Noise Management & Its Control
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Lecture - 51
Noise Coming from Motors & Pumps

Hello. Welcome to Noise Control and its Management. Today is the third day of the ongoing week, and what we plan to discuss today is a continuation of our last week yesterday's topic which is noise from motors. And then we will also start discussing on noise coming from pumps and tomorrow and day after tomorrow. Then we will go into compressors and close with the discussion on compressor.

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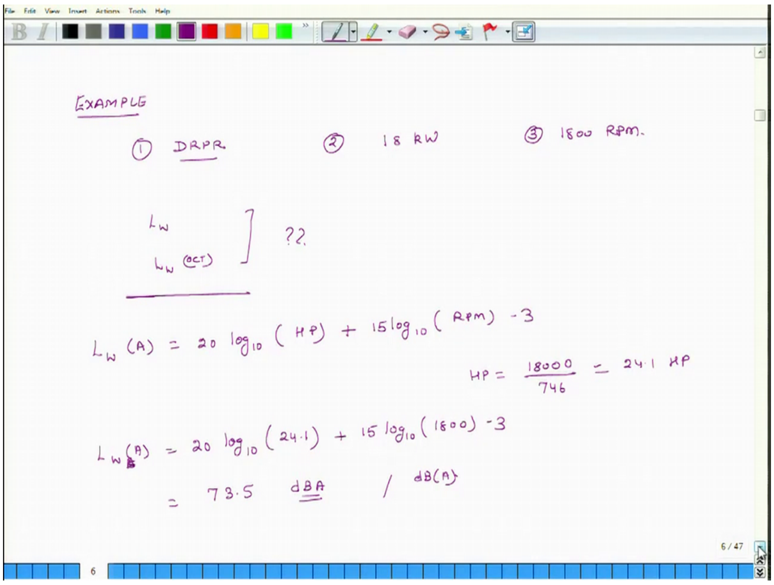

So, we will do an example on noise you are getting from a motor. So, let us say we have a motor and it is of DRPR type, DRPR that is drip prof motor. The second thing which is given is that the vertex of the motor or the horsepower of the motor. So, we are told that it is having its power is 18 kilowatts and it runs at 1800 RPM. So, with these data we are supposed to estimate L w and then L w for each octave band these are the things which we are suppose to compute.

So, if this is the information, then we first we figure out the sound power level which is (Refer Time: 01:57) and the relation for that is L w A is equal to 20 log 10 of the power of the motor expressed in horsepower's plus 15 log 10 into the RPM minus 3. Now the horsepower of the motor is what? It produces 18 kilowatts and we know that 1 ki horsepower equals 700 and 746 watts. So, 18000 divided by 746. So, that comes to 24.1 horsepower’s. So, L w A equals 20 log base 10 of 24.1, plus 15 log in base 10 of 1800 minus 3 and that comes out to be 73.5 and what will be the units of this it will be dBA.

So, I can either write like this or I can write it like dB and in parentheses a. So, this is a weighted sound power level of the motor, it is a weighted sound power level of motor.

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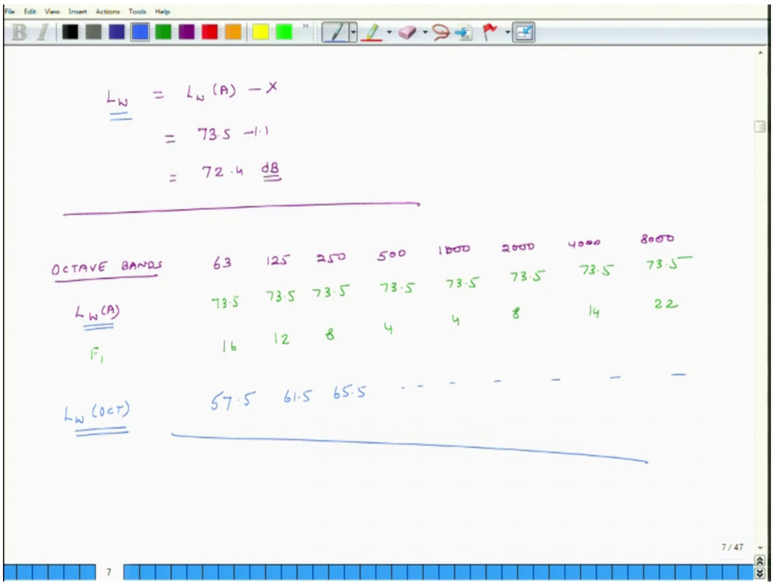

So, now L w equals L w A minus x where x is that factor which we have discussed and let us look at the value of that factor. So, x the power of the motor is 24.

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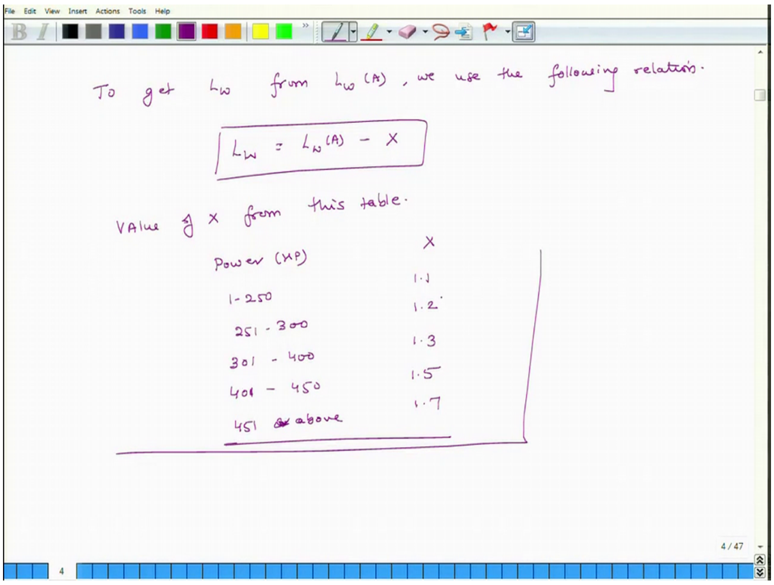

So, we are in 1 to 250 range. So, the value of x is 1.1. So, this is equal to. So, I think this is plus here. So, this is sound power level is a weighted power level minus this x and this is I have to subtract this value and the values are indicated here. So, with that, what I get is 73.5 minus 1.1. So, I end up with 72.4 decibels. So, I have gone from dBA to dB land. So, this is one, but we were asked something else also that I have to compute the sound power level in every octave band also in every octave band.

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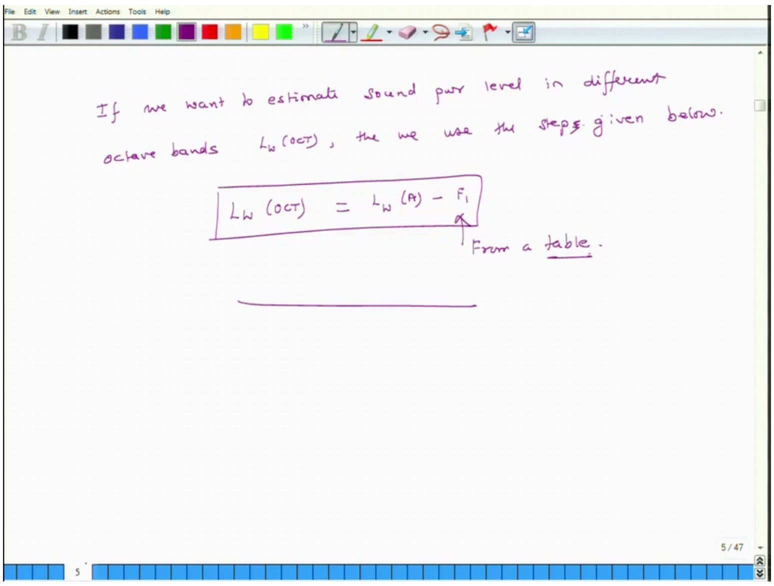

So, for computing sound power level in every octave band, we had another relation which is L w A minus f 1 and I have to get this f 1 from the table.

So, let us write down the octave bands. So, our octave bands are 63, 125, 250, 500, 1000, 2000, 4000 and 8000 and then of course, our L w A was calculated to be 73.5. So, I will just write down this 73.5 in all the lines and then I am supposed to get those factors f 1. So, let us look at some of those factors from the table.

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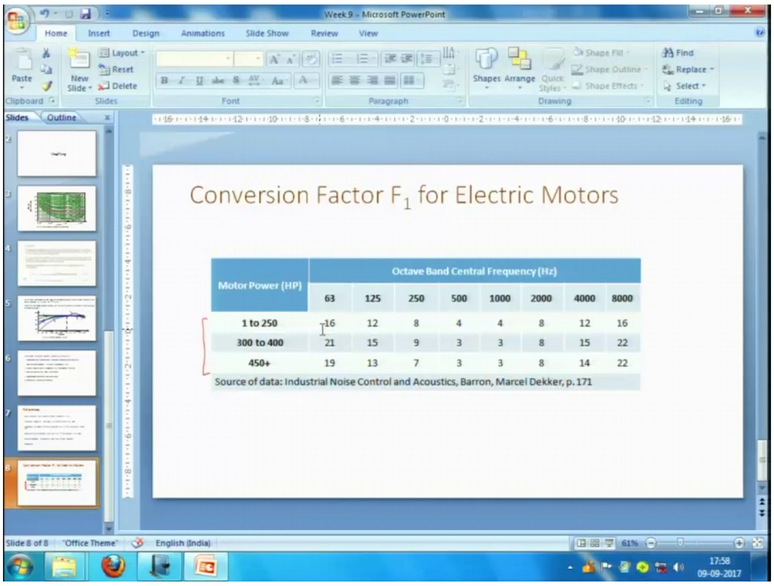

Motor Power (HP)	Octave Band Central Frequency (Hz)							
	63	125	250	500	1000	2000	4000	8000
1 to 250	16	12	8	4	4	8	12	16
300 to 400	21	15	9	3	3	8	15	22
450+	19	13	7	3	3	8	14	22

Source of data: Industrial Noise Control and Acoustics, Barron, Marcel Dekker, p. 171

So, it is 16, 12, 8, 4, 4, 8. So, 16, 12, 8, 4 4, 8 and then the next two values are 14 and 22. 14 and 22; so this is this factor F 1 and remember we call it factor because it is actually a ratio if this 16 represents a ratio, but when we take when we are taking logarithms because here everything is in decibels, then ratios to get converted into differences. So, that is why we subtract, but this we write it as factor or f because this actually represents a ratio.

So, my L w OCT for each octave band I all I do is I have to subtract these. So, this is 0.5, 57.5, this is a 61.5, 65.5 and so on and so forth we can calculate. So, this is how we do the computation. So, this a concludes our discussion on motors and this gives you some idea as to how to estimate the noise, which will be generated by a motor and you can calculate sound power level, you can also calculate it is a weighted sound power level and you can also calculate its sound power level for every specific octave band.

So, you have the whole gamut of things the next device or machine which we will discuss today is pumps, noise coming from pumps pump noise.

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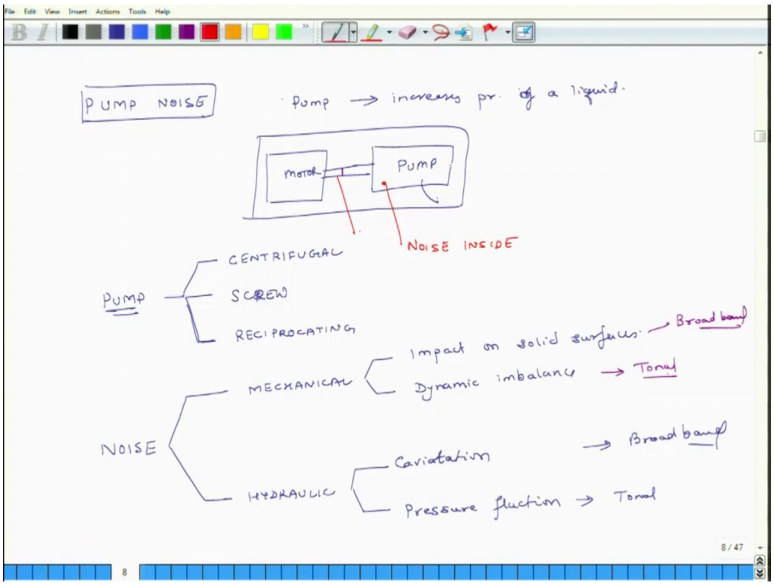

Now, once again what does a pump do? Pump it increases the pressure of a liquid and typically a pump has two parts, you have a motor which converts electricity into mechanical energy and this shaft it actually drives the pump. So, this is the pump this is the motor and this entire thing is also lot of times it is referred to as the pump.

But what we will discuss today is the noise coming from the pump by itself only. We will not discuss the noise coming from the motor part we will just focus on the noise coming from the pump. Now these pumps are of different varieties, for broadly speaking there are three types of pumps one is known as centrifugal type. So, here you have blades and the pump rotates these blades also rotate and that they push water at higher pressures, and because of the rotary motion the water or whatever the liquid inside the pump it gets pushed out at a higher pressure. So, that is the thing, the second one is a screw type of pump.

So, in a screw you have a shaft and in which you have threads or a screw type of threads and this thing rotates at a high speed and the motion of the fluid gets goes in the direction of the thread. So, there it is the thread which pushes out the fluid. So, these are screw type of pumps and the third one is reciprocating pumps. A very good example of a reciprocating or pistonic type of pump is a [FL] where you have a piston and you have a moves in a cylinder and it pushes out water at a higher speed, but a regular [FL] is different than reciprocating because it does not do back and forth, but if you take it out and move it back and forth repeatedly. So, it is like a rep reciprocating pump. So, these are the three broad categories of pumps from the stand point of functionality now let us look at what kind of noises are generated in pumps. So, noise.

So, broadly speaking there are two categories, one is because of mechanical effects and the other one is because of hydraulic effects. So, what are the mechanical effects? So, couple of example types would be that as water is pushed it goes and it strikes some non moving metallic surfaces and that generates vibrations in the metallic surfaces and that is creates noise. So, impact on solid surfaces (Refer Time: 11:57). So, that is one the second reason could be dynamic imbalance.

So, in case of motor in case of motor it is this shaft which could be dynamically imbalanced, but it could also be the part related to the pump, you know this because this motor is this motor shaft may be ending here and the other part of the shaft may be this guys. So, it depends on which shaft is imbalanced or which and because of that imbalance also there could be a lot of noise. Typically this would be tonal, I would expect and this impact would be some sort of broadband noise then in terms of hydraulic, you have two important sources one is because of a effect called cavitation, especially if the pump is rotating at a very high frequency, ok.

So, then some vacuums gets created because of this and because of that ah this cavitation phenomena starts occurring and that generates a lot of noise, and the other one is pressure fluctuation, because there is no pump which produces pressure at a constant which is constant across the period of time. There will always be some variation and it is a cyclic variation. So, it depends on the number of blades you have it depends on the RPM and all that stuff, but this is a cyclic variation. So, here this will be some sort of a tonal noise and this is in general broadband.

The third thing is you have this pump and the noise gets generated inside, noise gets generated this is noise inside the noise gets generated inside the pump and then somehow it gets out.

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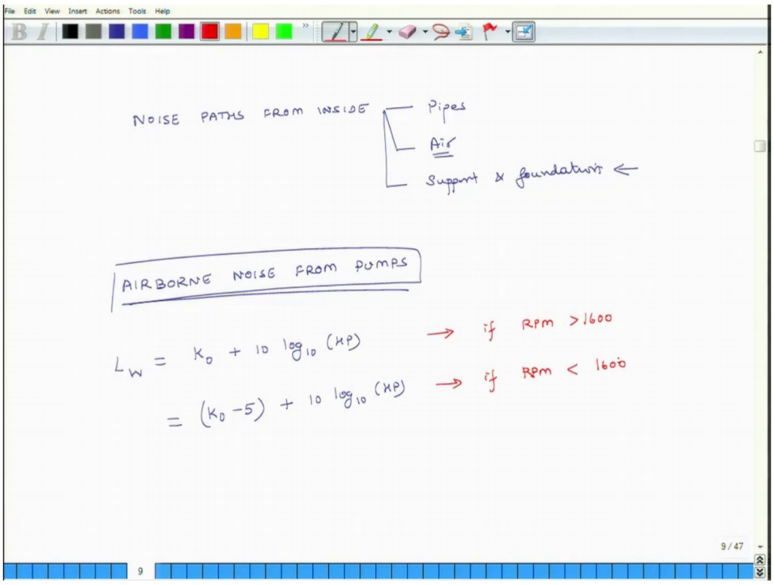

So, the question is how does it gets out noise paths from inside. So, in case of fan we had discussed one was through inlet one was through outlet ,the other one was from the housing and the fourth one was from the it goes to the foundation and the foundation spreads. Here it is somewhat similar. So, one is through the pipes, the other one is through air. So, the lets say the whole body of the pump is vibrating and that vibration is spreads out. So, this is through that is air bound noise and the third one is through the support and foundation.

So, this whole thing is vibrating and it is sitting on a foundation, because of which the foundation vibrates and once the foundation vibrates the surface where it is mounted it is vibrating and that in vibration creates a lot of noise. So, this noise a lot of times it can be almost eliminated based on the same factors which we discussed in case of fan. What we will discuss today is to figure out an estimate of this type of noise air borne noise. So, what we will look at is air borne noise from pumps.

So, once again what is it that we are interested in? We are interested in estimating the sound power level coming from the pump. So, again there is an empirical relation for this and the relation is L w equals a constant K naught plus 10 log of 10 of the horsepower of the pump. Now this relation is good if the RPM of the pump is more than 1600 and then the other relation and if it is less than 1600 then it is K 0 minus 5 plus 10 log 10 of the horsepower.

So, this is the situation if RPM is less than 1600 rotations per minute. So, depending on the RPM we chose the right relation and then the question is what is the value of K naught.

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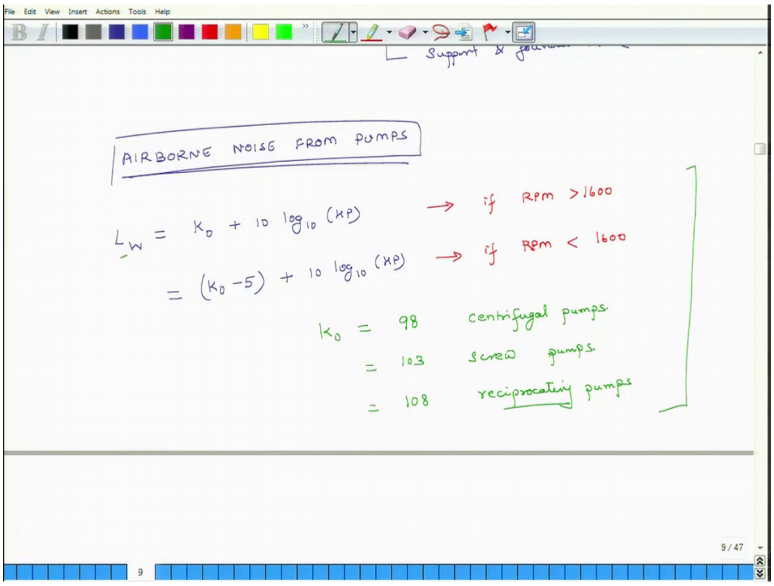

So, we have three different types of pumps. So, they have we have three different constants. So, K naught equals 98 if the pump is centrifugal and then it is equal to 103. So, it is 5 decibels more for screw pumps. So, screw based pumps are noisier compared to centrifugals and then it is equal to 108 in reciprocating systems. So, looks like the reciprocating are the noisiest if the power level same we will have least noise from centrifugal pump and reciprocating pumps will be the noisiest and then of course, if the RPM is high then noise becomes higher and so on and so forth.

So, this is the relation for L w. And then finally, if you are interested in finding out the sound power level for a specific frequency band octave band then we have to compute L w octave.

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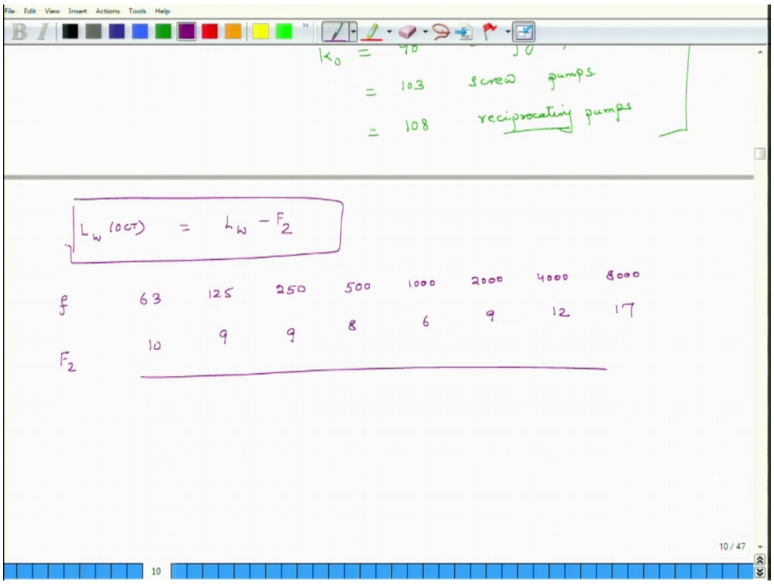

And that equals L w minus another factor and I call it F 2 and where do you get this things again people have done a lot of experiment and based on all that data I will just give you a 2 line table. So, for F 2 we have central frequencies. So, central frequencies are 63, 125, 250, 500, 1000, 2000, 4000 and 8000 and then we have F 2 10 9, 9, 8, 6, 9, 12 and 17. So, these are the values. So, I think this is how we can calculate sound power level for different octave bands.

So, what we have discussed in context of pump are different things that. So, this entire discussion on the noise is primarily from the airborne noise. So, we are not discussing about the noise related to which is coming through pipes and through supports and foundation, we would assume that if it is going through the pipes that noise level is very less and you would not think that you will just have in a room pump with no pipe you know. So, that is a not a realistic option. So, the airborne noise coming out from a pump can be expressed as L w equals k naught plus 10 log of hp and the modified relation if the RPM is less than 1600.

So, we have discussed the values of this K naught constant for different types of pumps and if you want to compute the sound power level for specific octave bands, then this is the factor which we use to compute energy octave band specific power levels. So, that concludes our discussion and what we will do today is continued this discussion on pump noise and we will actually do an example; where will have two different machines a motor which is driving a pump and then based on that what is the sound pressure level inside a closed room at some distance away.

So, we will actually do that example and try to understand things hopefully in a better way.

Thank you and we will meet tomorrow. Bye.