Surface Facilities for Oil and Gas Handling

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Heater Treater-01

So, gas, oil, water will be there and in that case also we assume maybe 50 percent So, good morning. So, we have complete already a 4 weeks class, now it is 5th week. So, 5th week we will try to discuss detail about hitter-titter, gun barrel and other mechanism how to separate systems. We have already gone through your emulsion treating methodology like you are using different, what is emulsion, how it is creating, how it is break, how you are breaking the things. So, that we have discussed, but actual mechanical equipment how you are using and how you are separating things we will discuss in this lecture. So, basically week 5 and week 6 will be combined.

So, let us see topics one by one, start with heater-titter and basic book will be like Arnold, Stewart whatever book we are following same book. And I found another book is there from Arnold and Stewart same authors emulsions and oil treating equipment. So, I will try to cover something from that area also and if you want to get more information you can go through like heater-titter YouTube video is there and many text also will be there in different web pages. So, try it so that you can go through those videos.

So, video will make more clear sometime because in class when you are teaching will be doing more mathematical fundamental aspect where video will be giving some basic concept which using that one you can understand very easily, but for our class understanding will be giving much more deeper because we have to go from mathematics calculation. So, video can give some outside some overview of things, but for detailed design and other part we have to go through the class. I hope there will be many other lectures also available. So, just if you can find good lecture you can watch that also, but for exam purpose you have to follow our video records and whatever given in the book. So, in previous lectures we have seen like two phase three phase separators right and two phase like we are assuming 50 percent almost 50 percent or more than or less gas and liquid will be almost 50 percent, but if we assume three phase.

gas and oil plus water that will be may not be 25, 25 it may be different ratio also. So, that we calculated, but we can calculate other ratios also for example, gas will be 60 percent, liquid will be 40 percent or vice versa. So, in that case also we have seen some formula you can see previous lectures and you can try to calculate. So, instead of remembering direct formula end formula you try to remember the steps how you are solving the problem then it will be easier for you otherwise you have to remember lots of constants and other parameters which may be wrong or maybe in exam I can give certain parameter which may not be directly related to your final formula rather maybe steps. So, you should try to remember the steps how you are solving the problem.

So, that will be more important than giving final formula and getting result. And we have seen vertical separator also same way like 50 percent field. So, in this case we will try to see three phase separation how we are getting gas, oil and how we are separating emulsion using heating method. Heat attitude means you are applying heat to increasing temperature, your heating, oil, gas mixture increasing temperature that will change your viscosity and viscosity changing heavier particle settling quickly lighter particle moving up. So, separation rate will be quicker so, retention time will be lower.

So, finally, you are trying to reduce retention time so, your system will be more compact and your process will be faster more fluid will be flowing through the separator system. But if you are not giving heat you can use other methods also. So, in that case your separation retention time may be higher and some particle may not be separated properly because heat will be lighter light weight molecules will be getting evaporated also. So, it will be separating quickly. So, to go through this chapter actually you have to remind you have to get you have to recap the previous chapters like emulsion treating theory we have already discussed actually so, why emulsion is getting created how you are separating and what are the chemicals you are using so, that theory also you have to go through.

Gravity separation already we are discussing gravity means because of gravitational force lighter particle will be falling slowly but heavier particle will be falling quickly and gas very light so, it will be moving up. So, that theory already you know but you can recap also coalescence so, different coalescing media will be there and coalescing means like particle collision is there. So, particle collision means you are getting bigger particle when bigger particle is there settlement rate will be quicker. So, how fast you are settling that will be deciding your separator size and different equipment sizing also. And you have

seen this treating equipment like horizontal separator vertical separator and we will discuss something electrostatic treating system also electrostatic.

So, using electricity you can separate that we already discussed but we will go more elaborate in this chapter. So, before we go through details of heater heater two things we need to know the dump valve we are using this term dump valve or this is having different name also like blow off valve. So, many time if people are not writing dump valve instead of that one they are writing blow off valve. So, you should not say I do not know this one that is why you should know the different names also alternative names different company will be using different names many time they will be patenting with certain name. So, you should know all the alternative names compressor bypass valve.

So, you are not using compressor, but this compressor bypass valve dump valve. So, you are bypassing certain liquid so that you can control the pressure after certain level. So, you are controlling pressure or you maintaining the liquid level. So, liquid level controller will be controlling the dump valve. So, that you can release liquid slowly.

So, you should know that names another will be relief valve, relief valve or pressure relief valve. So, when you are saying P or V this is in short form the relief valve or pressure relief valve like safety valve used to control or limit the pressure in a system. For example, you have seen gas your pressure cooker pressure cooker will have pressure relief valve or otherwise it will be completely unsafe. So, your separation system also you will have that sort of valve like say dump valve is not working or exert suddenly pressure is going up temperature is going up. So, in that case a pressure release valve must be working.

So, that will be reducing pressure quickly and system will be safe. So, heater teeter this term we have used several times heater teeter is a main function heat crude oil crude oil it may be water mixture also crude oil and water mixture only crude oil your heating to break down emulsion to break down emulsion and reduce viscosity reduce viscosity and temperature rise will be like 75 degree to 80 degree centigrade you have to convert into Fahrenheit 75 to 80 degree this is thumb rule about 75 to 80 degree centigrade temperature increasing. But the temperature increase also be differing we based on your viscosity gravity what type of fluid you are using based on that this temperature rise will be controlled. And heater teeter works basically this degassing also they will do when it is increasing temperature. So, low density or low molecular weight or short chain hydrocarbons will be evaporated quickly.

So, it will be separating. So, degassing will be possible and heating you are giving like 75 to 80 degree depending on the viscosity of crude the temperature you are applying depending on viscosity because how much viscosity already then how much you want to change. So, depending on that you are using. Sometime you are using natural or forced draft burner later we will discuss what is the natural draft and forced draft burner. And coalescing will be easier if you have heated because viscosity change and if you are using heater teeter other method then coalescing will be easier.

So, in many cases you are using heater teeter and electricity precipitator electricity separation system. So, in that case heat requirement will be lower actually because you are heating viscosity change now you are using electric field. So, both will work together and it will be reducing your attention time in the separator. So, normally in both cases horizontal and vertical and vertical we are both cases you are using heater teeter ok. Now, we will start with vertical separator.

So, how it is look like looking like I will draw vertical separator like this ok. So, in exam I can give like draw vertical because if it is online exam then I cannot give, but if it is paper pen best exam. So, in that case I can ask draw vertical separator and show the flow path draw different fitting inside and outside ok, but it is online exam. So, in that case what I will do I will give one separator maybe then I will put A B C D and mark it which one correctly fitted maybe I will give wrongly fitted your down comer or gas outlet maybe some wrong place I will put and I will ask you identify which is wrong ok. So, if you have practiced drawing this one and if you know the different compound of where it is fitted and how it is fitted.

So, in that case you can get good marks, but if you are not sure where my spreader will be there where my heat that fire tube will be located. So, in that case if I give wrongly something you will not be able to identify ok. So, you should practice how to what are the things are there inside separator ok. So, it will have one down comer down comer will be coming like this and it is this and there will be one chimney and you know already there will be one mist extractor this is gas source. So, this is called mist extractor or demister mist extractor ok.

And there will be inlet port and inlet will be passing through diverter right inlet diverter will be there. So, this is called diverter inlet diverter or diverter fine and this is called down comer and this is chimney and down comer when fluid is coming it will come from top and there will be one spreader ok. This spreader slowly you are spreading liquid or gas you are not creating turbulence ok. So, slowly you are passing the water zone and while this spreader will be located spreader will be located just below the water and oil interface area ok. You see this is my water ok, just below the water oil interface ok.

Now I have heater teeter right. So, heater teeter it will one pipe will come here like this it will be like this ok. So, this pipe is going and coming out. So, it is changing exchanging heat there ok. So, fire tube this is fire tube and there will be oil level here and there will be one coalescing section.

We are assuming this is coalescing section. The here maximum particle will be coalescing and water droplet will be going down or oil droplet will be going up ok. This area coalescing section ok. This is oil out we can put where or something ok and water you can take out and there will be drain valve. So, sand and other thing getting deposited.

So, the drain valve will be there. So, you can remove the sand there ok. And here one thing this ok you will see this one later ok. So, spreader should be below the water and oil interface and there oil and water mixture will be heated up using your fire tube ok. So, fire tube will be exchanging heat and lots of heat will be going to your mixture and when mixture is heated up your oil viscosity will change.

When viscosity changed so, oil particle will try to move up and it will not hold water particle tightly. So, water particle will try to fall down ok. When water tightly particle falling down so, it will go to water outlet line and you are getting water out ok. So, this is your vertical separator and if you have any other fittings. So, later we will discuss what are the different other fittings possible ok.

This is the simplest one. Now, it is four more major section gas separation section you can see this one actually gas free gas will be going out ok. Then this is coalescing section,

this is oil, this is oil, this is coalescing section. So, more emulsion will be there in coalescing section oil section means less emulsion ok. So, actually it is water particle almost removed there and water particle remove oil you are taking out and at the nearby bottom water is free from oil you can say.

So, this will be free water area ok. So, free water knock out area actually this bottom portion and top portion is free gas out ok. Gas separation is happening in the top portion and heating and water wash heating and water wash happening where fire tube is there ok. Fire tube is there it is heating and it is nearby water. So, water oil particle will be washed and it will be moving up ok. And coalescing settling section is there.

So, where lots of particle will be colliding oil particle colliding water particle colliding settling will be happening ok. So, gas separator section is very smaller if it is placed downstream of a separator. So, already upstream separator is there and already you your pressure is going down ok. Then you are moving to this heater heater.

So, in that case gas amount is lower. So, gas settling section will be lower ok. If that is size of that area liquid flow through the down comma to the base of it heated it of the heater which serves as a Fwko ok. Free water knock out will be like below of your spreader. So, this is for free water knock out.

So, water free water is there. So, it will be going out ok. If the heater is located downstream of a Fwko of a three phase separator. So, in that case free water already lower ok. So, the water section will be lower the size will be smaller ok. If total well to steam to be treated water retention time 3 to 5 minute will be ok ok.

To allow free water settle out to minimize fuel gas in heater ok. Fuel gas means like fire tube is there fire tube needs some energy to heat right. So, that to reduce that one. So, water heating time reduced if you are heating water for longer time.

So, it will take more heat. So, your fuel to heat this system will be more ok. So, to reduce

fuel requirement you are giving 3 to 5 minutes retention time and remove water ok. Then again when you remove actually continuous inlet flow is coming out and water retaining 3 to 5 minutes fine ok. Now, you have one coalescing section. So, coalescing section also will be different designs there will be one design is that like you have down comer ok.

Just this is my separator let us just assume and I have down comer ok. And I will have one plate I will have another plate like this ok. This is my down comer fluid is coming ok. Maybe there will be one spreader ok.

So, down comer is there. So, down fluid is flowing coming down like this ok and it will be getting spread like this ok. So, fluid will be moving like this and this and this maybe another another another different plates will be there in coalescing section. So, in coalescing section fluid is moving up or down. So, it will be flowing like this slowly it will be flowing and when it is flowing actually it will be creating more collision. So, when collision is more particle size will be increasing ok.

So, you are creating one calm zone again you are allowing fluid to flow with laminar creating laminar flow not turbulent flow. If you are creating turbulent flow again maybe particle will be broken or it will get separated. So, you are creating trying to create laminar flow and slowly particle will be moving and it will be getting more collision. When collision is there it will particle be increasing in diameter. So, diameter increasing is V t formula you can remember V t proportional d m square particle diameter square.

So, diameter increase means settlement rate will be increasing or separation rate will be increasing ok. So, that will be there in your coalescing section. So, baffles this is called baffles ok baffles with lots of pores or holes ok. So, baffles installed in the coalescing section because the emulsion to flow back and forth ok and particle collision will be higher and separation rate will be better ok. Heating removes more gas heated clean oil preheats incoming cooler.

So, now, this oil whatever you getting out. So, that will be having higher temperature also.

So, that temperature again used for heating inlet flow. So, that you are recovering some amount of heat ok because if you are not recovering you are giving some energy.

So, there are energy loss. So, monetary loss it is there. So, the designers will do like this your oil already heated water already heated. So, can I use that oil water or there will be heat in the source of your IC engines or other engine systems. So, that heat can I use. So, that some energy can be saved ok. So, just to optimize the whole surface production system so, load energy consumption and higher performance ok.

Separated water flows out through the water length ok later I will discuss water length and a vane type mist extractor normally vane type mist extractor will be there. So, different types of mist extractor I discussed already I think. So, vane type mist extractor you can use there in heater teeter system ok. So, now, if we have larger amount of gas. So, actually when you are using heater teeter heater teeter should be having lower amount of gas ok.

If you have larger amount of gas and you are heating so, large amount of gas bubbles will be coming out. So, when bubbles coming it will get lots of turbulence. So, it will be hindering your separation actually. So, the larger amount of gas separated it will be turbulence will be increasing and coalescence will be a problem ok. Small gas bubbles have attraction for water ok for surface active matrix material.

So, it will be creating small small bubbles and surface active agent will not allow to collide ok. So, that will be hindering your separation process ok. Standard vertical separator sizing will be like 20 to 27 feet ok. This is one thumb rule standard vertical separator size.

Standard vertical heater teeter heater teeter ok. And if you assume 3 to 4 cylinders ratio. So, just 1 by 3 or 1 by 4 you can make. So, 5 feet or 6 feet around will be your diameter.