MARINE ENGINEERING

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Lecture22

W3L8_Intercooler

Now, if you go to any cycle shop, modern cycle shop, those little bit bigger, they will have one compressor will be there. You go to a cycle or bike shop, there will be a compressor. Then one long pipe will be there. Then it will be put in your tube so you do not have to pump manually. there will be one arrangement will be there.

there actually reciprocating compressor will be there. reciprocating compressor will be there. that reciprocating compressor in one stage, normally they will not be compressing whole air, rather they will be making multiple stages. there will be two cylinders, cylinder 1, then air take, cylinder 1 you compress, you cool it, again you put in cylinder 2, then you deliver. there will be intercooler.

if we have intercooler in between two piston cylinder arrangement, then my system performance will be increasing. It will take less amount of electricity. And this intercooler will have lots of fins. it will be releasing lots of heat. because ideal process is ice thermal process.

As we are not so fast so that we can create ideal process. scientists thought let us create something which will be mimicking little bit ideal. just they put intercooler system to release heat so first compress it when you are compressing because of charles law you can see pv equals rt temperature will be going up when temperature gone up reduce the temperature using intercooler it is actually condenser heat will be going outside okay heat will be going outside then temperature going down then volume also will be going down pressure of pressure you are maintaining then you put in the second cylinder again you compress, maybe you can put another intercooler, again another cylinder.

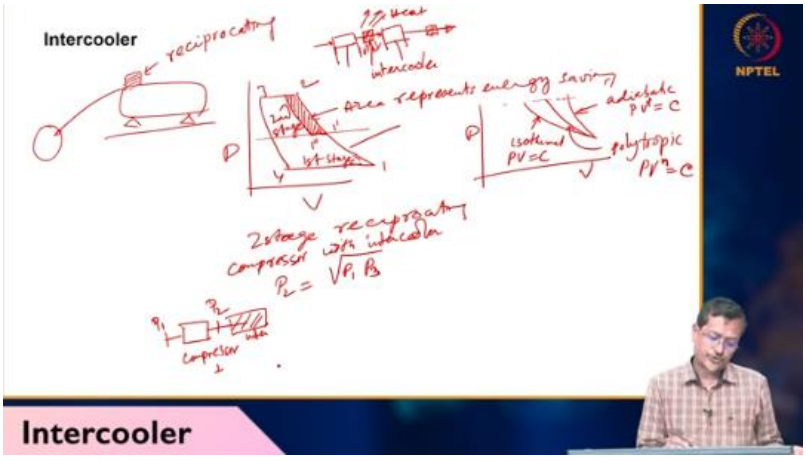
in that way, you are increasing the performance of the whole system. what happens if I draw the whole thing in PV diagram, it will be looking like this, PV. if I have only one

cylinder, so my compression will be looking like this. 1, 2, 3, 4. Now, you are an engineer, so you thought let us put two compression system with intercooler, then what will happen? First, you compress up to this level 1 dash, then you cool it, when you are cooling your pressure same volume gun down.

now again you compress so this much of energy saving will be there because of your cooling arrangement okay one dash one double dash okay so there's one dash and one double dash in between that area you are saving energy okay so this is area represents an energy saving okay first stage first stage this is the second stage okay so the ideal cycle will be like this pv let us say compression is polytrophic isentropic polytrophic this is isothermal isothermal PV equals constant. This is adiabatic. Adiabatic PV per gamma equals constant.

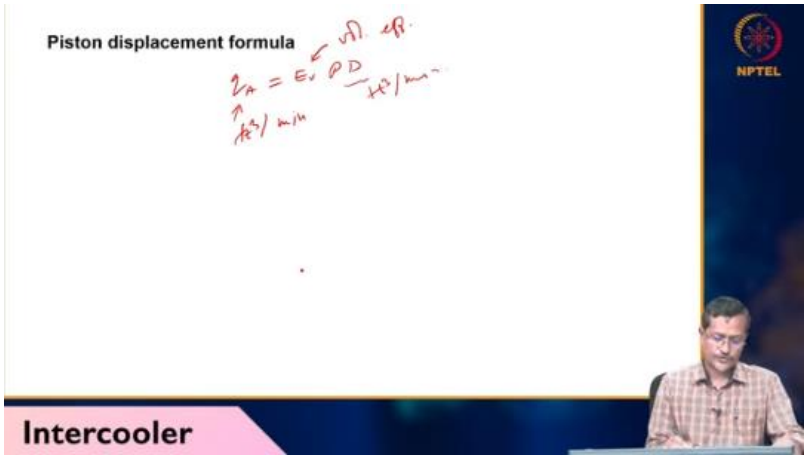
This is polytropic. So, polytropic PV per N equals C. So, gamma normally 1.4, N value maybe 1.33 or something because this is polytropic process and value will be changing. this is V, this is P. So, our target will be to reach towards isothermal. So, two stage supporting air compressor with intercooler, two stage reciprocating with intercooler formula will be like this P2 equals P1 P3.

So, P1 is first one P1 compressor 1 compressor 1 then P1 I will not write here I will write here P1 then P2 now we have intercooler. So, P2 after compressor 1 pressure and we have intercooler then compressor 2 and pressure is P3, then intercooler pressure will be P2 equals square root of P1 into P3. cylinder throughput formula. So, QA equals EV PD.



So, QA equals cubic feet per minute, EV equals volumetric efficiency, PD equals cubic feet per minute, cubic feet per minute. So, in a reciprocating, now you see the problem. In a reciprocating compressor, the swept volume is 0.9 times of the maximum volume, the

clearance ratio is. So, first you draw the figure. In a reciprocating compressor, you are saying that means it will be like this, piston will be here, piston rod will be here and valve no need to draw, PV.



now i have clearance volume actually okay now initially you have at point one then you are reaching to point two then you're reaching to three then three to expansion will be happening then suction will be happening so three to four okay now in a reciprocal covers vs uh so volume so from here to here vs so vs equals 0.9 v 1 v 1 means initial volume okay maximum volume is v 1 v 1 is the maximum volume okay and now v c this is v c this v c clearance volume or clearance This is swept volume. Swept volume. VC by VS equals we have to find.

V1 equals VS plus VC. VS equals 0.9 VC plus VS. So V VC Vc equals Vs minus 0.9 Vs by 0.9 equals 0.1 by 0.9 Vs. So, therefore Vc by Vs equals 1 by 9 equals 0.11.