Surface Facilities for Oil and Gas Handling

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Produced Water Treatment: Numerical

And you see one disposal pile, this is under water disposal system is fine discharge point for pre treated produced water and is designed to contain any upstream offsets preventing unnecessary discharge violation. So, this is the last stage of water disposal for offshore application . So, disposal pile will be pile will be like 24 to 48 inches diameter this one is okay. An open ended pipe, so this side open, this side opposite also open actually.Attached to the platform extends below the water surface concentrate platform discharge into one location. So, all the discharge will be going to this pipe actually.

So, there will be different separate mechanisms I will discuss later further ah it will be discharge deeper not on the nearby surface water surface ok. Useful for deck drain disposal, so deck will be some draining mechanism. So, the water or no whatever produced water or unused water is there, so it will go through this piping system. Small amount of separation occurs in disposal pile, no significant treating process happens.

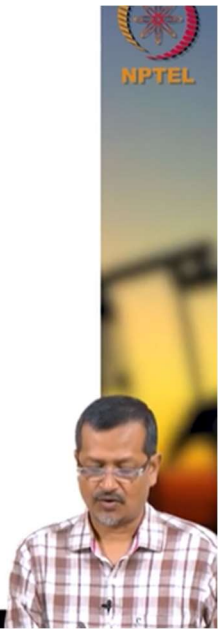
Problem

A field separation and treatment plant produces has the following information:

- Water flow rate: 8000 BPD containing 2000 mg/L,
- with a maximum oil droplet size of 500 mm.
- Water viscosity 1.1 cP
- Water specific gravity: 1.07
- The oil specific gravity: 0.87
- It reduces oil content in water to 800 mg/L.
- Water retention time: 10 min

Find the dimensions for the required treatment for

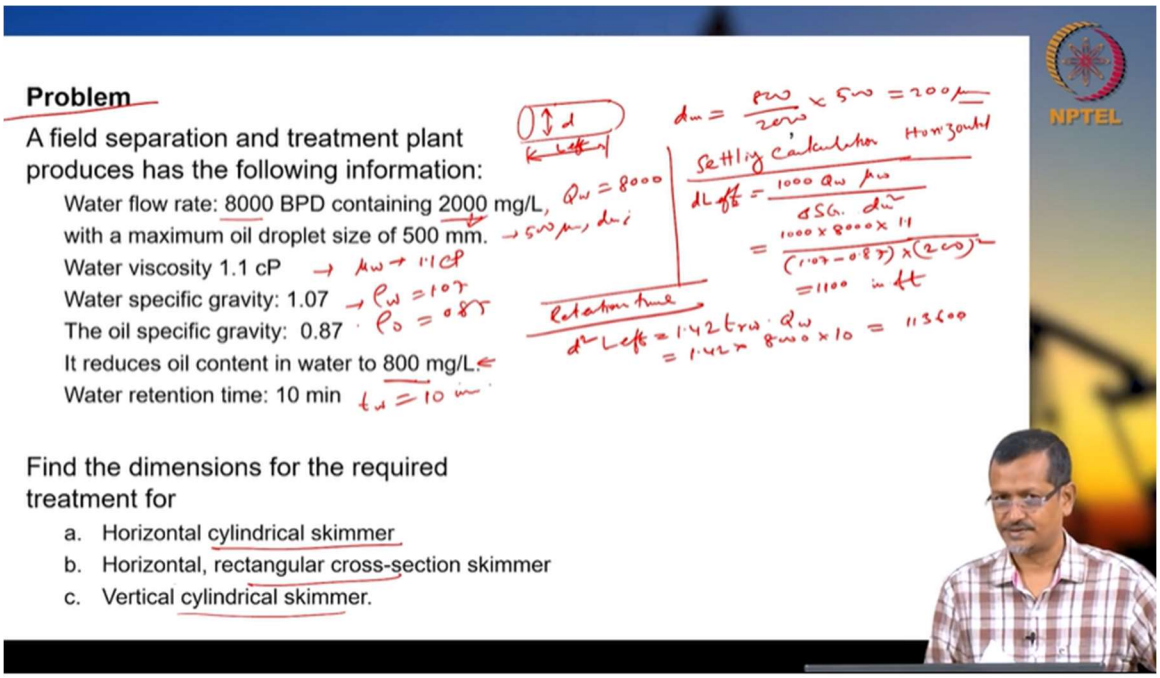
a. Horizontal cylindrical skimmer
b. Horizontal, rectangular cross-section skimmer
c. Vertical cylindrical skimmer.



So, treating process happened already. So, this is disposal system. So, you are not actually basically you are not purpose is not separate here anything ok.You are this purpose of disposing, but small amount things are there how to dispose separate or less explain later. Large diameter open ended pile these are ok.

And this design you see this one is a long pipe actually ok. So, I have taken one company website and this is clean water out clean water out ok. And here produced water coming in produced water ok and this is vent and oil outlet ok.If there is any small amount of oil, so some separation will be going on and that will be going out ok. So, major separation will not occur here.

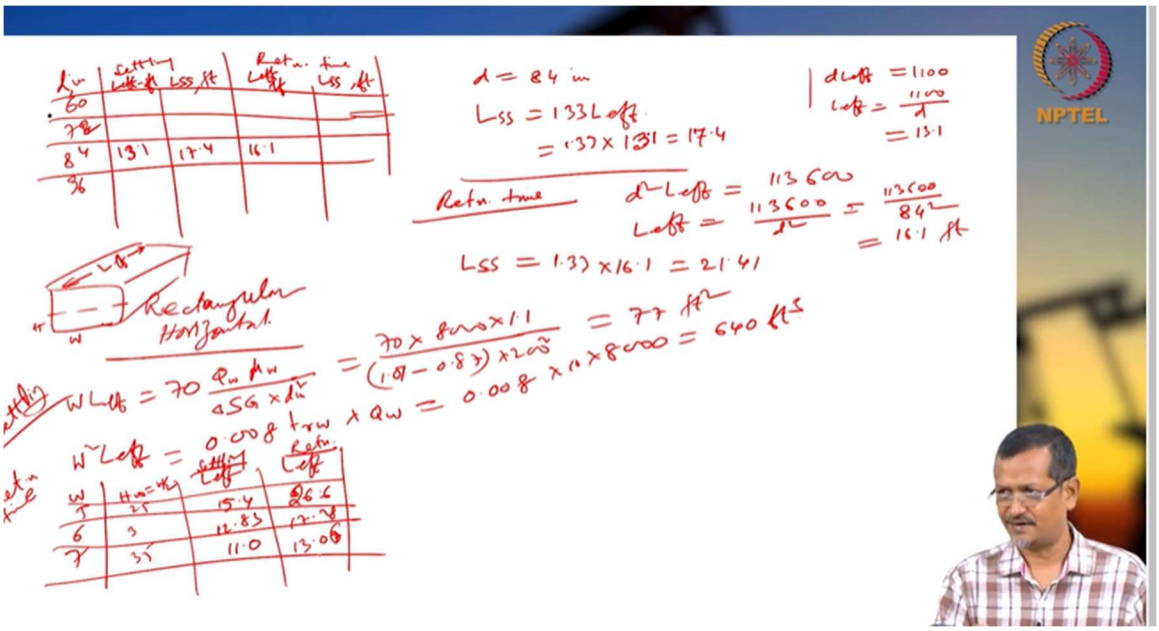
So, this is disposal water ok. So, produced water, disposal water anything is there they will be putting in single pileok. This is your you see wave action here water level ok. So, one of the disposal pile is called skim pile ok.Skim pile there some separation will be going on.



So, at type of disposal pile is called skim pile multiple series of baffle plates willbe there like these are baffle plates ok. These are baffle plates you can see. Left one is open casing there is no baffle plate, second one skim pile they are saying,third one is saying petro pile.So, there is some other mechanism also available there. So, sand must be disposed of without free oil.

So, oil is not allowed. So, sand is having some oil content that also you have to separate. So, they will be putting sand also there. So, everything will go down to the sea bed. So, if you see here oil let us say oil water entering ok it will go like this, it will go like this, it will go like this, it will go like this ok.

So, water coming out. Now, what is happening? When it is going through this, so there will be one quiet zone ok. There will be one quiet zone. So, quiet zone what will happen? So, oil particle will be collected here ok. So, it it will be like this I will draw again.



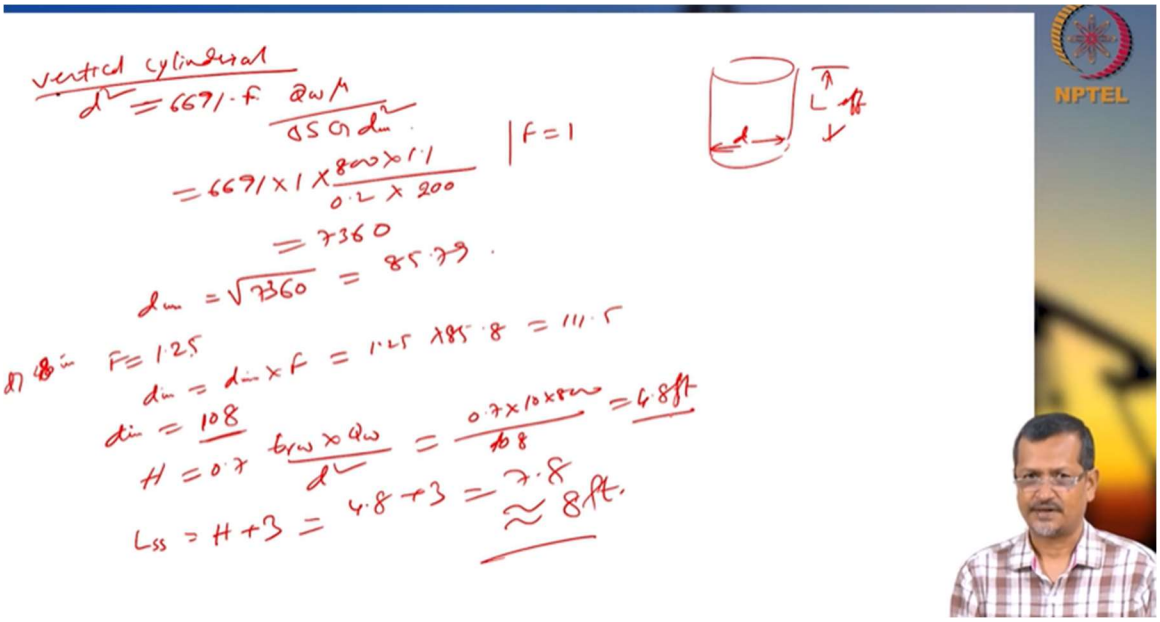
Now, like this it will be vertical like this, then oil water coming like this, then another will be coming like this ok. So, oil water mixture coming here ok and while it is crossing this one this area you seequiet zone no disturbance almost ok this almost no disturbance. So, this is quiet zone. So, what will happen? You collect oil here ok. Oil will be going through this one up ok and water it will go down down it will go out.

So, wherever quiet zone is there multiple baffles will be there. So, if you are creating several quiet zone. So, that quiet zone will allow if any remaining oil is there. So, it will be settling and it will move up ok. So, small amount of oil also you can separate here and if you have sand, so sand because of heavier sand will go down with water ok.

Sand also will get enough space and time there inside baffle quiet zone they will get you will get separated then you dispose it ok this is offshore system. So, disposal pile a large diameter pipe open ended pipe concentrate all platform discharge into one location. So, disposal pipe all platform water will be connected into collected into one locationok. Then provide conduit protect from wave action. So, that discharge can be placed deep enough to prevent sheens from the occurring during upset condition provide an alarm or shut down point at the event of failure also ok.

Drains, so drain it will be connected to pressure vessel let us say if you have closed drain. So, it will be connected to pressure vessel if you have open drain then it may not beconnected to pressure vessel it will be like atmospheric or gravity or open drain ok. So, college liquid spill over on the ground. So, all the liquid will be collected and it will be going through this open drain then pile ok.Liquid collected in open drain rain water wash down water or contaminated water this water will be collected in the drain ok in the offshore application.

Now, ah I got this summary actually from water environment foundation they have done good summary like gravitational separators CPI hydro cyclone where it is used and what arethe different comments they have ah make one made table. For example, dissolved gas flotation no use for offshore application because thisit will take lot lots of space chemical the sometimes they are using for destabilizing colloids or emulsions. So, that separation will be quicker. So, in that case applicable in all cases offshore onshore most oil and oily solids are stable in the produced water. So, destabilization is necessary.



So, in that case some cases you can add chemical also otherwise you can read through this all the points. So, now we will go to one problem ah this is the last section of this oil water handling system or water disposal system. Let us say one field separator system separator separation treatment plant it is having separator like horizontal vertical horizontal square cross rectangular cross section. So, what will be the sizing calculation. So, assume water flow rate Q water 8000 maximum oil droplet size 500 micrometer for for this condition ok 500 micrometer d m maybe I can write initial I water viscosity mu water 1.

1 ah 1.1 C p water specific gravity 1.07. So, rho water 1.07 rho oil 0.87 and it reduces oil content 800 initially it was 2000 reduced to 800.

So, ah oil content we have to put some name I am not giving any name now water retention time T water 10 minute is given. So, we have the dimension for the required treatment horizontal cylindrical schema if I am using if I am using horizontal rectangular cross section if I am using vertical. So, what will be the calculation for that.So, we have gone through all the formula .So, we will start one by one. So, here actually they are using one formula for droplet sizing they are not using 500 rather they are using ah one formula for this droplet calculation, but in exam I am thinking to give one fixed droplet size.

So, droplet for calculation they are using droplet size this 800 water 800 divided by 2000 initial droplet size in linear relationship they are assuming ok this is 500.So, there is a 200 micrometer.So, I am planning to give you the final exam or in the assignment ah a fixed diameter. So, that you do not have to guess or you have to remember this formula and for settling. Now, we have two equations settling calculation based particle settling calculation based formula so, for horizontal cylinder.

So, for that DLEFF you can go through previous lecture. So, formula is like 1000 Qw mu w divided by del SG dm square .Now, if I put directly the data 1000 is constant Qw is given 8000 mu w is given 1.

1 del SG 1.07 minus 0.87 into dm 200 we calculated. So, this will be giving 1100 ok. So, what will be the unit d inch and LEEFF feet actually inch into feet you can write .Now, retention time based calculation retention time based calculation formula is that d squareequals L D square into LEEFF effective length d diameter of the separator ok ah I should draw actually separator this is d this is effective length is not seems to seem length rather effective length.

So, 1.42 TR water into Qw so, from this formula 1.42 into 8000 into 10 TRw. So, it is coming 113600 again the unit will be like inch square into feet. I will go to next slide because this. So, now they have assumed many values actually 60, 74, 84, 72, 84, 96 for D ok and for settling calculation and for retention time settling effective length and L s L LSS this also feet this also feet this is inch this is L effective feet LSS feet ok retention time based and settling calculation based.

So, you are calculating effective length and seem to seem length LSS means seem to seem length .So, you can get all the calculation just I am showing only one calculation 84 84 let us say D assume 84. So, for that LEEFF what will be the LEEFF for settling calculation. For settling calculation formula if you see DLEEFF equals 1000 sorry you got 1100 value you got 1100 already right. So, LEEFF equals 1100 divided by D it is not equal.

So, this value will be coming as 13.1 13.1. So, LSS how to calculate? So, LSS formula actually I have not given previously. So, LSS is equal to 1.33 they have this standard formula empirical formula L effective.

So, then what is L LSS 1.33 into effective length 13.

1 13.1. So, it is coming17.4 17.4. Now for retention time retention time based calculation will go. So, in that case again D 84 we know. So, and our D square LEEFF value we calculated 113600. Now, D value 84. So, LEEFF equals 113600 D square D already 84.

So, 113600 into 84 divided into 84 squares. So, this value will be coming 16.1 actually feet 16.1.

Now, what is LSS? LSS will be 1.33 into 16.1. So, it is coming 21.41 . So, you can calculate all the data, but in exam purposes, I want to simplify. So, maybe I will give like take D value something and calculate .

So, that way I can simplify or I can ask take make this table then you decide which will be the optimal or you on based on your judgment if it is in class exam, but you will be giving for online exam. So, in that case, I have to ask specific digit for example, what is the difference between or calculated from settling equation LSS calculated from retention time? So, in that case, you are you will be forced to calculate everything and then finally, the LSS difference you have to show. So, this is this is for the horizontal separator . Now, if you go to horizontal separator cylindrical.

Now, if I go for rectangle rectangular cross section , rectangular cross section forhorizontal horizontal. Same same process we know the formula WL effective equals 70 if you see previous formula derivation 70 QW mu divided by del SG into dm square . So, this will give 70 into 8000 into 1.1 divided by del SG already we have seen 1.

07 minus 0.87 into 200 square . So, this will be given 77 and WLFF. So, it will be feet square actually both are in feet W is the width of the system This will be like height this will be L effective fine. So, W square formula this is the settling equation this is retention time W square LFF retentiontime based right tension time this is settling.

So, in that case 0.008 TRW into QW. So, it is coming like 0.008 into 10 into 8000 it will give 640 FTQ. So, in that case, they ask in the book they ask like assume like 567 W value . Then you try to calculate hw hw if you are assuming hw is half of the width.

So, Wby 2 equals hw . So, W by 2 and 5 half 2.5. So, 3 3.5.So, L effective from settling equation L effective from retention equation ok this settling this is retention ok. So, settling equation L is effective if you calculate it is coming to 15.

4 same procedure 12.83 11.0 26.6 17.28 13.0606 actually. So, this way you can calculate. So, they have taken actually 6 as an optimal and they calculate further. So, we will go to vertical cylinder vertical cylindrical schema. So, that formula also known.

So, vertical cylindrical schema it will be like this right? So, L effective and diameter we know. So, d square vertical cylindrical vertical cylindrical . So, d square formula we know 6691 one f term also will be coming because of your factor right qw mu del sg dm square ok. So, in directly formula we put 6691 f initially we assume 1 initially f assume 1.

Then qw sorry qw 8000 mu value given 1.1 del sg actually 0.2 and dm equals200 you have taken already . So, it is coming 7360. So, d min or square root is there.

So, square of 7360. So, this will be coming 85.79 . Now because it is coming more than 48 inch in the book it is they have written that ifit is more than 48 inch then you have to add f value more than 1 ok. So, let us say initially assume f equals more than 48 inch d equals d more than 48 inch. So, f value let us say 1.25 ok you can take a higher value also.

So, till you reach certain value more than 48. So, in using that one they got d min because factor came up. So, d min into factor.

So, it is coming to 1.25 into 85.8 equals 111.5 ok. So, after that, they are assuming dia equals 108 ok. So, after that h they are calculating water height 0.7 this formula is given previously t rw q w d square. So, it is coming if you put all the values into 10 into 8000.

So, d square 108. So, it is going 4.8 feet ok and the height of the skimmer L s is the seam-to-seam length of the skimmer height.

So, there is adding like h plus 3. So, h means 4.8 plus 3. So, 7.8.So, approximately 8 feet ok. So, this is the approximate value for height and this is the dia sorry this is the dia ok. Lots of assumptions are there if I am giving class exam in class handwritten face-to-face exams. So, in that case, I will ask I keep this example similar sort of, but I am taking an online exam. So, in that case, assumption part I will write what assumption you have to take in which step ok?

Otherwise, everyone will be getting different answers that will be very difficult to put in the computer fine. So, ok. Thank you very much for today's lecture. Next day we will start a new topic. Thank you.