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OCTAVE BANDS, WHAT'S THAT? (A Dialogue)

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Author's Note: This article is intended mainly for health and safety professionals.

Q. I just finished measuring the noise level in my workshop and the result is 93 dBA. What shall I do next?

A. My first question is, is this noise level constant or did you measured an instantaneous level?

Q. Because of the nature of the work performed there, the noise is more or less constant all the time and the workers are present during the whole shift.

A. Then, of course, your workers are at risk of overexposure and of losing their hearing. Since you are exceeding the limit of 85 dBA, you have also a potential problem with the Ministry of Labour.

Q. I know, I know it! The question is what can I do to solve this problem?

A. Obviously, you have to reduce the noise exposure of your workers and you have three means ways of going around:

1. You can reduce the time your workers are at this location. That is what is called administrative noise control, something often difficult to implement
2. You can provide your workers with hearing protectors, or
3. You can reduce the noise energy reaching your workers. This can be done either by controlling the noise generated by the source or by controlling the path followed by this energy. This is what we call "engineering noise controls" and is considered the best way of reducing the noise exposure of workers.

Q. Sounds good. And what do I have to do to implement this kind of control?

A. The first thing to be done is to measure the noise level in octave bands.

Q. Now, you really got me! Never heard of those bands. I know that a band is a group of people who perform instrumental or vocal music. Obviously that is not what you mean, right?

A. Definitely not! However, this word has more than one meaning and in acoustics we do have one. Here is how it goes. Here is how it goes:

You do remember that a pure tone is characterized by amplitude and frequency, right? And that noise in general is comprised by a variety of tones with different frequencies and amplitudes. Also, you know that audible noise goes in general between 20 Hz and 20 kHz. Another piece of information that is not strange to you is that if a tone sounds twice as high as another, its frequency is double of the first one. In such a way a sound of 200 Hz sounds twice as high as one of 100 Hz. The same applies to one of 2 kHz and one of 1 kHz.
Finally, and here goes your knowledge of music, do you remember that there are 7 notes in the musical scale and the next one after the seventh sound twice as high as the first and is called "one

octave higher?" If you know all of the above, you won't have any problems with understanding the octave bands issue.

Now, here is the story: sometimes (and noise control is one of those) we want to know the frequencies and the amplitudes of the components of a noise. But we are not interested in knowing all of them. (It will be quite complicated and with no real advantage of listing all 20,000 frequencies!). So, we divide the entire spectrum of the noise in frequency bands (using filters) in such a way, that each band is one octave higher than the previous one. They are centered at the following frequencies: 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz, and 8 kHz. (As a matter of fact you can go up or down the spectrum always dividing or multiplying the central frequency by 2, but for noise control purposes, only those are the 7 bands of interest). It is easy to see that the width of each band increases with each band, but we won't get into those details. You can see an illustration of the octave bands of a noise in Figure 1.

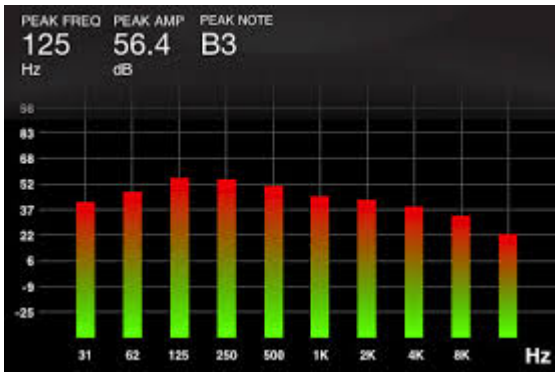

Figure 1. Octave band spectrum of a noise.

Q. OK, I think I got it. But how do I go about measuring the sound level of those bands?

A. Very easy: there are instruments, call Sound Analyzers (see one of them in Figure 2) that do that for you. They look very much as a Sound Level Meters. You just point the instrument follow the manufacturer's instructions and the instrument measures the sound, divides it into octave bands and in most cases saves the results for you. Then you can either read them on the same device or download them on your PC. Then you can see them as a table or a graph.

Figure 2. Sound analyzer.

Q. What I do then with those results?

A. You do nothing. Moreover, most probably you won't need to measure the noise in octave bands – that is something to be done by your noise professional.

Q. Are you telling me that I don't need to own such an instrument?

A. Precisely! Nothing wrong in having it, but the question is why? If what you want is just to assess a workplace, you only need a Sound Level Meter and a Noise Dosimeter… Still, no harm in analyzing the noise: it gives you more knowledge about its nature!

Q. One last question: if I measure a noise with an analyzer in octave bands, can I obtain also the sound level in dBA?

A. Here are two answers:

1. On top of giving the octave band sound levels, analyzers have also the capability of measuring noise levels in dBA, dBC, and dB linear. (dB Linear is the sound level that has not been filtered at all.)
2. The dB Lineal level of a noise can be obtained by adding the individual octave band sound levels. Now, don't forget that this addition is not straight, but logarithmic (2 dB + 2 dB IS NOT = 4 dB! [It is not our intention in getting into the mathematical side of this presentation]). Your PC will do the job for you…

A. Do you have any other questions?

Q. No, just give me some time to "integrate" everything…