Surface Facilities for Oil and Gas Handling

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Natural Gas Processing_02

So, before going into further details you should know the difference between LNG, LPG, and NGL. So, LNG form you should know liquid liquefied natural gas, liquefied natural gas or NG I am writing, liquefied petroleum gas, NGL natural gas liquid, natural gas liquid, natural NG liquid. So, whenever talking about LNG, methane normally methane will be there. So, many times you have you may have heard the term LNG terminal liquefied natural gas. So, in that case, you create a very low temperature you then you make a liquid of methane or natural gases. So, some amount of ethane also will be there.

So, this is called dry or natural gas. Normally this will be the term and again LPG you are using at your home in India like Indian or other company Indian oil supplying, right. Indian oil like Indian cylinder is coming right, Indian 14.2 kg per cylinder I think, per commercial will be 19 kg.

So, there is a low LPG, liquid petroleum gas. So, petroleum gas would have little bit longer chain hydrocarbon. So, propane 3 hydrocarbon, 3 carbon is there right CCC and normal butane CCC C for an isobutene again I just I already discussed CCC then 1 C will be here, okay. And all remaining bonds will be connected to hydrogen, okay. So, propane, normal butane, isobutene normally the constituent of LPG and natural gas one in pentane and other component if all are there.

So, all together they call NGL, okay. So, you see right side the definition C2H5, C3H8, C4H10 butane isobutene and C5 all comes under NGL or NG natural gas liquids, okay. LNG means liquefied liquid of natural gas, okay. CH4 primary component. So, normally 75% CH3 will be there, okay just approximate thumb rule.

CNG compressed natural gas. So, CNG is like autos and some buses will be there CNG bus. So, actually compressed natural gas they will be using. So, they will not be using liquid one, liquid one means you need very low temperature but you may not maintain the temperature in a bus or autos. So, in that case you use compressed natural gas.

LPG I already told you are getting in at your home in India. C3H8, C4H10 butane, isobutene will be there. It will be 50% butane or isobutene and 50% normally it will be like C3 or propane. So, about 50-50 and this depends on different country also. US they will be using 40, 70% propane, Mexico will be something different.

So, it depends on different countries condition. If they have more in their gas more propane is there so they will be having more propane content in your gas. So, that way they will be isolating, okay. And altogether it is coming under natural gas. Although you see natural gas definition is different, okay.

So, whenever you are getting gas from wellbore so there will be condensate, dry gas and some associated gas. So, different condensate sources has different compositions. Generally gas condensate has specific gravity 0.5 to 0.8 and is composed of hydrocarbons such as propane, butane, pentane, hexane, okay.

NG or natural gas condensate is also called condensate gas or condensate NGL. Okay, how to separate it? You say you are getting gas from different wells, gas wells, okay. So, from gas well you are reducing temperature initially, okay, this is cooling. Then you are sending to gas condensate was separated, okay. So, from separator you are getting certain liquid.

Then again you are sending to another level of separator. So, this is your gas condensate, okay. So, from there you are getting gas, you are sending to one compressor, okay. So, whenever you are drawing one compressor I think I told already that compressor should be like this. Compressing means you are reducing size.

So, you should not draw in opposite way. For example, if you are drawing this way, so actually you are expanding, okay. So, I am showing this one reducing size, okay. So, that means it is compressing, so volume getting reduced, okay. So, this is compressor.

So, so from compressor you are sending to pipeline, okay. And here gas again you are getting two layer gas condensate. This is high pressure separator, high pressure and this is low pressure, low pressure separator, okay. So, low pressure separator again you are getting, from high pressure also you are getting water, you are getting, okay. So, you have to dispose it.

Low pressure also you will be getting water, same way, okay. So, you have to dispose water, water. So, before disposing you have to remove all the hydrocarbons, okay, as we have seen in previous lecture, okay. Now from here you are getting certain condensate oil, okay, condensate to oil refinery, okay. After separation of all these impurities you are sending to oil refineries.

And after compressor you are getting pipeline to natural gas processing plant, natural gas processing plant, okay. And from there, from whatever gas from here you are getting from lower, low pressure separator, again you are sending to one compressor, compressor means like this, okay, from here, here, I have to show otherwise it will be confusing. Compressor you are getting this one, then again you are passing through this, you are reducing temperature again, okay. This is symbol for cooler, you are reducing temperature actually, okay. So, from cooler you are connecting this one to again upper compressor, because every time you have to use compressor because the high pressure separator will have some lower pressure, lower pressure separator will have much lower pressure.

So, when much lower pressure is not maintained properly, you are not increasing pressure there, so what will happen high pressure gas will enter into a low pressure separator, okay. So to prevent that actually you have to increase whatever gas you are getting from low pressure separator, you have to increase pressure, then you have to put in high pressure line, so that both gas can commingle and they can go to next level, okay. If you are not using compressor, low pressure separator let us say, there is two compressor I have used, there is a lower compressor I remove, what will happen? So high pressure separator will have gas coming out at high pressure, so that high pressure gas will be entering into my

lower pressure separator, so that is not desired, okay. So in that is why we have we must have one compressor for the gas coming out from low pressure separator, okay. So, natural gas processing, some processes done at the near at or near the well head for feed processing, complete processing at processing plant located in natural gas producing region for four main processing are there, oxygen and condensate removal, water removal, NGL natural gas liquids removal, sulphur carbon dioxide removal.

So these are main thing but some other component also will be there, so that I am not I have not listed, so first assume this is a major separation process. So first oil and condensate if you separate, okay, so you have gas mixture you got, so lower higher molecular weight hydrocarbons you remove, lower molecular weight hydrocarbon you take, okay, water you have to remove, acidic gases, S, CO2 you have to remove, separation of NGL, so whatever the high density or high molecular weight fluid you got, again you have to separate that one, there you get light weight fluid, high then a higher weight fluid or long chain short chain hydrocarbons, so you separate and you send to your customer or for next processing. So heater or scrubber installed near the well head, I already told that heater is required because if choke is reducing too much pressure then you have to heat actually, if you are not heating then what will happen, there will be frost formation or gas hydrate formation that will be hindering your process, okay. And scrubber removes sand or other large particle, if sand or other large particles are there you have to remove using one separator system that is called scrubber, so heaters temperature does not drop too low, okay, if temperature it will be maintaining temperature, if it is reducing temperature then issues will be coming hydrates and frost formation. Natural gas with low quantity of water, gas hydrate form at lower temperature, okay, hydrate accumulates impede the passage of NG through valves and gathering systems, so you have to avoid hydrate formation or frost formation, so hydrate will be hindering all the processes like ice like structure, so whenever it is formed through the pipe, so it will be getting deposition of pipelines, valves, chokes and it will be blocking the flow, so you have to avoid gas hydrate, so one best way is that remove water or increase temperature, okay, if you can do both that will be fine, if you are unable to increase temperature then you have to remove water, okay.

Now natural gas processing flow diagram, okay, so you see this gas well, top left corner, the gas, from gas well you got certain fluid then you increase temperature and condensate and water removal, so first step, condensate like two phase separator you have, you are separating gas and liquid, okay and gas whatever you are getting first you have to remove acid then sulphur removal, then tail gas treating, some small amount of traces elements will be there, so you have to remove then off gas to initiator, so there may be cells line you

have to send, okay. And condensate whatever you are getting, acid gas after removing, you do dehydration then after that if mercury traces is there you remove it, if you have nitrogen you remove it, you have NGL, natural gas liquids, if it is there you also remove again, then some other like ethane separate, propane separate, butane separate, okay. Then sweetening process, so in sweetening process means you remove mercaptan, mercaptan, mercaptan actually is very pungent smelly gas, normally the household you are using the LPG cylinder, there will be some mercaptan gas because the gas at your gas cylinder at home, so that is actually odourless and smellless, odourless and it is colourless, so if there is a leakage you cannot identify whether leak is there or not because it will mix with air and it will create one combustion mixture that will be very much dangerous. So what they do, the companies they will be adding certain amount of mercaptans, so that will be giving some pungent smell, so if there is any small leakage actually you get smell and you can say okay there is leakage, okay, that is why that you the companies will be using mercaptan for increasing odour in the cylinder or gas. But in processing plant if mercaptan is there actually it is it will be containing some amount of sulphur, so it will be giving corrosion, so the companies will be removing actually, removing and they will be adding the fixed amount of mercaptan, so that if leakage is there people can identify but it will not be harmful also.

So there after that you get ethane, propane, butane, pentane all these things you get and you send to your customer or next level. So this is the whole process in my lecture I cannot discuss everything but a few things I will discuss next lectures, for example acid gas removal, dehydration, so these are basic thing I will discuss and other thing also I will be giving some idea not in details, okay. So, process things is so big but in one plant everything may not be there, because based on your requirement the plant will be set, so some plant may not have certain like say for example mercury is not there, so mercury part will not be there in your case maybe, but some part may have some more difficult situation, so they will be handling. So basically this is the overall view of NG processing flow diagram. Oil and gas condensate removal, in many instances natural gas is dissolved in oil at high pressure, at low pressure again it will be separating, okay.

Low temperature, when temperature is low like LTX, one heating arrangement is there, so separator with low temperature often uses for oil producing for high pressure gas along with light crude oil or condensate, okay. In many cases it is being used LTX unit, we say LTX unit. Wet gas enters the separator, cools, travels through high pressure liquid knock out, okay like this. While it enters the separator, so there will be cooling unit, so it will be cooling, travels through high pressure liquid knock out, then flow into this low temperature

separator through a choke mechanism, then gas will be expanding, gas will be driving back through heat exchanger, it will be warmed by the incoming wet gas, so this way the LTX will be working and it will be removing the unnecessary particle or it will be separating the different component of hydrocarbons, okay. So it change, you create different temperature zone, so different temperature zone will be separating different component of hydrocarbons.

Water removal, so we will discuss in this one later also but this is just overview for this introduction part. Water vapor removal, absorption or absorption, so if it is liquid then it will be absorbing the water particle, if it is solid then it will be adsorbing, adsorbing means surface phenomenon. Glycol dehydration, a liquid desiccant dehydrator, so it is absorber for water vapor from gas stream. So for example, I have glycol in a certain way, this is glycol stored here, okay and you are putting water gas with water, okay. So when it is passing through this chamber, lots of bubble will be created, okay.

So this gas bubble, this glycol will be absorbing the bubble, it will be reacting with the water and it, there will be water free gas, water free gas, okay. So this is called glycol dehydration unit, okay. Diethylene glycol or DEG or triethylene glycol, DEG absorbs water particle, so water particle will be absorbed by this one, this process will be there, okay and become, the particle will be heavier, there is glycol particle and it will be falling down slowly but gas particle will be moving up without water. Another solution put through a specialized boiler, water, okay. So now you got this glycol with lots of water actually, once you operate for longer time, the gas with water particle mixed up, going through this glycol unit, so glycol is absorbing all water.

So after a certain time, glycol will have lots of water, so it will not be able to absorb more water, okay. So what will you have to do? You take out this glycol, then again you separate water and glycol, again prepare pure glycol, okay. How to prepare the pure glycol? So you have to increase temperature, then how things will work? So if you increase temperature of glycol, let us say one pot you are taking glycol and water, okay. So glycol boiling point 400 degree Fahrenheit, water temperature boiling point is 212 degree cent

Fahrenheit or 100 degree centigrade, okay. So because of this temperature difference, so you heat the system, let us say up to 230th 50 degree temperature.

So what will happen? All water will be evaporated but glycol will not evaporate because it is not reaching, it is still up to its boiling point, okay. So water got boiled but glycol will be remaining, water will be going out, okay. So then without water that glycol again you use inside your system, water plus gas, water we absorb, gas you take out, okay. So just way this glycol dehydration unit will work. Flash tank separator condenser, this is a condenser, flash tank separator reduces pressure of the glycol solution, allows methane and other hydrocarbons to vaporize or flash, okay.

So glycol solution travels to boiler, okay. Glycol solution will be traveling to boiler again to be boiling, again you flash it, so this cycle will go on. So later we will discuss in details about dehydration with glycol. Solid desiccant dehydration, okay, that was liquid. So you are using glycol means there is a liquid dehydrant, water is getting absorbed in liquid.

What if you have solid? Okay, like say activated alumina or granular silica gel material if you have and if you pass the gas over it, so gas molecule, if water molecules are there, so those will be absorbed. So you see this absorption and adsorption difference, so absorption means, absorption means molecules are going inside, okay. So there is mixing up and chemical reaction happening, but adsorption means on surface those will be attached, gas flowing, then water molecule will be attached on surface of the solid or alumina, okay, this is called adsorption. Wet gas pass through the towers with desiccant from top to bottom over desiccant material, water retain, okay. Desiccant material means like alumina, activated alumina, granular silica, it is there and gas with water passing over it.

So water will be absorbed and gas will be flowing over it, okay, so that way you are separating water and natural gas. Solid-exhale more effective than glycol, okay, but there are difficulties in technology, so we will discuss later. This suited for large volume of gas under very high pressure, this is usually located on a pipeline downstream of a compressor station, okay. High temperature heater-heater regenerates the desiccant, so you need a high temperature heater-heater more than your liquid glycol the temperature 400, in this case the temperature will be much higher. Separation of natural gas and liquid NGL, NGL

from natural gas absorbs method, NGL from natural gas absorption method and cryogenic expanded process, so cryogenic aorta there is low temperature size, you have to create very low temperature.

So there you separate different component of fluid, NGL can be absorbed by oil, so it creates certain systems, so where you pass the system there and NGL will be absorbed, there each oil is fed into lean oil steel, mixture is heated, temperature above NGL boiling point but below the that of oil. This process allows recovery of 75% of butane, 85% to 95% pentane and much higher molecules. Absorption method extract heavier NGLs, okay. So cryogenic exponential process, cryogenic term again and again I am using, cryogenic low temperature signs, low temperature signs, low temperature means like you want to create liquid nitrogen, in that case normal refrigerator system at your home will not work, so you have to create certain special type of cryogenic system which will be creating very low temperature, so that will be helping you. Cryogenic process extracts NGL drops temperature minus 120 degree Fahrenheit, okay, high recovery rate for extract, high recovery rate to extract butane and other lighter hydrocarbons.

Among methods, turbo expander process is efficient, refrigerants cool natural gas stream, expansion turbine rapidly, so because of expansion temperature will be dropping, so that technique you use for separating different hydrocarbons. This process allows recovery of about 90 to 95% of ethane. I think this should be C2H6. NGL fractions, after NGL removal fractionation done, fractionation is different boiling point hydrocarbon to be separate, boiling of the hydrocarbon one by one, the fraction it is follow order like de-ethanizing, de-propanizing, de-butanizing, so you have to separate one by one, this is called fractionation, okay. C4H10 splitter or de-isobutanizer also happens in this step, okay.

So we will not go discuss details of this one, only this much you study for your exam. Sulphur and carbon dioxide removal, this is a very important steps for oil, for gas processing, so natural gas whatever you are getting it may have sulphur content like in the form of hydrogen sulphide. So if H2S more than 5.7 milligram per meter cube, it can be called as sour gas. Removing hydrogen sulphide called sweetening process or amine process or girdler process.

Sour gas run through a tower with amine solution, amine solution MEA, DEA, so different

types of amine solution possible and amine solution will be reacting with your sour content component like say H2S or carbon dioxide and it will create a rich mixture of amine, okay. And the gas without this sour content will be moving and you will be collecting that one, okay. And whenever you produce this rich mixture of MEA and DEA with lots of H2S, so you have to increase temperature and you have to separate it. So, you can have a loss process separate sulphur directly, okay, using thermal and catalytic reaction method. So there are several techniques for removing acidic component, so we will discuss later but just for quick reminding, so basically amine solution based system are more common and other system also can be used based on requirement.

So, condensation stabilization, so condensation or fraction or NGL recovery, removal of light and more gaseous component particularly ethane, propane, butane from a gas stream, okay. So one term is the stabilization is used because whenever you are having NGL and you are trying to separate the component is called stabilization. So, distillation column can be used for example, if you see right side, so light liquid the gas you are sending here and it is passing through liquid, okay. And passing through liquid means you are changing temperature at different temperature different gas you are collecting, okay. So different stages you create, so vapour rises up, so vapour going up, okay and you are forming liquid, so that liquid will be coming and will be collected here, okay.

So it is coming through different trays and trays are at different temperature, so in different temperature this separation will be happening and you collect whenever required, okay. Liquid removal and separation of liquefiable gas component from liquefied process fluid, so you call liquid stabilization. Liquid separated to meet transport and sales requirement, so this is required for sales and transport criteria. LTX, heating is required, okay in certain steps. So what is LTX and line heater? Those terms are used frequently.

So LTX is a low temperature heat exchanger, okay. Low temperature exchanger is called is for high flowing temperature of well stream to melt the hydrate often they are formed. Since they are operated very low temperature they also stabilize the condensate and recover the intermediate hydrocarbons, okay. So this stabilizes condensate, this stabilizes, this stabilizes condensates and they breaks the gas hydrates, gas hydrate melting, okay, they help in gas hydrate melting. Heat also helps in separating other component, helps in separating other components, components, okay. Line heater or indirect fire heater, indirect fire heater, okay.

So line heater, heat the gas stream before or after the choke, gas stream after or before

the choke, before the choke, okay. So that the gas is maintained above hydrate temperature, to maintain temperature above hydrate temperature, hydrate temperature, okay. The heater also can be used to heat crude oil for heating. It can be, it also can be used, can also be used for heat treatment, to use for heating the crude for treating.

Thank you very much for today lecture. Next day we will come with next topic called, next day we will come with new topic called gas sweetening process. Thank you very much. Thank you. Thank you.