Plant Wide Control of Chemical Process
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Lecture - 15
Control of Complex Column Configurations

So, welcome all to this next lecture, up till now we have looked at control of simple distillation column and by a simple distillation column, what I mean is or what we mean is called a single feet and you get two products streams that is distillate and the bottoms. Now, anything beyond this; that means, if you get another extra field or extra side draws, extra product streams is called a complex column configuration. And this complex column configuration is there are quiet few that are used in the industry, and why this configurations are used is essentially due to economic reasons and some time due to feasibility reason.

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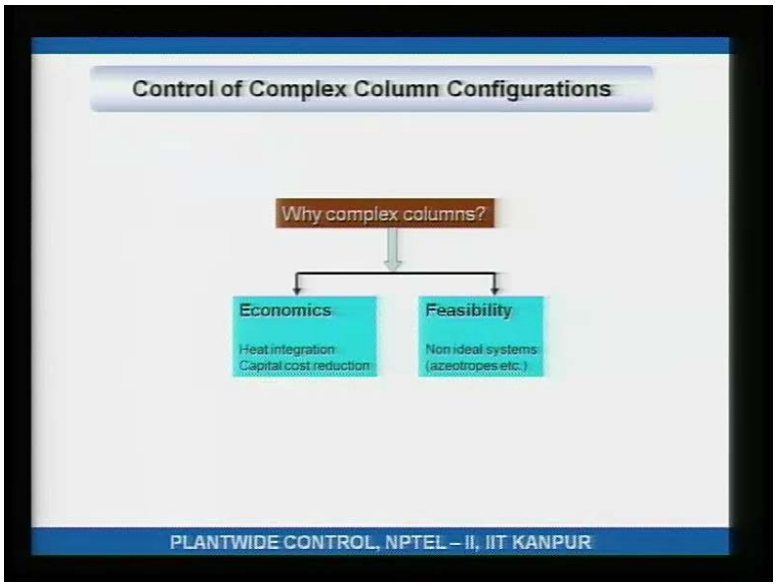

Economics in the sense that the complex configuration actually uses less energy or less capital cost, feasibility, sometimes feasibility becomes another issue because of non ideality in the way of product equilibrium and then we get complex columns.

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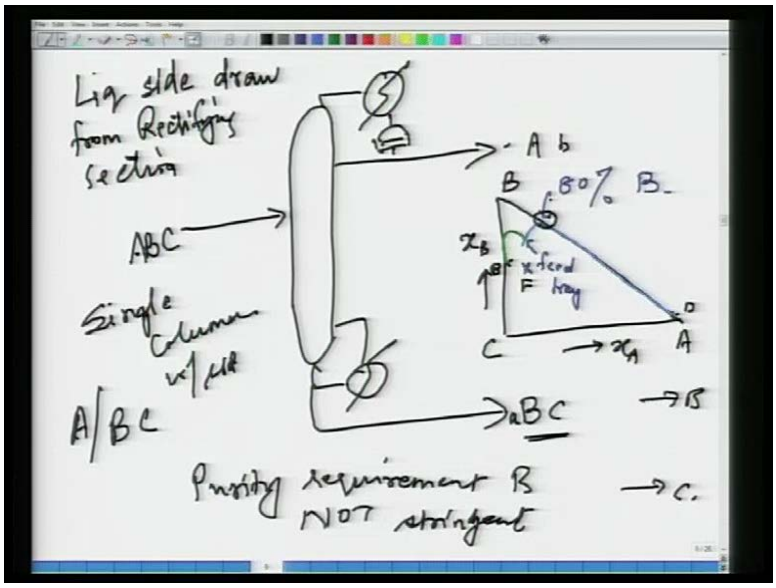

Now, we are going to look at some common complex column configuration and there control. Let see you got another A B C mixture; A being the lightest, B being the intermediate and C being the heaviest, let say you take another A B C mixture and you get it through a pass through a simple distillation column, let say a nearly pure a it is an it is an A B C split; that means, A goes to the top, small amount of B goes to up, all of the B C go down bottoms, small amount of A goes down, so it is A B C split, let say this is our situation, if you look at the composition profile inside the column across the trace, this is pure A, this is B, this is C, so this is mole fraction of A, this is mole fraction of B, let say this is the feed composition, it is a mixture of A B C, at the top, I am taking out the distils that is nearly pure A down the bottom, say that serious such that you got a lot of, small amount of A and a lot of B C so; that means, is you are you are feed composition is somewhere, you know it is A B C mixture with a little bit of A in it, so let say small towards this B C edge.

So, this is you are feed composition, so you are taking out pure A at the top B C down the bottoms, if you look at the composition profile inside the column, what you find is that composition profile actually looks something like this, and by material balance the B composition would be the bottoms would be here, these three points that distill it, the bottoms and the feeds should be on straight line by lever rule and the scripting profile would be something like, why is this figures? Why am showing this figure; two things just

to explain, this is the feed tray, this is the feed tray, this is composition on the feed tray, this is the feed composition this write here.

Now if you look at this section, what is this section doing? This section essentially preventing the C from going up the top, you can see moving towards the A B edge, the C composition is decreasing, so the trace immediately above the feed as you initially preventing the C that the C from going up the top; what do these trace do, let me remove this, these trace are preventing the A from going down the bottoms right, I hope this simple figure, this simple figure explains what the purpose of the trace immediately above the feed tray and immediately below the feed tray.

Now, if you look at this composition, it is quiet rich in B, rich in B, a bit of A almost no C; for example, this composition may be I would say let us say 80 percent, 80 more percent B, I may have a processing situation, where I would like I may have a processing situation, where if I want to produce pure A, pure B, pure C, the only way of doing that is you know, if this is A and this is B C than you take this B C stream, distillate further than you will get pure B and pure C all right, I may have a situation, where purity requirement of B, which is the intermediate boiling component, purity requirement of B is not very stringent, what do I mean by very not stringent; that means, I do not want for example, 99.9 percent pure B, even if the B stream is you know 80, 85, 90 percent pure that is acceptable; common example may be that the B stream is, let say B is reactant; it is being recycled back to the reactor, even if it is it is got some amount of A or C in it that is acceptable you, it is not a product stream, it just merely a recycle stream, even it is impure that is acceptable.

Now, instead of producing pure A, pure B, and pure C ,which would require more energy because you are getting all components that are pure; I may do a sloppy split, what I mean by sloppy split is that I get pure A, I get pure C and than I get B stream that is you know, it is got some amount of purity in it like that, so many let us say 90 or 85 percent pure B, in this situation because impure B is acceptable in the processing scenario that we have, I may get away with using only a single column with side draw; single column with side draw, where do I place the side draw was this is location, where the B composition is the is the highest, where so I will place my side draw somewhere here, also note that in the rectifying section B being heavier than A, its composition in the liquid phase would be more weight, so this is the rectifying section, this is the blue line is the rectifying profile, the green is the composition profile than the scripting section.

So, I can see that the maximum B composition that am getting is in the rectifying zone and you also note that because B is heavier than A, it could preferentially go into the liquid phase and not in the vapor phase, if you compare the composition of B in the liquid phase will be more than in the vapor phase, so you would like to take a liquid side draw from rectifying section and I hope this ternary plots lot of explains to you or clarifies to why am taking liquid side because here, it get nearly pure B, its nearly pure B its 85, 80 percent B and I liked to take it in the liquid, I liked to take a liquid side draw because B would B being heavier than A, it would be more in the liquid than in the its composition more in the liquid phase more than in the vapor phase all right.

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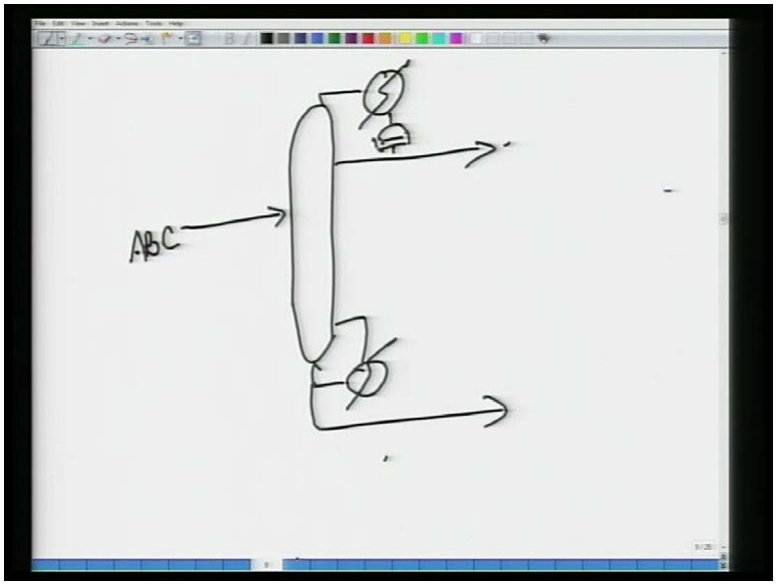

So, what I do now after all is blah blah blah, I have another A B C mixture, purity for the B stream is not very stringent, so I like pure A pure C, but little bit of impure B is, so what I do may I should draw this also again, may I should go to the next page.

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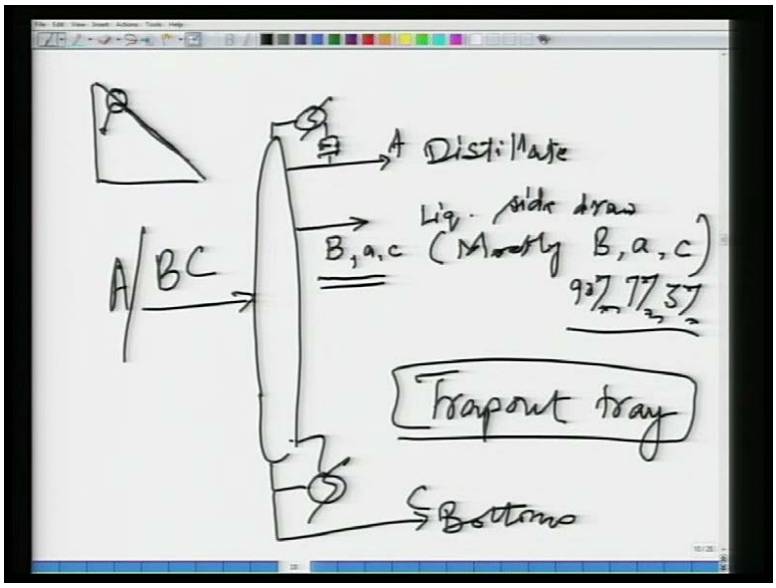

So, I got this simple distillation column, reflux distillate reboil and the bottoms, so what I do is, I take out A liquid side from somewhere in the rectifying section, so this is a side draw, so this is a distillate bottoms, this is a liquid side draw and its composition will be mostly B with a with some a, and if you close to the field you may also get some C, but C would be probably less than a, so let us it is about 90 percent B, 7 percent A, 3 percent C that may be a typical, so this side draw, what am now getting is pure A pure C and A stream that is B with a little bit of a and still smaller C right, why do I use such a configuration A, for capital cost reasons, I was trying to produce pure A, pure B, pure C. I would have require at least 2 columns, 2 columns may be you know I take out A at the top, B C down the bottom, B C stream sent to another column that gives you B at the top and C down the bottoms right, it requires two columns; alternatively I may take A B at the top, C down the bottoms and I split this further take out A at the top B down the bottoms, if I try to produce pure A, pure B and pure C, what I will get is I need at least 2 columns, also each of the components pure therefore, the amount the scheme consumed whether it is this scheme or this scheme a large, on the other hand since I had know very well that I do not require nearly pure B, somewhat impurity in the B steam is acceptable because for example, let say for a study cycle stream; in this case I get way with one column and I get a stream which is mostly B, not pure B or nearly pure B, but mostly B and this can be for example, recycled, so this is a cheaper process that does the job consumes less B right.

So, another example, where A liquid side draw column is used, so this is liquid side raw and the liquid side draw is typically taken out of a out of a from the rectifying section somewhere in the rectifying section, and the way to do it is you have a to trap out, what you will have a tray on which the liquid is accumulated and this is not a usual tray, it is called a trap out tray, it traps the liquid and than you got a side draw stream with there at the pump and it will pump, the liquid out, so the side draw tray is not a standard tray, it is a trap out tray, so this was the case where you had a small amount of A in the feed stream lot of B C mostly B C, so what that essentially did was my composition is here, so you know my rectifying profile would go like this and therefore, I had get a section or a location in the rectifying section, where the purity of B is very close to you know 80, 90 percent.

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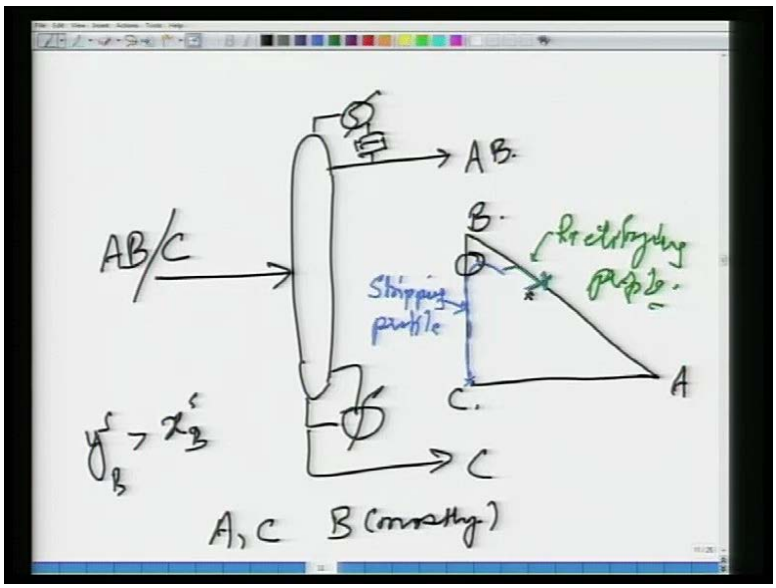

On the other hand I may have another situation where, where I have a lot of A B and a small amount of C in it, in this case if I again take a simple distillation column, it is a simple distillation column, I am taking out pure C down the bottoms A B at the top, if you look at the composition profile for this kind of a split again, let us look at our ternary plot, see what can, see out what we can figure out from here, this is pure A, this is pure B, this is pure C light intermediate boiling A B components, since I am taking nearly pure C at the top, at the bottoms the bottom composition is close to the C vertex, the way I defined the problem, the feed is a lot of A B with the little bit of C.

So, the feed composition will be close to, let say this is the feed composition; by material balance my distillate composition would be in a straight line with this and it will be some place here, let say here, now if I look at my stripping profile; it would go something like this is, my rectifying profile green is my rectifying profile, blue is my stripping profile; this is the stripping profile, stripping profile and the green is the rectifying profile, again if you look for the locations, where the where the tray composition is the nearly pure B or mostly B A, you can call it nearly purely B well ,this guide is nearly you know a lot of B is closed to, the B vertex is closes to the B vertex, what that tells us and note that in the stripping section, so this is in the stripping section, the liquid somewhere the liquid composition is close to the B vertex, if I look at the vapor that is in equilibrium with this liquid, each composition would be because B is lighter than C, the composition of B y B in the stripping section would be greater than x B in the stripping section, x denotes liquid phase composition, y denoted vapor phase composition.

So therefore, if I look at the vapor that is in composition that is equilibrium with this liquid composition that vapor would actually richer in B, so if this liquid is 80 percent B, the vapor in equilibrium leaving that tray would be let us say 85, 90 percent B; therefore, in this case since I want to get pure C, pure A and I want B stream that is mostly B; that means, some amount of impurity, small amount of impurity in B are acceptable is acceptable, so what I do here is again as before instead of taking A instead using two columns that produce pure A, pure B and pure C what I do is, I use a single column which was doing another indirect split, where you are removing the pure heavy components on the bottoms.

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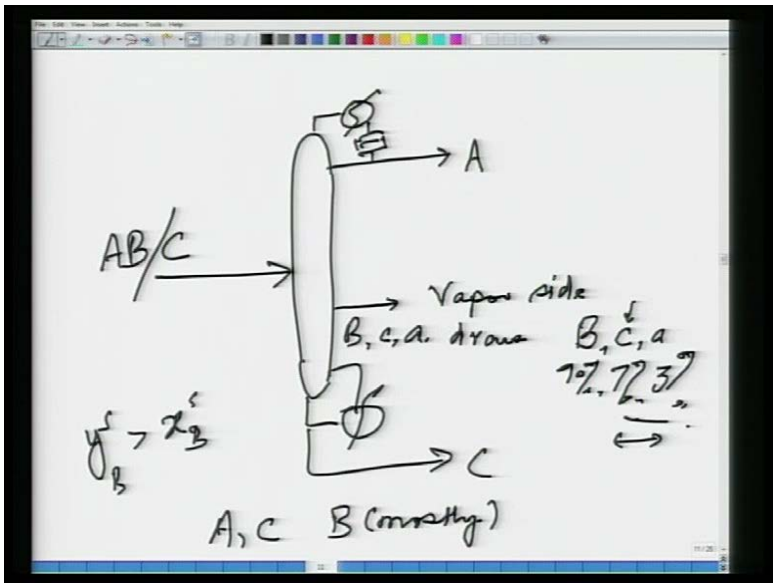

So, what I do here is, I take a vapor side draw, what does this vapor side draw and this vapor side draw will have a lot of B with, I do no what is the principles impurity that depends on, where you locate it, little bit of C and may be a little bit of B, I think C would be the primary impurity here speaking, let us this may be I do no 90 percent,7 percent, here I do no may be 3 percent something like that, this may actually you know interchange that depends on where you are locating a side draw, but the point is my side draw stream is essentially mostly B with a little bit of B and C impurities all right, so here I have a configuration in which if I take a vapor side draw from this stripping section, I will get this stream would be most of the B goes out here, so I will get, so I get lot of B small amount of C and A all right, so these are two side draw columns configurations that I used when you want the intermediate when you to the have the intermediate boiling components which is not nearly pure, it should be mostly, it is not necessarily to have pure B, so these are side draw columns.

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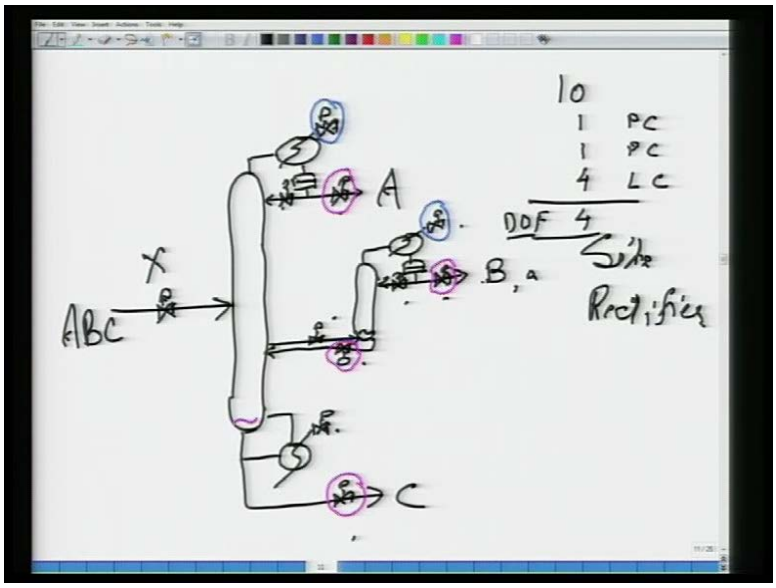

They material further say well, so let us say I got a liquid side draw column, where the liquid side draw is been taken out, so I have a stream which is A B C, this is the feed stream, this is my distillate that is my reflect and am taking out side draw bottoms, what I can do is, this liquid side draw can be sent in to a stripper, a stripper is a small towel sec column section, whether small reboiled it on there, and what this rebolier is doing? You see my stream that is coming out from the side draw is essentially lot of B and some A, I would not like the A to come down here, I would like to another hands another recovery of A which is freshest, so I would not like to lose out my A with the side draw, so what I do is I put a side a side what is this called as side stripper, so here is a side stripper.

And what the side stripper does is? It does not allow the A to take down the bottoms, so here is a side stripper complex column configurations, in case I am taking a vapor side draw from the stripping section as we discussed earlier, I can send this vapor to a side rectifier and what the side rectifier does is? It condenses the vapor goes to the bottom of the column section which is a small rectifier goes up to a condenser condenses out and because am having this reflex, so this reflex right here what that does is since this side draw is mostly B with some amount of C and all most A.

So, what the side rectifier does, is does not allow the C which is heavier than B to leave up the top all right, so this will be B with any amount of A with this coming along with that, but no C right, this side rectifier essentially enhances the, what the hell did I do here sorry,

so this is A, this is C, this is B and the liquid that is dropping down the column sent back to the column, the side draw vapor side draw shows a lot of B some amount of C and a very small amount of A, well if you put the side rectifier a, this is a side, this is a side rectifier, if you put the side rectifier there, it does not allow any of the C to go up you top right, so this is a complex column configurations in the side rectifier.

How do we control these things? Well that should become a obvious to you and you think, first thing what is what are the degree of freedom, so you got a value here which is not in you are hands, pressure is lot of fixed, you got to control what, these are the values, you can also just how much side draw, you have taken out, I am not drawing a valve here, because whatever is the reflex everything as to go down here or if I do draw the valve the here, well this valves are used for bottom level control all right.

So, let see these are all the independent valves, feed is not in my hand, it is coming from another upstream process, for example, reactor, so total number of valves is excluding the feed is 1,2, 3,4,5,6,7,8,9,10, these I have got 10 valves that can be adjusted of these 10 valves one would go for the main column pressure treasure control, one valve which probably would be this guide, if you see this these guides the once in blue will go for precious control than what about level control? Well if a look at level control, let say I am controlling top level using this I also have to control, this level let say am doing that using this, so 1,2 also have to control this level, so this is also gone, I also have to control this level let say am doing that using this is also gone, so 1, 2, 3, 4; 4 of the valves go for level control how much am left with 10 minus 4,5,6; 10 minus 6 is 4, my degree is of freedom is 4; that means, the operator as got 4 things in his hand to a just to get the kind of separation that he got all right, what are those 4 things? The reflex the amount of side draw that has been taken out to, how much reflex are you having in the side rectifier 3 and how much team you are putting in the main column 4 right, these are the 4 things that operator free towards the just to ensure that he is getting pure A, pure C, and pure B or nearly pure B right; similarly if I look at a side strip area that I should do that since I have to remove it anyway, so if I look at the side stripper column this was a side rectifier column.

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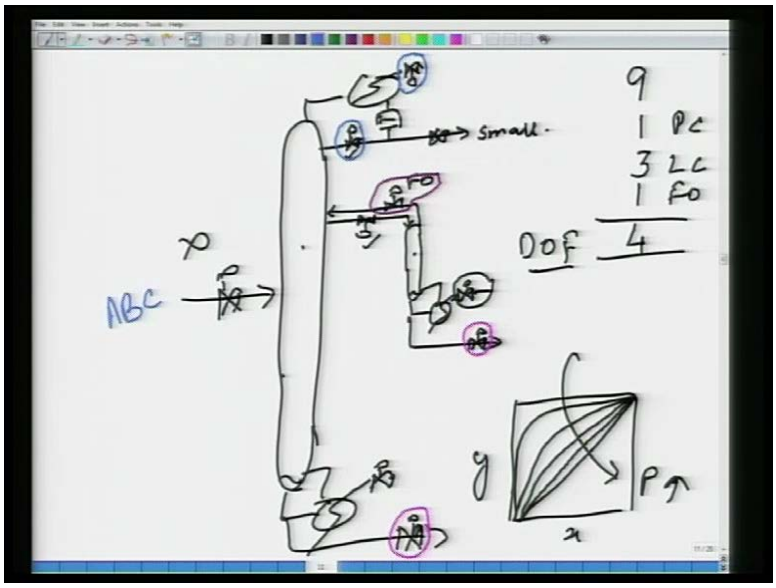

If I look at the side stripper column, what I have here in that case what I have in that case is I have got this is my main column, feed well feed is coming from upstream off course it is not in my hand, I have got main condenser was in to reflex from to reflex than I have got a side stripper, so liquid side draw which is sent to a small side stripper which is called as small reboiler, and the vapor is sent back, this is my side stripper configurations, how many independent valves that I got, now if I draw a valve on, this valve be typically fully open, because there is no point taking extra pressure in sending the vapor from here to, there vapor already has to overcome from the resistance of the trace as well as the liquid that stub on the trace will be said to side rectifier, no point starting this valve because than the vapor will take a extra pressure drop all right on that will be unnecessary.

So, if I draw this valve this will be fully open, alternatively you can think of it has, this valve is said to be maintain the pressure in the side rectifier, but the in the side stripper this is the side strippers stream in the side stripper, so if I draw this valve this is fully open or it is used for pressure control, but there is no point control in the pressure because I would like to pressure of this to be about the same as the pressure as the main column why is that? That because, if I have in this is just a very rough explanation.

If I look at the x y plot vapor liquid equilibrium, vapor y is in equilibrium with liquid of composition x, if this is the x y curve for a certain pressure as the pressure is increased, this curve will move closer and closer to the 45 degree line, so as pressure is increased; the x y

plot, the x y really plot vapor liquid equilibrium diagram moves closer and closer to the 45 degree line what; that means, is the separation becoming another more and more difficult, so at a higher pressure, the same separation is more difficult therefore, it will consume more steam, so therefore, you will like pressure of this column which is side rectifier to be as low as possible; as low as possible means that, you take as little pressure drop as you can across this side rectifier and what; that means, is if you are drawing this valve it should be fully open, so there are, so there is no pressure drop across this valve right, and what that do is make the pressure of this column in the same as you know the side, there is side rectifier in the same as the main column ok.

So, now, how many valves do I have, well I got excluding the feed 1,2,3,4,5,6,7,8,9, so total number of valves is 9; if I look at pressure controllers, there would be this pressure controller, there is one pressure controller, there is 1 valve goes for pressure controller; if I look at levels, well I have got 1, 2 and 3, 3 levels to control, so if I look at levels, so let us say am controlling that top level using this valve, this valve goes for level control of reflex drum, this valve goes let us say for level control of the side rectifier bottom some this valve let us say goes for level control of the bottoms in the of the sump in the main column.

So, I take out 3 valves for level control, I also have the specification that this valve is fully open right, so what I say is well, one of the valves is fully open, so what us does that leave me with that leaves me with 9 minus 3, 4, 5; degrees of freedom is again 4. So, what are 4 valves that the operator can adjust to get the kind of separation that is desired, if you can adjust the reflux that is the way it has been shown, you can adjust the reflux side draw floor, it you can adjust the steam in the side stripper and you can also adjust the steam to the main column all right, that just by the way I explain it like this, but you will note that this configuration make sense, where this stream is the small stream, because this stream is a small stream; probably you will have level control this way and not that way, because the amount of a that is coming in the feed is small right, but the point is in this columns side rectifier and side stripper column that degrees of freedom is 4; that means, the operator can adjust 4 things to get the kind of separation that you want well.

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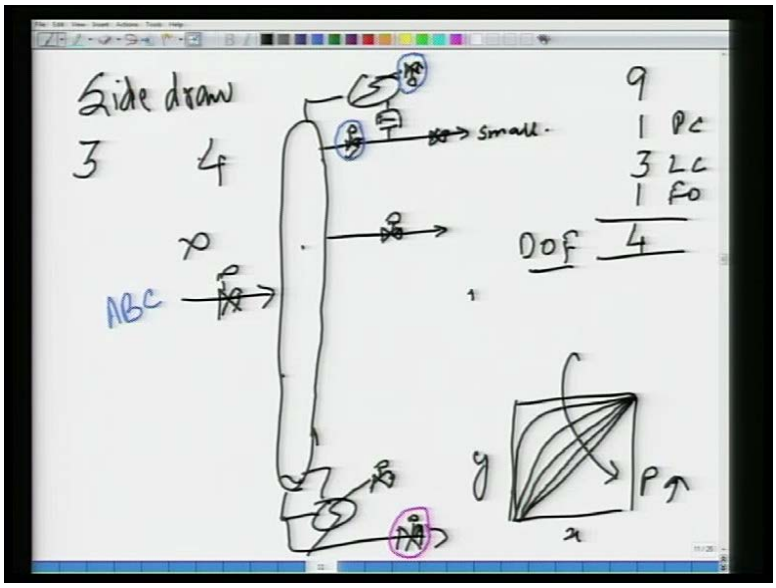

If I do not have the side rectifier, if I do not have the side stripper than what is the degrees of the freedom well you got the control one pressure, you got the control two levels right, so degrees of freedom whatever it become it becomes actually 3, so for a side draw column whether you are taking a liquid side draw of the rectifying section or the vapor side draw of the stripping section, degrees of freedom is 3 for a side rectifier or a side stripper degrees of freedom is 4 that is additional degree of freedom comes from that fact, it can adjust the reflex or reboil in the side rectifier or side stripper all right, so what will talk about control structures for these columns and that probably is best done using the presentation that will do all right.

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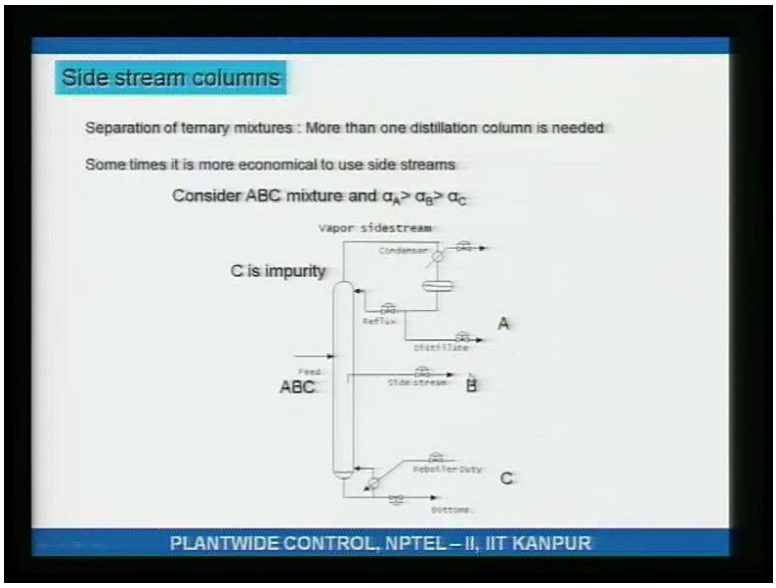

So, now we are going to look at how do we control, straight stream column, straight draw column like I explained previously, in the separation of ternary mixture, if you want all three pure components more than one distillation column is needed, you will need at least two distillation column, sometimes it is more economical to use side streams and I also explained the context in which it is more economical to you side streams, now if you consider another A B mixture, let us say you got a small amount of A, well than you take a liquid side draw that was also explained, alternatively if you consider again another A B C mixture, where C is the impurity than you get a vapor side stream from the stripping section this was also explained all right.

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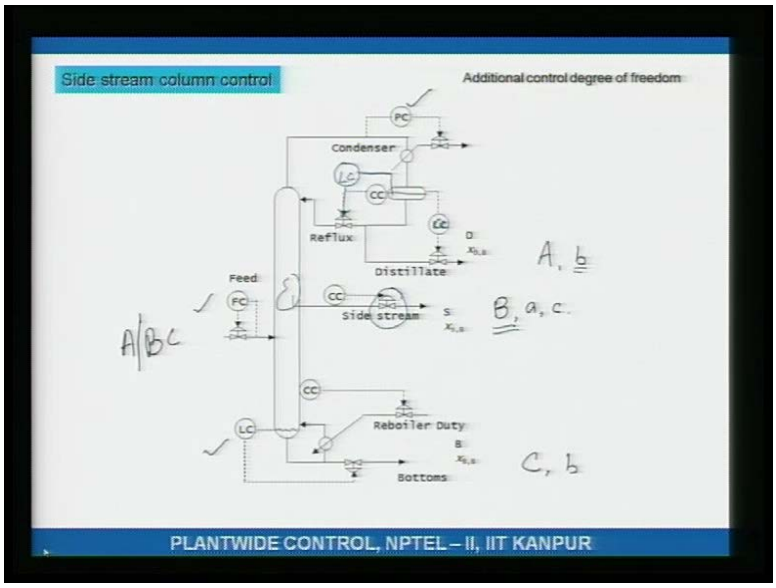

Now, we get to controlling these things, well series under flow control am scare, the top condenser duty is to maintain the column pressure that is clear, the bottom sub level is maintained by adjusting the bottom stream flooring that is also clear, the principle impurity in the distillate which is actually nearly pure a is small B well, B is the principles impurity in the distillate, the principles impurity in the bottom stream is again what is again B, this bottom stream will be mostly C with a little bit of B, the side stream gone to be mostly B, where a little bit of a and may be some C also so.

So, what we do here is, I think this since we have state previously that am doing you know, A is in small amount components fluorite of A in the feed is small B C is B C are large, so therefore, this fluorite will be small, since the distillate fluorite is small, it would it does not make sense to control the level this way what do you should what should probably done is control the level using reflux, because reflux is the larger stream all right, and then you control the composition this way, so how much reboiler duty, how much stream you are putting well if the amount impurity which is B in the bottom stream is increasing, you increase the rebolier duty, was that would do is the B that is falling down or wont fall down, if the amount of impurity that is component B in distillate is increasing, what you would do is reduce the distillate, what that would do is that would cause the reflux to go up and what that what that in turn to do is the fluorite of distillate will go down and therefore, since the reflux is since the reflux is gone up; what that will do is? It will prevent the B going up to the top right, if the composition of B the purity of B in the side draw is

increasing than what you do is you increase the side stream fluorite; that means, the B is accumulating somewhere here if the B is accumulating somewhere here each composition will go up, each composition is going up to take out more side draw, so I hope this is clear, note that there is this additional control degree of freedom how much side draw, you are drawing out, by the way a similar control scheme also be there, if this was a vapor side stream right very, similar control scheme will work here also.

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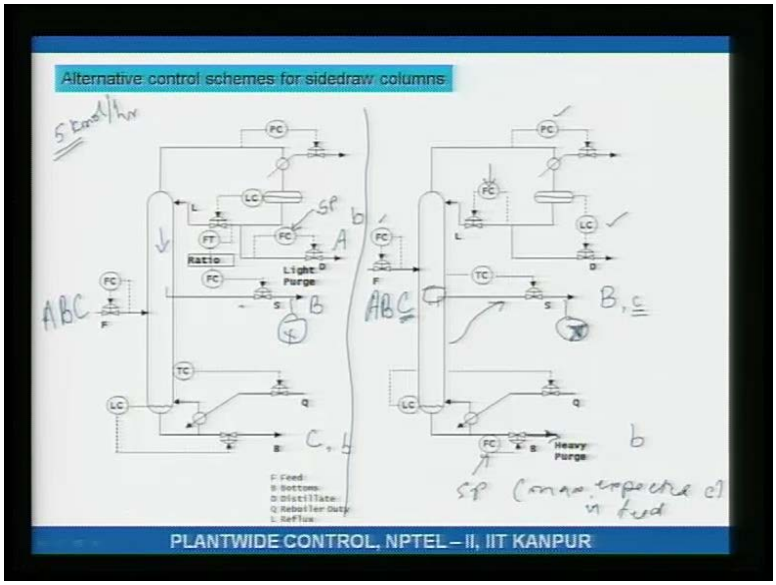

Here are alternative simpler, simpler schemes and I say they are simpler because well will explain this, so I got a lot of small amount of A, I got lot of B C coming in the feed all right, I would like to take out most of the A at the top C down the bottoms and mostly B down on the side in the side stream, now since A is in a small amount what I do is, I flow control the distillate stream when am control flow and I said this set point to be whatever is the largest expected component flow rate of A, so let us the largest expected component flow rate of A is 5 kilo moles per hour on, usually what I what I get is you know maximum amount of component a that you are expecting in a field, let us say 5 kilo moles per hour, so the set point will be set it 5 kilo moles per hour, now even if the amount of a that is coming in the field less than 5, let us say 3, 4 kilo moles per hour and I have said this at 5, the amount of loss of B, here is still very small at 1 kilo moles per hour 1 or 2 kilo moles per hour all right, then the level control is this way, now if this level is increasing, what it is mean, is the level in the reflux drum is increasing what does it mean is the it means am sending too much B to the top which is y the level is increasing, because the a flow rate

cannot go beyond the 5 kilo moles per hour is still the level is increasing that is B is sent to the top.

So, what do I do, I open the reflux valve and since this reflux is gone ultimately and appear, I also open the side draw valve, I hope that make sense, I am forcing the a or the distillate flow rate to be constant, if the level is increasing, all of the material will be sent back to the action of the level controller back in to the column, this material which is sent back in to the column has to be taken out some place, what does accumulation of the level in the reflux drum or increase in the level of reflux drum mean; it means that essentially B is being sent to the top. So, therefore, what I do is because the reflux is increasing; that means, more B needs to be taken out, so what do I do if the reflux increases by 10 percent, I increase by side draw by 10 percent, so essentially I keep the side draw in ratio with the reflux, of course than I have a temperature controller they act as just the steam, and what that temperature controller is doing is, preventing the B from the liquing out the bottom.

So, if the temperature is increasing or is the temperature is decreasing; that means, too much of light B is going down, increase the steam, so that the B does not drop out column, now what is that this is the elegance team in the sense that you do not have any composition controllers, you only have one temperature controller that is you know standard flow control, level control, temperature control, pressure control, etc. It is a very simple scheme.

Split side most of the time you are losing some amount of B with the A, if the component a flow rate goes beyond 5 for whatever reason, this control structure is bound to fail because this set have to set, you have to essentially increased this set point, so what another operator would do is? You know you find that you know this too much A is coming out here, because I am not taking out the A here, so that a is essentially going back down here and its coming down in the side stream. So, if you are doing some amount of A, if you are doing a composition analysis on the side stream, you find the too much A is coming out, so what the operator would do than is essentially increased flow set point of A that would allow the A to get removed from the top of the column.

Here is the other scheme and what we are doing here is, here you have a vapor side draw and you use the vapor side draw when the amount of C in the A B C mixture very small, so C essentially, so the feed stream is essentially A B with the little bit of C, so that little bit

of C is being removed down the bottoms since you are removing the little bit of C down the bottoms, and you do not expect that C flow rate to go beyond the certain maximum, what I do is? I hold this bottoms act that maximum flow rate, since this maximum flow rate is itself very small, even if the amount of C that is coming in the feed is less than that maximum, the amount of that the loss of, but you read B the loss of B down the bottoms would not be very large, because the flow rate of this stream itself very small compare to the feed distillate and the side draw.

So, therefore, I just flow control this and this set point and this set point will be max expected, what max expected C in feed, now the level in the bottoms is to be controlled you cannot control it, if the bottoms of level is controlled using the stream and that make sense, because this you know that bottom stream is very small in terms of flow rate, you can the control the level using the bottoms right, of course feed is under flow control, the rest is self explanative pressure is controlled using condenser duty at standard, distillate level is controlled using distillatory that is also standard, and you hold the reflux constant, of course is the temperature is increasing, a tray temperature is controlled using the side draw, if this temperature is increasing what does it mean, these essentially B with A little bit of C, so if the temperature is increasing, I think what it means is, amount of C that is the impurity is actually increasing.

So, if the temperature C is increasing too much C is accumulating, what would you do? You would increase this side draw, would you decrease this side draw, would you decrease this side draw, so that the C goes down I am just thinking out lot, here is the temperature is decreasing; that means, the amount of C is actually going down, so B composition is going up; that means, B is accumulating here; that means, to take out more of the side draw right, that what it would means I think that is the way you need to work.

So, again this control structure is very simple in the sense that uses only flow controllers, level controllers, pressure controllers, and temperature controller. It avoids the use of composition control, of course you are losing some amount of B here, because you are holding the fluorite of B constant, now if in the feed stream the component fluorite of B goes beyond these set point for whatever reason than what would happen is, that B would start coming out here, no C sorry; if the C component fluorite goes up than the set point, but C has no way out of the column that C is gone up to end of here, and what is the case you are taking the composition measurement here, you know you will essentially lose

temperature control, because C has no were to go and what than you will have to do is essentially increased the set point of this guide, so that this C finds its way out.

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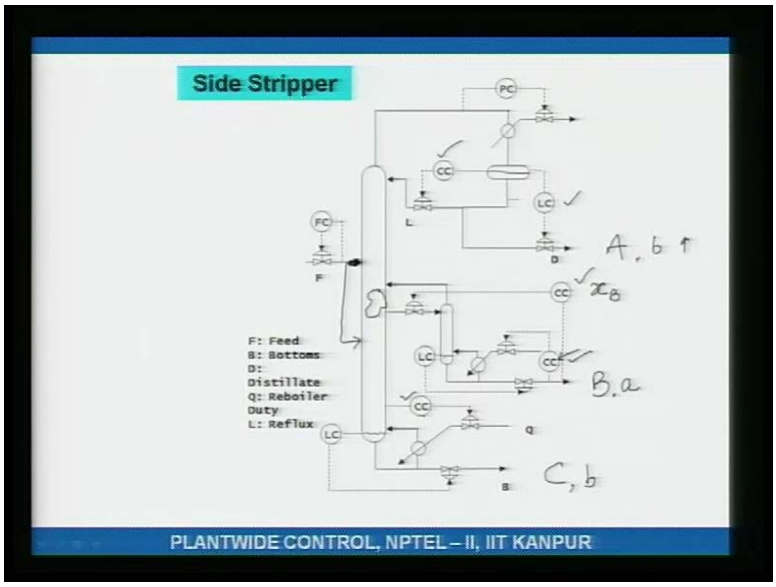

So, I hope these side draw columns are clear, now what we will do is should this feed streams actually be heavy going below this, that is the mistake where I want to point out, side stripper what will you do? Well I think it is self explanatory level control, now what will do in the side stripper if the this is pure A, this is nearly pure B, this is nearly pure C primary impurity here is small B primary impurity here is what is being sent back, sent back is primary impurity here is a primary impurity here is small B. So, if the amount of B is leaking at the top starts to increase what you need to do? You need to increase the reflux, so that is what this guide as is the composition is the impurity level of B in the distillate is going up, you increase the reflux; similarly what does this guy do is? the amount of impurity B is that leaking down the bottom goes up; that means, too much of the right stub is leaking down, leaking down, leaking down the bottoms increase the reboil, but it does not leak down that what this guide as what does this guy do? The purpose of the rectifier side rectifier is to not allow the A to leak down the bottoms of the side rectifier.

So, if the composition of A in this bottoms from the side rectifier is increasing, you need to increase the reboiler duty side rectifier reboiler duty that is what this guide as what about this guy, well if the composition of B in the side stream is increasing what; that means, is the B is accumulating towards the section of the column, I need to increase the flow rate,

so that that B which is accumulating in that section is taken out finds a way out of the column, so that is what this guide as the rest is standard pressure control using condenser duty, but bottoms level control using the bottom stream, reflux drum level control using the distillate stream and the bottom sump in the side rectifier, the level is controlled using the using the bottom stream from the side rectifier, this is again a sorry, this is side stripper I am sorry, so the bottoms in the side stripper is its level is controlled by the corresponding bottom stream and that is what this guide as, so I hope this is clear.

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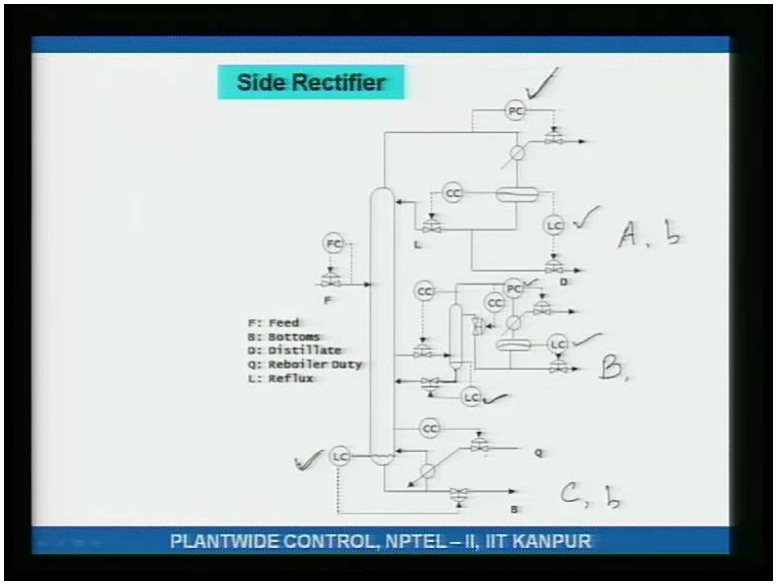

Now, side rectifier well something very similar pressure control, level control, level control, level control; I hope this is clear, so we have the pressure controller at the top, we have reflux drum level control using the distillate that is standard; the bottom sump level control using the bottom stream that is also standard, then we have level controller of the side rectifier using the bottoms from the side rectifier that is also standard; pressure control of the side rectifier using the condenser duty that is also standard; level control of the reflux drum in the side rectifier using the using the corresponding side distillate stream that is also standard; now what does this component, again the distillate is essentially pure A with a little bit of B the bottoms is pure C with a little bit of B, the side draw is essentially pure B with a little bit of what will be here with a little bit of C and that C is here, C is not taken out fine all right, so what does this composition controller do if the impurity of B in the distillate is increasing, increase the reflux. So, that the B is not taken out that is what this guide as what does this composition controller do? If the impurity B in the bottoms is

increasing; that means, the light B is actually leaking down the bottom well in that case increase the stream.

So, that the light stub does not leak out sent back, so that is what his guide as, what does this composition controller do, if the impurity C in the distillate from side rectifier is increasing, increase the reflux, you know too much C is going out to the top instead of taking and put it back in that is what you do using this guide and what about this guy? Well if the composition of B here is increasing; that means, the B is accumulating here, it has to find the way out of the column, it convert the top, it convert the on the bottoms what will you do, increase the side draw rate, so that B that was accumulated as reflected in the increased composition of B it finds the way out all right.