Surface Facilities for Oil and Gas Handling

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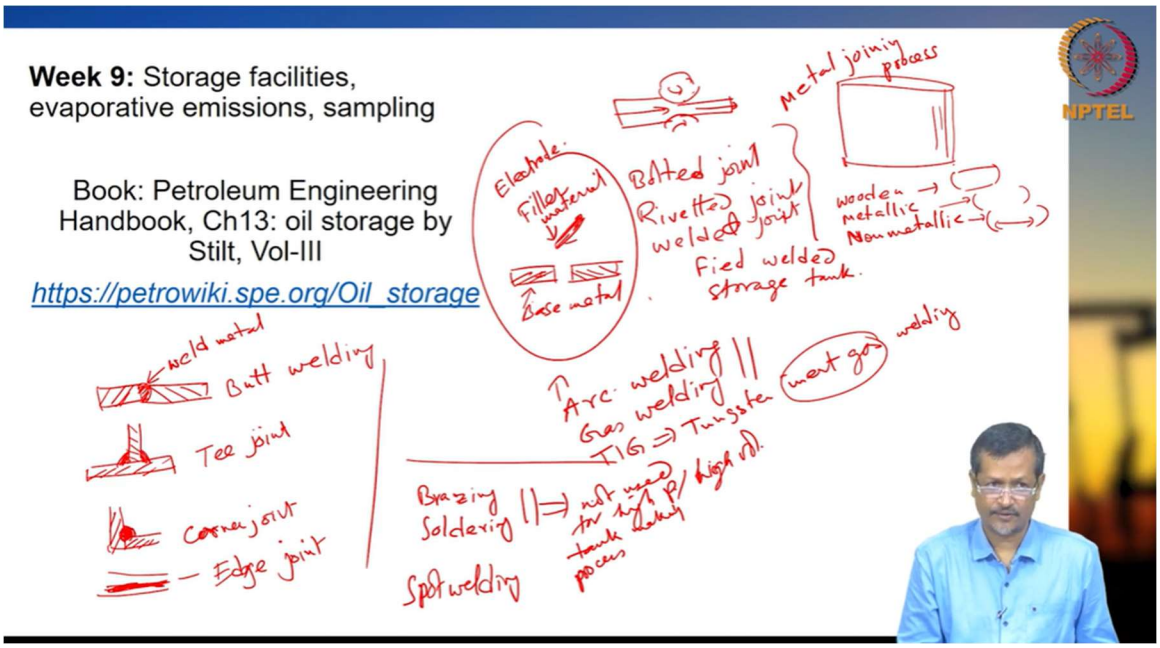
Crude Oil Storage Facilities-03

Good morning everybody, we have started Oil Storage Systems. So, in oil storage system we have seen we have to make tank ok. Tank can be vertical or rectangular also possible. So, if we have vertical tanks. So, if we have vertical tank we have wooden made tank possible, we have metallic, we have non-metallic. So, wooden or metallic.

So, in wooden case we have this older tanks normally smaller older tanks will be wooden, but metallic tank this is near and if we say non-metallic. So, non-metallic also is being used in the oil field for storing purposes. And whenever you are making sheet, so normally rolled sheet steel sheets you used I already told you that gauge is your parameter. So, number of gauge increasing means thickness will be reducing ok.

So, this is like roller, so very high pressure and if you rotate the roller, so this will be this metal will be passing through this one and it will be thinner and thinner every time one pass to pass if you make many times it will be thinner and you make desired thickness sheet. And normally if it is made of iron and pure iron like if you are using mild steel it will very much corrosive. So, you have to see whether steel and different types of steels are there. So, specific type of steel you have to use, so that corrosion will be less or strength will be higher. Now you got sheet, so sheet you have to join like you have to make cylinder.



Whole thing cannot be manufactured in your industry or in machine shop because it is very big like 400, 170, 2 feet a very large diameter, very large height also there. So, that much of size and manufacturing industry or in machine shop will be difficult. So, you have to if you are making very large system then you have to go to field and there you have to take small sheets and you have to weld one by one and you have to make the system the whole storage system. And when you are joining there will be option bolted joint and there will be riveted joint and there is welded joint. So, smaller tanks you can manufacture or you can prepare in machine shop and you can transport.

So, if you are manufacturing in machine shop actually you can test everything pressure and other thing in machine shop and you can transport. This is very good for a small shop, but smaller tanks, but if you have very large storage capacity. So, in that case you cannot manufacture in your machine shop. So, you have to go to field and there you have to construct the system whole tank. So, there is a field welded storage tank ok.

In previous lecture I explained what is bolted joint, what is riveted joint. Now I will explain about welding welded joint. You may have seen in machine shops the welding will be there like two metal I have ok. Now if I have to join these two then I need one filler material or electrode filler material or electrode ok. Normally filler material will be softer material.

So, that high pressure when high temperature when high voltage is applied base metal will have less positive this is negative or positive you are creating and you create very small gap in between then spark will be created. So, that spark will create very high amount of heat. When high amount of heat is getting created the base metal this is called base metal because these two you want to join ok. So, base metal ok. So, in base metal will be melted when it both metals are melting they will get fused together.

So, molecular assembling possible ok. So, base metal fused together to join this one. So, in welding process in arc welding. So, you are creating electric arc ok arc ok. In arc welding you need one electrode ok.

So, if you if you go to any machine shop when people are welding you will see one glass will be wearing ok black color glass and they will be welding and they will be melting small gap. So, that spark will be created if you touch it then current will be flowing. So, that time there will be no heat generation ok. If you create spark, spark will be giving lots of heat, but if you are touching this one it will not weld it will not create lots of heat. So, heat is melting the system then you are fusing together to metal ok.

So, the the welding people who are the person welding they will be trained to make the small gap maybe 2 millimeter gap ok. And high voltage is there because of high voltage spark will be created. So, that spark will generate lots of heat ok. Heat will be melting to metals this base metal ok, it then it will be joined fused together you when it will be solidified it will be solidified up temperature will go down it will solidified and it will be unseparable permanent type of jointing ok. And there are different types of welding methods are there welding is fusing two metal base metal must be melted ok.

One is arc welding another is gas welding ok. In gas welding case what they do they will be taking acetylene gas ok. And through one nozzle high volume very gas will be coming out at very high pressure ok. And you give small flame there. So, flame will be creating very large amount of heat ok, heat energy.

So, large amount of heat will be it will be generating and that will be melting the base metal ok. In that case this electrode is not getting consumed because this is gas ok. Gas will be burnt it will be combustion will be occurring and that will

be giving melting the base metal and both will be joined. In some cases the electrode will not be consumed for you know tungsten inert gas TIG they say TIG tungsten inert gas welding ok. So, in tungsten inert gas welding what will they do? It will create a spark, but tungsten needs very high temperature to melt.

So, the electrode will not be consumed ok, but normal electrode will be consumed. So, in that case tungsten will generate heat, but electrode will be as it is. And why inert gas is there? Inert gas actually when two metals are melting at very high temperature it is possible that oxygen will be reacting with them and corrosion will be occurring ok. So, that they will be shielding the whole area will be shielded by inert gas. So, you give lots of inert gas surrounding.

So, that oxygen will not come nearby and welding will be proper. You mean electric arc welding also you have to shield with some inert gas actually ok. So, nitrogen also you can give ok, helium you can give, argon you can give ok, helium argon normally you can you can use for shielding purpose welding is happening. So, that area oxygen should not be coming. So, you give lots of argon gas.

So, the oxygen you are removing from that area ok. So, when it is solidifying oxygen not there solidified after that oxygen coming there is no issue, but when it is very hot that time oxygen will be reacting quickly ok. For that is why this inert gas will be coming up fine. And there are different types of joining method one is like butt welding. So, two metal like this one is here another is here and this area filled with filler material ok.

So, this is called butt welding. So, two face to face two metals are joining metal sheets are getting joined ok. So, this is called ok. And there will be T joint, T joint is looking like this. You take one metal another metal vertically sometime you have to join is equal to T joint if you make like this T and you feel this material both side.

So, you see this figure you this side this side you feel with material. So, you are feeling and melting also. So, both metal you get fused together ok. So, this is called T joint T ok. And there will be corner joint, corner joint is like this I have one metal and I have another metal ok.

So, this area you are giving filler material ok. So, both will be melted plus extra filler material also you are giving. So, the support it will get excess support this is called corner joint ok. Another called edge joint, edge joint means take two metal ok, two metal you are joining edge edges ok. So, this is the edge joint this area will be welded.

So, edge joint EDGE edge joint ok. So, there are butt welding, T joining, corner, edge many other types of joining also possible and you are covering with inert gas just to avoid oxygen ok. Other gas are coming nitrogen coming there is no issue, but oxygen is a problem because it will create oxide ok at high temperature reaction rate will be very high. So, you have to avoid that one.

So, you have inert arc welding. So, you are creating electric spark you have gas welding ok. Some other terms also used when you are joining two metals ok. This is called metal joining process ok. This is metal joining process, this is called metal joining process wooden rebated, golden, welded ok.

These are metal joining process ok. So, another joining process is there brazing, soldering ok. So, these two actually they are not metal base metal will not get melted like you are sticking together ok. So, for high pressure application for example, your field application brazing and soldering will not work, brazing means you are giving some softer material bronze and you are trying to stick together like very quick some gum you are putting in paper and you are joining together ok, two papers. So, in that case paper is not getting melted, just your surface property will be used and both will be attached ok. Soldering like electric people will be doing soldering right.

So, in that case also filler material will be melted, but base metal melting not required two electric where they will be joining right that electric people. So, in that case filler material one rod will be there that will be melting, but your wires are not getting melted ok. So, just so, those two things will not be used for your high pressure application field big tank design ok, not used for your high pressure tank joining process ok, high pressure or high volume ok, but for specific other purpose for electric cable joining use for your field application. So, there you can use soldering, brazing or other materials fine other joining process also fine some other process like this seam or welding like joining one sheet material is there another sheet material is there make like this that also one joining process actually. So, there are very thin sheet they can use that sort of technique.

Another technique is there spot welding, spot welding also there one option. In spot welding what will we do two metals are there and use very high amount of heat no filler material anything. So, small amount area will be melted here small things will be like two ice cream you press join release it ok. So, that way it will be joining very high temperature pressure maybe some small area spot area will be temperature will be very high melted join reduce temperature done ok. That also you cannot use actually that is only surface some metal you are melting and you are using for welding purpose.

So, that also you should not use for very high pressure application ok. So, welding proper welding if you are doing so, that can be used for your high pressure application. So, if you want to make permanent very high pressure application welding is better then riveting then your nut bolt thing ok. And a very lower pressure application low volume application then wood end or some other also ok. So, welding is a fabrication process that joins metals using high heat to melt the parts together and allowing them to cool causing fusion.

So, metal will get fused it is not brazing or soldering. So, brazing or soldering done at lower temperature than a welding temperature because when you are doing welding temperature must be very high 800 or some something ok. And brazing or soldering do not these do not allow melting base metal ok. The metals you are joining this should not get melted in brazing and soldering, but spot welding melting possible, but normally strength will be lower than your actual welding process arc welding or gas welding or TIG welding TIG also arc welding. TIG tank so, gas tungsten arc welding I already told ok.

So, in that case tungsten and inert gas argon and helium normally it will be used ok. So, non consumable tungsten electrode here I am saying ok. So, tungsten is not getting melted. So, to iron you are melting, but tungsten you are also infusing not possible.

So, tungsten is very high temperature to melt. So, in using during arc welding process tungsten will not get melted because of this high temperature. But base metal will be melted ok. So, welded advantage that strong and durable welded tank have good structure integrity less prone to leak and corrosion. So, for high pressure field application they are using ok. But it is expensive because very high tank you are manufacturing and welding very large tank is very much expensive very high skill required actually ok.

And riveted tank less frequently used ok because you got welded tank very high strength and high capacity thing. So, riveted tank people are using less ok. It will be simpler to construct because just put rivet and put hammering or something and then you make a rivet ok. So, leakage and corrosion may be issues. Welded tanks commonly used due to their superior structure integrity, durability and lower long term maintenance requirement.

However, some older tanks specially those with historical significance may be still riveted ok. So, tank battery. So, each tank will have some vapour space ok. So, vapour space it will be sucking outside air inside air also vapour also will go out. So, this is your breathing because of temperature difference or pressure difference the breathing is possible.

So, breathing sometime can be dangerous because it is creating combustible mixture maybe in surrounding or inside system. So, you have to handle that vapour properly. So, you allow vapour or you do not allow you have to decide that one ok. So, it will give emission vapour space breathing cause emission. So, air vapour space emission the vapour space expands contacts daily and it will be interacting with ambient air then there will be problem ok.

There should not be any fire source nearby if fire source is there then you have to handle that one maybe you have to use fire extinguisher or specific fire handling system ok. So, heating and cooling if you have then breathing possible and breathing means vapour will be going out air will be sucked in and it will be mix it create it will be creating mixture that will give you emission and combustible mixture is also dangerous and more volatile components bore more vapour oil vapour you will get ok. So, venting and flame arrestor specially designed pressure and vacuum vent valves protect tank against over pressure or vacuum condition. Air should not enter tank mixed with hydrocarbon in the vapour space ok.

So, gas blanketing system sometimes used. So, inside pressure there will be venting little bit higher. So, with predetermined pressure. So, that is called gas blanketing system. So, that external air will not get sucked ok. And still you need flame arrestor because if there is any flame source from anywhere it should not enter your tanking system.

So, there should be one flame arrestor which will be controlling fire going inside the system ok. In tank vent piping it protects the tank if there is a lightning or any spark or any other fire source is there then you should have flame arrestor because tank is there. So, nearby vapour will be mixed with your fuel hydrocarbon and oxygen. So, that will be combustion mixture. So, you should have flame arrestor which should not allow flame to enter into the system ok.

So, newer design such as fluidic seals and molecular seals used for reducing flame. So, fixed roof tanks and failed in excessive high pressure low internal pressure if high pressure is there or low pressure is there again it can fail. Maintenance of pressure and vacuum vent valves and flames arrestor required ok. So, if you are not maintaining regularly you are not checking then if fire source is there it will not handle.

So, that will can be dangerous. So, that you should maintain regularly. So, inspection and maintenance those are very important part ok. So, let us see one flame arrestor how they are working. So, flame arrestor you see left side lots of flames are there ok and right side there is no flame.

So, there is one sieve ok. How this sieve is look like? Like they will make small pores long pores. So, that if left side lots of flames are there that flame will not enter into the right side because this small they will be dividing small pores ok. So, that will not allow to transfer heat or combustible material inside the system ok. So, it will be absorbing heat because heat is the ok when you want to you get fire, fire needs three things actually combustible mixture, one fuel source, one oxygen, one heat or flame source ok. So, if you cut any of these is called fire triangle I think you remember oxygen, heat and fuel ok.

So, in atmosphere this wood can burn right this table, atmospheric oxygen also there which is not burning this temperature or heat is not there, if you give heat also it will burn. So, this fire triangle any arm of this triangle if you break then there will be no fire ok. If you all together all three then there will be fire. So, this fire flame arrestor actually they will try to break this one, one arm ok. So, if they can reduce heat this flame arrestor absorbs heat that means, it is reducing heat.

So, temperature will be going down from the flame reduce temperature below its auto ignition temperature, auto ignition temperature means that if you raise temperature suddenly the fuel will be burning. So, there will be reducing below that one. So, channels design into an element absorbs heat ok. These channels are designed to absorb heat actually ok.

So, floating roof tank when oil 0.5 vapour pressure less than 0.5 psi to 11.1 the US environmental agencies permits floating roof system ok. So, floating roof means it will give less vapour because the roof is floating with oil level ok. So, there will be no free space for vapour, but it is not suitable if only oil is not stabilized. So, if lots of vapour is there not stabilized then it is not suitable because lots of bubbles will be getting created ok.

To provide safe efficient storage of volatile oil with minimum vapour loss. Internal floating roof tank IFRT uses an internal floating roof eliminates natural ventilation of the tank vapour space ok. And there are another type closed floating roof also there. So, closed floating is one internal floating plus one top roof will be there. So, the closed floating roof tank similar to an IFRT internal floating roof.

So, CFRT is equipped with pressure vacuum or PV vent system gas blending blanketing system used with fixed roof emissions from CFRT same as IFRT ok. So, there are different cross and pros and cons for every system. So, you have when you are preparing for exam. So, you should look at those things ok. And you can see two figure I have copied from two Wikimedia common source and this is largest storage tank system.

So, you can look at this figure and you can see how this systems are fixed like bottom there will be some entry point, top will be top will be entry point, bottom will be exit point, there will be floating system, there will be metering system, how much fluid is there. So, that measuring system will be fitted together. So, whenever people are constructing the tank system they will be fitting all together, but when you we are operating also you should know all the systems ok. So, tank battery, tank battery means many time one tank will not be sufficient.

So, you need multiple tanks ok. So, a group of tank connected receives crude oil from well also called battery or tank battery ok. In battery oil volume is measured and

tested before pumping into pipeline. A typical battery two or more tanks usually has capacity equal to 4 days production. The tanks should be level with each other.

So, and spacing about 3 feet between them ok. And tanks can be there in a dike, dike means like pond like structure. So, if there is any leakage anything. So, fluid will not be spilled out everywhere. So, it will be placed in inside a dike. So, pipe connection located below the thief hatch minimum 12 inch above the tank bottom.

So, tank bottom is there and 12 inch above you have you will have the pipe connection. Inlet connection is the top deck. So, from top there will be inlet actually from bottom you are taking out fluid. So, drain connection immediately above the tank bottom and normally tank will be designed for 25 30 to 50 years ok.

You can see this one picture of tank battery like these are a pipe connections ok. To pipeline outlet and these are the entry fill in pipe, filling here filling here filling. So, three tanks are there. So, filling from top ok and taking out from bottom to the pipeline outlet. So, this way they are designing tank battery ok.

So, if you have iron sulphide H2S then FES also one important part. So, that tank design requires special attention because it is H2S and FES all this corrosive material will be there and contaminant will be there. So, you have to select proper material. So, that there will be no leakage because H2S already dangerous to environment and human life ok. FES deposit keep corrosion and can go unnoticed, H2S is poisonous ok.

We have already discussed certain amount of H2S can give death also instant death ok. So, it is poisonous all tanks opening should be closed. Walls permit sampling on the ground without the tank being opened ok. Small amount of sweet gas may be fed into the top of the tank to establish gas sweep ok. So, that H2S should not go out of the tank ok and positive pressure is maintained to avoid air entry to reduce corrosion ok.

So, if oxygen is entering then corrosion will be increasing. So, just you have to stop air entry. So, extend the tank vent line away from the tank battery use back pressure valve flame arrestor the vapour flare vapour is flared not vented ok. So, back pressure

valve you have to use you have to use positive pressure. So, that H2S should not go into atmosphere and oxygen also should not enter it will be give more corrosion because your metallic tank you have and you have already H2S corrosive system and oxygen you are giving also then everything will be dangerous. So, you have to take care of all the aspect if you are handling H2S or very highly acidic gas ok.

Thank you very much for today lecture. Next day we will try to go for some calculations on metering how to measure flow and how to calculate the flow rate ok. Thank you very much. Thank you.