MARINE ENGINEERING

By

Prof. Abdus Samad

IIT Madras

Lecture21

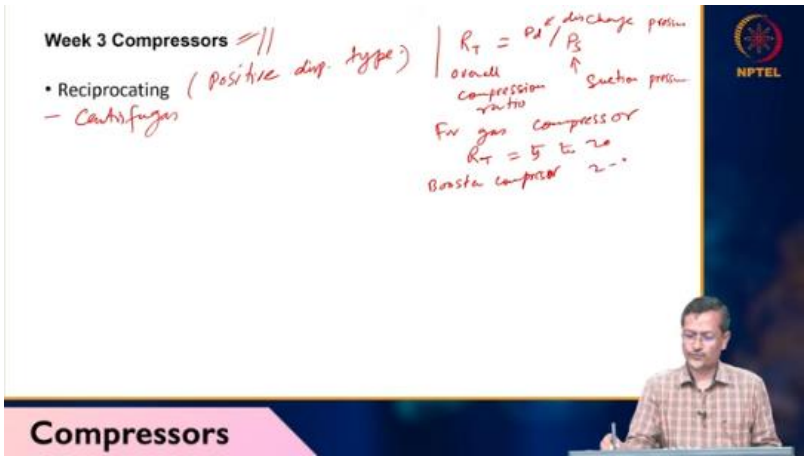
Compressors

compressors, compressors like pumps, I already told that fluid is taking energy from the machine. that is the pump. in that same definition, this is also actually a pump. How it is happening? In the compressor, you are compressing.

In pump, normal definition pump, actually it is in compressor fluid, you are delivering from one place to another place, you are adding energy to the fluid. In the compressor also, it is compressive flow, so you are compressing, increasing energy. There will be two types basically compressors, one will be reciprocating, another will be reciprocating or positive displacement type, displacement type and another will be centrifugal type. So, reciprocating or many other types of positive displacement is also possible for compressing gases. So, compressor low-pressure to high pressure

development will be there. Flash gas compressors are normally characterized by low throughput rates and high differential pressure. Differential pressure is expressed in terms of the overall compression ratio. So, RT equals PD by PS. So, overall compression ratio, overall compression ratio and PD discharge pressure

maybe psi whatever unit you use because finally it will be ratio, psi is suction pressure. So, for gas compressor RT will be like 5 to 20, booster compressor to increase pressure 2 to 5. 2 to 5, this RT value. So, whenever we are, we have seen already the overall compression ratio RT equals PD by PS. Now, the PV diagram, sometimes this is an indicator diagram also.



First, you draw one piston-cylinder arrangement, then you draw VP. Now, the piston will be moving from this end, A, B. Let us say piston moving from B to A. So, what will happen? Initially, all valves are closed. initial compression will be happening. piston, let us say sucking fluid from here, C, D. C, D, see your suction valve.

d is your delivery valve okay and initially pressure atmospheric pressure and you are delivering at higher pressure let us say from the cycle pumper okay on roadside cycle pumper initially you are lifting up then you are pushing down when you are pushing down initially some gas will be compressed okay so initially you are compressing certain amount of gas your day you are compressing certain amount of gas, then you are reaching up to certain pressure, then you are delivering that compressed air into your cycle tube. you compressed up to this level, then you delivered. let us say 1, 2, 1 to 2 you compressed, then 2 to 3 you delivered, again 3 to 4 you are lifting up your piston. when you are lifting up, actually what happens in piston cylinder arrangement is

the piston is there cylinder is there so piston you are moving down down moving towards the top dead center this is called top dead center TDC or top dead center and this is called bottom dead center or BDC bottom from piston moving from bottom dead centre to top dead center the piston will not touch the top dead center it will keep certain amount of gap that gap is required for mechanical reason because continuously you cannot hit this top dead center okay so you have to keep certain amount of gap and again you have to move backward again forward backwards forward that way you are delivering fluid now initially you compressed then you delivered the fluid Then certain compressed gas is here. Now the piston is moving backwards. that compressed gas, again it will be expanding.

After a certain amount of expansion, it will be sucking air. Then again compressing, delivering, sucking. now some expansion will be happening. Then again suction will be happening. 3, 4. So then 1, 2, 2. adiabatic compression.

I am assuming that when the cycle pump area compressing, the event is happening very quickly. it is adiabatic, no heat transfer happening. If heat transfer happening, then it It can be a polytrophic process. Polytrophic means neither adiabatic nor isothermal.

Isothermal means it is very good, but we cannot achieve that. Normally, it will be a very fast process. So, let us assume it is an adiabatic process. 2 to 3 processes,will be a delivery process, constant pressure or isobaric, I can say isobaric, isobaric delivery process. of air to your cycle tube and 3 to 4, 3 to 4 the amount remaining, the air amount remaining that is expansion, expansion of remaining air in the cylinder.

And 421, it is happening like this. 421 is suction of air, suction air at constant pressure Now, you can see I said like some amount of air will be compressed, but it will not be delivered. piston moving BDC to that level is called swept volume. my swept volume is B to A, B to A is swept volume.

And some part piston is not moving. that part is called clearance volume. Let us say A, B, C, I will put some name, let us say E. A, E is called clearance volume. piston will not be traveling to clearance volume. That gap will be maintained all the time.

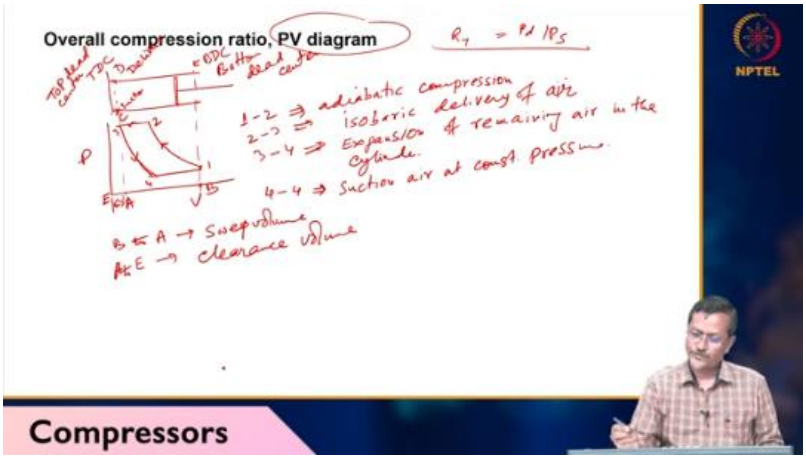
some compressed gas will be there. Again, expansion will be happening. Once expansion done, then air intake will happen. Again, you compress, deliver. Again, that very highly compressed gas will be expanded a little bit.

Then, air intake will be happening, then delivering. So, if you go to a roadside cycle shop, they will have a cycle pumper. Just you can do an experiment also. Initially, you take air, try to compress. After certain time only, the air will be entering into tube.

You can feel that one. Again, when it is moving up, quickly it will be helping you to move up. Then after that, you have to pull it up so that atmospheric air will be entering into the cycle pumper. Then again you are delivering. that whole sequence will be continuously happening.

this is called PV diagram. This is called PV diagram. normally adiabatic compression or polytropic compression. Practically, it will be polytrophic, but ideally, we can assume

adiabatic. Polytrophic means some heat already gone to the atmosphere, so you cannot get back that heat.



That is why that can be polytrophic. Or you cannot make isothermal because the process is not so slow that all heat will be dissipated. So, in that case, some heat will be remaining, some will be dissipated, so it will be polytrophic process.