularly affected by long-term average levels of noise.

BS 4142: 1997 gives a general simplistic view of how to define the impact of noise from an industrial site. It has been widely used by the courts and in planning inquiries to determine what levels of noise might be considered to be a nuisance. The basic approach assesses the noise relative to the prevailing background noise level. A difference of 10 dB(A) or more above the background level indicates that complaints are very likely; a 5 dB(A) difference is marginal and, below that figure, the lower the value, the less likelihood there is that complaints will be made.

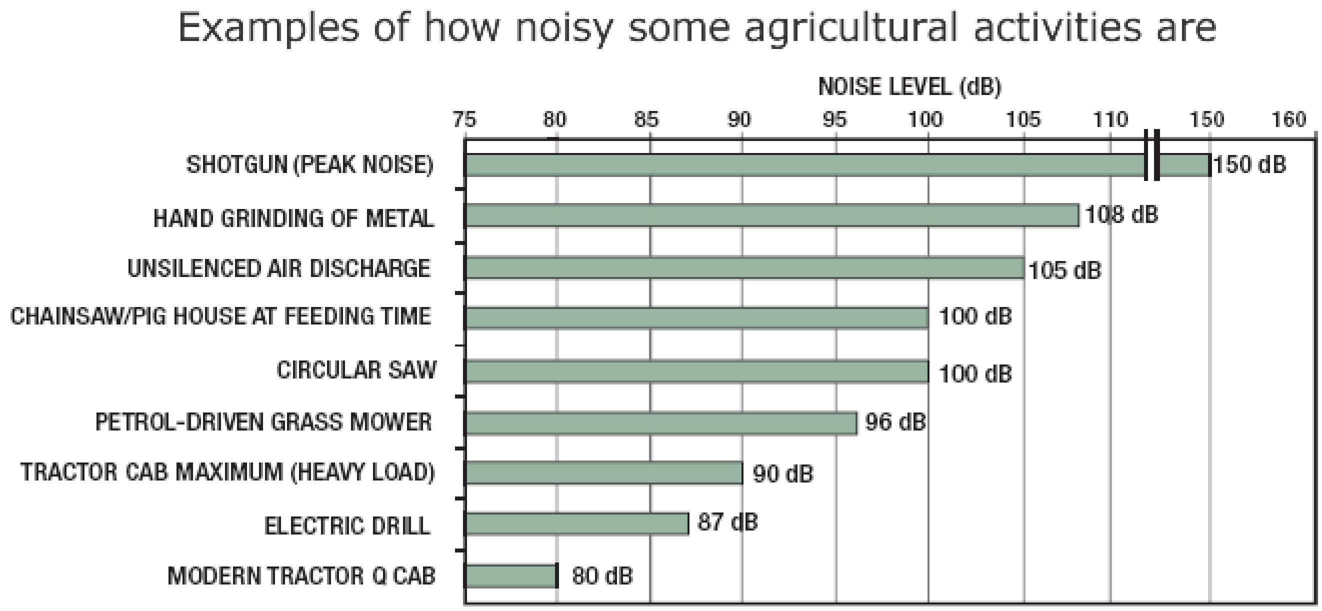

Figure 2 - Typical Noise Levels **Source: HSE**

What the Electricity Transmission and Distribution Industry is Doing

The main sources of noise associated with transmission and distribution are high voltage transmission lines, substations and machinery used in streets for distribution maintenance.

Overhead lines and pylons can be a source of wind generated noise. Although a source of complaint, there is relatively little that can be done to avoid wind noise.

Noise from high voltage overhead transmission lines is also generated by electrical discharge activity and has a characteristic crackling sound. Transmission lines are designed to operate below the threshold voltage for discharge but surface irregularities such as rain drops or solid debris can cause discharge activity (and hence noise) to occur. The industry's quality control requirements for both the manufacture of conductors and the construction of lines ensure that initially the conductor is free from solid debris and surface damage. Wind-borne debris may stick to lines and increase noise levels during long dry spells, but heavy rain washes the conductors and decreases the noise levels again. The industry has also designed insulators and fittings which are free from continuous discharge activity.

Noise from corona discharge caused by water droplets cannot be avoided. This noise consists of a crackle which is sometimes accompanied by a low frequency (100 Hz) hum. The mechanism of hum generation is not fully understood, but it seems to occur only above a critical rainfall rate or when the conductors are sufficiently wet.

In steady rain the droplet distribution on the conductors is relatively stable and the noise levels during rain can be predicted for different line configurations. The industry has developed methods for assessing transmission line noise based on BS 4142 which take into account the nature of the area and the existing background noise level. Appropriate corrections are made for the presence of 100 Hz hum. Consequently the routeing of new overhead lines takes into account the effects of noise on nearby dwellings.