Dairy and Food Process & Products Technology
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Lecture - 57
Transportation of Ice Cream vis a vis Frozen Foods

So, you are in, discussing for overrun of ice cream. Now, today's in Dairy and Food Process and Products Technology 57th class, we will discuss on Transportation of Ice Cream or in general Frozen Foods. So, any frozen foods come under, that whether it is ice cream or frozen food does not matter. They come under the same umbrella, because all are frozen, right. So, transportation, we can call it to be transportation of frozen food, but before that I would like to also highlight that, how much refrigeration load you have to calculate, right.

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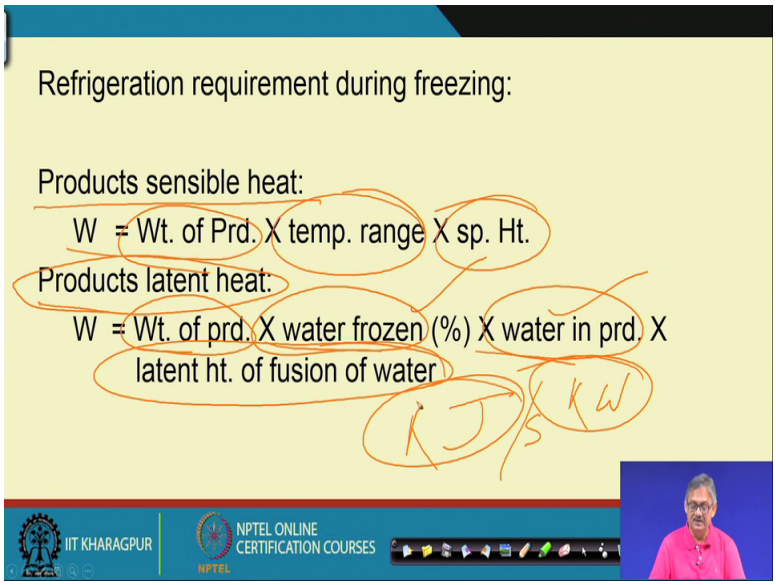

For preparation of ice cream, how much refrigeration load you need this is like that, that products sensible heat is there and that is what there is weight of the product into temperature range into specific heat and this plus products latent heat. Latent heat is weight of the product percent water to be frozen percent water in the product percent water got frozen percent water in the product and, this into latent heat of fusion of water. So, these two brings together how much joules of or kilojoules of refrigeration and this

when term comes in terms of per second or hour. So, that becomes watt; so, how much kilowatt of load you are to deal with that you can simply calculate, right.

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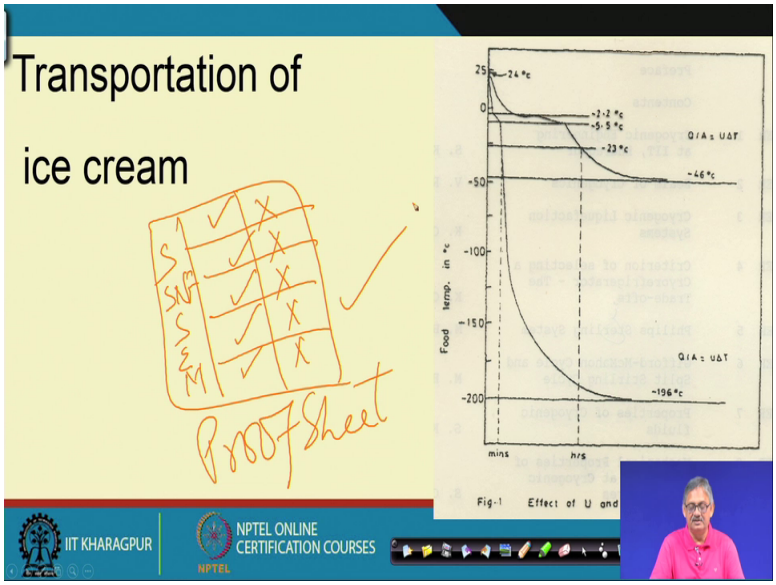

I also said another thing that we need to know that, before this, of course, here I have not perhaps given, but let me tell that, there is a proof sheet which I was referring to, I had deleted that, because of time constraint. So, this kind of proof sheet they prepared, right. This is like, this your items are like that, say here your sugar, right you need say 12 percent sugar, right and it has a solid. So, here your total solid must be balanced.

So, 12 percent sugar your, solid not fat, that do consider their, your this is the 12 percent solid or this is one eraser yes. So, 12 percent solid; so, that 12 comes here should, it should be here somewhere, because here it is fat normally and here it is solid and here, it is the total solid like that they have distribution.

So, in that SNF may have say 0.5 percent fat maybe say 9 percent, solid like that this total solid balance. Here, total solid balance these two together is given and they make a proof sheet which looks like this to this total solid is known this, how much they have to fill that, ok. Let me, how much they have to fill, that they should know with the proof sheet, that you make sugar.

So, much solid not fat, so, much stabilizer so, much emulsifier; so, much then the milk if required. So, much all these must be known to them and this is called a proof sheet, this

proof sheet they do have this, your workers do have and they bring accordingly and they will say, because you being the senior and you being the hierarchy. They will ask and tell you that, yes you have told that, this much has to be there this much has to be there, this much has to be there we have made this much, this much. So, it is absolutely and matching this proof sheet they should have, ok.

Now, we go for transportation before that, I was saying regarding the types of freezers or freezing quick freezing or slow freezing with respect to cryo freezing, where you see your temperature is getting dropped as so sharply you see times in seconds or minutes depending on what you are doing. Whereas, in mechanical refrigeration this changeover is taking place around say minus 2 or minus 5 and you are coming up to minus23 so, minus 23 or minus 50, whatever your temperature.

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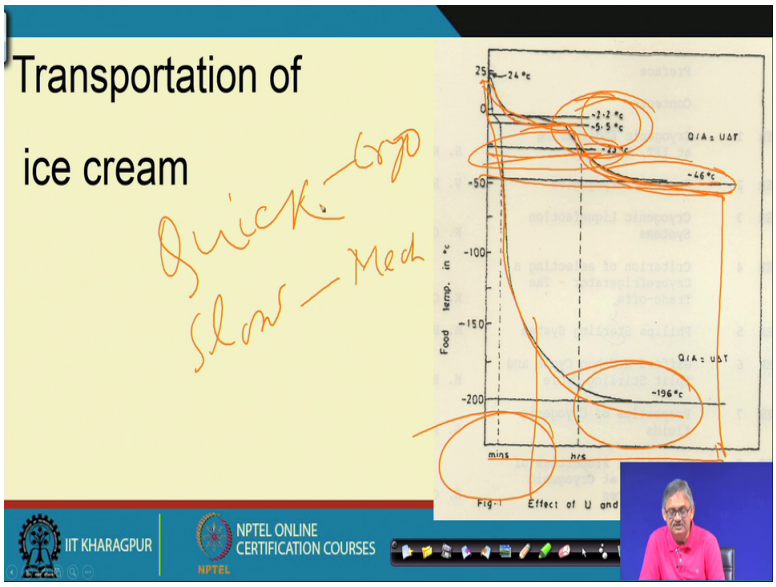

So, it is taking hours, right. It is taking hours. So, that is why quick freezing and slow freezing is different quick and slow freezing are quite different, in this respect mechanical is, slow freezing and cryo is quick freezing, right. So, this we keep in mind the and the moment we have the slow and quick freezing. And, since it is out of place I am not able to tell the detail on freezing, but in that small, small crystals are being formed in quick freezing for which that 911 matter comes in, whereas, in slow freezing bigger, bigger crystals are being formed you see for from a liquid to a solid when you are accommodating such a huge volume.

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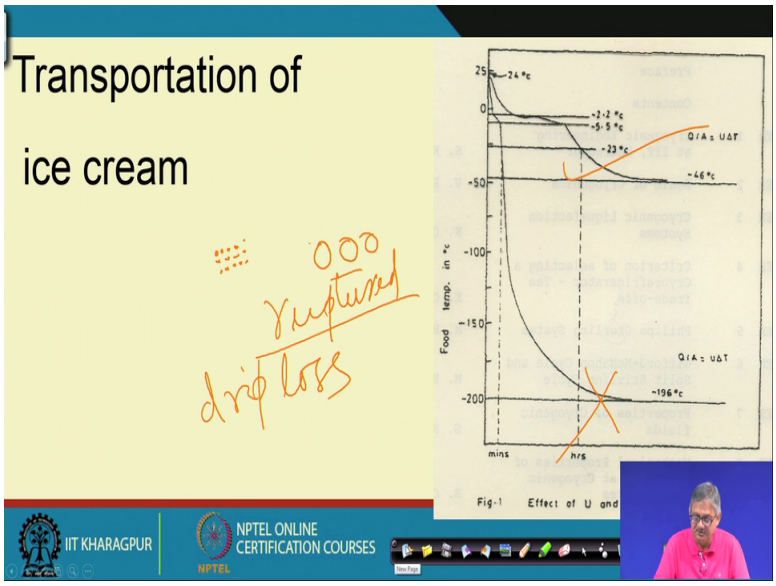

Then the surrounding cells are getting damaged or deformed and many cases it may get ruptured also and for that you are losing the liquid in terms of that is called your this loss is called drip loss right. So, that drip loss is more in terms of mechanical compared to you know the cryo, ok. So, from that let us go into the transportation of frozen food.

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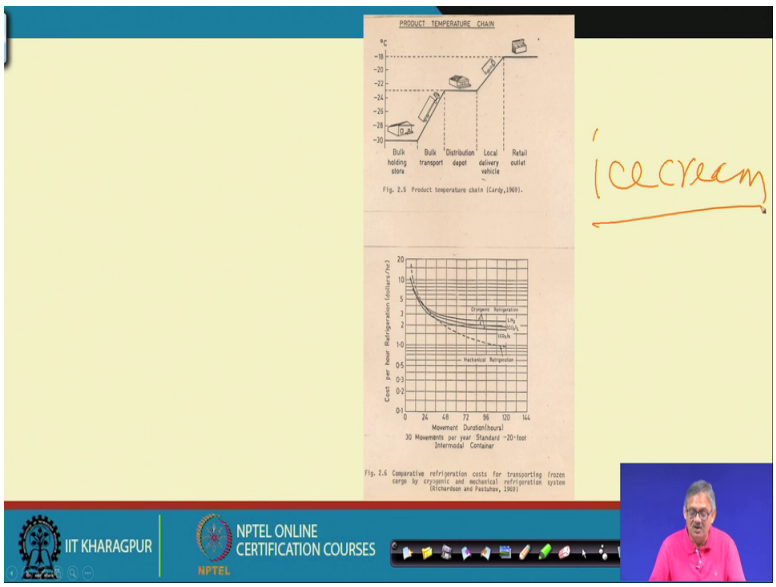

Now, in transport frozen food a concept of cool, cold chain a concept of cold chain has to be there. Right now, this cold chain concept in our country is yet to yet to look into, because till now there is no such cold chain? All over the country or even part of the

country only this cold chain is maintained for the product called ice cream where there is no other way had it been that ice cream could have been without cold chain.

Our country would have been irrespective of quality of the product, but since ice cream if it is under high temperature, it will get melted. So, that is why this cold chain is in ice cream industry, but not in any other industry, that a whether it is frozen, food or any, but cold chain is not there it is always a disrupted one. So, in cold chain what do you need that this is your, the production right bulk handling, where you have been producing that is stored at very low temperature supposed to around minus 30. Then it is going through bulk transport to one place where it is being stored at say 24 25 32.

Depending on the temperature then from there it is going to another place where the distributor or depo could be there then from there it is going to another local place and there, it has to be always minus 18 or below. This is supposed to that minus 18 or below degree centigrade has to be kept all over right, all through has to be minus 18 or below, but fortunately this cold chain is only possible in ice cream, but not to eat any other product. However, when it is being with ice cream then how this is being maintained from my practical point of view I can share with you that.

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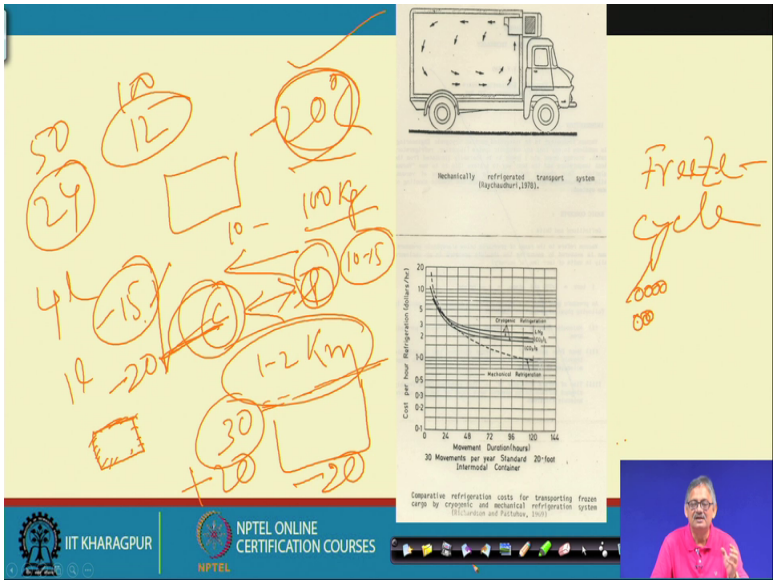

I can share with you that, if suppose your production is being held here this is a place called say P and if your consumer or distributor is here right and if this distance is say around 1 to 2 kilometre with all possible things. Because, your ice cream is at minus 20

or below right and there in big-big contacts, like as I said that 50 ml cups are with 24 cups in a pack and 100 ml, 100 ml cups are 12, cups in a pack right, in a paper carton they are used right or full litre.

So, on each or 1liter tax is there. So, all (Refer Slide Time: 11:20) minus 20 or below right. So, what they do if it is within 1, 2 kilometres and suppose from here some 100 kg, they have loaded and this loading time may be around 10 to 15 minutes and this transportation time maybe another 10 to 15 minutes. So, within 30 minutes; this minus 20 will go up to say minus 15 and then in this area cold store, they have a cold store which is minus 20 or less.

So, they are dumped into this and this minus 15 again, gradually goes up that is why I said, if you remember that freeze thaw cycle that remains and this makes the ice crystal size bigger. And your mouth filling is bad. You always feel that is sandy -sandy appearance is there in the product which is not desirable this is, because of this freeze thaw cycle; that means, you are warming and then it is cooling warming and cooling. This is more prevalent in the sellers point a sellers point means suppose you are going into multiplex there you will see that this freezer container is always open there is supposed to be a lead, but this lead is always open whereas, the room temperature is say plus instead of minus 20 the room temperature is say plus 20 right

So, in that case what will happen say, if this is an ice cream the surface they will get melted, right. They will get melted and again, when it is coming in the night when everything is closed. So, that time it is getting represent. So, like that, once it is getting melted and again it is getting frozen. So, that is forming the ice crystal size big and big and you get, filling in your mouth that you are taking some sand though there is no sand, right. This is, the defect of the maintenance of the continuity of the cold chain everywhere right, and for that what is the most required thing is the awareness among the consumer also, not only to the production I tell you that the manufacturers for their safety, they always try to keep it at low temperature.

In many cases, it may not be feasible, because in very high warm condition typically say in Bombay, where it is almost throughout the year it is warm throughout the year it is warm and, it is and almost throughout the year there is demand, because the hot it is the demand is more, that is why maybe in Delhi or in very cold places the demand is not. So,

during the winter then that in the summer right so, but in Bombay it is not be climate is such that all the time it is cold it is hot rather and ice cream demand is very high for which the maintenance of the cold room may not be at minus 20 sometimes it goes higher.

But, that is a debatable right debatable why, because somebody who are really working they will always claim no it is not, but in act practice in actual it is. So, right; so, this is the reality, but the thing is you are supposed to keep it at minus 20 or below there is a must. Otherwise, that freeze thaw, these cycle will go on and that is not desirable for the product right. So, how they are then transported number one is only in plane vans as we said plane vans if the if the distance is very low, very-very small and, if it is only one time.

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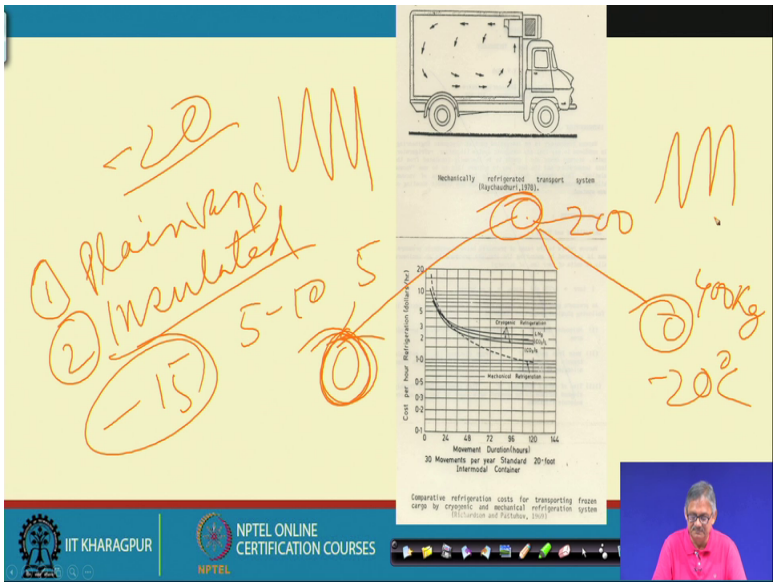

So, from one place to another place within 1, 2 kilometre, then they may be taken just like that in any, in any container or any van, right who had just the keep it in there and from one place to another place dump. Second is through insulated van may be that distance is not 1, 2 kilometres, maybe 5, 10 kilometres and, and maybe not only in one place, but also in 2-3 places they have to go. So, what they do; so, they load it at here, at around minus 20. That come the, the product temperature, then go here may be at say 5 kilometres from there and maybe if they had taken four 100 kg material right. So, 2 100

kg is, is removed from there or an unloaded here and another 2 100 kg to another 5, 5 kilometres.

So, there they are unloading right. So, this if it is taken an insulated van maybe that will last way from minus 20. Again, it may come to minus 14 15 degree centigrade and which again in the cold room at this place or at that place. We will again go up, but this freeze thaw cycle, that will remain. Third one could be that insulated van with mechanical on-board refrigeration right. This is one, such unit mechanical on board refrigeration that this refrigeration unit is over the driver's cabin and the evaporator is inside the cabinet. This is the close insulated cabinet.

So, that evaporator there is a fan. This fan is circulating the cold air and the whole thing is dumped with ice cream right. So, this fan will make the circulation of the cold air throughout and maintain the temperature at around minus 20 or below right. There this is the rare, that rare, there is a door and that door is there is a small window also in this door there is a there is an anteroom here also there is an anteroom. So, when from the if say this is the cold room from there it goes here to the anteroom some loader is here. So, he takes it to gives it to the fellow here and through, open small window. These things are again inside there is another person who is going all around and loading right, who is going all around and loading it.

So, once the entire thing is loaded right; obviously, there will be some, small areas through which air can pass and this circulation of fan will keep the material throughout at minus 20 or below supposed to, because this is on board. This is reference this is, getting electricity from the drivers cabin from the engine, from the engine it is getting the electricity and the compressor is continuously running as and when required to maintain that minus 20 or below temperature right.

So, during loading unloading period, this temperature may go up. So, after some time when this is running, this again goes down right. So, this is one and this is for large distance or if the if it has a 1000 kg, somewhere you have to give 100 kg at one place maybe say 100 kilometre away, you have to give 100 kg. So, another 50 kilometre away you give another 250 kg.

So, like that if you have to go door to door at different places then this on-board refrigeration I helps you to maintain the temperature right. This is one way how things

are being done right and make this is a mechanical, but since this is a mechanical system there is only one risk is that, because of the wear and tear of the mechanical system. So, it may go long on the way, but generally people who handle it, they are good enough to repair it. This then unless it is beyond repair right and that circulation of air inside the cabinet inside that, insulated van this is, insulated this is these are the insulation.

This is a good insulation is there and, there is no other pipeline or other thing right there is no other pipeline other than the fan and the evaporator of behind the evaporator, there is a fan that fan blows and that cold air gets circulated as the arrow it is being shown right. And there are some other this is a mechanical one right now, imagine that you do not have this unit on the board right, you do not have that unit on the board, but here on the ceiling you have some all through the ceiling some sheets like this right.

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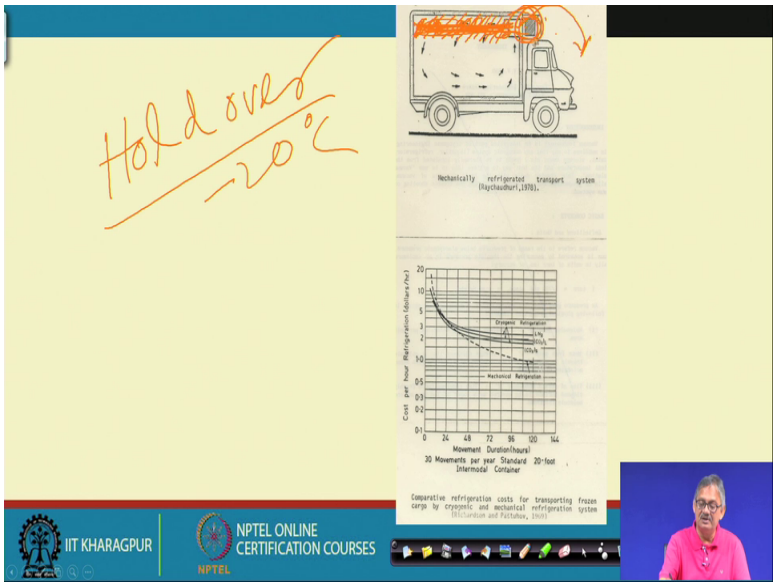

This is called holdover, holdover refrigeration right where brine solutions, brine solutions are inside that, tubes and, and before the commencement of the journey overnight this is being cooled through another heat exchanger or through an through another refrigeration system where this holdover plates are getting frozen and it is around minus 20 or below temperature there right.

So, only the thing that you need to you need to, continuously supply the electricity, that can be from point to point right. So, there you are not carrying this, there you are not carrying this along with you right.

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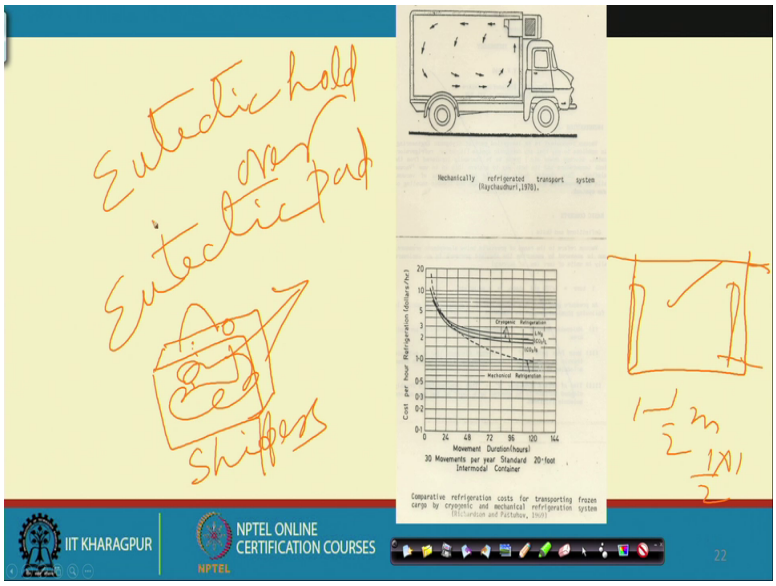

So, this is another and that is called eutectic hold over right [FL] or there are some Eutectic Pads also pad van eutectic pad vans the pads are like this maybe 1 centimetre, sorry 1 meter by 1 meter maybe by 2 inches. So, there is one opening here; so, inside that eutectic solution is put and this is again like the drain tank of the earlier we have shown, seen with the lolly those kinds of tanks are there.

So, they are there is a holder. So, that is dipped into that and this is getting frozen right. And then they put it in shippers, say, one and half meter, by half meter by this could be another meter by one meter. So, another this kind of thing and these units are placed here. So, they then serve as the, this refrigeration source and there is a top which is covered and this is called shippers S H I P P R S. Shippers right and these shippers are then taken into either insulated van or non-insulated van also.

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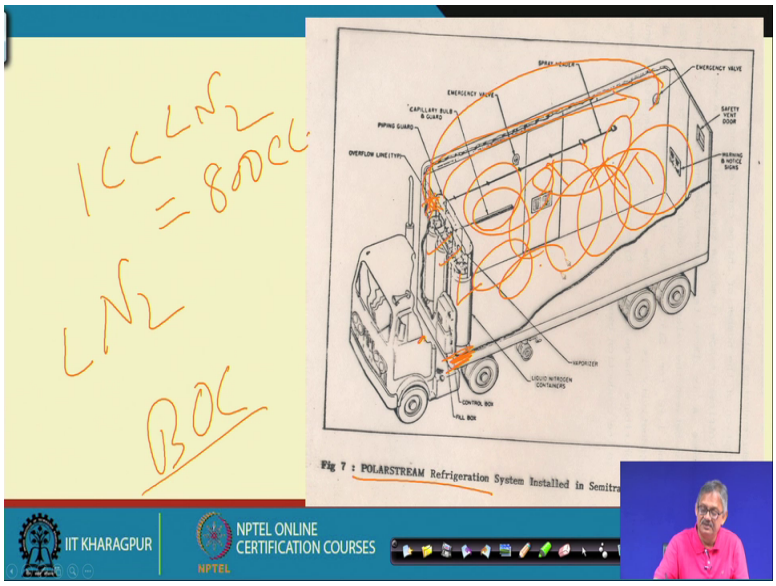

So, another thing which not in our country in other countries that is called polar stream in our country it is not yet BOC tried busy oxygen company they tried, but, could not succeed the one of the failure resonances the availability and price of liquid nitrogen right. This is an again your liquid nitrogen cylinders are being kept on the board behind between the trailer this is a trailer system. So, between the cabinet and the drivers cabin they are kept and they (Refer Time: 28:21), there is all over the pipeline through which and there is a three-way valve there, there is a three-way valve. So, that opens and close as and when there is a sensor.

Sensor senses the temperature and opens it and liquid goes there, gets agree spread and, this spraying takes place and since, 1 cc of liquid nitrogen when it is converted into gas makes around 800 cc of gas. So, a lot of expansion takes place and then the expansion there is without any fan. These circulating inside thoroughly right; so, this is called Polar Stream.

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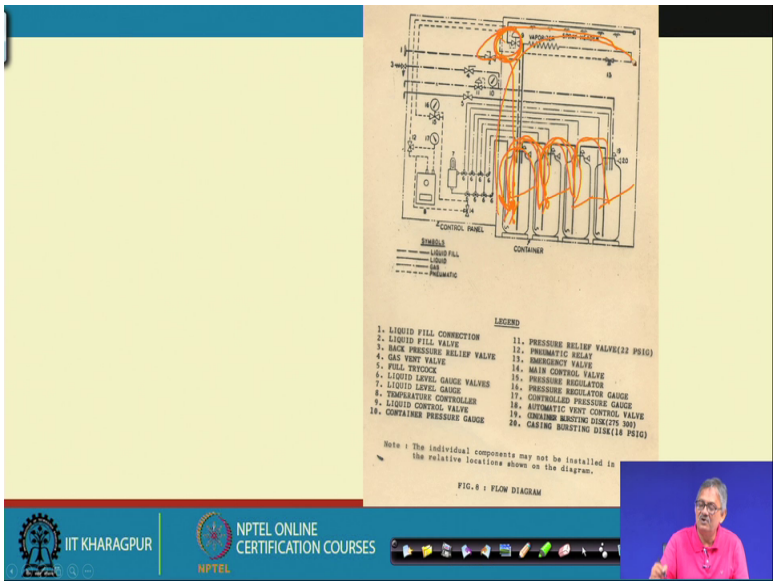

So, the way it towards that, we can show it here, that it is like that you are 1 cylinder 2 3 4 as many cylinders are there they are interconnected. So, this is connected to this, three way valve and which is controlling the flow right and as this is getting empty liquid from the air is coming as it is getting empty liquid from there. And in turn from the air select, that this from here then this from, there then this from there this transfer is getting on and you can carry for an very-very long time right.

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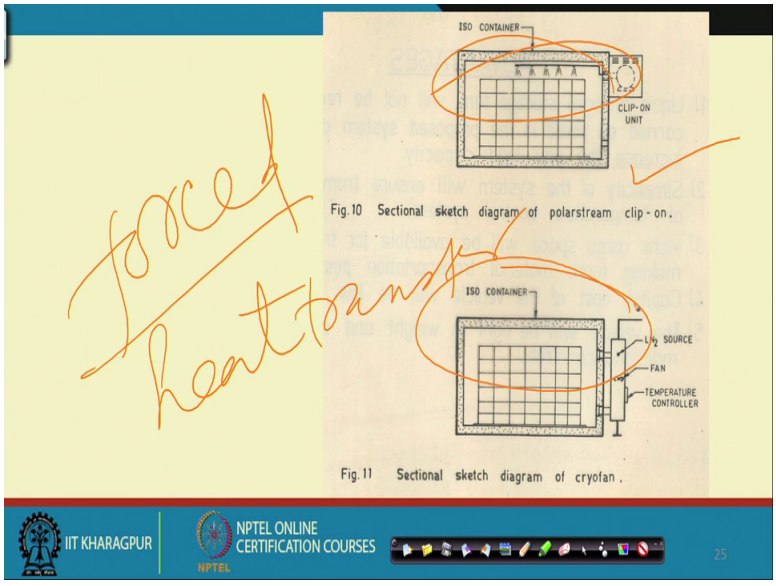

So, there are some other techniques also by which it is, that is called this kind of where in earlier case there was no fan, but people have seen if fans are also used then; obviously, there will be forced circulation and forced heat transfer is much-much better than unforced heat transfer right. So, if fans are there that is much-much better than if there is no fan right. And this way there are many ways by which it can be and during my PhD program.

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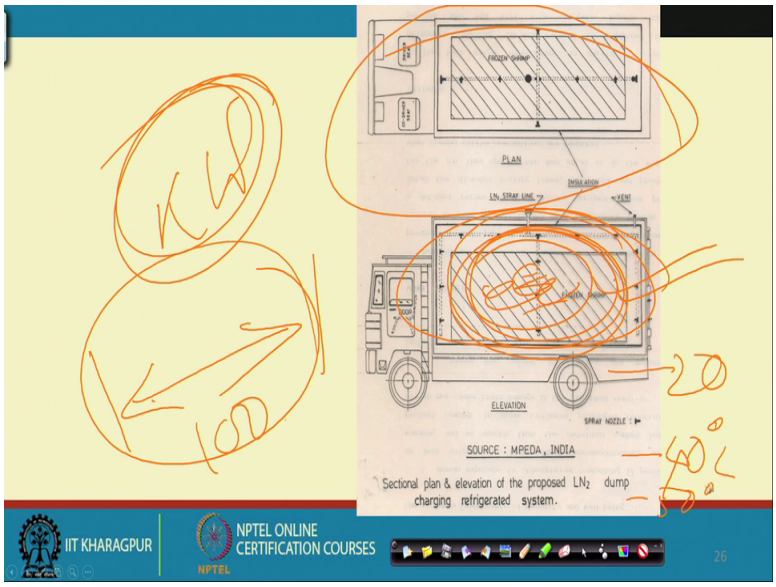

I made it that this is called dump charging right before the commencement of the journey. You find out what is your total, heat load from a point to another point maybe 100 kilometre or 200 kilometres; so, whatever that this load needs total this much quantity of refrigeration. So, before the commencement of the journey if this is kept that refrigeration is supplied to the product. So, product temperature instead of minus 20 will come say around minus 40 or minus 50 or minus 30, depending on that load.

So, you have supplied it, before the commencement of the journey and this during journey extra load which you have given will take care of the heat load and you will remain at minus 20 or look below this is called dump charging liquid nitrogen dump charging system right.

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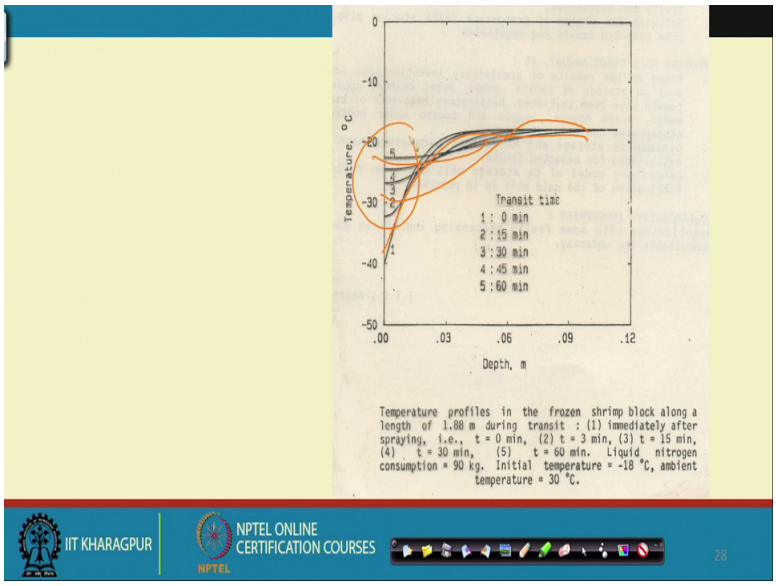

So, this way you can make the refrigeration and this is how the temperature sorry, how the temperatures are getting affected right this way; obviously, surface will be affected first than the interior right. So, this way you can keep your material transported from one place to other place and whether it is ice cream or any other food material if it is present they are supposed to be under cold chain which is lacking in our country try to put it when you are getting to the real life.

So, try to make these things implemented and then; obviously, will also find the someday, that things are implemented nicely.

Thank you.