Surface Facilities for Oil and Gas Handling

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Heater Treater and Gunbarrel-01

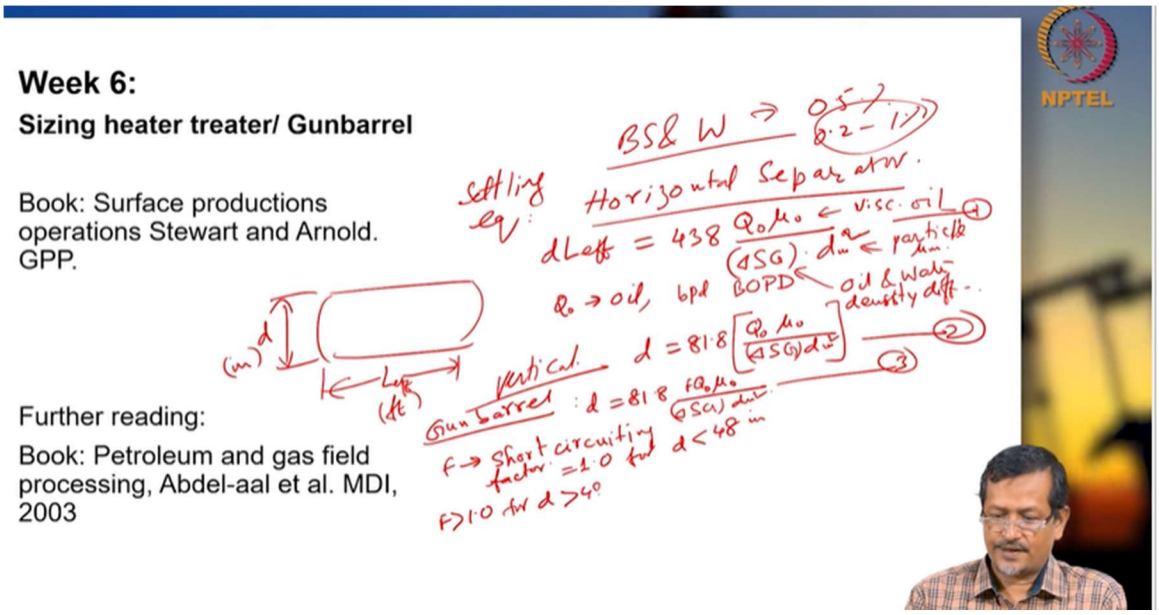
Good morning, we will be starting our sixth week lecture on Gun Barrel and Heater-Titter Sizing. So, we have seen in previous sizing calculations like two phase separators, three phase separator there on gas phase separation there. So, in this case normally we will try to separate oil particle water particle from oil ok. So, when we are trying to separate water particle actually it flow is very slow ok, it will be holding laminar flow. So, your stokes law will be holding ok, and you are applying heat, you are applying maybe electric field, you are applying chemical then you are separating and you are trying to maintain your Bs w Bs and w let us say 0.5 more or less percentage ok.

Sedimentation water content should be within that range. If you are getting more then you have to check your system whether it is conforming your bias requirement. If it is not conforming then again you have to maybe redesign system or you have to you may have to add separate another separator systems or you have to give more attention time or you have to give more electric field. So, you have to check that one ok.

So, normal this Bs w will be like 0.2 to like 1 or 2 percent ok, within that range it will be there. So, let us say first settling equation a c t t l i n g settling equation ok. When you are going for settling equation first equation is that for horizontal separator horizontal separator ok. In previously we have seen the horizontal separator vertical separator for two phase three phase flows, here also we have horizontal separator vertical separator and one gun barrel.

Actually it is diameter is larger than your length ok. Horizontal separator the sizing formula is a d L e f f equals 4 3 8 q oil mu oil divided by del S g into d m square. So, here you can see this d term is there ok. D means diameter of the separator ok, d in inch

ok. So, if it is given in feet then you have to convert into inch and L effective when you are talking about L effective it will be in feet ok.



So, d into L effective actually unit is different one in inch one in feet ok. And q o q o is oil flow rate oil flow rate and its unit will be cubic feet per second q o of unit will be barrel per day BPD or BOPD whatever you write ok. Whenever you are using unit you use uniformly same unit in the same problem or same definition you are giving in some big paragraph do not mix up the units. So, BOPD you are writing you write everywhere BOPD otherwise there will be confusion the reader will get confused whether this is different a B small b p d or BOPD capital will be different ok. Whenever you are writing in article thesis or anything you use uniformly one unit.

If you are using different then actually you have to define why this is different ok. So, better use single unit and represent your thought ok. And mu o viscosity of oil because water particles settling from oil layer. So, oil viscosity will be important not water viscosity that is why this is viscosity of oil and del S g gravity difference or density difference of oil and water oil water density difference ok. DM is particle size particle size already you know the unit micron or micrometer ok.

So, all the terms are different fine. Now if I go for vertical separator this is for

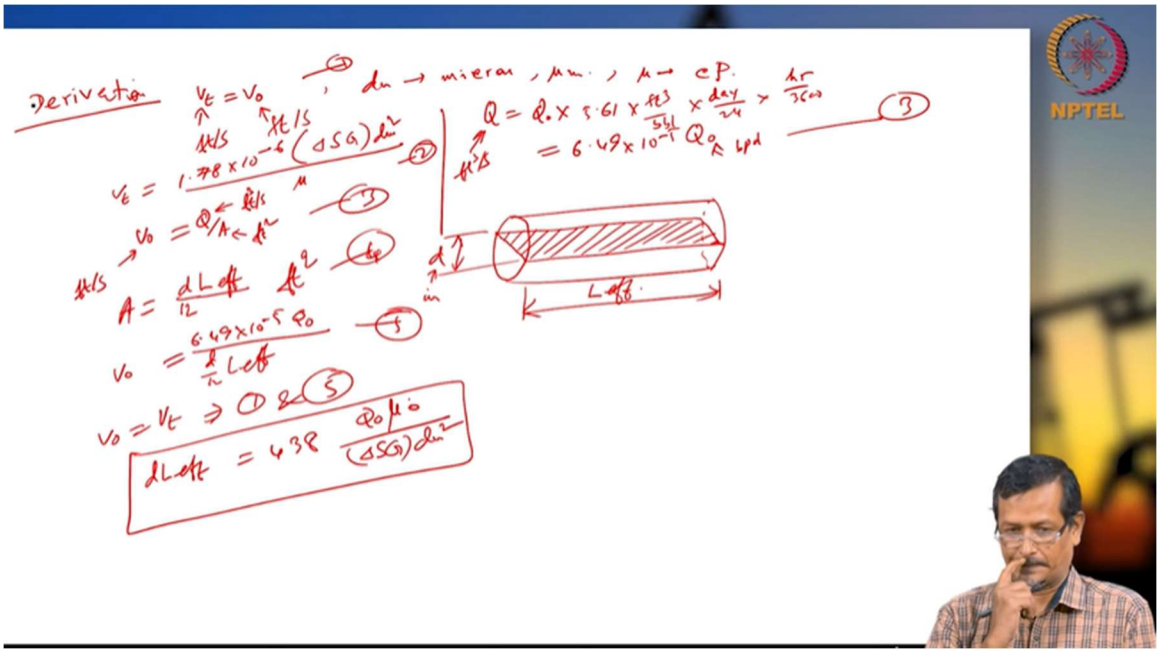
horizontal ok. You should remember and vertical. If I take vertical separator the formula will be like this 81.8 Q oil mu oil del S g d m square ok.

Better I will write this one square bracket ok. So, this is your formula for vertical separator. So, I can mark as equation 1 this is equation 2 ok. And if I have gun barrel. So, gun barrel equation will be like this D equals 81.

8 F Q same as vertical separator then you are adding one factor F. I will explain factor mu o same thing del S g. Dm square ok. This is 3. Now F, F is your short circuiting factor short circuiting factor ok.

Short circuiting factor means like when mixing is not proper and you are not getting proper efficiency. So, some allowance you have to give. So, that is called F short circuiting factor and 1 for 1.0 for diameter less than 48 inch and greater than F greater than 1.0 for D greater than 48 inch ok.

So, roughly this value will be holding ok. So, derivation. So, you can remember the equation also, but if you can derive that is better sometime I give problem such as that you have to understand the derivation then you can actually give answer ok. So, for derivation V T equals V o oil flow rate and terminal velocity we are assuming same. So, V T unit will be feet per second.



So, definitely this also feet per second all right same unit you can compare and dm is micron dm in micron or micrometer or you can write micrometer ok, mu in C p C C p capital ok. So, many books they do not follow the standard rule actually and V T formula you already know 1.78 into 10 power minus 6 del S g dm square divided by mu ok. So, now V o equals Q by A ok. Now, this is V o already we have seen feet per second.

So, definitely this will be feet per second cubic feet per second this will be feet square ok. So, how to get Q? Q if you can remember Q equals Q o into 5.61 into cubic feet per barrel into day by 24 into hour by 3600 this is hour 3600 second right into hour by 3600 ok day by 24 ok, this is not required. So, finally, it will be coming as 6.49 into 10 power minus 5 Q oil ok.

So, this is feet Q per second this is barrel per b p d ok. So, just conversion you can remember direct formula also or you can convert whatever you like ok. Now, A how to calculate A? First you draw one separator I am drawing some 3 dimensional type ok. Now I will cut. So, I will cut I will cut here and I will try to see the water surface liquid surface ok.

So, this is my surface I am assuming or the emulsion zone where separation will be coalescing will be happening ok. So, this is D this diameter is D and this is L effective

length ok. Then what is the area? Area is will be like D into L effective ok. Through this one actually water or oil will be flowing ok, this is the area and if because this is unit in D in inch and in this case we are calculating feet. So, A must be divided by 12 ok.

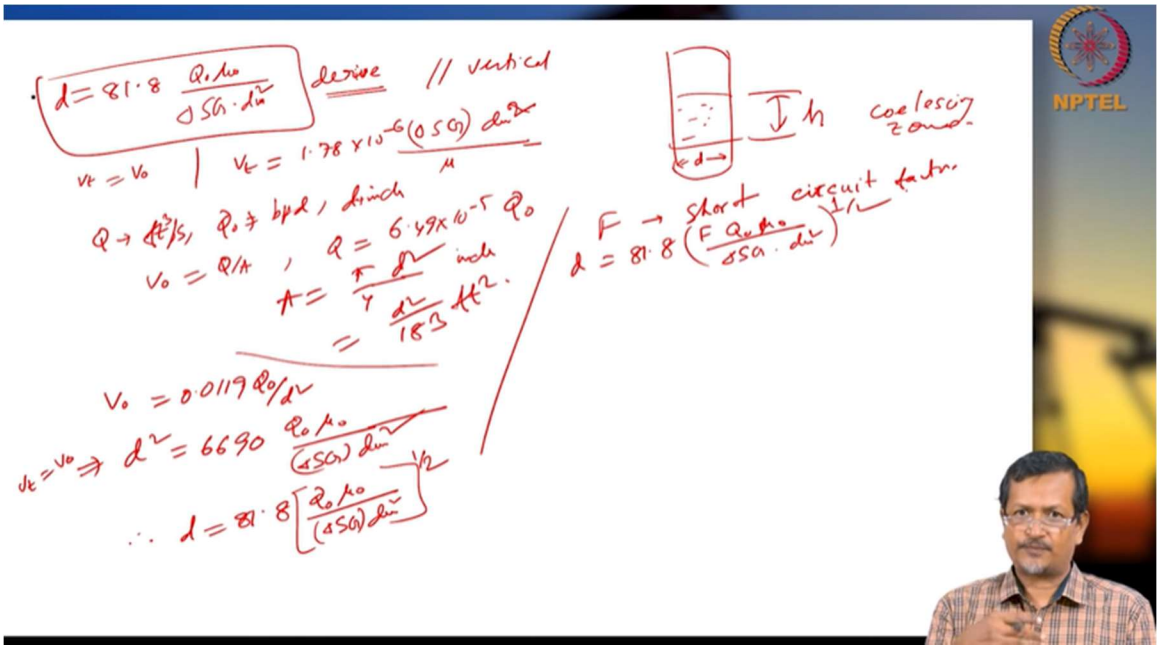
So, you got feet square ok, sorry feet square you got the unit. Now Q by A, Q already we have calculated 6.49 ok. I could I can put in equation number maybe 1, 2, 3 for this slide only. So, do not mix up with other slides ok, 3, 4 for this slide I am putting some equation number.

So, A you got. So, V o equals how you got V o Q by A. So, Q got 6.49 into 10 power minus 5 Q o divided by A you got D 12 L effective ok. So, finally, if you equate D into L effective D L effective if this will give 4, 3, 8 Q oil mu viscosity some viscosity term missing somewhere ok. So, V T V o you got 5 actually V o and V T equals.

So, you have to equate first not this one V o equals V T. So, if you equate 1 and 2. So, 1 and 5 then you will get D L effective equals 4, 3, 8 Q o mu o del S g d m square ok. So, this equation you get this is mu is it ok.

Things should be ok. Now, we will go to the next equation derivation D equals 81.8 Q o mu o del S g d m square. So, derive. So, how to derive? The same procedure you have gone through this type of derivation previous lectures also let us see again V T terminal velocity equals V o ok. This is for vertical separator actually ok.

This is vertical separator. So, let us say this is my coalescing zone and diameter again D. If I writing in this book actually this Morris and Stewart capital D they have used as a unit feet small d they are using unit inch. So, do not do not be confused if you write small that means, it is inch ok. And V T formula again 1.78 into 10 power minus 6 del S g d m square by mu d m square ok.



And Q in feet Q in feet Q per second Q o when you are writing this will be BPD small BPD I have written right ok. BPD and D in inch ok. The same equation units I am using a same symbols I am using. So, V o equals Q by A ok.

And Q already we know 6.49 previous slides if you can see 6 6.49 into 10 power minus 5 Q o ok. A is different here. A will be different. A will be pi by 4 d square ok pi by 4 d square here right.

So, this will be giving if you are using feet then you have to change finally, this is inch ok. This is inch where is inch ok inch and if you are converting to feet. So, it will be coming like d square divided by 183 feet square ok. So, V o will be coming as Q by A if you make it will become a 0.

0119 Q o by d square ok. And D then V T and V T equals V o it will be giving d equals d square equals 6690 Q o mu o del S g d m square. So, therefore, D equals 1881.8 Q o mu o del S g d m square. This is power half because square root you made. So, it can it can power divided by power will be 1 by 2 ok.

And again if you are using for gun barrel. So, one factor you add for gun barrel for only vertical heater heater you can use this formula, but if you are talking about gun barrel in heater heater also you can add that factor short circuit factor actually because of certain issue that separation is not proper. So, some factor they are adding. So, that is called short circuit factor, circuit factor ok. So, formula will be like D equals 81.

8 F Q o mu o del S g d m square ok. So, this way you are writing short circuit factor. So, this factor accounts for imperfect liquid distribution across the entire cross section of the treating vessel or tank and is function of the flow condition in the vessel. The larger the retention time the larger the short circuit factor larger the retention time larger the short circuit factor it may be necessary to apply a short circuit factor for large vertical heater as well ok. You are using gun barrel also you can use for large vertical heater heater also one short circuit factor ok. So, that factor you can get from some table or in problem I will give some value then you can include that one ok.