

Exercises solution

Master's degree in environmental science and engineering

Occupational and environmental health

Physical agents - noise and vibration

1) The noise of three machines

Calculate the sound level resulting from 3 machines each producing the following levels: 80 dB(A), 85 dB(A) and 90 dB(A).

You have to add up the noise intensity ratios (but not their dB(A) logarithms)

$$L_i = 10 \log I / I_0 \Rightarrow I / I_0 = 10^{L_i/10}$$
$$L = 10 \log \sum 10^{L_i/10}$$

$$L = 10 \log [10^{80/10} + 10^{85/10} + 10^{90/10}] = 10 \log [10^8 + 10^8 \cdot 10^{0.5} + 10^8 \cdot 10^1] = 10 \log [14.16 \cdot 10^8] = 10 \cdot (1.15 + 8) = \mathbf{91.2 \text{ dB (A)}}$$

2) Noise level

A noise dose measured over 4 hours gives a result of 67%. Calculate the average noise level in dB(A) during this period.

The noise dose, ND, becomes after integration over time from 0 to T/8 :

$$ND = 100 \cdot P_{(t)}^2 \cdot [T/8 / (0.355)^2]$$

$$\text{In our case } 67 = 100 \cdot P_{(t)}^2 \cdot [0.5 / 0.126] \Rightarrow P_{(t)}^2 = 0.169 \text{ Pa}^2 \text{ and } P_0^2 = 4 \cdot 10^{-10}$$

$$L = 10 \log 0.169 / 4 \cdot 10^{-10} = \mathbf{86 \text{ dB (A)}}$$

3) Site drilling machine ?

An investigation is carried out in the vicinity of a construction site drilling machine. Despite the wearing of adapted protections (hearing protections), the operator complains about hearing annoyance and sleep disorders. A noise measurement carried out by the site safety

officer shows a noise level of 92 dB(A). This safety officer also carries out an impact noise measurement and obtains 96 dB(C), which turns out to be lower than the legal threshold.

What hypothesis(es) can you formulate, what do you recommend?

Although the impact noise is below the regulatory threshold, the significant difference observed between the two measurements (sound level > 2x higher) suggests a strong presence of low frequency noise.

A frequency analysis would highlight the possible presence of infrasound, which could explain the symptoms experienced.

Low frequency noise is likely to be related to the mechanical vibration of the drill. Therefore, it is important to ensure that the operator is not exposed to excessive vibration at the drill rig.