Lighter Than Air Systems
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Lecture - 47
Effect of change in Lifting Gas Volume

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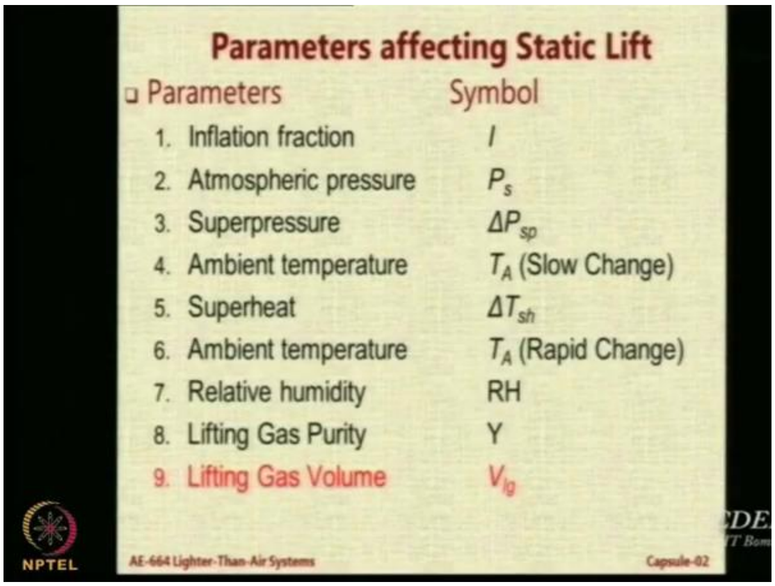

So now, the last thing that we have to consider this is not a variation this not a parameter. This is an outcome rather lifting gas volume.

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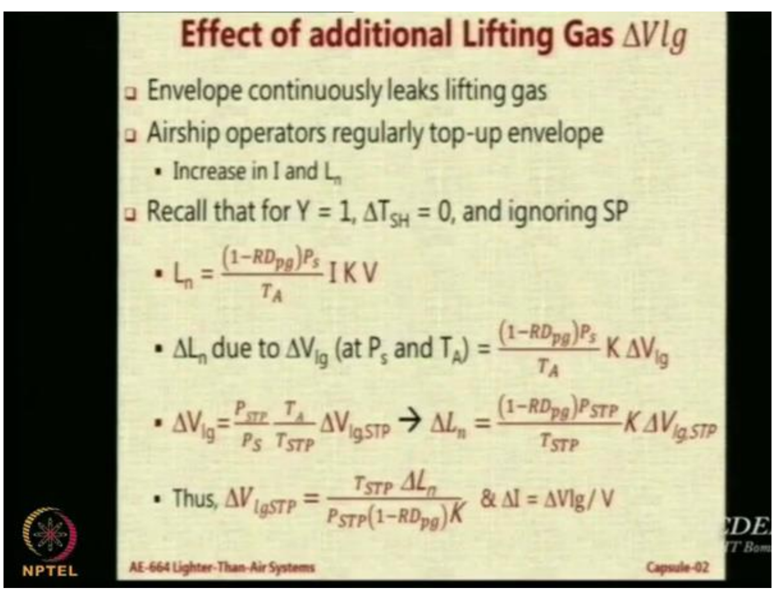

Now the thing is we know that this envelope LTA gas envelope it continuously leaks gas. Now what is the typical leak rate of gas from an envelope? Anyone 1 liter per meter square per day that is one of the benchmark values people try to beat this value but if it is worse than this you think that the envelope is not a very good envelope. So, over a period of time gas is going to leak from the envelope. A time will come when the lift, gross lift will not be able to overcome your requirement.

So, you may have to pump in more gas. During that case the volume of the lifting gas and also the weight will change. When you pump in the lifting gas the total volume is the same. So, airship operators regularly top up the envelope. The frequency varies some people do it on a monthly basis and some people do on 3 monthly bases, depending on at what leak rate that they are getting. So, the moment you top up the envelope the inflation fraction will increase because there be more gas the volume occupied by the gas will be more compared to the total volume.

And if you do that the net static lift also will be changed, increasing. So, if you assume Y = 1 that means the whole envelope is full of pure gas and I neglect T_{SH} also the superpressure and I am just knockoff of these terms for simplicity then the net lift is equal to

$$L_N = \frac{(1 - RD_{pg})P_S}{T_A} IKV$$

So, ΔL_N because of ΔV_{lg} will be essentially subtraction is taken care. So, if you replace V with the ΔV_{lg}.

But ΔV_{lg} not envelope, envelope value remains the same. So, if you add ΔV_{lg} value amount of gas. Then the additional net lift will be

$$\Delta L_N = \frac{(1 - RD_{pg})P_S}{T_A} K\Delta V_{lg}$$

there is no I here because you are not looking at a fraction of the total you are adding so much gas you directly get so much of Additional net lift. Now how can we bring simplification here.

So, volume of the lifting gas is nothing but the pressure of the lifting gas under standard conditions divided by the pressure at ISA condition and temperature upon T_{STP} into if we do that so this is basically equating conditions which are standard and ISA. So, therefore additional net lift will also be expressible in terms of P_{STP} and T_{STP} if you use $V_{lg\ STP}$. So therefore, change in the volume that you need is directional proportional to how much lift you want to generate.

So, if for instance you realize that we have to take care of loss of lifting gas by putting so much to generate so much lift this is a simple way to estimate how much gas you will have to put and when you put more gas, then the change in the inflation fraction will be the ΔV_{lg} added upon the envelope volume.