Surface Facilities for Oil and Gas Handling

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Introduction to Electrostatic Treater-02

Now, because you said this low water cut or high water cut you have to create two fills. So, one company Slumberger I think you know the very famous very big company they have one design called net code dual polarity system. So, dual polarity system if you see the left side bottom you have one electrode, two electrodes, three electrodes, and four electrodes you can create many. And the upper part you see they have given DC, the lower part they have given AC. Lower part. So, the lower part means lots of water is there nearby.

So, water cut high water cut high, there are low water cut this area low water cut. So, there you can use the DC field. So, if you are using vertical or horizontal maybe electrodes in the low water cut zone apply DC, but the bottom portion separately they are giving AC. So, when DC they are creating bigger particles they will come down to the AC zone .

AC zone again there will be a collision. When a collision is there it will create further bigger particles and take water from bottom bottom portion. So, so, they have given I have taken from their actually brochure this figure ok. So, this net code dual polarity treater you can see this one AC DC if they are applying their rate is higher rate index and if you are using only AC the rate index is lower AC conventional electrostatic and they are dual ok. So, when DC field it is getting some small bigger particles coming to further lower it is getting further bigger particles then get separated fine.

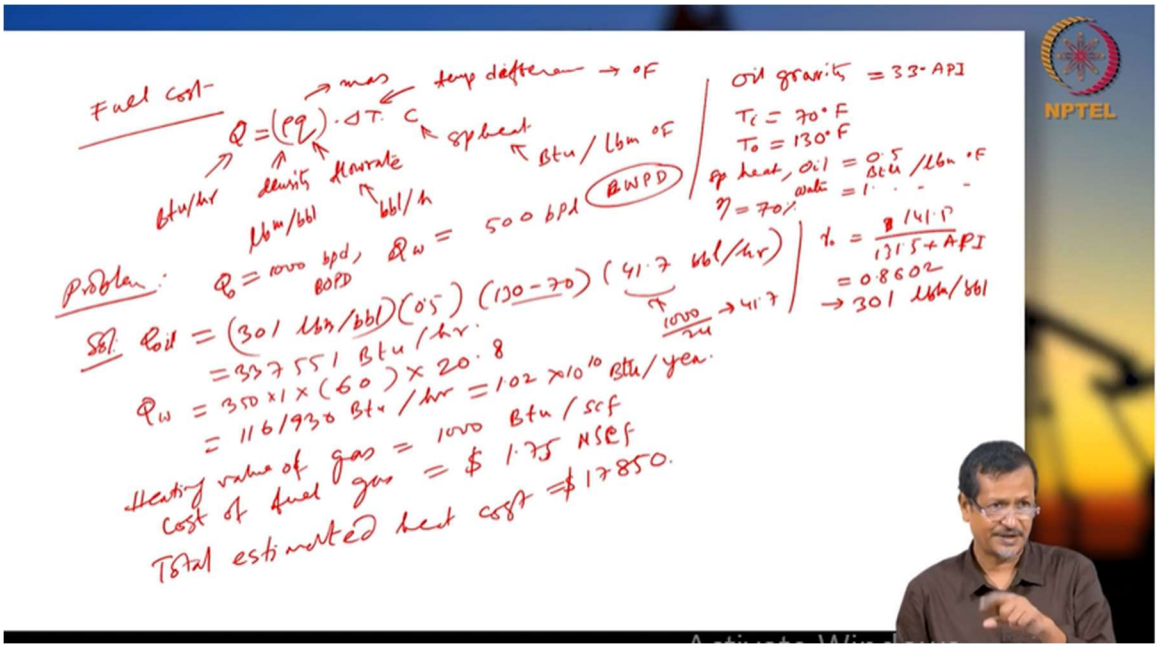
Principle of separation. So, already we discussed V t formula this is the universal formula you have to remember all time ok? This is 1.78 10 to the power minus 6 S g delta d m square by mu and emulsion treating when you are treating emulsion d m should be a larger emulsifying agent if you there then you have to use de emulsifier de emulsifier and settling

time also you can change based on your how much hard emulsion is there or moderate emulsion is there or unstable emulsion is there based on that you can give settling time S c t t l I n d. You can give settling time and when you are treating emulsion you can use a heater treater along with your electrostatic treater.

So, these are key terms ok whatever we are discussing based on all these things ok. So, gravity settling is also part of this one right? So, because of gravity settling fluid will be falling down first level next level you are separating oil water you are getting 2 layers and 2 layers done and oil when you are sending to your gun barrel and a stock tank barrel before that you have to remove water sedimentation. So, B s w you have to maintain then you put your tank from tank people can take ok refineries you can send to refineries ok. We will do some calculations based on I will go to next slide fuel cost.

So, this is a heat duty calculation of how much heat you are giving. So, based on that you can calculate fuel cost ok how much fuel you are because the heater treater you are using without an electrostatic Pacific AH separator then in that case your temperature rise will be higher. So, your money for buying fuel will be higher, but if you are using a heater treater as well as your electrostatic separator. So, in both cases actual cost will be going down. So, how do I show that one? So, using some calculation we will try to do that.

So, flow you know heat calculation rho del t q c or better I will write a differently ok? Rho q del t c MST rho q means mass right rho means density flow rate and temperature difference q equals MST formula you can remember heat equals mass into specific heat into delta t temperature difference right and specific heat. Now, we have to know the units also here ah they are using units as Btu per hour I think the density will be LBM per barrel, and the flow rate it will be barrel per hour, delta temperature difference degree Fahrenheit they are taking. So, specific capacity also you have to take accordingly specific heat you have to take Btu per LBM degree Fahrenheit, q unit ok, unit ok fine. Now, using the formula we try to calculate some heat duty.



So, problem so, problem is that q oil is given 1000 barrels per day BPD q oil q water 500 BPD BPD I can write BWPD also ok BWPD also I can write ok many authors will be writing like this BPD the many author can write BOPD also ok. So, do not be confused it is all the same ok I can write barrel per day also in full form ok? So, all are valid oil gravity is given oil gravity 33 degrees API ok. So, that means, it is a light oil zone medium or light oil all right oil gravity is there inlet temperature is given inlet temperature is given 70 degrees Fahrenheit and treating temperature operating temperature they have given t operating temperature. So, I am writing just to 130 degrees Fahrenheit and some assumptions they are asking to take like the specific gravity of oil specific heat capacity, not the specific gravity specific heat oil is 0.

5 British thermal unit pound mass degree Fahrenheit for water 1 the same unit ok. And efficiency also they gave 70 percent means 30 percent energy loss is okay previous day we calculated for 10 percent they gave 70 percent means 30 percent loss ok. So now oil q oil solution ok so solution q oil equals 301 I will say how 301 I am getting LBM BBL 0.5 130 minus 70 and 41.7 how 301 I got first you have to convert the specific gravity 33-degree gamma o specific gravity 30 141.

5 131.5 plus API ok. So, you are getting here 0.86 to 8602 ok 0 2 now if you convert to LBM per cube per barrel yeah per barrel then that will be converted into 301 ok that is density ok LBM per barrel ok. So, this conversion you should remember is very difficult

convergence, but you should try to remember then q water. So, this will give the value of 337 better I will write that 337551 British thermal units per hour ok q water also you calculate the same way.

So, it will be instead of 301 it will be coming 3501 into again 130 minus 70 it will be coming 60 into 0.2 and the last digit 41.7 is coming like barrel per day is given like 1000 divided by 24 it is coming like 41.7 ok 1000 barrel So, in water case also you have to convert 20 not 0.

2 20.8 OKs. So, this value will be coming from 1161930 British thermal units per hour. Now, if you convert into per year how much total energy you are giving then per hour into 24 into 30 or 365 we have to multiply and in that way, you are getting 1.02 into 10 to power 10 British thermal unit BTU per year ok. This is this much heat you need ok now if you know the price .

So, some example price is given, but the present price may be different in the book whatever price is given I am trying to put that one heating value of the gas heating value of gas ok because 1000 BTU per SCF standard cubic feet cost of fuel gas they have given like 1.75 MSCCF I do not know the same price is still there ok. So, the total estimated estimated heat cost will be 17850 dollars. So, just you can calculate you can get this much money. Later we will see how it electrostatic heater will help to reduce this cost.

So, whenever you are heating, the oil shrinks ok, so the oil shrinks. So, there is one curve temperature oil weight ok, oil shrinkage. So, oil shrinkage 0 to 3 percent shrinkage possible, and API gravity API API gravity ok API gravity loss. So, oil for different 1, 2 like 40 API, 30 API, 20 API, and loss of volume you are increasing temperature. So, volume will be lost.

So, the temperature it will be like 50 to 180 they are giving 1 to 3. So, you can see the temperature increasing your volume also changing and specific gravity how it is changing T the specific gravity 120.825 lower. So, it is like this. So, the specific gravity also changes with increasing time and BSW changes.

This is time BSW 0 to 12 conventional system 30 minutes 0 minute 30 minute ok and this is conventional this is electrostatic BSW this will be conventional this settlement ok. So, you can see in this figure conventional will have more time to settle conventional and this is electrostatic ok. And how this electrostatic separator will be placed electrodes inside a separator. We have to make it like this and the oil is here heater teeter it will be giving heat here . Normally there will be a flame arrestor.

This is a heater teeter pipe and water will be deposited here and oil will be going out here this is oil. This is gas there will be 1 gas out and here you are putting electrodes and here you are spreading properly spreader. Whatever fluid is coming here it will be deposited here then you are spreading from here properly. So, that electrode will get almost equal everywhere there is water particle and you are putting an electrode in the upper side if you have these very sparsely distributed particles small particles are distributed. So, you are putting here ok and you are collecting water here at the bottom, and if you are creating wear or something then water if the oil you can collect from here.

Because in between the center portion, there will be electrodes. So, the electrode will be separating oil and water, and the top portion of the water you can get oil you can get water will settle the bottom you take from there. This will be simple this is a fire tube. So, fire tube is there one firebox from the firebox you can give direct heating or indirect heating. We will discuss electric versus thermal ah teeter or electrostatic versus ah thermal or heated heater.

How the electrostatic system is helping we can discuss. So, an electrostatic heater reduces maximum temperature which means reducing maximum temperature reduces ok. So, when it is reducing maximum temperature that means, fuel consumption also goes down. not to does not affect the viscosity of crude oil. Give lower shrinkage because the temperature is lower. So, shrinkage is lower shrinkage lower low low gravity low low API gravity loss around 40 degree temperature lower temperature possible temperature reduction of 40 degree Fahrenheit possible .

And for 20 to 35 API oil API oil with moderately stable emulsion is okay. Now, we will

try to solve one problem we will try to see how much saving is possible. So, previously we have seen one problem with heat duty calculation. The same problem we want to solve with an electrostatic AH separator where the temperature rises 40 degrees the maximum temperature is reduced by 40 degrees. So, then what will happen max temperature or separator temperature separator ah temperature is reduced by 40 degrees Fahrenheit?

So, in that case, Q oil from the previous formula we can get 125517 Btu per hour and Q water 145600 Btu per hour. So, a total of Q 387310 Btu per hour is ok. This will be 3.39 into 10 power 9 Btu per year ok. So, total heating cost total heating cost equals 5932 per year.

So, assuming 1.75 standard cubic feet of fuel gas ok. So, estimated saving saving let us say V ing estimated saving is 17812 minus 5932. So, it will be like 11879 per year because of the temperature reduced. Now, if we calculate the shrinkage and another parameter also then this saving will be further lower as further higher.

Now, we will discuss electrodes ok? Electro spacing will be normally 3 to 5 inches this one thumb rule is there. So, electrostatic heat can reduce water by 0.2 to 0.5 percent. So, low reduction possible in Bs w Bs and w .

Now, the attraction force between droplets attraction force between droplets ok. The force is equal to k s epsilon square dm square by s power 4 where with s greater than equals dm . k is constant, f is an attractive force between droplets force between epsilon is your voltage gradient dm particle diameter or droplet diameter ok and this criteria should be satisfied s greater than equals dm so, if we have this s part also the distance between droplets distance between droplets ok. So, the distance between droplets increases small increases it the attractive force drop in attractive force will be very high because you see power 4 is there ok s power 4 dm power 2.

So, dm small increase will increase the attraction force, but if you are increasing s 4 then actually it will reduce the attraction force very high level. So, whenever you see the particle size located a very long distance then the attractive force will be much smaller maybe in that case you have to apply more voltage gradient. So, you can get sufficient force to attract one particle by another last topic of this one is droplet size, but already you have seen V T ah V T proportional to dm square ok. So, particle size means the settlement rate will be

high. So, the oil-water interface zone where all coalescence normally will be occurring will be assumed and it will be happening also.

So, the temperature effect on water droplet distribution is small. So, the temperature effect on water droplets is small, but it is high for oil viscosity. So, normally retention time will be like in an electrostatic separator 10 to 30 minutes. If you have changed viscosity and density water viscosity density does not change using an electric separator you can get better separation and the electric separation can be assisted by a heater teeter and another mechanism.

Thank you very much for today's lecture. Next, we will start a new topic.