Aspen Plus Simulation Software - a Basic Course for Beginners

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Lecture - 02
Understanding Resources and my Exchange, Start using Aspen Plus

Welcome to the massive open online course on Aspen Plus. This is the lecture two of this lecture series. In the introductory lecture we have seen how Aspen plus software can be used for process calculation, process engineering calculations, modelling and simulation. In that lecture we had taken an example of flash vaporization in which an equimolar fluid mixture of n-pentane and n-hexane where flash vaporized in a flash tank into two phases namely vapour and liquid.

First, we had done some hand calculation through textbook approach. We have gathered the data and relevant correlations from Perry's handbook. And after that we have carried out the same calculation in Aspen plus domain and we have got comparable result. We have noticed that Aspen plus software does the job rather fast and quite easily and most importantly we did not have to write even a single code for that task.

Today we will go into the details of Aspen plus and how it is used. I would like to tell important information that Aspen plus is available only for windows operating system. Unfortunately, it is not available for Mac or for Linux or anything else. So, whoever wants to use Aspen plus they must have one windows operating system.

(Video Starts: 02:36)
So, this is a typical window desktop and here you find the Aspen plus icons. I have already loaded them in my machine. So, you can find the Aspen plus icon on the desktop. I have two versions; one is version V 8.8 and the latest version V 11. Now in this lecture I shall follow version 11 because it is latest. But whoever has 8.8 version they also will be benefited with this lecture series.

So, in order to work with Aspen plus first we have to double click on the icon. It will take some time, yes now it has opened. Here you may notice the topmost ribbon. Here you can just go one by one. The first one is what is new. So, what is new it gives the information about new features in this version of Aspen plus. For an example if you click on it, you will find what is new in Aspen plus version 11.

Now on the left side you can see what new features of Aspen plus of previous version is starting from 7.3, they are all given here. For instance, I have version 8.8 which I was using some time

back and between 8.8 and the present version that is version 11 two more versions have come out and I have never used them. But I may be interested to know what these versions have as new. So, I just click on what is new in Aspen version 9.

It says it includes new features in the following areas like engineering enhancements, physical property enhancement, workflow usability enhancements and its features. So, if you want to see what are the enhancements in physical property you can check over here? It says volume translation Peng Robinson property model is now available. Now this is a thermodynamic model, Peng Robinson model is quite known.

But volume translation Peng Robinson model may not be known to many people. Perhaps some scientist or researcher has published a journal paper on volume translation Peng Robinson method or some advanced version of it and they have added in Aspen plus data bank. Further the PURE 35 data bank has the following added compounds. For instance, sodium phenate, it was not there in earlier version.

If I open version V 8.8 in my machine, I will not get this sodium phenate over there. It has been added in version V 9. Similarly, version V 10 we have similar kind of new features in the same areas for instance physical property enhancement you just check. It has list of previously unannounced compounds added in PURE 32 or PURE 35. So, just expand you will find calcium hypochlorite, ammonium bicarbonate, dimethyl mercury, these were not there earlier, now it has been included.

Similarly, version 11 it has quite a few new features. And all of them are explained below. Now it might not be of very interesting at this moment for you, because you are a beginner. But if you practice more and be expert in the version 11 then suddenly whenever version 12 come you may be curious to know what the new features in version 12 are so, that you can use them if it is required.

Next one is examples. So, it contains the example files delivered along with Aspen plus software. So, you do not have to download from anywhere or you do not have to purchase it separately, they come along with the software. Just let us see what the things available are. So, examples with graphic user interface you have batch modeling, biofuel, bulk chemical, carbon capture, energy analysis, and fertilizers et cetera.

Now let us see what is there in carbon capture? Let us open we find many things. Among them this might be interesting Amines E-NRTLRK. Now those who are familiar with thermodynamic models you know what NRTL means it is Nonrandom Two Liquid Model and RK means Redlich K-Wong, here E means electrolyte. Let us open this basically is amine-based absorption of carbon dioxide.

You might be aware that amine-based carbon dioxide absorption is a very well-established technique for CO_2 sequestration. So, here they have given the model for amine-based CO_2 absorption where this thermodynamic model has been used but with different amines. So, you have say mono ethanol amine MEA means Mono Ethanol Amine. It is Di Ethanol Amine it is MDA; PZ means Piper Azine and so on. This is a mixture of Piper Azine and MDA.

So, let us open this particular model mono ethanol amine, just open it. Let us see what is there. So, you can see a graphic user interface opens where you will find heater, absorber, stripper, this is a heat exchanger, there is a pump there is a mixture and so on. It might be a flash. So, this is a model where the amine-based absorption of CO_2 is carried out. There is an absorption and desorption cycle that is shown over here.

There is a recycle stream along with it. Now if you want to see what are the components you will find over here? Property set component specification. So, these are the components, mono ethanol amine, water, carbon dioxide, carbon, hydrogen sulfide and so on, nitrogen, oxygen, carbon monoxide many things are there. So, these are the components. If you want to know what the reactions are happening inside you can go to the reaction side.

So, these are the reactions going on over here these are equilibrium-based reaction, kinetic reaction and these are the reaction stoichiometry. If you click on kinetic you will find the very known Arrhenius equation, E is the activation energy whose value is also given. Now these are the information given in this model now you can work with this model to learn how they have done it.

For instance, if you work for a project where carbon dioxide sequestration is the main theme then this kind of model will be of great help to you. The next one is the training actually this whole portion is of resources training resources, model resources, events, announcements. Now let us see what it is. This is called my exchange, you can view your own downloads and browsing history.

Now for that you have to register for it and you have to log in then only this can be stored in your name. Aspen plus software comes with a lot of training material, documentation, models, one of the models that I have already shown to you and other literatures and tools. For instance, it has over 30000 literatures, 6200 documentation 794 models, 135 training videos, 34 product updates and event announcement everything is there.

For instance, if you want to be curious about methanol, let us write methanol and search. Here you find 241 literatures available on methanol, 78 models that use methanol in it, 68 documentation and two training videos. Now let us see what it is? The title is how I model a

system with formaldehyde, methanol and water. All this search result they have methanol the keyword methanol in it. Now let us see what it is, and it is a freely available.

You do not have to pay anything for that. So, it is developed by organization Aspen tech. It is a free item so if you want to see the article just click on view article. So, here it will show how do, I model a system with formaldehyde, methanol and water. So, this is a problem statement, and this is a solution where they will tell you what kind of model has to be used for such modelling. It is UNIFAC liquid activity coefficient model.

And this property package is applicable for the following range of condition and they have taken it from the reference. These are the references. So, from AICHE journal, two are from AICHE journal and the third one from AICHE symposium series. So, it is not from any arbitrary source the source of their information is also reliable. Now suppose you want to check something about the carbon dioxide for CO_2 sequestration.

So, just write carbon dioxide and search. So, here you have how to fit CO_2 partial pressure, how do you model liquid CO_2 and so on. Suppose you want to see what the training video is available for CO_2, just click on it. So, one training video is available on thermodynamics university module regression of Henry's constant from vapour liquid equilibria. So, if you view this article or this is a video, I think.

So, if you click on it the video will open, there is an article associated you can see the article. But you can also view the video. So, welcome to Aspen plus V 8.6 regression of Henry’s constants from vapour liquid equilibrium data teaching module. For information on navigating the course please refer to the navigation hints located above the slide click the next button on the right-hand corner to begin.

So, not only you can watch the video but there will be verbal description of the product also. So, if you press next. Gas solubility is generally very small up to a few percent. Henry’s law is used to model vapour liquid equilibrium of non-condensable gas as supposed to Raoult’s law. Because the liquid vapour pressure of the non-condensable components required in Raoult’s law does not exist above its critical temperature.

Both carbonated drinks and diverse thickness are common examples of Henry’s law in which the solubility of a given gas in a liquid is directly proportional to the partial pressure of the gas above the liquid. So, I close this video. Now there are lots of such videos which are very helpful for a beginner as well as for an advanced user. Similarly, you have models, literature, tools and events.

So, if you click on events, you will find the upcoming events which are based on Aspen plus. For instance, it is a Korea operational excellence forum they have some I think it is a webinar, although I do not know Korean language. But it appears to be a webinar on November 19, 2020 from 9:30 to 12:00 p.m. November 12th there will be an APAC webinar on learn how Aspen HYSYS offers Refinery Streamlined Workflows to update refinery planning. Similarly, December 2 there is a webinar, December 1 there is another webinar and so on.

(Video Ends: 20:47)

So, obviously if you are watching this video lecture of November and December then these events are not of any use to you. However, these kinds of event announcements always come up along with the Aspen plus software. Because the moment you connect to the internet the Aspen plus software connects to its database in Aspen web. And from there it gathers the information to your desktop.

(Video Starts: 21:25)

And you can check the events and announcement. There are announcements also you can click on the announcement and check. It is news about product releases and patches. So, these are the announcements we have the recent announcements. And whenever there is a new announcement which you have not seen since the last time you have opened this block you will find a small red button and a number written within that red button.

Actually, it means red button means a new event or a new announcement has come up, the number inside means how many such events or how many such announcements you have not seen that it suggests you to see. So, these are the announcements like product life cycle announcement for Aspen SEM model export. The second announcement is about Aspen tech is pleased to announce that Aspen one 2004 update one is now available.

So, these kinds of announcements are also very useful for an Aspen user. So, here you have certain blogs and discussions of user forum.

(Video Ends: 22:45)

There are millions of users of this software they write blogs and they discuss about the problems they face. So, if you are facing some problem you can register in the blog and discussion you can share your problem and somebody may answer, some expert comments you can get, all sort of all sort of necessary help that you can expect from them.

(Video Starts: 23:15)

Now this ribbon actually is very helpful for beginners as well as the advanced user. Now we go back to our original starting page. So, when you open the Aspen plus software the starting page will be like this. So, you have already been updated about this ribbon now we shall talk about

using the Aspen plus for that you have to open a new file or open an existing file. Now for opening an existing file they will give you some hint of recent model.

Because you may be willing to start your work with the recent model that you were working a few minutes back or few hours back, we always try to work with some recent model first. So, these are the recent model that I had worked with in past few days. For instance, this particular model we were working with just now five minutes back we explored this model the features and all.

Now this flash you might recall in the introductory lecture we had worked with the flash vaporization and I had showed you the example and that file I have saved as flash, so flash dot the file extension. Now here you can see an interesting thing. The file that today we worked with that has an extension bkp whereas the file that I worked with to show the introductory in introductory lecture its extension is either apw or apwz.

(Video Ends: 25:48)
That means all of them are Aspen plus files, but they have different extensions. So, before going into the details let us discuss what the types of Aspen are plus files that you will come across. So, these are the file types and extensions of Aspen plus. Now let us know what are the file types that we have for that let us try to open an Aspen plus file.

(Video Starts: 26:19)
So, click open. So, it is asking for file name and Aspen plus files so you can see there are 1, 2, 3, 4, 5, 6 bkp, apw, apt, inp, apwz and apm. So, there are six types of files. Now let us see what those file types mean. So, these are the file types and extensions that we have. We have template, user model, input, backup document and compound. The first one is template file its extension is apt.

Now it is a template with preferred unit's property methods etcetera for repeated use. For instance, you are working in a team and your team is working for a particular project. So, certainly in that project you will have to operate on a particular process and that process condition will be repeatedly used by your team members everyone and every time you try to model that particular system.

Then you do have to set the units set the property methods and other environmental things. But instead, you can make a template. One template for all your team members, in that template you fix the preferred units whether you want to work with SI unit or the British unit. You can fix the property methods whether you want to use Redlich K-Wong whether it is Peng Robinson whether it is an ideal system and you fix a template file for everyone. So, all your team members will begin from that template file.

So, that the; vials should not be reinvented every time they work. The second one is user model, most of the Aspen plus unit operations that you will be using in a model they are already in the software because most of them are very standard. For instance, your reactor, distillation column, pump, flash tank, heat exchanger they are all standard unit operations. These models are standard and are available along with the Aspen plus software.

But you may have to work with certain equipment or unit operations which are not standard you might be knowing the underlying equation the mechanistic or the first principle equations that are governing the system. But Aspen plus does not possess any kind of standardized block in its menu for that. So, you have to develop some block for yourself that and you call it a customized model.
And that customized model will have all the underlying equation. You make it for yourself and your team members and whoever wants to work with that particular equipment he or she can bring it down from the menu and set it for its operation. So, that kind of set or that kind of model can be kept under this user model whose extension will be dot apm. The third type of model is input model dot inp.

Now this model is a compact summary of input specification, but no result. Now you may be willing to work with a model but you do not want to save the result you may think that why to save the result unnecessarily, whenever I want to know the result, I can rerun my software it is just a few minutes job and I can get the result. So, you want to save only the input specification of the process.

So, such kind of files can be named dot inp file. So, it contains only the input specification. The next type is backup file. So, backup file it not only contains input information, but it contains the results also. So, in input file if you run this and get the result and if you save it in dot bkp file then it is called the backup file. Now all these files that I have talked about just now they are ASCII coded.

The next file that I am talking about is document file, its extension is apw it is a binary coded file. Now I will tell you the difference between them. But this binary coded apw document file it contains input information, results as well as the convergence information. That means not only the final result but what are the intermediate convergence that you had achieved while attaining that result each and every convergence information is also available in that file.

Now mostly you would be willing to send or share this apw file with your colleagues or your team members. Now the question is what the difference between apw file is and apwz file. This apwz file the z stands for zip it is a zipped version, it is a compound file which is also binary, it is

a compressed file of bkp, apw along with all its ancillary external files. Now in recent versions of Aspen plus by default they are saving the file at apwz in the form of compound type.

Earlier this compound file was not existing you had the choice of only bkp and apw files, this file options. Now it is always better to save as backup file. Now the question is which type of file should be saved? Now for that we need to go deeper into these two types of files. For that let us go to the location where I had saved my files. Now this is the location where I have saved my files.

You can see the folder flash you will find two types of files. The first one is apw the second one is bkp. So, I have saved them in two versions. Now let us explore further here you type flash dot apw, it is a binary coded file. But if you type bkp it is ASCII coded. That means you can take a printout of this file and keep it somewhere as a printed document. So, that in future if your storage gets corrupted then you can recover your work although it will be a tedious job, but you will not lose anything.

So, it is always better to save it in bkp version rather than apw version. Aspen plus by default it saves in apwz file from there you can extract bkp or apw later whenever you want. But you also have the option to save in these versions the way I have saved the flash bkp and flash apw files. Now there are various types of runs that can be conducted in Aspen plus domain. These are the types of runs that you can do.

The first one is Property estimation, the second one is Assay data analysis then Property analysis, Data regression and the fifth one is flowsheet. Now this flowsheet environment we have already seen when we worked on the flash vaporization problem. So, it is used for standard process simulation including sensitivity studies and optimization. Although the sensitivity studies and optimization we have not done in that exercise, but it can also be done.

But this flow sheets run it is dependent on other things other type of runs. Whereas these four types of runs are all standalone, they are independent runs. Let us discuss one by one. The first one is property estimation that is to estimate the property parameters. For instance, in the flash vaporization model we worked with n-pentane and n-hexane. If we recall we had the inlet fluid although equimolar, but they were having the temperature 140-degree Fahrenheit at 75 psi pressure and inside the flash tank the temperature was 130 degree Fahrenheit.

And the pressure was 15 psi. Now obviously the physical property or thermodynamic property of a component likes n-pentane and n-hexane they depend upon the temperature. We all know Antoine's equation it is for vapour pressure measurement. So, we have measured vapour pressure we have measured the specific heat we have measured the enthalpy of vaporization in that flash vaporization exercise.

So, all of them were temperature dependent. So, we had to measure this property is at 140-degree Fahrenheit as well as at 130-degree Fahrenheit. So, how will we do it through property estimation? So, not only that you may have to work with density, thermal conductivity of the fluid and many other things, many other physical properties so, unless you estimate those properties you cannot go forward.

So, property estimation is a very important thing. The second is assay data analysis, it is also standalone. It is to analyze petroleum assays and blends and generate pseudo components. Now in oil refineries we work with crude oil, now each crude oil type has its unique molecular and chemical characteristics. No two crude oil types are identical and there are crucial differences in those crude oil qualities.

Now, extensive hydrocarbon analysis has to be done before sending the crude oil for further treatment in the refinery. So, we can do the analysis using Aspen plus and that is called the assay data analysis. So, the next one is property analysis this is also standalone run. It is used to generate property tables. I mean it is somewhat similar to property estimation but in property estimation we estimate only the data and we end over there.

But in property analysis is one step further to it. So, it generates the property tables the pt envelope residue curve maps and other property reports. So, it just analyzes, and it can give you a comprehensive report on the property data of those components. The fourth one is data regression; this is also standalone. For an example if you have a pure component which has not been there in the database of Aspen plus, it is a new kind of component then you can do the you can take the experimental results.

You can have the density versus temperature or vapour pressure versus temperature data and you can do the regression to find out the model parameters and you can set it. So, that kind of regression also can be done through Aspen plus. So, it is to fit the physical property model parameters to measure pure component this VLE, LLE and other mixture data. And certainly, it can contain the property estimation and property analysis calculation.

So, the kind of calculation that they do they use property estimation and property analysis as well and finally, flow sheet that I have already discussed. Now overall the Aspen plus modeling and simulation procedure it can be divided into these following steps, setup, units, components, properties, blocks, stream and run. So, these are the stepwise procedure for Aspen plus simulation.

The first two things are not mandatory, but they are advised and the last five are mandatory for a successful operation. Setup defines the title, description and purpose of the job. For instance, if

we go back to our flash model, so this is flash dot apw that we have developed in the introductory lecture. Here I did not give any title but still it worked. But I should have given a title. Let us give a title you can write it as a flash vaporization example.

The next one is description. Description you can again write this example model was created for demonstration purpose of flash vaporization operation. The next one is accounting. Again, your company may give a username to you for all your work you can write that username or account number. The project that you are working with that project id also can be written over here and the project name in which this software is used that project name also you can write.

Now the next one is units. That is unit of measurement SI or English for input and output data. Here also in the introductory lecture the flash vaporization example we worked with English unit. So, here English unit was given but you can change the unit over here. Instead of English unit you can write metric or metric with C bar temperature is in centigrade pressure is in bar or purely SI unit.

So, everything will be in kg, kilo mole, kelvin etcetera or else if you are not happy with these units you can create your own unit. Here if you click you will get this you can say new and you can write it as my unit set. There is a character limit you cannot use more than 8 characters. So, my units that is all. So, here it is asking for defining your unit. So, use copy from SI unit and then change as per your requirement.

For an example you may say that I will put the mass flow rate in not in kg per second, but I will give it in pounds per hour whereas moles I want to keep it in it is kilo mole per day or per week although it is worth but you can change your units accordingly. Temperature you may say that I want to give it in ranking. Similarly heat you may say that I want it into a mega joule whereas heat flux I want to give it in giga calories per hour m.

Now you can mix and match depending upon your wish you can mix and match and create your own unit set. And once you set it then you can choose my units rather than your SI unit. So, accordingly you will get all your results. So, these are all globally set units. That does not mean that while working with the problem you do not have the opportunity to change the unit. You do have the opportunity to change the unit.

But if you change it globally once for all then you will have less requirement to change the unit inside the simulation. But they are not very much required. So, these two things you can always skip, you can use the default one whatever it is there. But these are very important. First is the component and properties the next one is blocks and streams, the third one is run that is the run that you want to do.

Now obviously if you want to do property estimation then you do not need this block and streams, they will come only for flow sheet run. Now the components are chemical components to work with. For instance, we worked with n pentane and n hexane for our flash vaporization operation and then the properties physical and thermodynamic property methods and model. In our flash vaporization exercise, we have done we have taken an ideal system.

But in reality, some kind of non-ideality will always come. So, based on the components and the system you will have to choose your physical and thermodynamic property methods and models. So, you have to know what kind of models that you will use. So, there are help files for property methods that I will explain later. And finally, the blocks and streams you have already seen a small glimpse of how the models and streams were set in the flash vaporization model.

There were a model library at the bottom and we had to choose the flash tank and we connected the streams in this fashion, this stream we named as feed, this feed we named as vapour and this feed we named as liquid. So, choosing unit operations blocks for the simulation environment and connecting the feed and energy streams to the block. Now on that day we only showed the feed stream we have not shown the energy stream.

But I will definitely show you an energy stream how it is added for a particular example at certain time in future. And finally run the simulation and analysis of result. So, this is the complete modelling and simulation procedure. Now to summarize, we have two important environments that we have to set, one is component environment, the properties environment and the second one is simulation environment.

These are the two items that we have to take care, properties environment and simulation environment. Next one is setting the environment. What are the items that we have to set in properties environment? We have to set components, physical property, thermodynamic property, equilibrium model and gas model. Whereas in simulation environment we have to add flow sheet which contains the blocks and streams, streams will have both mass and energy.

Now let us get introduced to various features that are available on the aspen plus simulation window. At the top you have menu bar, file, home, economics, batch dynamics, plan data et cetera we will learn one by one later. But these are the menu bar where you will get various features of aspen plus. Then at the corner you may find one question mark sign, this is help button.

So, if you click here, you will get help ready help. For instance, if you want to know about some thermodynamic model Peng Robinson. So, you write Peng Robinson then it will search and there are 59 results Aspen plus has various documents where Peng Robinson has been mentioned. This is the original Pang Robinson equation of state this is volume translated Peng Robinson method

that we just talked about half an hour back and various other variation of Peng Robinson equation.

So, you can get lot of information over here. So, this is the equation for Peng Robinson model. This obviously the main flow sheet where you can build your model you can get models from the model pellet. This is model pellet here you have mixers and splitters, separators, exchanger column, reactor, research changes et cetera. So, you can just bring in the model that you want in your system and this is the material stream and you also have heat and work stream, heat means energy stream.

So, it will not carry any material, it will carry energy. Then obviously this is the scroll bar these two are scroll bars and this is the select mode. If you select like this then the whole part is selected, or you can select only this much then only the block is selected. And then you can copy you can cut you can paste elsewhere, and this is the prompt area, prompt area means here everything that happens over here will be prompted.

For instance, suppose you go to the stream, so this is the stream it is feed stream you change the input of the stream. So, instead of 140 you say 150, the moment you change it will be prompted input changed. Now when you run this is the run button so when you run it will show results available. Now it did it too fast, but between input changed and results available there was a very short period of time you might have seen processing.

So, they are processing the calculation. So, that message also appeared but for a very brief period of time. So, ultimately the results available right now. And the last one is the next button. If you press next, then the Aspen plus will take you to the point where the next input is required. It will go in series until unless all the inputs are given and the model is ready for further simulation. So, it is always better to press next whenever you are building a new model in Aspen plus.

Now we will learn about various symbols which are used as stator indicator for Aspen plus simulation. For example, suppose in input you will find that this there is a small blue circle within which there is a white tick, this always means that the input is complete or if it is there in results then results are available either it means results are available or it means the inputs are complete.

For instance, suppose these are the minimum input information those are required for the simulation to go forward. Now if I delete this information then it will show a circle with half red and half white. This particular symbol indicates that the input is incomplete we just over around it. It will show required input incomplete that means the simulation cannot go forward with this. So, if you do not want to give pressure you can give vapour fraction.

So, you can say vapour fraction anything between 0 to 1 but information has to be given. So, if you give vapour fraction say if you say our input contains 50% vapour and 50% liquid then vapour fraction if you give 0.5 again you will find blue tick, I mean white peak within blue circle that means input is complete. Now you might see that you have got a new type of symbols that have appeared over here.

This symbol will occur if the input has changed. So, here the result summary exists but input has changed. So, the results that you will get over here that are not reflecting the result of the simulation for this set of input because the input has changed. So, when you run it if you run this is the run the simulation button. So, if you run again, you will find all of them with white tick within blue circle.

So, that input change option has vanished. Again, if you change it to say 140 to 150, this symbol arrives again and there is another type of symbol which is red colored cross mark. And that means the results are available, but there is a calculation error in it. I will change the simulation a bit for instance let us change the simulation condition a bit. Let us say our pressure is 1 atmosphere 1.1 atmosphere and our flow rate are 1 kilo mole per hour and then we want actually this particular vapour too.
Let us change the name so that we can understand it better. Let us go to the flow main flow sheet we rename it as feed this we rename it as vapour and finally this we rename it as liquid then we will learn it better. Now feed we have reformatted, now we have changed the feed condition, now vapour condition we may not give. Because vapour condition is not required, it will calculate of its own.

But let us demand the Aspen plus to calculate a condition through which we will obtain the vapor at 150-degree Fahrenheit with pressure one atmosphere. And we want the entire vapour, entire content of the feed to go to vapor and let us add another component, water in it. So, for that we need to go to properties here let us add water and then let us run the property estimate, go back to simulation.

Here in feed let us change it to 0.4, 0.4 and give 0.2 to water and we want the vapour to have the same composition. So, let us go to block and we will say that block temperature should be 200 Fahrenheit and there is no heat duty, zero heat duty. Now let us see what happens? We have so let us understand, what are the changes that we have made? First, we have added new component water and then we are saying that my feed contains 40% pentane, 40% hexane and 20% water.

The total mole flow rate is one kilo mole per hour, the temperature 140-degree Fahrenheit and pressure is higher than atmospheric pressure, so it is one atmosphere. So, that enters in the block flash where the temperature is higher it is 200 Fahrenheit and we are not giving any heat duty the

heat duty is zero. And then we are going to vapour phase we are expecting the entire fluid content will come out as vapour at the same mole fraction.

Obviously if everything comes here then mole fraction will be identical. But we want the temperature to go up as well as the pressure should go should be reduced. So, think of the condition my feed is at lower temperature, higher pressure, vapour is at higher temperature lower pressure in between it goes through a block flash where the block is maintained at 200-degree Fahrenheit with zero heat duty.

Now this kind of situation is practically impossible. So, now if we say next then it will say the required input is complete run the simulation now, we will say yes you run the simulation. Immediately it will give some error message. So, what it will say it says results available but with error. So, this is the red cross mark I mean red button with a white cross inside this means results available but with error.

So, it is severe error actually, so these are the problems that have been stated over here. Simulation, calculations completed but with severe error. So, these are the various status indicators and they are symbols.

(Video Ends: 1:09:43)

So, we end our lecture at this point we will continue in the next lecture. Thank you.