Surface Facilities for Oil and Gas Handling

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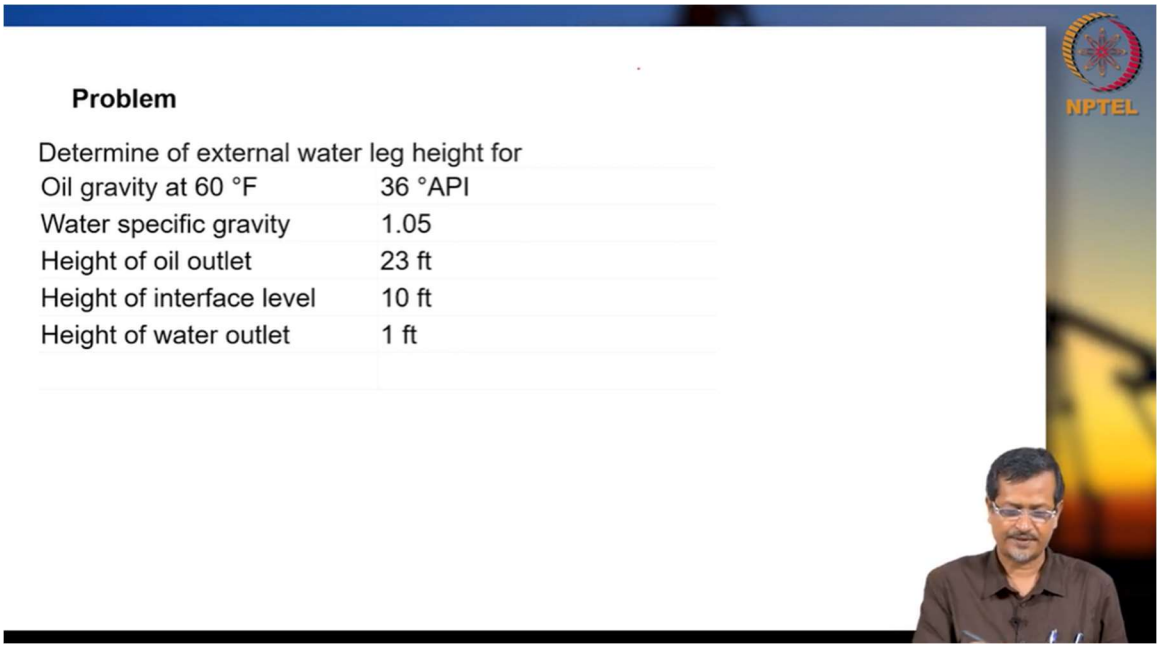
Gunbarrel

So, one problem is we have to write. So, determine the external water leg height for an oil gravity at 60 degrees Fahrenheit, 36 degrees API, water specific gravity 1.05, the height of the oil outlet, the height of interface level, and the height of the water outlet all these data are given. Some more data also should be given, the freshwater gradient is 0.455 psi per foot, and the oil gradient is 0.433 psi per foot. So, you can assume if data is not given otherwise normally, I will give in problem. Again assumption should be realistic if you say 5 instead of 0.45 this is complete. So, I will assume that you can guess the nearest value.

Everything data may not be available when you are working in the oil field. Every time you do not you may not get all the data, but for some thermal, you will have to rule you have to apply and you have to guess this is feasible, or maybe someone selling a separator and they are saying 3 minutes gun barrel settling time. So, it should be identified that the people are wrong. Thus you should know which is correct and which is not correct. Then if you want to solve this problem you have to draw one gun barrel.

So, the gun barrel will be like this one I am drawing first down comer. Then this is like this gas is going out then gun barrel. Then you have an oil layer, you will have a water layer, and you may have a thin emulsion layer. The oil you are taking out oil and this is H water is given height of height of interface level 10 feet right? This is interface level 10 feet given and height of water outlet, 1 foot is given here water outlet height and height of oil outlet.

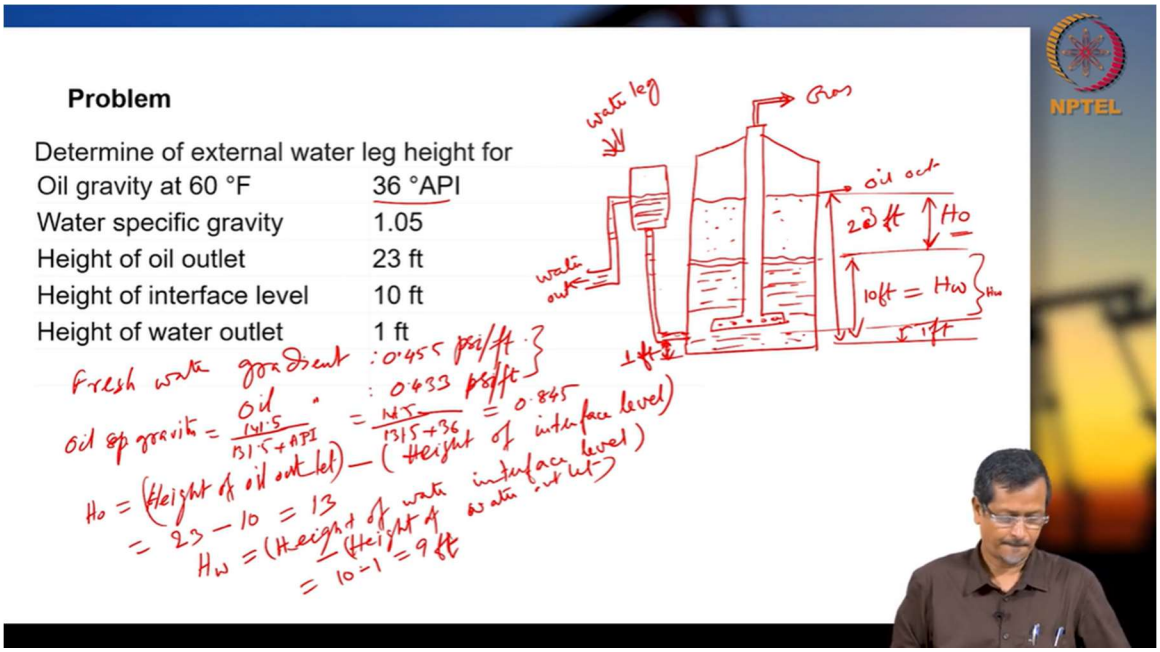


So, this is given 23 feet. Oil gravity, now water is out here, but actually, you have to calculate water leg height. So, leg you have to draw first. So, you have to draw one leg here like this. So, you have to draw one leg here like this. So, you have to draw one leg here. The leg will have water then from there your water is out, this is the water leg. The water leg's purpose is to control the interface level actually, water will be going through the leg. Instead of directly controlling the water interface level you are controlling using the leg. So, because it is outside the separator system.

So, controlling will be much easier. So, there will be one down valve also, there will be one floating arrangement. So, that you can control this level ok. And this is spreader spreading here fine. Now, if you want to solve this one what you have to do, first you have to calculate the specific gravity. So, oil gravity oil specific gravity equals 14141.5 into 10 to the power 131.5 plus API equals 141.5 131.5 plus API is given 36 . So, it is coming if you calculate 0.845. Now, oil gradient oil and water gradient are given ok, oil water gradient is given here. So, h o you can see h o the water, we should not like like this we take like this . So, h o equals the height of the oil outlet height of the water outlet height of water outlet height of the oil outlet minus the height of the interface level.

So, 23 oil outlet height 23 given right minus interface 10. So, it is 13. So, h o become 13 fine. Now, what's . So, the height of the water interface level interface level minus the height of the water level height of the water outlet equals 10, this is one fit you see the left side I have marked this as 1 and 10 feet. So, it is becoming 10 minus 1 it was 9 feet. So, the actual height of the water was 9 feet this one is fine, this is h w. So, the height of the water height is fine. Now, I should go to the next page . Now, pressure balance how to do

pressure balance? Hydrostatic pressure inside tank hydrostatic pressure inside tank equals hydrostatic pressure in the water leg hydrostatic pressure in the water leg.



Now, you just remember this one , gas oil water and you have one system like this right? So, hydrostatic pressure inside the tank like at this point what is the pressure right? So, 13 this one 13 into 0.433 that pressure gradient you can remember 433 sorry 0 0.433 plus this one 9 9 into 0.

455 equals hydrostatic pressure in the water leg water leg means this height. So, this height is if h is h into this water column. So, the water column is 0.455 multiplication 0. 455 . So, let us say I am calculating pressure at this point I put on the circle and dot you can see that point pressure if you see inside tank 13 plus 9 13 into 0.433 9 into 0.455. So, pressure at this point is right, and if I extend this one to the leg side and also the leg side completely water is there in the leg. So, leg ah height h into 0. 455 . So now, you calculate h value h equals 13 into 0.433 plus 9 into 0.455 divided by 0.455 . So, this value will come to 19.

5 feet . So, you can see your water leg height is 19.5, but the total height for oil and water is 23 feet. Oil height is higher because oil density low and water leg height is 19.5 feet. So, similar way I can change some data or can a little bit twist the problem I can give you.

So, you can calculate the water leg height or I can give the water leg height so you can calculate the interface level. For example, if I give the same problem I will give then I will say calculate interface level. So, we calculate the water level height. So, you can calculate. So, one parameter I will keep an unknown parameter I will give an.

So, if if you understand this thing these steps how to solve this problem and it is very easy. So, there will be several types of gun barrels, ah, there will be shop welded, field welded, and API specifications. So, one specification I just copied from one book crude oil treating system Morris Stewart and Carnold , there is also actually API in the specification you see this capacity oil capacity 90 barrel. So, working capacity will be 72 with some will be dead zones. So, the outside diameter is 7 feet 11-inch outside diameter, and the height will be 10 feet.

So, it will be longer height and height of overflow connections. So, if you go like field welded and other part. So, their size will be much more bigger this is like a factory shop welded. So, it is a little bit smaller if you say field welded it will be much bigger. And now the heater why heater again coming because in the gun barrel also sometimes you are using a heating element in the heater to heater also you are using a heating element.

So, how the heater is being used. So, the heater will have a burner ok? So, sometimes normally the heater will be like two types one will be a direct heater another way indirect heater. So, what is a direct heater. Let us say I have one separate system and heating let us say combustion is happening inside the system in a closed vessel and heat is going directly to your fluid ok. So, in that case, you are saying direct heater, but in another case what will happen you have one combustion chamber a burning fuel combustion means a chemical reaction happening and an exothermic reaction happening right combustion chamber in that case exothermic reaction happening. Endothermic reaction means it will absorb heat exothermic is releasing heat like whatever fuel you are burning petrol diesel wood anything.

It is an exothermic reaction. Heat is released when a chemical reaction is happening heat will be released. So, in your boiler system heating element will be releasing heat. So, your burning fuel may be solid or liquid fuel you are burning, and an exothermic reaction happening you are getting heat. So, heat instead of directly putting into your separator system do you put lots of water pipe, and that hot water or steam you pass through your separator. So, indirectly one place you are heating you are increasing the temperature of water as the boiler system works.

So, that hot water or hot steam you are passing through your boiler system then what is the benefit of direct system indirect system. So, the direct system is that it will be quickly heating and the direct heat is your actual fluid working fluid is nearby it will be heating, but in the indirect case you are heating water, water will be absorbing heat water or any other fluid you can take and that heat will be transferred to your boiler system. So, indirectly heating. So, in direct case what happens if there is any rupture any heat suddenly

temperature increase is there. So, then there will be disasters because it can reach to ignition temperature.

In the direct heater case the is called a firebox, A firebox means where heat is getting generated you are burning and fire is there inside and when heat is released the system is releasing heat. And that must be submerged in water all the time if the water level goes down by mistake by any blockage or any leakage anything then the temperature will shoot up. So, that will be disasters ok when the temperature is going up and fuel will have one combustion or burning temperature. So, if it reaches that burning temperature suddenly the fuel can burn like an IC engine what is happening inside the IC engine, you are giving compression for example, I will teach you later IC engine means an internal combustion engine in that case compression ignition system is there. You are compressing air and increasing temperature that temperature will be burning your fuel petrol diesel whatever.

So, the same thing can happen when a temperature reaches a certain level then suddenly burning can occur. So, then this firebox must be submerged all the time in liquid, especially in water in the direct heating system. In a direct system because the fire is somewhere else and you are giving hot steam. So, the maximum temperature limit will be there for hot steam or hot water whatever you are saying. So, in that case, that problem will not be there, but another thing is that direct case you are heating directly.

So, instantly you are heating, but indirect case you have to heat water water will pass through this. So, it will take it will be a slow process, but it will be safer. So, it will be your choice which one you want to want quickly, but little bit unsafe that if you are making it unsafe then you have to put lots of thermostat thermometer pressure sensor temperature all the sensors you must fix and if the temperature is going up or if you find some leakage somewhere and fire is going out. So, that can be dangerous. So, those instrumentations must be proper, but indirect cases if a little bit lower amount of instrumentation may be ok because the direct flame is not there inside your separator flame if outside you are giving only hot water temperature you can control .

And scaling boiler if you study a mechanical student they can they may know boiler scaling . Scaling means when fluid is flowing through the pipe and fluid is having a contaminant. So, contaminants will get deposited on your teeth also get scaling right say hard material will be deposited. So, similarly, metal inside or outside where fluid is flowing scale or so, harder material will be deposited. When harder material is deposited heat transfer rate will change.

So, whenever you are using any heat exchanger or heat transfer medium metal let us say normally copper metal will be there heat transfer rate is very high conduction is very high which is why you are taking copper right. Now, if you have the scale scale inhibit it will

not allow so, much heat transfer. So, if any scaling is there then heat transfer will not be proper. When heat transfer is not proper so, finally, what will happen to overheat let us say one firebox is there and the heat you have calculated this much of a heat transfer rate Btu per hour Btu per second will there, but because of scaling heat transfer is not happening. So, what will happen inside temperature will go up after a certain level it can burst also it can create leakage material properties will be changed why the material property will be changed.

Let us say material you design something that will be working up to a certain temperature limit, but your temperature limit has gone up. The material property will change iron property will change when iron property changes more corrosion will be there leakage rupturing possible micro-crack possible because high-pressure equipment already cracked or rupturing and scaling shooting up the temperature and if there water level is going down because of certain reasons outside your firebox again that will be a dangerous situation. So, whenever you are using things or designing using on surface system or designing then you have to take care of all this scaling you have to check have to check the temperature auto cut system like say temperature shooting up suddenly you are you have to stop your fuel supply. Especially if you are using direct system temperature let us say 100, 200, or 300 you are looking at the temperature going up automatically this signal will go to the fuel supply system and you have to stop the burner hey do not take more fuel. Then the fuel supply stops again temperature will go down check where the problem. Then again maybe you can restart, but if you this was that is why the thermostat is. So, your fittings will be like thermostat thermometer pressure gauge pressure gauge. These are common fitting elements and the safety valve will be their pressure relief valve or safety valve. So, those fittings must be there on your safety system because already you are playing with hydrocarbon a small fire source will be a disaster. All systems you have to check whenever you are using and you have to check your fire tube system whether you have scaling, a rupture, or any breakage in your water level you have to check the water level sensor must see if the water level is going down.

Let us say your pipe is here and water must be all around, but the water level went down. So, this water is there means the heat transfer rate will be higher so the convective heat transfer coefficient in water is higher. So, if water is not there, the surface temperature of the pipe will be higher when the surface temperature is higher it can melt can burst. So, to reduce that one water must be there and if water is flowing is very good. Water flowing means water getting heated up to what hot fluid is going to the outlet may be and again low-temperature fluid will be coming.

So, constantly you are maintaining temperature and you are monitoring your thermometer and the thermocouple system will be there. So, there you are maintaining temperature also. No problem. Your time was over. Thank you very much. Tomorrow we will start you will

continue the same topic we will do some numerical calculations also. Thank you very much.