Engineering
FACTSHEET

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NOISE

DESCRIPTION

Noise is one of the three disturbances specifically mentioned in the *Farm Practices Protection (Right to Farm) Act.* Noise is a result of many farm practices and can be a frequent source of complaints concerning farm activities.

What is Sound?

Sound is a pressure variation in air that the human ear can hear. If pressure variations in the air occur more than 20 times a second then they can be heard and are called sound.

The number of pressure variations per second is called frequency and is measured in units called Hertz (Hz). Most people hear in the range of 20 to 20,000 Hz.

The common units for measuring the loudness of the noise are called decibels (dB). Walking deep in the woods, we would experience a sound of 10 to 20 dB; the sound level in a library might be closer to 30 to 40 dB; a business office has a level of 60 to 70 dB; a heavy truck would generate 90 to 100 dB and a jet liner taking off 120 to 130 dB. The threshold for hearing is at 0 dB and the threshold of pain can be over 130 dB. Although an increase of 6 dB represents a doubling of the sound and pressure, humans perceive an increase of about 10 dB in sound to be twice as loud. The smallest change we can distinguish is about 3 dB.

The human ear is a remarkable organ that does not respond the same way that a sound meter does. A young healthy ear is able to hear a wider range of frequencies and detect smaller differences in sound. The perceived loudness is determined by several complex factors. One factor is that the human ear is not equally sensitive at all frequencies. For example, a 50 Hz tone must be 15dB higher than a 1000 Hz tone at a level of 70 dB in order to give the same subjective loudness.

What is Noise?

Noise is sound that is unpleasant or unwanted by the listener. People's sensitivity to and perceptions of noise depends upon sound pressure and frequency. The human ear is most sensitive to sounds between 2000 Hz and 5000 Hz. The level of annoyance depends on the loudness, frequency and the listener's attitude to the sound. Fingernails scratching on a board have little volume but may be very annoying to some people. On the other hand, the volume of sound from a racecar is large but is likely to be considered to be music to the ears of racing car enthusiasts. Similarly, attitude plays a large part in public perception of noise on farms.

Sound can also be damaging to the human ear. Annoyance caused by sound is nearly impossible to measure but damages caused by sound can be measured. While there is little risk of a neighbour's ears being damaged from noise on a farm, farm workers, exposed to equipment noise are at risk and should wear appropriate noise protection equipment.

MEASUREMENT

The measurement of sound is a complex operation that is best carried out by trained personnel. Sound level meters are designed to respond to sound in approximately the same manner as the human ear and to give objective, reproducible measurements of

sound pressure level. Meters generally consist of a microphone, a processing section and a read-out.

The microphone converts the sound signal to an equivalent electrical signal. The correct microphone for the application should be used and the microphone must be protected from wind, vibration and other environmental factors. The direction the microphone is pointed can also impact readings.

The signal from the microphone can be processed in different ways to account for a variety of factors. Weighting networks may be applied to mimic how the human ear hears noises at different frequencies. The most widely used is the "A" weighting and sound levels are indicated in dBA. Often sounds levels vary so the signals are reported as a Root Mean Square (RMS) values which are a special kind of mathematical average.

When measuring fluctuating sounds older (analog) meters were standardized with "F" and "S" response characteristics. The "F" indicated fast and "S" slow. The "F" setting could be used with steady sounds and "S" with sounds that fluctuated too rapidly to read on the "F" setting. To measure sounds of short duration or impulse sound (less than 1-second duration) an "I" characteristic is needed. Although the perceived loudness of short duration sound is lower than that of continuous sound, the risk of hearing damage is not necessarily reduced. For this reason some sound level meters include a circuit for measuring the peak value of the sound, independent of its duration.

Measuring environmental noise involves measurement of the total noise at a particular location. The noise may be due to many sources including the reflections from people, buildings and other structures. Because environmental sounds come from various directions, the sound level meter should be omnidirectional. It must have a uniform response regardless of where the various sound sources are located. Wind direction and other factors can affect how sound travels. Vegetative growth (time of year) can cause surfaces to change from reflective to more sound absorbing thus affecting noise levels as well.

Sound Energy Parameters

Hearing damage potential of a sound depends not only on the level but also the duration of the sound. Combined level and duration of sound are referred to as energy. For constant sound levels it is easier to provide an energy measurement. However, for varying sound levels it is possible to calculate a single value known as the "Equivalent continuous sound level" or Leq which has the same energy content and the same hearing damage potential as the varying sound. There are "Integrating Sound Level Meters" which can automatically calculate the Leq.

Setback Distances and Sound

Sound propagation in air is similar to ripples on a pond of water. The ripples spread uniformly in all directions, decreasing in amplitude as they move further from the source, For sound in air, when the distance doubles, the amplitude drops by half – which is a drop of 6 dB. Thus, if you are one meter from the source and move one meter further away from the source, the sound pressure level will drop by 6 dB. If you move to 4 meters, it will drop by 12 dB, 8 meters by 18 dB and so on. However, this is only true when there are no reflecting or blocking objects in the sound path. Such ideal conditions are termed free-field conditions.

Creating Barriers to Noise Transmission

When sounds reach an obstacle, part of the sound will be reflected, part absorbed and the remainder will be transmitted through the object. The amount of sound reflected, absorbed or transmitted depends on the properties of the object, its size and the wavelength of the sound. Generally, the object must be larger than one wavelength of the sound in order to significantly disturb the sound. High frequency sounds have short wavelengths are more easily absorbed and insulated than the low frequency long wavelength sounds. You have probably noticed the low frequency bass sounds inside your room when music is played next door or from a vehicle passing outside.

ACTIVITIES TO REDUCE COMPLAINTS

The ability to see the source of a noise usually increases the number of complaints arising from the noise. To some degree 'out-of-sight, out-of mind' applies to noise as well as other disturbances. Other factors that increase annoyance include:

- Loudness
- Pitch or frequency; high frequency more annoying at equal loudness

- Intermittence or irregularity; random sound or sound varying in loudness or frequency is more annoying than predictable or unchanging sounds
- Localization; a sound which appears to change its relative location to the listener is more annoying than a stationary source
- Background noise; annoyance can increase as the level of the noise increase above the background noise level (i.e. worse at night than during the day)
- Exposure time
- Control, lack of; not being able to do something about a noise can be very frustrating and annoying

Farming can generate many noises, which may be annoying to neighbours. In some cases it may be very difficult to avoid those factors which make noise annoying. For example, propane powered noise devices imitating shotguns are designed to scare birds and therefore must be loud, random noises that change direction and should be working when birds are present from dawn till dusk. These noisemakers have most if not all of the factors listed as making noise more annoying.

However, even with propane powered noisemakers, there are things you can do to minimize complaints. Explain why you use them to your neighbours so they can better understand why the practice is necessary. Make sure they are off at night (when the birds are not feeding) and turn them off when they are not needed (birds not present or the end of the cropping season). Follow the guidelines for the various farming activities (***Wildlife Damage Control Guideline*** in the case of propane powered noisemakers).

When field based farming activities must take place at night, time the operations around neighbours' houses for the least annoying time. Eliminate the unnecessary noises such as truck engines running while parked and the excessive or unnecessary yelling of workers. Site new buildings farther away from property lines especially where neighbouring houses are or are likely to be built. Site noisy equipment within the buildings or use the buildings to buffer the noise. Consider the loudness of equipment when making purchasing decisions. Maintain machinery and equipment in good working order with functional mufflers. Use and maintain landscaping to buffer and provide visual screening for noises.

LEGISLATION

Noise levels for workers are provided in the ***Occupational Health and Safety Regulation*** by the Workers Compensation Board. In 2000, an employer must ensure that a worker is not exposed to noise levels above either of the exposure limits of:

a) 85 dBA Lex daily exposure, and
b) 135 dBA peak sound level

If the noise in the workplace exceeds either of the exposure limits, the employer must develop and implement an effective noise control and hearing conservation program. One element of the program is hearing protection. The "dBA Lex" means the level of a worker's total exposure to noise in dBA, average over the entire workday and adjusted to an equivalent 8-hour exposure.

The ***Motor Vehicle Act and Regulations*** outlines the requirements for vehicles on Highways, which essentially includes all public roadways. Division 7A of the ***Regulations*** (2000) generally prohibits "any loud and unnecessary noise".

The ***British Columbia Building Code*** regulates the sound transmission levels allowable for airborne sound in spaces in buildings that adjoin other spaces within the building but does not regulate these levels for free standing structures or buildings. This is intended to protect dwelling areas within buildings from noise from elevator shafts, refuse chutes or other spaces within buildings where noise may be generated.

Numerous jurisdictions in the province have drafted and implemented bylaws that regulate or prohibit noises or sounds which disturb the quiet, peace, rest, enjoyment, comfort or convenience of neighbourhoods or person(s) in the vicinity. These bylaws most often spell out the hours during which certain levels of noise are not acceptable such as between the hours of 10:00 p.m. and 7:00 am. These bylaws are now subject to the approval of the Minister of Agriculture, Food and Fisheries where agriculture is impacted.

REFERENCES

Measuring Sound, Bruel & Kjaer, Denamark. 1984.
Motor Vehicle Act and Regulations
(Updated to March 10, 2000)
Occupational Health and Safety Regulation
(BC Regulation 296/97)

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