Surface Facilities for Oil and Gas Handling

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Three Phase Separation-02

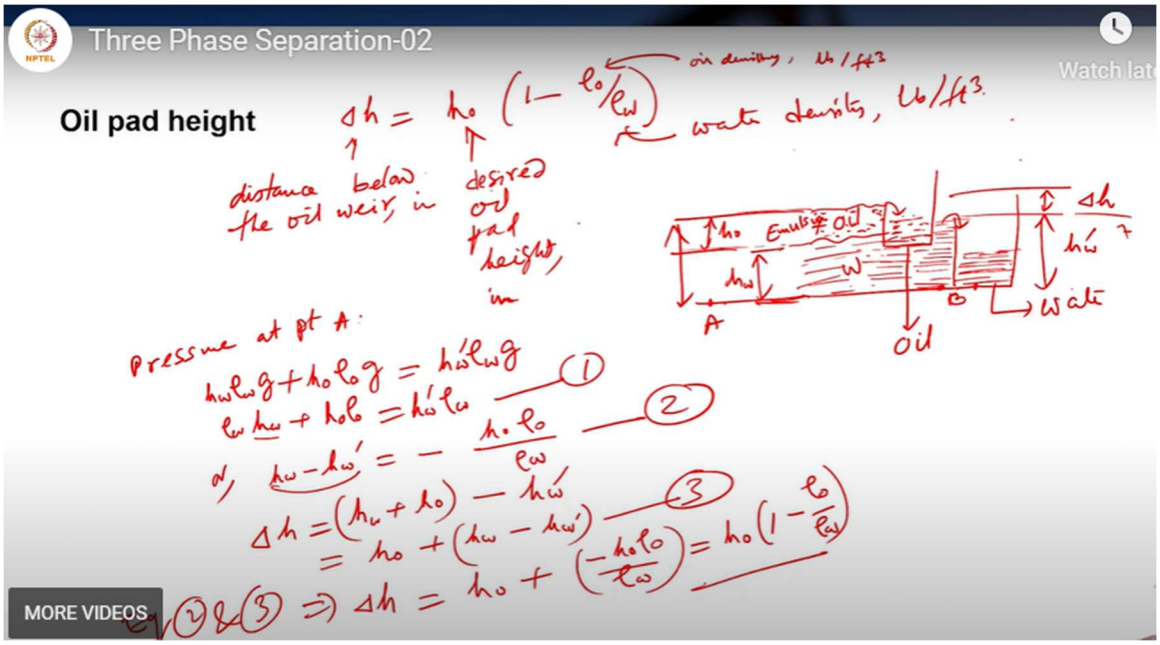
We already explained the bucket wear design, bucket wear design means like you have one separator you are creating one small bucket, one leg longer and you are creating another wear and you are getting fluid flow here like this oil, water, oil plus emulsion. So, in the next stage oil and emulsion when you are getting, you will be separating oil and water and treating the emulsion separately. So, initially when you are separating the pressure stage. So, there may be you will not be putting your heater and other equipment. So, you will be taking three phases separately then you will get oil, and oil will have lots of water particles forming an emulsion. So, in that case, you have to separate that one properly with different techniques.

Now, height of water wear controls the liquid level. So, this water wear height like A B C D. So, this AB height will be controlling the liquid level. So, this is oil and water wear height difference controls oil pad thickness.

So, this oil and water level wear this one this height, this height controls the oil pad thickness, controls the oil pad thickness. And later we will try to derive some formula for this del H calculation. Water wear height should be below the oil water height ok. So, water wear height should be P Q. So, P Q should be below the Q point should be lower than A point ok.

So, P Q maybe I can write A B K just some term I am giving A B C D symbol ok. A P Q should be lower than A K ok. P Q this water wear height and oil wear height water wear height should be lower than water wear height ah. Water water wear height should be

lower than the oil wear height ok. Again we have seen that B C should be lower than the interface height, D C should be longer than A B.

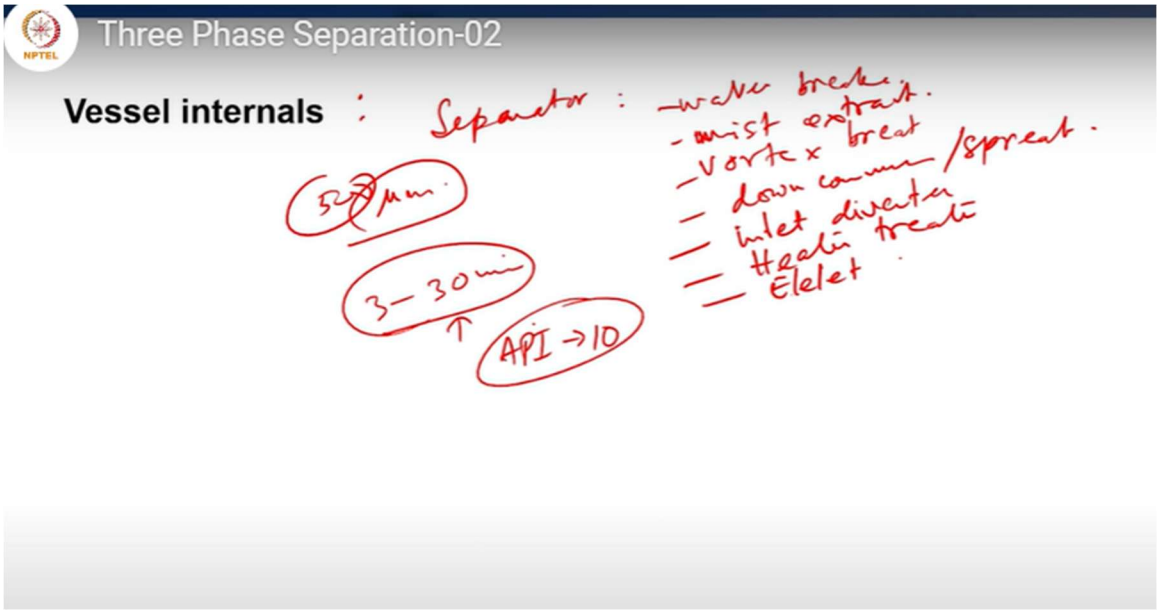


Oil pad height del H equals H naught 1 minus rho naught rho w ok. This formula we will try to derive. So, del H is equal to distance below the oil wear first I will draw the figure ok. Then oil water interface and my water oil plus emulsion ok. Then bucket we got oil out and water will be collected here ok fine.

So, water you take out sorry water ok. I am not drawing whole separator, other I am drawing only the wear part ah. So, this is H w this is H o del H this is H o this distance is H w dash ok. So, this is like you can assume this is separated, this is separated this inlet inlet is there. So, I am not drawing other part ok.

So, I am erasing this part. Now del H unit, del H the distance between distance below the oil wear in inch H o oil pad thickness desired oil pad height desired ok. This is also inch. So, every time I am I will write unit also. So, that you should not get confused sometime we write unit mixed up for example, D L F and previous class we discussed separator sizing there inch and feet was multiplied ok.

So, here all are in inch rho w is oil density oil oil density unit is L b per F t cube and then rho w is water density L b per cubic feet ok. Now how to derive it? If you see this assume point A another point here I am assuming B not here here B ok. So, at point what is the pressure? H rho g H water rho water H water w H w rho water g I can write plus oil height H oil rho oil and g g constant. So, fixed for all oil or gas ok left side should be equal to right side. So, right side H w dash rho w g.



So, all g will be cancelled out. So, finally, you are getting rho w H w rho rho w H o rho o equals H w dash rho w ok. So, you are getting this equation 1 ok. Now we can calculate H w minus H w dash equals minus H o rho o divided by rho w or ok. So, you are getting equation 2.

Now del H equals from the figure you can see from figure you can see del H equals H w plus H o minus H w dash ok from figure you can see. Now from equation 2 and 3 if we replace H w and H w dash ok. So, just I will rewrite this del H 1 H o plus H w minus H w dash ok. Equation 2 and 3 implies 3 I will put here del H equals H w plus H w H w dash from 2 and 3. If we replace so, it will be minus H o rho o rho w ok.

Now H o common H o common 1 minus rho o by rho w. So, this is the derivation of the equation ok fine. Now derivation done next what is the next one ok. I try to create one problem. So, if I want to create one problem using that derivation of del H.

So, let us say assume rho o equals 0.97 oil density and water density is 1, oil pad height is 50 inch then what will be the difference of water and water wear and oil wear. So, just basically use the simple formula del H equals H naught 1 minus rho o by rho w. So, if you use the data 50 into 1 minus 0.97 divided by 1 equals you are getting 1.

5 inch ok. So, just I created a very simple problem so, that you can remember. Now another topic is level controller already we explained, but there are different types of level controller we and I will show here using one vertical separator ok. You have inlet diverter then you have maybe oil layer, water layer, water, oil and you have gas out. So, in that case you have one floating device level level controller then oil out dump valve is going this like this ok. This is simplest design again for water also you will have similar sort of level controller dump valve ok.

So, water going out so, this is normal simple interface level controller ok. Now you have interface control with oil chamber. So, you create one oil chamber already we explained, but again this is oil you are collecting, but here you will have one level controller you are getting oil out ok. So, water also you are getting like with level controller ok. So, this is a interface level controller interface or normal level control also there ah l c and this one with where or oil chamber another is that water leg with or without oil chamber.

So, how this water leg working? So, in this case you will have separate one pipe you have oil controller you have water, but what are you taking out you are getting another chamber gas will be equalizing gas equalizer ok. And water will be spread here and you have l c here. So, you are creating separate complex more complex system, but you will have more control because you can change the length of this spread spreader ok. We change length change possible or length or height ok. And so, again you are putting level controller l c here ok.

So, this way you are creating this is called water leg. So, separately you are creating one another leg water leg with or without oil chamber ok. So, different other type of also possible again electronic control system also there. So, you can use, but you should know different options also like what are the different possible combinations. Again there will be lots of innovations also if you search patents and other document you will find new ideas new documentation.

In oil and gas industry basically they are depending on patents innovation. Academic research will be lower academic research following them, but in other industries many time academic research will be first starting point then other industry will be taking up they will be implementing. But oil industry normally if you search any document normally you will find patent industrial product then academic papers because academics are not ahead of industry in this case. But if you say aerospace and other industry you will get too many academic papers. So, academic research will be translated into industry industrial product, but in this case it is happening industry is doing something then academic people doing some research they will be setting level control pressure or the other part ok 5 minutes I will take.

So, vessel internal already we discussed separator, separator vessel will have wave breaker right in 2 phase separator whatever fittings or things we discuss the same thing will be applicable here also you may have more systems here in 3 phase separator than 2 phase separator ok. So, wave breaker will be there mist extractor will be there, vortex breaker will be there ok. So, these details discussion will be there in previous lectures. Then down comer, spreader, inlet diverter ok then maybe heater treating equipment will be there, maybe electrostatic separation system will be there electrostatic system right electrostatic. So, many internal components will be there gradually we will be learning.

So, already we know something, but whenever we discussing further for example, electrostatic separation system heater treating system and other system we will see much more complex system. Presently we are discussing simpler one actually water droplet size normally 500 microns will be there size micron ok. And whenever we start calculating initially it will be 2 phase separation liquid and gas gravity settlement. So, when liquid and gas settlement we are considering normally we will be considering this 100 around micron particle size liquid particle will be 100 micron, but when you are separating oil and water 3 phase we are saying oil water also separation will be there. So, in that case like water droplet size will be 500 micrometer or micron.

So, similar way water droplet size also will be there ok. So, there will be retention time, retention time normally 3 to 30 minute ok and high viscosity fluid high viscosity fluid or heavy oil heavy oil like API 10 API 10 ok. So, in that case viscosity high. So, fluid particle not get separate quickly. So, you need more retention time, but you thinner oil light oil.

So, in that case separation will be quicker ok. So, in this case this retention time will be lower ok. So, in exam I can give if I give API viscosity based on the retention time I can give some randomly. So, you can actually identify which retention time will be for which separated system as which oil ok.

Thank you very much. So, next day we will discuss about gas separator 2 phase 3 phase separation mathematical calculation some example problems also ok. Thank you very much.