Lecture – 28
Design, Rating and Simulation of Heat Exchanger

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In today's lecture, we shall perform a case study on design, rating and simulation of heat exchanger. Already we have discussed about heat exchanger few lectures back. Today we will do it relatively in a more comprehensive way. The problem statement is something like this. The benzene at 80,000 lb/hr and 70 ^{0}F and 45 psi pressure had to be heated by o-toluidine which is at 230 ^{0}F and 40 psi using a shell and tube heat exchanger.

The outlet of the flow rate of benzene and toluene should be 140 ^{0}F and 150 ^{0}F respectively. There will be a pressure drop of 5 psi at both the sides of the flow. Note that the outlet flow rate of o-toluidine has not been given. We have to estimate that. Now, it is very easy to estimate when you want to do in pen and paper mode.

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$$Q = \left(m\right) C_{p_1} \delta T_1 = \left(m\right) \frac{C_{p_2} \delta T_2}{} \quad \text{(DS)}$$

For that what you need to do is your simple heat duty is mCpdelT which is true for both the ends.

$$Q = mCp\Delta T$$

So, if this is for benzene then m CP1 delT1 is equal to for o-toluidine, this is also m 2 C P2 del T2. Now, we know that benzene flow rate is given which is 80,000 lb/hr. C P1 and CP2 for benzene and toluene will be available from Aspen database. Delta T1 we know that the benzene is available at 70 ^{0}F and it should come out at 140 ^{0}F.

So, we know the difference between 70 and 140. So, deltaT1 for benzene it will be 70. And we want to achieve 150 ^{0}F at the outlet of o-toluidine flow whose inlet is that 230 ^{0}F temperature. So, obviously it should be 235 – 150. So, this will be delta T2 for o-toluidine. So, we know one side it is 70 another side it is 235 – 150 so, it will be 85 ^{0}F. So, it is very easy for us to calculate m 2.

So that is on pen and paper but unfortunately it is not a one step job in Aspen because in Aspen one needs to give this information m 2. You cannot give a outlet information and find out the m2 in a straightforward manner. For that you know we have to use design spec. So that is the job that we need to do for estimating the flow rate of o-toluidine. And that we have to do using a simple heater block, not using a shell and tube heat exchanger and we have to estimate the heat duty.

Obviously, we can estimate the heat duty without even using any of them. Just on pen and paper we can use provided we know the specific heat of benzene. Anyway, once we know the

heat duty then we have to design a shell and tube heat exchanger on the basis of that estimated heat duty. And these 3 things we have to note while designing it, the hot fluid flows through the tube side and the exchanger should be multi pass.

So, there will not be a single tube pass, the tube may be of this nature or it should be this nature or they should be more than that. So, it will be multi pass exchanger and the fouling factors at both the ends have been given. Now, after designing the shell and tube exchanger we have to save that information in an EDR file. EDR file is a file that contains all the heat exchanger design and rating information.

And then we have to perform the rating and simulation of the designed exchanger. Probably you know what is the difference between rating and simulation? Simulation means you have the heat exchanger; you have the input. So, what will be the output? So that is plain and simple simulation. And rating means you have the input you, want to get this output. What should be the ideal heat exchanger? I mean if you have this its exchanger, whether that particular heat exchanger is over designed or it is under designed.

So, the rating calculation will give you this particular information. So, we will do this rating and simulation with the designed exchanger. And now, we have a situation, methanol at this temperature, pressure and flow rate has to be heated by water flow whose temperature, pressure and flow rate have been given. The heat duty remains Q, whatever we have calculated and we have to use the above designed shell and tube exchanger for rating and retuning calculations.

That means we have this particular set of process fluids and we have this exchanger which we have just now designed and we have to check whether for the new set of process fluids, our exchanger is fit or not. In other words, whether our exchanger is over designed or under designed that we have to find out. And finally, we have to design a plate type exchanger with the above data.

Now, this is the complete problem which we need to solve over here. So, for that let us go to the Aspen Plus Simulation Window.

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We have 2 process fluid benzene and o-toluidine. So, press benzene and then o-toluidine. So, you write o-toluidine. This is the component that we are looking for. So, just right toluidine. Now, press next. Now, it is asking for the property method.

Now, you can use any property method. In fact, you can use ideal property method only because the process fluids are not mixing that there is no mixing between benzene and toluidine. In heat exchanger, there is only transfer of heat; there is no mixing between the process fluids. So, benzene will remain benzene, toluidine will remain toluidine. There will be no mixing. So, we can safely use ideal property method and run.

So, property analysis is complete, we can go to the simulation. And first let us use the blocks. So, first we take a heater blocks and this is benzene stream. So, let us write benzene-in and benzene-out. So, press next. So, benzene-in we have 80,000 lb/hr of benzene 70 ^{0}F and 45 psi. So, we have it is a mass flow rate. So, and we will take English unit because all the units are English over here.

So, it is 80,000 lb/hr 70 ^{0}F and 45 psi. Press next. It will ask for the inputs of heater. So, heater temperature as we understand that the outlet flow rate of benzene has to be 140 ^{0}F and there will be a pressure drop of 5 psi at both the sides of the flow. So, there will be a 5-psi pressure drop in the heater. So, we right over here 140 ^{0}F and pressure drop means –5 is the pressure drop

It is ready to run. So, run the system and you will get the stream results. Yes. So, stream results are available now, we can directly go to the main flow sheet and tick temperature, pressure and mass flow rate you will get the information on the screen itself and if you press heat duty this information will be available that is 2452197. Now, the same amount of heat duty will be required by the other flow. That is for o-toluidine.

So, let us take another heater and this is the toluidine-in this is toluidine-out. We rename them as tol-in, tol-out and in this case again we do not know exactly what will be the flow rate of toluidine. But as Aspen once a data, so, we have to give, we have the information that inlet

temperature and pressure of toluidine is 235 ^{0}F and 40 psi pressure. So, we have 235 and 40 psi, we do not know the flow rate of toluidine and let us say it is 60,000 lb/hr.

So, it is defined and the heater we will use the same amount of heat duty. And what is the heat duty? Heat duty is 2452197. So, we give the heat duty of 2452197 and there will be a pressure drop of –5 psi because –5 psi will be at both the sides. So, –5, it is –5 psi, it is ready to run. So, run the process, it is done. So, let us take the value well, it is going up to 310 ^{0}C. Now, here we have done a mistake.

We have to take out this heat from here because this is heating but this should be cooled and we have to reach 150 ^{0}F. So, it should be less than 235. So, we should not do this mistake. We have to give –2452197. So, –2452197 and run the simulation once again. The temperature is 155 now. Obviously, it will be slightly less than 60,000. We do not know what should be the value.

But obviously, it should be between 50,000 to 60,000. We will reach 150 ^{0}F. So, we will use a design spec. It is available over here. So, take this design spec and this design spec will ask to define the temperature. So, let us write T 8 temperature, just a name, there is no significance of 8. It just came into my mind and I have given the name T 8 which is a stream variable.

So, stream variable and the stream are tol-out and the variable is temp and we have to give the spec T 8 150 with a tolerance of 0.0001. And we have to vary the toluidine flow rate in. So that is also a stream variable and the stream is tol-in and the variable name is mass-flow. The lower limit, let us give 50,000 and upper limit let us give 60,000 which is the current value of the flow rate and we expect that the exact value will come within these limits.

So, press run. So, it has converged and let us see. It has come to 150. And the flow rate is 56883. So, it is 56883.2. Now, let us go to the stream input and write 56883.2 and then we do not have any need of this B 3. So, we can just simply, we delete this B 3. Now, we have arrived at the answer to the first question. Estimate the flow rate of o-toluidine using simple heater block and estimate the heat duty.

So, we know that the flow rate of o-toluidine, it is 56883.2 lb/hr. And the heat duty Q, it is 2452197 BTU/hr. So, this 2 information will be needed for our subsequent calculations. Now,

the next thing designs a shell and tube exchanger on the basis of estimated Q that is 2452197 with this estimated Q. The last digit over here is 2196 and 97 for a 7-digit number this kind of differences are very common.

So, do not worry about it, you can use either 2196 or 2197 whatever you may like. At this moment, let us delete these blocks because its purpose is over. Instead, we have to insert a heat exchanger block. So, this is our heat exchanger block and this is our cold stream because it is coming in at 70 ^{0}F. Benzene is the cold stream and toluidine is the hot stream because it is entering at 235 ^{0}F.

So, this we have to attach with the cold, this we attach with the cold, this we attach with the hot and this we attach with the hot. And we do certain cosmetic changes so that it looks better. So, it is done. Now, we have to design the heat exchanger. So, open this and for designing always you have to do the shortcut designing first. For any kind of designing, you have to start with shortcut design.

Now, you may remember that there are 2 or 3 information that are very important over here. One is, hot fluid flows through that tube side, exchanger should be multi pass and there will be a fouling factor. So, first let us use the first 2 information. So, hot fluid passing through tube side and is a multi pass heat exchanger. There are various calculation modes, design rating, simulation and maximum fouling.

First, we have to start with design calculation mode. So, exchanger specification you can give so many information. You have to enter either of them. Now, let us use the heat exchanger duty because we very well know this figure. And what is that figure? It is 2452197. So, we write 2452197. Now, it is said just run. Run is complete. Now, here you can see that you have arrived at 150 ^{0}F which is expected anyway.

Now, we have to design the heat exchanger in a more rigorous way. For that you might remember the last time we design a heat exchanger interactively in this fashion. So, we can convert. The moment we type this convert, this will open and we will get to know all this geometry. So, this is the EPR sizing console that means exchanger designing and rating console. And you know how it worked. But today we shall not use this one.

We say cancel, rather we shall use this one. This is Aspen exchanger, design and rating program. If you click it, a new dedicated heat exchanger designing console will be opened. And here it will ask you to size the exchanger and you have to just press size exchanger. Then the options will be open for you. Now, this one we may learn 1 by 1. First of all, at the right-hand side, you may find these options.

So, not only shell and tube exchanger, you can coil would, plate and fin, fired heater, air cooled and plate type exchanger. And in addition to process design, you can do the mechanical design as well. So, all those informations are over there. And here you will find the place where you can give input and you can get the result, all in the same window. So, just click, you will get all the results.

Now, let us learn them 1 by 1. This may be very familiar to you. We have got the configuration TEMA type. What is TEMA? The full form of TEMA is tubular exchanger manufacturer association. This is TEMA. Now, whenever you give the order for manufacturing, you have to follow certain rules which has been accepted all over the world among the manufacturers.

So, you cannot give any information as of it. You have to write it in a proper manner following certain protocols and this TEMA protocol is accepted everywhere. And Aspen Plus writes the information as per the TEMA protocol. Now, for that let us see 1 by 1. This TEMA types, it is bonnet, bolted or integrated. So, these are the types of bonds that you get. This is the end.

So, it may be A type, B type, C type, N type, for high pressure enclosure, it is D type. This is the middle one. It may be 1 pass shell, 2 pass shell with long baffle that is F type, this is split flow, G type and so on. And then M, M is the other end of the heat exchanger that is another bonnet. It may be M type, N type, P type. So, you can choose between them as per your requirement.

Then the location of the hot fluid you know, it should be in the tube side. And then tube OD and pitch has been given. Now, in Aspen Plus you have an advantage that some of the common parameters are given by default and they will remain as default value until and unless you change them. In this case the tube OD has been given and it is pitch. So, if you want, you can change or you can leave it as it is.

Here you have got a tube OD of 0.75 inch. Let us accept or let us keep it in that fashion. Similarly, tube pattern, whether, it is a triangular or these rotated or it is 90 ^{0}square or 45 ^{0} square rotated squares. So, this tube pattern also you can choose. Similarly, tubes are in baffle window, baffle type, whether baffles are single segmental, baffle cut orientation is horizontal or vertical. This is a word for baffle.

And the default exchanger material whether, it is carbon steel or stainless steel, these informations can be given. And then some size for the design whether you want to give the size that is up to you. For instance, you may want to give the shell ID or shell OD that tube length. Because you may have certain restriction in housing your exchanger at the place of your work.

Now, you may have space constrained lengthwise. So, you may limit the tube length but you may not have any constraints on shell ID. So, you can make your shell ID much wider. So, it is up to you whether you want to specify shell ID or tube length or baffle spacing or number of baffle or number of tubes per passes. All those things you may define or you may not.

You can leave it up to the Aspen Plus to calculate. Aspen will give some values based on its calculation. Later you can change yours. It is not that if you choose no over here later you cannot change it. It is not like that you can change it later also. At this moment, let us keep it as a default value and that total cost you may like to use Indian figure so, Japan, Hong Kong, China, UK, India, Canada these many currencies are there in Aspen.

So, you can just choose rupee India. You will get a figure which is very much you can identify with and then, it is setting plan. Now, first let us run the process. That means, it will size the exchanger. So, it sized and there are certain error messages. What are those error messages? You did not put any fouling resistance. Yes, we have forgotten to give the fouling resistance information.

So, we will give, fouling will reduce the calculated exchanger duty et cetera. And no maximum allowable pressure drops. Yes, this information also we forgot. We have given it in the heater block but in exchanger block we have not given. So, we have forgotten but Aspen did not forget. So that is the beauty of an Aspen. And it estimated the values at 3.77 psi hot side and 7.25 psi in the cold side.

And Aspen knows that in our requirement, we have 5 psi change in pressure, where, it is going above 5 psi. So, what you will do? We will give set process data. In the set process data, the allowable pressure drop we will put 5 psi and here we will put 5 psi as well. We can give some more tolerance limit in the hot side and then fouling resistance will be 0.0015. So, we have 0.0015.

Here also 0.0015 and then runs once again. So, 2 warning messages have gone, the other warning message is there, this is about program definition. At this moment, let us not go into that detail. The purpose of this exercise is to let you know how you can debug your system. So, this is the way you can debug. We can think about these warnings when we actually do a serious problem.

Now, this is the console, this is the TEMA sheet. Here the sketch is given. So, you can understand that the length of your tube is quite big and you may not like your exchanger to be that long. So, you may want to limit the length. So, you have to identify the number of passes. Here you can see, you can write the company name of yours like you can write it as Indian Institute of Technology,

Guwahati and the location you can write North Guwahati. The service of unit, reference number, item number, date, job number, remarks, notes everything that you can write. Now, these informations do not directly matter for the process calculation part of it but this information is needed for the completeness of the project. When you do certain project of heat exchanger designing and all, better you should write these headings and remarks for future reference.

And if you are working in a company, obviously writing this information might be mandatory for you. The application process, it is design, tube side, SI unit. The application is liquid, no phase change and application control, some of the informations are given. These are process data we have already seen it and we have edited a few things here and there. This is a property data, this hot stream composition.

Hot stream properties, you can see the hot stream properties as the temperature decreases from 235 to 150, how the liquid density for each and every temperature these changes. So, at 150 the liquid density is 59.869, at 235, it is 57.446. Liquid specific heat, liquid viscosity, liquid

thermal conductivity, surface tension then molecular, it will be same for all the temperatures, enthalpy, mass fraction everything has been given for that particular temperature.

This is the phase composition. Component properties, this is the property plot. If you want specific enthalpy versus temperature, you will get this way. This is the Y variable. Liquid density versus specific enthalpy is you can get it this way. This is temperature versus liquid density, temperature versus specific heat, temperature versus specific enthalpy. So, all those property plots can be obtained over here.

Same thing for cold stream. These are all cold stream properties. Then this is a geometry summary. We have chosen BEM. Exchanger position is horizontal. If it is vertical, then you can change it. Then we have shell head, flanges, tube sheets. So, you have chosen your bonnet, 1 pass shell and another bonnet at this end. So, figures are drawn over here. These are the covers.

These are the tube sheets, flanges, the type of flanges, whether, it is lap joint or hub. Ring with overlay, ring. All sorts of options are there you can choose. Then the tube sets, tube outer diameter, wall thickness, tube pitch, pattern, these informations are there. Tube insert type, it is none but you can choose either of them. Then we have baffle supports. How many battles are there? There are 6 battles.

Now, if you have chosen the baffles in this manner, baffle cuts, you will get them. Then we have bundled layout. So, this is a tube layout, tube side nozzles, domes belts impingement. And then construction specifications, you have material of construction, carbon steel in most of the cases by default, gasket material. Tube properties, if your tube material is uncommon, you can give the thermal conductivity, density and modulus of elasticity information over there.

Aspen Plus will calculate otherwise, it will calculate from its default value. This is the design specification, design code is ASME code section 8 division 1. You can find the design code in the heater exchanger design handbook and TEMA class is refinery service where you can choose chemical service, general service, refinery service, et cetera. It is refinery service by default and there are similar informations over here. So, you can choose any one of them.

Here certain options and limits are given for instance number of tube rows between sealing strips is 6. Geometric limits number of tube passes, the minimum is 1 and maximum is 8. That means in this design you cannot use more than 8 passes. If you want 16 passes, it is not possible within this particular design limit. You can change obviously, if you want and the heat transfer options.

If you want to provide this extra information on heat transfer coefficient, 2 phase, vapour phase, liquid phase you can give the pressure drop information delta t, fouling all those information you can give extra information. These are the method or correlations those who are aware of this HDFS analysis procedure. It is for advanced users. If you know what it is, you can understand that Aspen has such a comprehensive way of analyzing the things and there are calculation options also.

Here you can change the number of tube passes. If you see the TEMA input, you will find the number of tube passes is 1 and final design says the exchanger will be very long. Now, this type of long heater exchanger may not be very good. It might require a lot of space for you. So, you might want to decrease the length and, in the bargain, you have to make the diameter wider.

So, instead, if you give to pass and read on it then you can see the length has decreased. If you make it 4 passes, run it and see that TEMA input, the length has decreased a lot. So, these are the inputs that we are talking about. Now, you will get the input summary over here. So, this is the problem definition. The company name, location, reference number, everything will be given is the design sizing, hot fluid goes to tube side and there will be no phase change.

Everything is the liquid, the hot side and cold side, flow rates, temperature, pressure drop there given. Fouling resistance is the process data. These are the hot side properties. You can check the values of hot side properties. And then cold side properties are also there. This is geometry 1, BEM, bonnet types and 1 pass shell or 2 pass shell, shell types and then you have the front cover, rear cover then tubes. You get the tube diameter, pitch, et cetera.

These are the baffles; this information is there. These are geometry, baffles, bundles, the nozzles. Geometry 3, you have thermosiphon piping. Now, we are not working with thermosiphon. So, this may not be useful. These are the construction specification; the material

of construction and the specifications and certain program options are given. Now, warning and messages you already know.

Optimization path, recap of design. Now, 6 options are given, you can choose either of them shell ID, tube length, et cetera. If you choose this one, it is okay. TEMA sheet, this is very important. This TEMA timesheet will have all the necessary information and when you want your manufacturer to manufacture the heat exchanger for you, you have to give this TEMA sheet to them.

If you give this sheet to them, they will understand exactly what you want. This is the overall summary. And this is the hydraulic and thermal summary. Is the performance. So, shell side and tube side, fouling, resistance distribution, shell by shell condition then heat transfer information is there, pressure drop information is there, flow analysis given, vibration and resonance analysis, methods and convergence and finally, the mechanical summary.

This is very important because, if you want to know the exchanger geometry, you will find them. Here, these are the tubes, these are the baffles, support miscellaneous baffle, bundle, enhancement, everything is there, setting plan and tube sheet layout. This is the engineering drawing of the exchanger, a printout of this can be taken and given to the manufacturer and this is the tube sheet layout.

This also can be taken and given to the manufacturer. And finally, the cost and weights and some calculation details are also given. Analysis along shell side and analysis along tube side. So, in short this particular design has everything that you are looking. Now, we have done the design comprehensively, I mean at this moment maximum thing we have taken as a default value.

But the experience designer, they will go through each and every of those values and they will edit as per the requirement but finally the design is complete and you want to save the design. So, for saving you have to save it in EDR file. So, we can write it as say heatx.EDR. This heatx.EDR file will contain all the information of the heat exchanger. So, you can save it. Once you save, you just close it.

Now, you can choose the shell ID, you can specify geometry because you have already designed and you can import the EDR file. So, browse and heatx EDR contract. So, it has brought all the information that you are looking for. You can go to this EDR result, you will find this information. Now, once you do it, your heater exchanger is ready for simulation and rating.

Now, if you want to do rating, at this moment rating and simulation will give you almost similar value because you have done the exchanger on the basis of what you need that is benzene in at this temperature, benzene out at this temperature, hot fluid in at this temperature, hot fluid out at this that temperature. So, only thing is that you may like to check whether you have all the information in the EDR browser.

Well certain informations are not there. So, you just enter that information like you may want 20-inch diameter, 88.58 tube length, you can say 90 inch and baffle spacing you can say 6 or 9, there will be 10 baffles then, number of tube passes, you can check 4 passes also not a problem. So, this is the setting plan, this is the tube layout, you know what they are. So, you have done this small changes.

So, now, you can run it once again and check the rating. So, the rating calculation has been done. Now, check the results and you see that required exchange area for the type of work that you wanted to do is 394 square feet and your exchange area is actual exchanger area of your heat exchanger it is 459 square feet. So, actually you have 16% excess surface area you have.

So that is understandable because here instead of 88, you took 90. Instead of 19.5, you took 20. So, these are the small changes that you have done for that reason, the extra over design has been done. But 16% over design is okay, not a problem. So, go to the main flow sheet you will see, it has not changed. It is 150 and this is 140. But now, if you do the simulation law then see that it has changed from 150 to 145 and it has become 144 from 140.

So, as we discussed earlier in simulation run the output will be calculated based on the input and the instrument. Whereas, in the rating calculation the instrument will be evaluated based on the input and the desired output which we want. So, the calculation will decide whether the instrument is over designed or it is under designed. So that is the difference between rating and simulation. Now, we go to the second phase of our problem.

We have second set of process fluids; one is methanol and other is water. Their flow rate and temperature pressure informations are given and we will use the same heat duty whatever we have calculated over here. We will use the same shell and tube heat exchanger which we have designed just now and do the rating. So, for that let us open a new simulation. So, this is the component ID, we have water, we have methanol, press next.

Reviews ideal property method, run and then go to the simulation. We bring in the exchanger material in, material out. And then what is the hot fluid or cold fluid? Methanol is the cold fluid and water is hot fluid. So, methanol we write meth-in, meth-out, wat-in, wat-out. Then meth-in, it is 90,000, 60 ^{0} and 100 psi. So, it is, it should be English unit and 90,000 flow rate is 90,000 lb/hr.

Now, this is 60 ^{0}F and 100 psi pressure. Then water, it should be 26,000 500 100. So, it is 26,000. This is 500 and this is 100. Next shortcut hot fluid passing through tube, multi pass and for any design we have to do the shortcut design first. So, exchanger duty we put 2452197 as before and then run it. Shortcut is done. So, the outputs are given over here 500 to 328 and 6200.

So, this is the temperature increase for methanol cold fluid and temperature loss of the hot fluid. So, we have to design or we have to rate the heat exchanger that we have designed a few minutes back. So, press shell and tube exchanger and specify the exchanger geometry and we will not input the key geometry rather we will import the EDR file which is available over here heatx and convert.

So, it has brought in the values now, it is ready to do the simulation. So, just go to the setup and do the rating and then run the simulation. Now, go to the results. Now, you can see, in this case for methanol, water case the required exchanger area is 73.782 8 square feet, whereas the actual area that we have designed is 459. So, the excess surface area is 522%. That means this exchanger is heavily over designed for the system that we are working with.

The second time that is methanol-water time. You can try out with various other pairs of process fluids for heat exchanger rating calculation and they may come over design they may come under design. So, plus minus 10 to 20% of over or under designed may be acceptable.

Now, we go to the last segment that is designer plate type exchanger with the above data. Now, if you see the setup, there are other things also.

There are kettle re-boiler, there are thermosiphon, air cooled. Now, any one of them design procedure will be somewhat similar to shell and tube. Because re-boiler also, it has shell and tube, thermosiphon also they have shell and tube the design procedure will be somewhat similar. Only one that is not similar is plate type. So that is exactly what we will do. So, for that first we will delete the one which we have and we will bring in new exchanger.

And connect this one, connect this one, connect this one and connect this one. Then we will press next. For shortcut we will take exchanger duty 2452197. So, shortcut run is done then instead of shell and tube and other things, we will choose plate type exchanger design. Again, we have to select the conversion method, specify exchanger duty, input key geometry, import EDR file. Now, EDR file of shell and exchange will not be valid over here.

So, we will say input key geometry and convert. Now, this will open. So, total number of channels are being asked. So, those who know what is plate type exchangers, it is something like parallel plates and the fluids move in the alternate manner. So, suppose this is one process fluid, it will move like this and then like this and then like this and so on. On the other hand, the other fluid will move like this and then this.

So, this plate will add a barrier between this channel and this channel on this channel. Similarly, this plate will act as a barrier between this channel and this channel and so on. Basically, the plates will be sandwiched between 2 parallel flows of the fluids and those metallic plates will be a good conductor of heat and they will transfer the heat from one plate to another. So that is plate type exchange.

Now, total number of channels you have to set. For instance, we said 20 channels this side and 20 channels this side. So, there will be one pass only. And here, it will ask for the plate data. There are several parameters that are standard over here which has to be given. Instead of giving each and every parameter you can choose from plate databank. So, you have the manufacturer, standard manufacturers APV, alpha level, tranter.

APV manufacturer they manufacture several models like junior, U2, P4 et cetera. For junior type of plate, you will have Chevron angle 30 and their parameters are given over there. So, let us use these APV junior 30. Then not only that you have got all the information stored. It will give you a fear at the right-hand side where the structure of the plate will be visible to you and then you can go and check the geometry.

These are the construction details, material of construction, stainless steel 304. SS 304 you can use SS 316 also, if you want. It will be more costly I believe. And there are certain design options, thermal options, if you know the heat transfer coefficients of hot side and cold side you can give. Otherwise, methods and correlations you can choose but in the very beginning you have to give certain process data.

So, this information you need. Some process data has been already over there because you already have inserted this through shortcut exchanger design. But this estimated pressure drop has not been given. So, it will ask for, let us say 5 psi pressure is there then all this data is fixed. Hot stream composition and hot stream properties, it has already been set. The beauty with Aspen Plus is, whenever you give very minimum information.

The rest of the things it is calculated by its own and you do not have to do any more work. So, now, I think all the calculations are already done. So, we just press run. So, run is complete and you can just check the EDR plate results. So, it says required exchange area is 78 that you know in the previous run itself. But the actual area you have calculated with 402 square feet which is very high.

So, with this we can understand that there will be 412% of excess surface area that we are designing with, by choosing the APV type of plate over there. So, we can change our plate and recheck the calculation. This is the way you can design a plate type exchanger.

 (Video Ends: 01:08:18)
So, we have designed the plate type exchanger with the above data that means with the estimated Q and using methanol and water as process fluids with this temperature, pressure and flow rate information.

So, with this we come to the end of this lecture and in the next lecture again we will come back with another case study which will be more interesting I believe. Till then Thank You and Goodbye.