Cooling Technology: Why and How utilized in Food Processing and allied Industries

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Module No 05

Lecture 22
Psychrometrics Contd

Good morning my dear students. We are continuing with the Psychrometrics, right and the psychrometrics that we have learnt till now, how to draw the relative humidity line right? So, we have come to know dry bulb, we have come to know saturation temperature, dry bulb temperature and relative humidity right. Now, for other thing like humidity ratio, this we have already said many times right as you see these lines are humidity ratios. So, what we do? We draw that outline. So outline is like this and this right. I am not mixing up with relative humidity, dry bulb, everything then, it will be jumbled together, afterwards obviously, we have to do.

Now, the parallel line to x axis, they are as we said earlier also, they are the humidity ratio, or absolute humidity line. So, these lines are humidity ratio, or absolute humidity line right. So, these are all parallel to x axis. Again, as we said, the earlier, that you can buy between 0 to 50.

I know definitely, 0 to 50 and 50 to 100, are available, but I heard from students that in between are also available. So, if it is 0 to 50 so, corresponding to the temperature these relative or absolute this is, these are the absolute humidity numbers. So, those are available and they are putting here, whatever be the number. So, those numbers are printed here. So, along this line we can find out what is the humidity ratio, or absolute humidity right.

So, if we know absolute humidity, then, along the, earlier also we said along the absolute humidity line, when we are reaching to the saturation line, then from there, the vertical line is indicating the saturation temperature right. So, once we have come to know this, then let us look into the other things like volume right. So, volume, again, we go back to that we have this, this is the line, right and the volume lines, as you see from these, hopefully you can see, right this is the volume line, this is the volume line, this is the volume line, this is the volume line, this is the volume line right. So, these are volume lines, and you see, these are having certain angle with the x axis. Roughly, it could be around 70 to 75 degree, roughly right.

From this, you know that it could be 70 to 75. This angle, obviously, that angle will be the rest of 180 right. So, this way, you are drawing the volume line and all volume lines are of course, parallel this was not parallel right. All volume lines are parallel. So, you have this, you have this, you have this, you have this, these are volume lines and as you said roughly, it could be between 70 to 75 degree angle, with the x axis right.

So, those with the 70 to 75 degree line with the x axis, they are volume and the volume numbers are also given here right like here it is 14, here it is 13.5, here it is 13, here it is 12.5, here it is 14.5 and here it is 15. So, between 12.

5 to 15 the lines are shown right. So, they are quite apart, you see 12, obviously, that air with water that is air water mixture, the volumes will not be very high, right rather, volumes are, their density are low. So, specific volume are high, and liquid only density is high. So, specific volume is low ok. So, only volume, that is not the specific, where the mass is not there.

So, there the volumes are also very very high it is 15, 14.5, you see, the distance, this distance is maintained for 0.5 volume, this is 14.5, to 14, then to 13.5 to 13 to 12 to 12.

5, like that. So, all the lines, which are, which are, making around 70 to 75 percent, inclination with the x axis, that, those lines, are volume lines right. Now, it comes, to another, after the volume, there is still now, there are two more we have not done, what are those one is enthalpy and the other one is wet bulb right. So, these two, we have not, done if we say, that, instead of volume, if we write here, wet bulb, w e t b u l b, wet bulb lines, l i n e s ok. So, wet bulb lines if we look at, then again we go, draw the basic, and the basic is like this.

So, here, here, and here, ok. So, this is the saturation, 100 percent line, 100 percent relative humidity, and volume you have seen it is around, 70 to 75 degree angle between the x axis, and that. But, there are other lines also, like maybe, a roughly to 45 degree lines are there, and these lines are reaching again to the saturation line right. These lines are reaching to saturation line, and these are parallel lines, parallel to each other meeting the saturation line right. Then, where from we are getting temperature, because, yes, this is a line say 45 degree line, yes, along the line, I can move fine, yes, along the line, I am reaching at 100 percent relative humidity fine, but, where from I get the temperature? I get the temperature, when it is intersecting with the saturation line, from that point of vertical line to the x axis, that is wet bulb temperature, right that is a wet bulb temperature.

So, what did I do? What did we do rather? So, in the 45 degree line we proceeded up to the saturation let me, let me, let me, let me, clear this part, otherwise, it is becoming clumsy. So, here it is saturation. So, when it is reaching the saturation line, from there, if we make a vertical, where it is intersecting with the x axis, is the wet bulb line. Obviously, this will have a number, whatever 20, 30, 40, 12, depending on what scale you have chosen, what are the other information. So, from the saturation line, a vertical reaching the x axis, intersecting there that point is what the wet bulb temperature.

So, wet bulb also, you are getting similar to dry bulb, vertical and saturation also you are getting, similar to dry bulb, vertical, but the difference is that for wet bulb line you are moving along the line which is 45 degree and these lines are called wet bulb lines. Whereas, for saturation we were moving along the line, which is parallel to x axis right, and which is meeting the saturation line, and from there, the vertical reaching the x axis is the saturation line, or temperature, rather, right. So, all 6, we have covered how to draw all 6 parameters thermodynamic parameters in the psychrometric chart. Now, the last one remaining is the, last one remaining is the enthalpy. So, enthalpy lines, they are also similar to, you see, wet bulb.

So, this may not be 45, may be around 40, right may be around 40 degree, but you see, the gap between the lines and these lines are meeting with the scale that is the enthalpy scale. So, directly, from there, you are able to read what is the enthalpy. So, move along the enthalpy line, where it is reaching in the scale, you can say, that is the enthalpy. So, if we draw that in as we have also drawn outside, because, this is black may not be so much visible from your side. So, if we do this, that we have the basic drawing, vertical then, RH line 100 percent, then this, ok.

So, the there is a scale here, and that is called your enthalpy scale right. So, this scale and along this scale, the lines which are there, they are called the enthalpy lines right. So, they are called enthalpy lines. So, these are the enthalpy lines where the enthalpies are red along this scale right along this scales enthalpies are read ok. And enthalpy, as it is the unit of the enthalpy, will be of course, this is in, as it is written, this is in FPS, but we have said earlier it could be joules per kg or kilo joules per kg, that is the unit right.

So, we have now come across with all the lines to be identified in a psychrometric chart right right. So, then let us have all the lines how it will be looking at. So, we are drawing a bigger one. So, this, this, this, and this, right. So, our vertical lines are like this, and they are the temperature lines, right they are the temperature lines.

So, we call it to be temperature lines TEMP. Now, the horizontal lines these lines, we call it to be constant humidity line, right because it is parallel to x axis, so, constant. So,

this is called constant humidity line. So, constant humidity line we have drawn. Next is coming relative humidity lines.

So, these are relative humidity lines, like that right. Next is coming wet bulb lines. So, these are wet bulb lines right then enthalpy lines. This is the enthalpy scale right. So, enthalpy scale according to that this is a little angle different, than that right enthalpy lines are maybe 40 degree and the other one that is wet bulb lines, they are around 45 degree roughly, like that and all, not only that the enthalpy lines are reaching with the scale, and the wet bulb line, that is not going up to the scale, that is going up to the saturation line right.

So, one more line is still, I mean required and they are called volume lines and they are as we said around 70 degree to 75 degree. These lines are volume lines. So, all the lines we have found out and we have found out how to identify number 1, dry bulb temperature, number 2, wet bulb temperature, number 3, saturation temperature, number 4, relative humidity, number 5, volume, number 6, relative humidity, absolute humidity ABS absolute humidity, and number 7, enthalpy. So, all these we have now found out how to identify right? Next, if we look at the problems, hopefully we can draw, hopefully we can identify as well. We can proceed with the problem.

If you are not able to understand, then it is difficult for you to solve problems, but as I told you that, it is not so great by which you will not be able to identify, or do, only you need to practice. So, if you practice you will be able to solve the problems right. For example, this, the room, where we are sitting, it has one initial temperature, that is, the dry bulb temperature, and it also has a wet bulb temperature right. Suddenly, you add some heat to it. So, both, the dry and wet bulb temperatures will be changing.

So, from this psychrometrics, can't you find out what are the new set of dry and wet bulb temperatures? or others because, we said, if you remember, we said that if we know two property values, out of the 7. What were those 7? One was dry bulb, one was wet bulb, one was saturation temperature, one was relative humidity, one was absolute humidity and other one was volume, and the last one was enthalpy. So, out of these 7 properties, if two are known then, we can find out the state point 1, which is thermodynamically in equilibrium right. So, if we again, if we have this right. So, if we know, out of dry bulb, wet bulb, saturation temperature, relative humidity, absolute humidity and volume and enthalpy, out of these 7, if we know two properties, right say dry bulb, and relative humidity, You are said, your dry bulb is 35 degree centigrade and relative humidity is 70 percent right.

Then, we can, then this is a state point 1, S t a t e state point 1. So, this is the state point

1, where the point is saying, that is temperature is 35 degree centigrade, and relative humidity is 70 percent. So, we draw the 70 percent relative humidity. This is 100 and this is 70 percent, right, and we said our dry bulb temperature is 35 degree, say this is 35 degree. Then a vertical line intersecting this 70 percent relative humidity is the state point 1, which has 35 degree as dry bulb and 70 percent relative humidity, as relative humidity.

So, we could identify state point 1, right. Similarly, say we have given, we have been given one absolute humidity, right say point 0 0 1, and that is this point, and we are given, say a volume, say as we have shown earlier, volume say 13.8. So, the line of the volume, these were the volume lines.

So, 13.8 line, if it is there, then, when it is moving like this, intersecting with the point, this is called the state point 2, right. Now to go from this point to that point, you have to be following certain rules. It is not just like that you will be going like this, or if it is here, you will be going, just like this, you have to follow the procedure, and those procedures will come across with the solution of the problems right. So, next class, we will try to solve some problems, so that, you are acquainted with the psychroetric, and you never do any thing wrong ok.

So, with this, we conclude today's class. Time is up. Thank you for listening. Thank you.