Surface Facilities for Oil and Gas Handling

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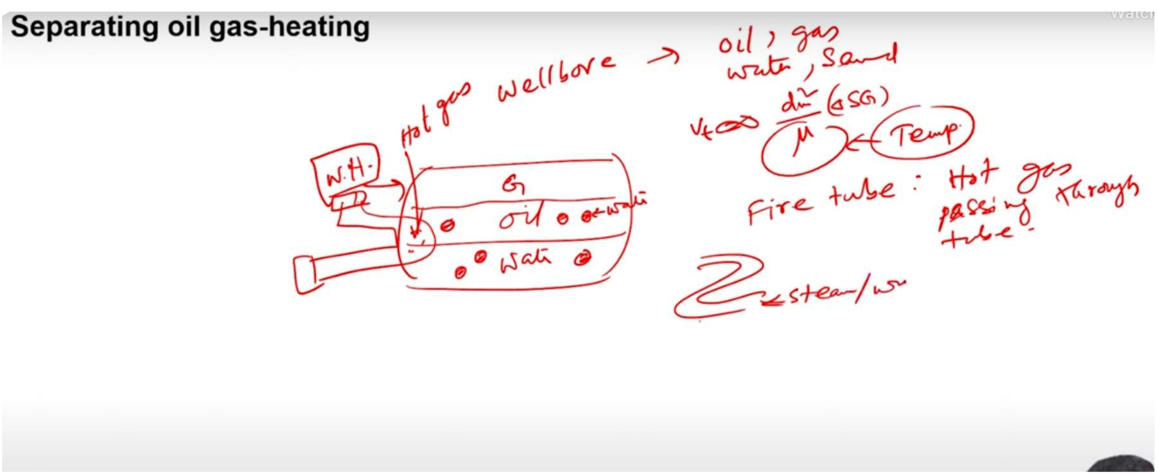
Heat calculations for separation

Good morning everybody. Today's lecture will be based on Heat Transfer Calculation or WELLBORE. Whenever you want to get separate fluid, oil, or gas quickly, sometimes you add heat also. So, how much heat do you need to separate, that sort of calculation we will try to do in this lecture. So, we have seen oil and gas WELLBORE typically produces oil, gas, water, and sand. Now, because of gravity or weight of the liquid is higher than the gas, so liquid will form a lower layer and the gas will go out.

When you reduce pressure in different stages of the separator, gas will be coming out more and more. So, let us say one separator I have injected one WELLBORE fluid, it is coming from the wellhead I am writing WH. So, well head then there will be a choke, then there will be maybe some other manifold, then it will come to separator then you are creating a gas layer, oil layer, water layer ok. Now, oil particle, water particle is here ok, water particle these are water.

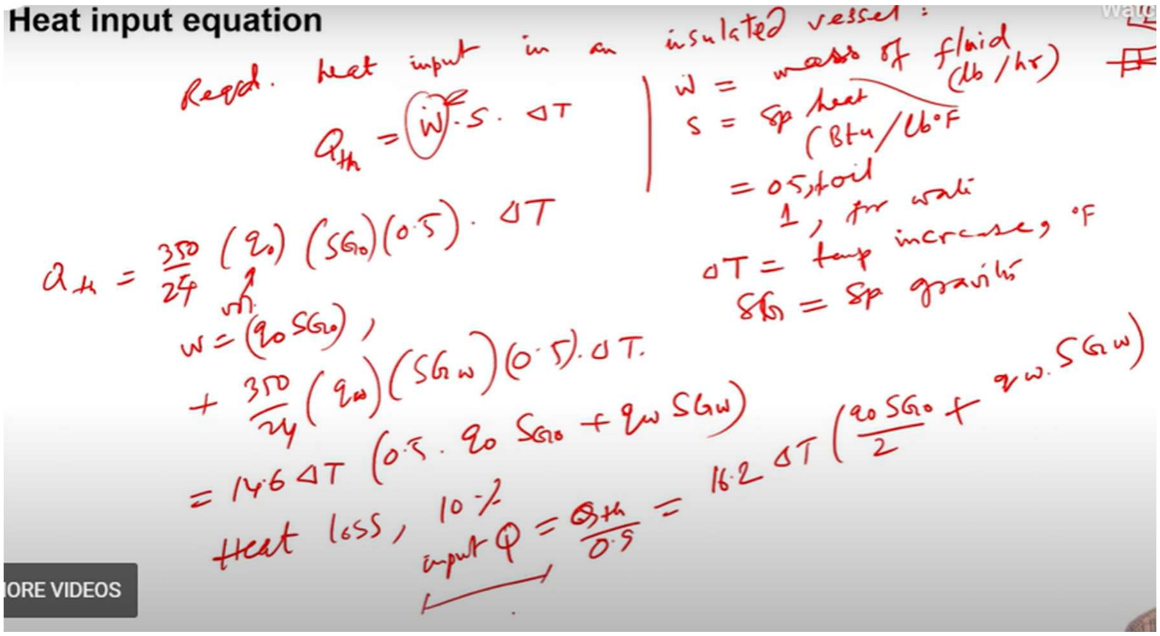


Now, or oil particle is there in water ok. If you want to separate, there are several mechanisms we have discussed already electrostatic coalesces are there, and mechanical coalescing systems are there. You have a chemical mechanism to change fluid surfactant property and you can get bigger particle size because you have seen this Vt terminal velocity is proportional to dm square or particle or droplet diameter square and reverse inverse proportional to viscosity, viscosity increasing terminal velocity will be reducing ok and depends on del Sg specific gravity. So, specific gravity is very high, your terminal velocity also will be very high, the difference in specific velocity. So, you need high terminal velocity, so that quickly particle will get settle.

So, if you are increasing it will settle quickly, if you can change viscosity your particle will settle quickly. So, using heat you are changing viscosity. So, the temperature you are changing ok, when the temperature viscosity changes. Now, in oil gas separator systems there will be one heater teeter or heating element will be here somewhere ok, it is like this. If you see these symbols it will be like this, so heating element will be there, so you have one fire tube, so you get hot gas, so hot gas will be passing through this hot gas.

So, hot gas passes through the pipe and fluid surrounds all around the pipe, so the fluid will get heated ok. When it is getting heated your viscosity property will change and this is ok. So, fire tube water tube, so sometime in the boiler when you are heating water, boiler you are using it for thermal power plants NTPAC or all this thermal power or coal-based power plants they use boiler ok. They will be using a boiler and the boiler will be producing lots of steam, so that steam is used for power generation, but in this case, you are not using it for power generation you are using it for heating your fluid inside the separator ok? And hot gas is passing through the pipe which is why it is called a fire tube boiler, so fire tube.

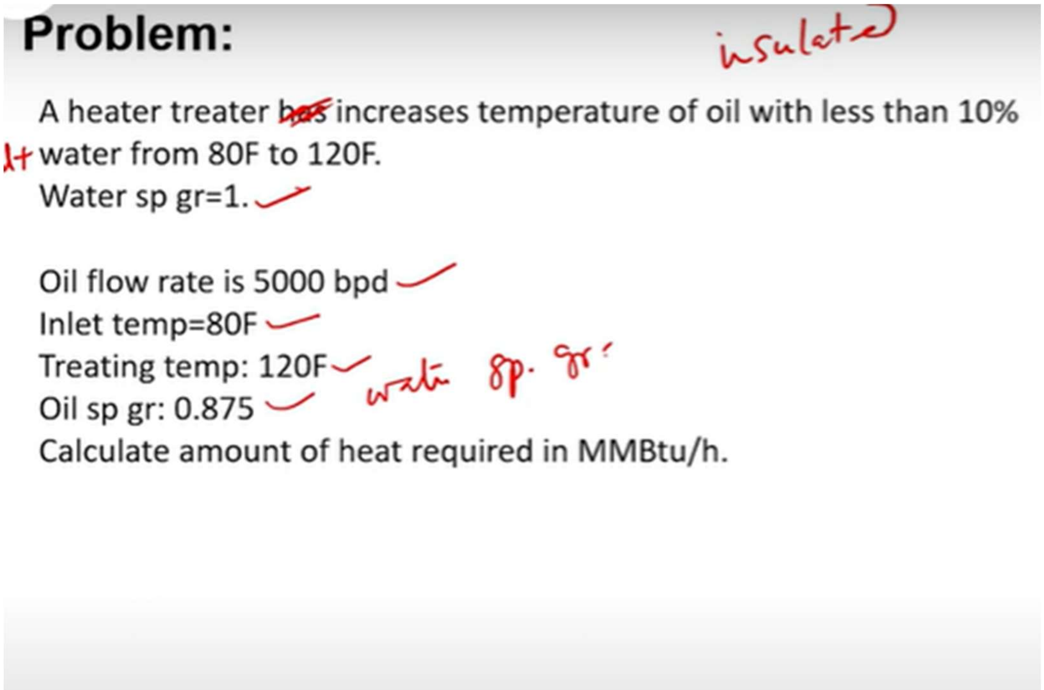
So, hot gas passing through the tube ok, that is why fire tube. When hot steam is going through the pipe and outside flue gas or hot gas is there for example, ah you have one pipe passing lots of steam or water and outside burner is there ok. So, hot gas outside pipe, so that will be water tube boiler water tube boiler. So, in your case, you are using a fire tube, not a water tube, so you should know the difference. Now, when you are heating how much heat will be required there are some formulas just we will try to solve some problems.



The heat input requirement heat ok heat input equation, so required heat input required heat input in an insulated vessel in an insulated, insulated vessel you know insulated an uninsulated means like you are not allowing heat to go out insulation you are using for electrical conductor system also. But here in in heat transfer system insulation means you are not allowing heat to go out. So, whatever heat you are giving that heat will be used for heating your fluid only. Insulated vessel theoretical heat transfer heat will be W dot S dot del T ok. So, the W dot is your specific ah weight of the fluid weight of fluid or mass of fluid instead of weight we can write the mass of fluid going through the pipe or ok or let us say fire tube is there ah you are drawing like this right fire tube ah sorry you have drawn fire tube like this right.

So, the mass passing through this fire tube is W S is the specific heat, and the mass of the fluid unit will be in pounds per hour, The specific heat unit will be Btu British thermal unit per pound degree Fahrenheit and it will be 0.5 for oil and 1 for water ok. And del T is a temperature increase say temperature increasing 80 to 100 degree centigrade. So, the temperature difference will be like 20 degrees. So, the temperature increase will be it is not unit less.

So, it should have units of degrees Fahrenheit. So now, Q th equals 350 by 24 you are converting unit. So, this factor coming to Q o S go S Q o means oil S go again specific gravity S g specific gravity ok, specific gravity volume into a specific gravity ah 0.5 S T into del T ok. So, W you are writing as an ok.



So, W you are writing Q o S go ok and S value already 0.5 and unit conversion 350 by 24 ah. Now, this is for oil the same pipe will have an oil and water mixture in some vessels. So, yeah this mass is mass whatever oil or gas you are taking inside the separator. So, that mass you are calculating here ok.

So, 350 divided by 24 now Q oil Q water S g water 0.5 del T ok. Now, if you summarize all this part then it will come in like this 14.6 del T 0.5 Q o S go plus Q w S g w specific gravity oil specific gravity water ok.

Heat loss here water is 1. So, 0.5 the term is not coming ok. Heat loss of 10 percent we are assuming ok. So, input heat input heat equals Q theoretical 0.

9. So, 90 percent of you are using. So, it will be like 16.2 del T Q o S go divided by 0.5 or by 2 I can write plus Q w ah and S g w ok. Q w means water flow rate S g w oil flow rate.

So, this is the formula for calculating how much amount of heat is required for a certain amount of oil and gas passing through that separator. So, what happens separator is there. So, continuously oil and gas will be entering oil gas and a mixture of fluid will be entering and continuously it will be going out. So, how much heat will be required? So, this calculation will give that much heat that the input heat is there that you have to calculate ok.

Now, see a problem a heater heater has a heater heater increases not has heater heater increases I created this problem. So, there is some mistake ok? A heater increases the temperature of the oil by less than 10 percent ah and it is insulated again to insulate ah system water from 8 water from 80 degrees to water, not water you can write oil and gas oil plus water temperature increasing 80 degrees Fahrenheit to 180 degrees Fahrenheit water specific gravity 1 oil flow rate 5000 psi inlet temperature 80 degrees Fahrenheit ah treating temperature 120 degrees Fahrenheit oil specific gravity 0.875 water specific gravity equals 1 and it is insulated ah ok water specific already given ok no need this one then ah. Then you have to calculate the amount of heat required in a million British thermal units per hour.

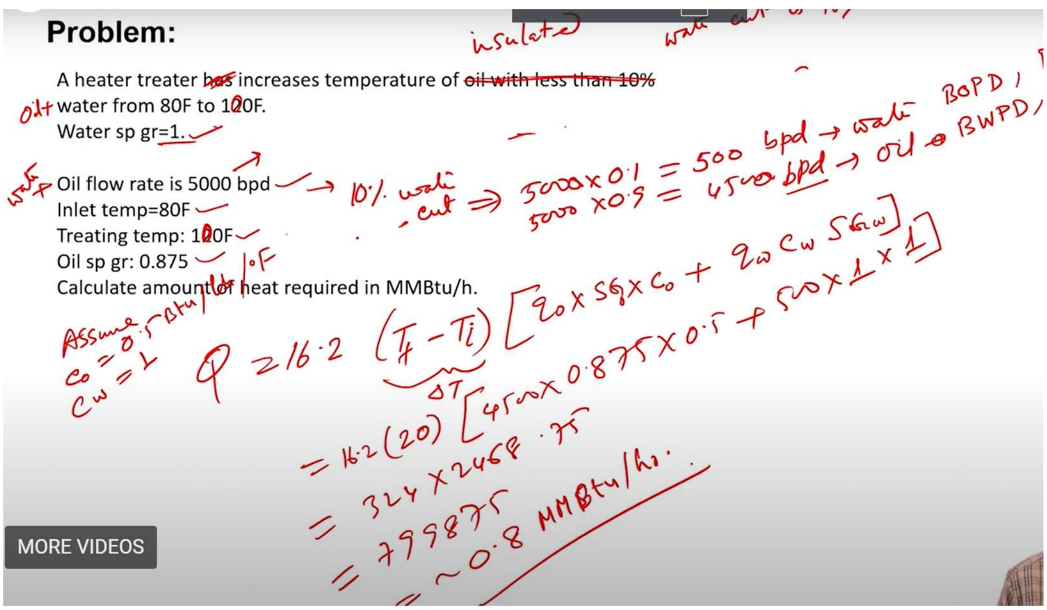
So, how to do it? So, Q heat Q formula you remember 16.2 100 minus 80 4500 because 90 percent ah ok less than ok. So, here I was assuming that the water cut is 10 percent ok. So, the oil content is 90 percent. So, oil oil is oil plus water oil plus water flow rate 5000 BPD.

So, actually because of 10 percent water cut implies ah 5000 into 0.1 is 500 BPD water is there ok and remaining 90 percent means ah 5000 into 0.9 equals 4 0.5 0 0 ah B BPD oil ok. Here I am writing BPD small b ah again I am repeating BPD or I can write BOPD or I can write B BWP D or B for D ok.

So, I can ah there is no standard rule. So, many books will be writing BOPD B BWP D means barrel of water per day BOPD means barrel of oil per day B slash D means barrel of barrel per day ah. Sometimes we say blue barrel, the blue barrel is initially that 100 years ago people used blue-colored drum barrels. So, that is why they write the name Blue Barrel ok? So, if you write in small letter capital letters or B per day BOPD or BPD everything ok because there is no standard rule for that.

So, I will write the formula for Q, Q equals 16.2, and temperature difference, temperature difference means T final minus T initial ok or del T this is del T ok. And then Q o into S Q o into your specific gravity into your heat capacity C plus Q water this is oil, oil Q water C water S g water ok ah. And the heater increases the temperature of the oil with less than 10 percent worth ah with less than I will not write ah this one temperature oil and water heater increases the temperature of oil and water 80 degrees Fahrenheit to 100 degrees Fahrenheit ok this is better this is not good ok ah. So, now, we will put the value 16.

2 and temperature difference increase of 80 to 120 degrees Fahrenheit that means, this is 40 ah ah 80 to make it 100 this is easier ok. So, it is 80 to 100. So, it is 20, and Q o is given 4500 into S g o S g o given 0.875 C C value it is not given.



So, assume C value C oil equals 0.5 C water equals 1 again Btu per ah unit you have to check Btu per lb ah per degree Fahrenheit ok. So, this is 0.5 plus Q water 500 into ah C water C water is 1 and S g water specific gravity 1 ok. Now, if you calculate all these parameters 324 into 2468.75 finally, it will come to 799875 or almost 0.

8 mm S mm Btu per hour ok. So, this is your final calculation ah. So, similar question I can give in your exam. So, I can change the data. So, initially created some problems when I was solving I changed the data. So, you have to use the changed formula and you have to check this calculation if things are okay.

Similar problem I can give you your exam or its assignment also. So, thank you very much. We will start the next lecture ah with a phase separator.