Steam and Gas Power Systems
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Module No # 03
Lecture No # 11
High Pressure Boilers (Part-2)

Hello I welcome you all in this course of steam and gas power systems today we will continue our discussions on high pressure boilers.

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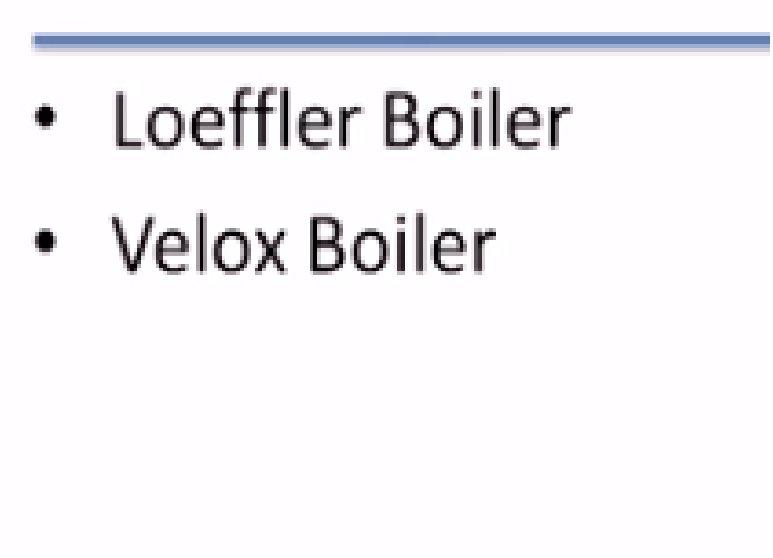

Today we will discuss two high pressure boilers one is Loeffler boiler and Velox boiler.

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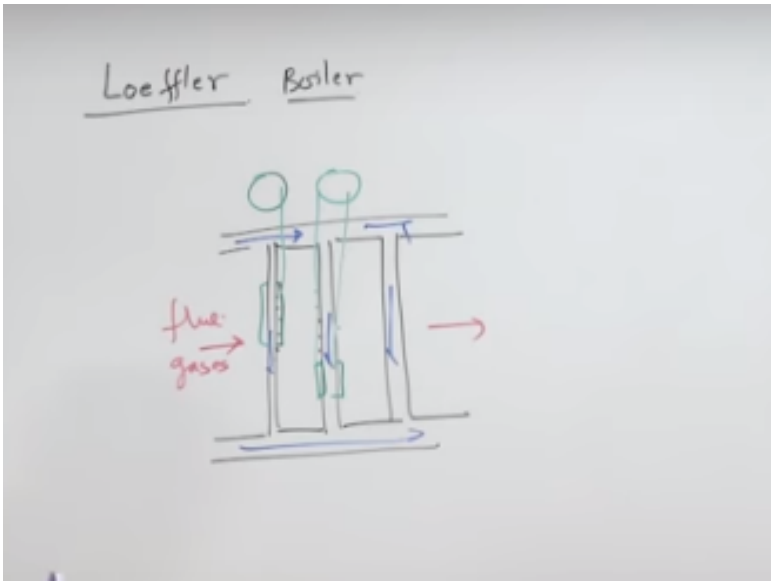

Will start with the Loeffler boiler now in this boiler we use turbines as well in this boiler not only there is a circulation of the steam turbines also that means that makes us interesting. Another feature of this boiler is that heat is generated with superheated steam. A steam it itself generated by superheated steam so there is a suit deposition in the evaporator.

Now suit deposition in the problem in the boiler especially in the economizer if you look first of all in brief I will explain how suiting is deal in case of economizer what happens in economizer there are number of tubes and economizer and they are connected with the help of the header and water is circulated inside this tubes the flue gases coming from the boiler they are passed over this tubes right and transmission of this heat takes place flue gases on the boiler.

Because this flue gases consist of the burnt carbon particles right and this particles is stick on the surface of the tube and when this suiting takes place in the surface of the tube this hampers the heat transfer. Effectives of the economizer is reduced and inside the economizer there is a flow of water right. So scrubbers are provided on the surface of the boiler this tubes scrubbers are provided different types of scrubbers are provided.

The job this scrubbers is to scratch the surface of the tube and there is a mechanical arrangement pulling and (()) (02:50) type of arrangement for the movement of this scrubbers along the length of the tube so slowly it keep on moving in order to remove the suit from the tube surface.

However in this case in in in in Loeffler boiler the steam generated with the help of the superheated steam so there is no flew gas at all.

So steam generation does not involve generation of suit of the surface so that is another benefit of this boiler. So first of all we will draw the schematic of the boiler to understand the functioning of this boiler.

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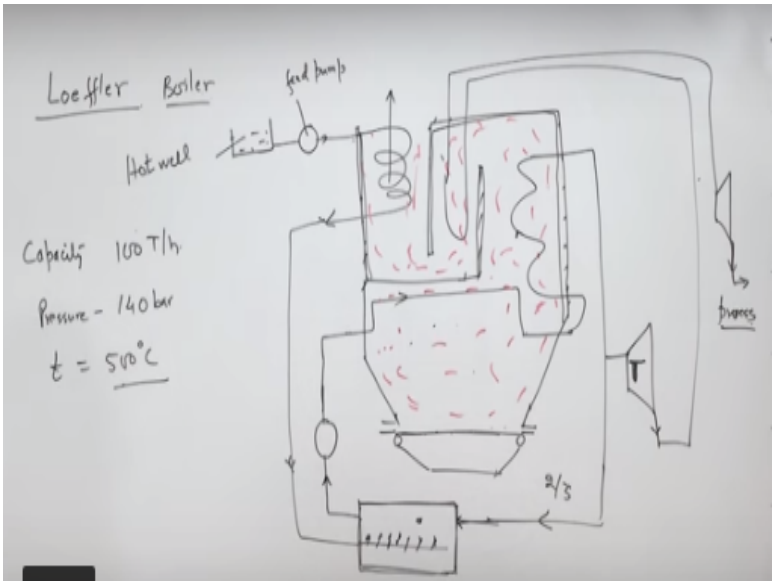

Am drawing with the simplified schematic diagram right there is a grate here the fuel is burnt okay a separate arrangement is made for steam generation it is separate from the boiler okay and here the generation of the steam takes place with the help of superheated steam. So first of all we will start with the hot well this is hot well consisting of water and as we did earlier also here the heat is extracted here will be extracted through an economizer by heating feed water.

So in the feed water is circulated through economizer for the heating purpose so heating as been done by flue gases which are name in the boiler that the heat is trapped and this feed water is sent to the evaporation drum right. So simply by adjust taking here the feed pump as to be placed feed pump. So just from hot pump the water is taken and goes to the feed pump.

Feed pump circulates water in the economizer and where the exchange of heat takes place between the flue gases and the water which is circulated in this tubes and that heated water goes

the evaporation drum and inside the evaporation drum they are number of nozzles right. There number of nozzles which spray this water and this water is converted into this steam and superheated steam is supplied from this side.

And later on I will explain you how the superheated steam is generated superheated steam is supplied from this side and this water taking heat from the superheated steam is converted into the steam and this steam goes to the shell there is a steam pump this is pump for circulation of the steam right. And from here it goes to the shell and for the heating purpose and heating in the shell takes this is shell because here the burning of fuel is taking place the entire space filled with flue gases.

This is on all is filled with the flue gases so water which is circulated in this tubes is heated and is subsequently converted into the steam so we can directly get saturated steam from here but as a aspect is we have to superheat the steam right. Because superheat steam is very much required here especially this superheated steam will be used for converting water into the steam so this place also filled with in the flue gases this is also filled with this is all filled with the flue gases right.

And they are separated by these valves this is very simplified diagram right now this steam which is preside in this tube is gain sent for superheating here the steam is again superheated and after superheating it is taken out and this steam is not directly sent to this place then it will become a close loop then we do not required feed water feed pump because in this system we are feeding the water.

So what we are doing here two third of the steam is only going to this place evaporation drum two third of the steam this is two third of the steam and where the one third of the steam is going, one third of the steam which is high temperature if you look at the a specifications of the boiler which I forgot tell you earlier the capacity is hundred tones per hour pressure is 140 bar and temperature is 500 degree centigrade.

So superheated steam is very on high temperature so one third of the steam is used for generating power in high pressure turbine after expansion in the turbine right it again goes for heating this is again heating cycle. So the steam goes for reheating and then it goes to low pressure drum this is low pressure drum right the exhaust of low pressure turbine shall have I mean sufficient energy for another process.

So it can be used for sum process so it can go for some doing some process for the process it can be used for process heat and remaining two third of water for superheated water it will go to the evaporation drum where evaporation of saturated liquid is taking place form of the steam and the rest of the cycle already explained.

So it appears to be slightly complicated because here we are not generating the steam but directly heating from the flue gases through the flue gases simply the superheated steam is obtained and this superheated steam is used for heating the water in the evaporator. Now the best part is there is no suiting here normally this boiler is used for marine application right there is not suiting here that is the best part of it so we can go for saline water also here in this boiler right.

So and rest of the characteristics are I mean rest of the things are same addition to that we are getting output also to this turbines this two turbines we are getting the output from this boiler it is a compact boiler and actual boiler this is also only schematic representation of this boiler actual boiler if we look at it is quite different from this I mean but the basic working of the movement of fluid is like this only now after this we will take up the last one is Velox boiler.

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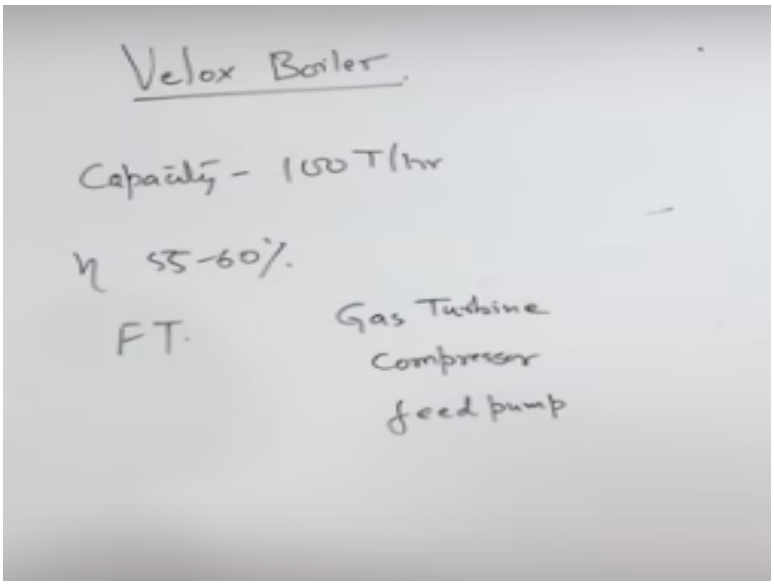

Now Velox boiler now let us write first characteristic of this boiler the capacity of this boiler is the boiler is 100 tones per hour and efficiency you will be you may be surprised in this only 55 to 60 % and it is a fire tube boiler it is not a water it is fire tube that is unique test of this boiler. It is high pressure fire tube boiler normally they are high pressure fire tube boilers this one is high pressure fire tube boilers and this boiler contains gas turbine compressor feed pump rest of the things are same feed pump and generator and all.

But the main thing is it consist of gas turbine and compressor as well right and the flow of gases is supersonic air this boiler the flow of the flue gases is first of all I will show the schematic of the boiler right.

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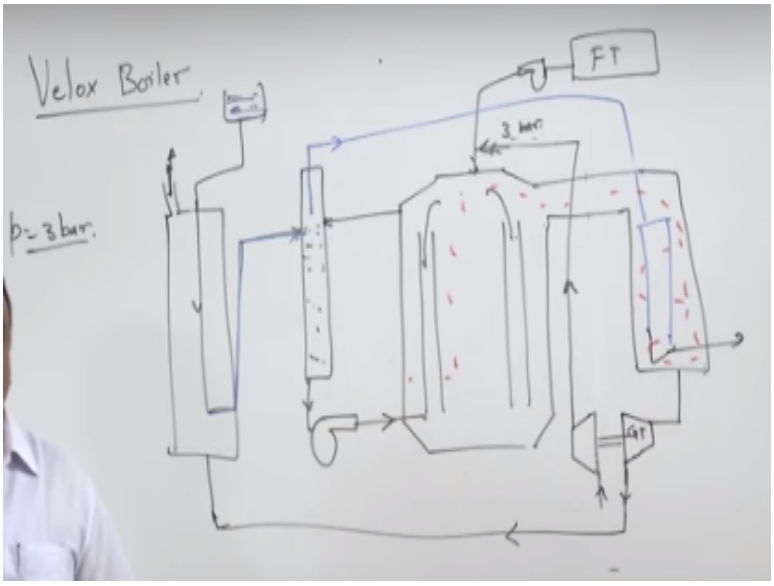

Again there is a sort of vessel in this vessel the fuel is supplied there is a fuel tank and from the fuel tank there is a feed pump and through the feed pump the fuel is supplied through this boiler this boiler is also supplied air at 3 bar pressure of the air is 3 bar. Now this air pumps this fuel and the velocity of the flue gases where even remain same because 3 bar schematic pressure is quite high pressure.

So at this pressure the velocity of the flue gases in this boiler is the supersonic the velocity of the flue gases is supersonic and their vertical tubes and there are fire tubes it means the constructing tubes inside tube there is a flue gas and in (()) (14:27) space there is water. So they are fire tubes and this fire tubes have another space which is filled with the water and water is circulated with the help of the pump there is a pump which circulates water in the (()) (14:47) space.

There is a steam separator which is connected so pump is drawing water from steam separator and generated steam is going back to the steam separator so it is a closed roof. So it is drawing steam from the separator after generation of the steam a steam is collected in the steam separator. Every high boiler pressure must have a super heater so super heating arrangement is made and flue gases from this chamber they go to the super heater there is a super heater.

So the steam saturated steam is character here so this saturated steam goes the super heater is it clear steam is generated here in this housing there is a separation steam separator where water

and the steam are separated the steam generated because it has to be superheated, super heating arrangement is made and this area is filled with the flue gases right then superheated steam then can be used for process work.

I mean it can go to the turbine generate power but still we have flue gases and their flue gases are at very high temperature. Now here in this case the turbine and compressor combination is taken first the gases are run through a turbine gas turbine there is a gas turbine. So gases are pass through a gas turbine and gas turbine runs a compressor now the gas turbine runs a now this gas turbine is coupled with a compressor so is coupled with a compressor right.

Compressor takes care from the surroundings and the air is compressed and is sent for burning the fuel right so the high pressurization of (()) (17:14) air is done with a air of the compressor. Compressor runs with the help of gas turbine and gas turbines runs with the flue gases coming out of the super heater. Now exhaust of the gas turbine because gas turbine exhaust temperature gas temperature is also quite high after extracting high grade energy from the heat is still the temperature of the gas is coming out of the gas turbine is high.

So this high temperature gas turbine gases are sent to the economizer for heating the feed water so there is a economizer in this economizer the feed water is heated and then feed water is supplied to the separation tank. So the exhaust from the gas turbine it is sent to the economizer this economizer where exchange of heat takes place that then heat is sent to the movement of flue gases right.

So this is economizer feed water comes from here so feed water coming from the feed water tank it is sent to the economizer where exchange of heat takes place between the flue gases and the feed water and this high temperature feed water is again sent to the separator and from here again the same cycle takes place. So this is the working of Volex boiler and specialty of this boiler is there pressurization of air which is used for burning the fuel is done with the help of exhaust gases coming from the super heater.

It is a compact boiler it is a compact boiler it is a very quick start type of boiler it is a quick start type of boiler very high combustion rate and access air which is required for the burning of fuel is less in this boiler because there is a lot turbulence in the boiler in addition to this boilers there are fluidized boiler also which are now a days very popular.

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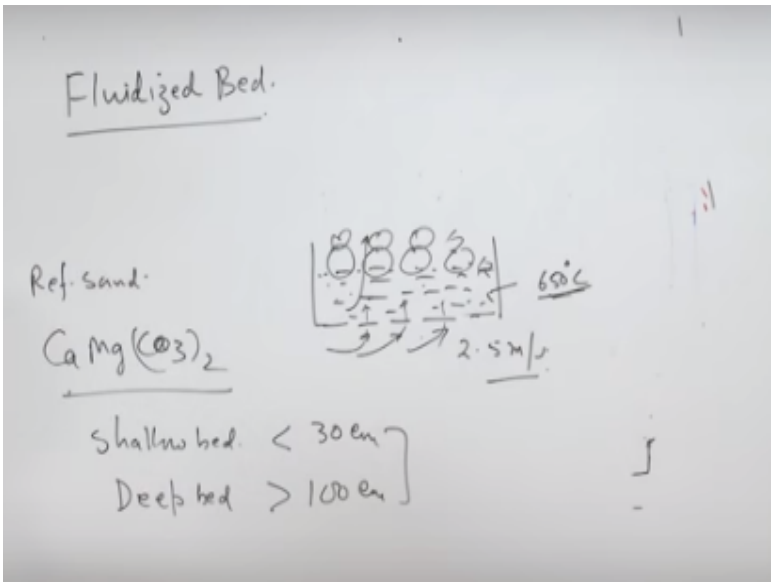

Fluidized bed boiler these boiler they come in different combination and fluidized bed boiler there is a bed of may be refractory set of very fine particles and this bed is heated with the help of flammable gases which is LPG right. And when the temperature of this bed is two fifty degree centigrade right and air based from the bottom that is why it is called fluidized bed these fine particles they suspend into the air.

So from the bottom side their holes in the bottom side or provision of supply of the air from the bottom side and this bed is filled with the refractory side or some other material and air is passed from the bottom side these fine particles they do suspend in the air by the pressure of air and these particles are then heated with the by burning fuel in this bed and the temperature of the bed is increased to 650 degree centigrade.

I am simply explaining the working of principle of fluidized bed boiler their many their available many combinations after that attaining the temperature of 650 degree centigrade coal is put on the fluidized bed right and the auxiliary fuel I will call it auxiliary fuel which was used for recent

temperature of the said 650 degree centigrade the supply is cut off and now coal burns on a fluidized bed.

Complete combustion of coal takes place in this case fluidized bed can be of dolomite also in some applications dolomite also used for effective sent the dolomite send is also used as a this fluidized bed in such type of boiler and there are two types in classification is there the depth of bed is one feet less than one feet it is known as shallow bed right so in that case it is less than thirty centimeter right and deep bed boiler when it is greater than 100 centimeter.

So this is how the classification of fluidized bed boiler is done and the air velocity is means approximately 2.5 meters per second okay. And another thing is we can do the desulfurization can also be done here so that sulfur does not go with the flue gases. So for the desulfurization the dolomite or lime stone also can be used we can put some lime stone here.

So desulfurization can also take place so the fluidized bed boiler also becoming popular their efficiency is quite high and complete burning of fuel takes place in such type of boiler. So I think that is all for today and in the next class we will start with the draft.