IMPACT OF FLOW OF FLUIDS IN FOOD PROCESSING AND PRESERVATION

Lecture02

LECTURE 02 : PRESERVATION OF FOOD

Good morning my dear students and friends and senior student members. This is the second class of this course of fluid flow, right? Primarily the course is flow of fluids in food process engineering, right? So, we were in the introduction part and introduction to the course because that is the basic requirement to understand why flow of fluids are so important, right?

So, we come now, we had said in the previous class that what is food, what does it do etcetera etcetera right. Now, we go to another where we shall be where we shall be saying that there are different types of food materials available, right? We, because our course is this, flow of fluids in food processing and preservation, right?

If that be then we must be able to divide different food materials in different categories, different baskets, right? Because all the foods cannot be put in one basket. Like all the people all over the world cannot be put in one basket because there are different types of people. Like Sir Isaac Newton.

Everybody is not Sir Isaac Newton, right? Similarly, there are many, many people who are definitely put into different baskets. Similarly, food materials, they are also put into different baskets. Some food, which are called perishables. You have seen in your house, either your parents or senior people, they are bringing food from the market, right?

And you also have seen, if you have observed of course, that these food materials, out of which some are deteriorating quickly after harvest, if you have in your house some garden, some trees, some fruits, flowers, then you might have seen, say, very common one, is a guava tree. Those, who are having gardens in their house, they may know. People like us who are staying in flats, there is no such possibility.

But, if you have some place to grow, then Guava is one example, very common. You have seen, that it is growing and from green to yellow it is getting converted in the tree itself and

after some days, if you do not pluck it, if you do not take it out, then, it drops from the tree itself, right? So, they can be called as they are deteriorating quickly, after the harvest.

Once you pick it up from the tree, then it gets deteriorated. Similarly, that example I gave for fruit guava, maybe many vegetables, many other fruits, right? So, they are called perishable food materials. So, after harvest, or soon after the catch, or slaughter, they get perished.

So, examples could be fresh meat, poultry, fish, fruits, vegetable etc. So, they are called perishable foods. Their life or storage life, life means storage life. Now, what is that storage life? Storage life is that life when you are plucking or harvesting or slaughtering or catching from that point to till it is getting perished.

That is the storage life under normal condition. Yeah, under different conditions, it can be extended. That is again part of the food engineering or food science course. That is different, right? But, our intention is to have some idea about what types of foods are available.

So, perishable food materials, should be taken into deep consideration, so that they are not easily perished, right? Because, if it is easily perished, your production has to be very high, you are producing and it is getting spoiled. So, that is not desirable. your consumption and production should be commensurating with each other.

So that consumption is also not affected, ok. Then, another category, that is called semi perishable food material. The semi perishable food materials, from the name itself, it appears that these food materials are not so easily perished unlike fruits, vegetable, fish, meat, poultry etc., right? They are called semiperishable food materials and these food materials contain natural inhibitors.

Now, what is that inhibitor? An inhibitor means those substances or species or whatever, they do prevent spoilage. For example, one of the best example is egg. You take egg, maybe every now and then, or sometime. If you are not taking egg, obviously some other material will come for you.

But, those, who do consume egg, you have seen that there is a coating over it, right? And this coating is preventing egg to get spoiled. That is why you have seen in the market also, eggs are not kept in different conditions. It is in the normal natural condition and by that it stays maybe 5 to 7 days just like that without getting spoiled, right? So, that means, that coating in the egg this is acting as the inhibitor of spoilage,

or those which have received some type of mild preservation treatment, which creates greater tolerances to the environmental conditions and abuses during handling and distribution. One such example, I said that those who do not consume egg, I will give some example for them also. For them, is that, the pasteurization, right? For them is that pasteurization. Pasteurization is what?

It is associated with, can you name? It is associated with milk primarily. There are many others. Primarily, it is associated with milk. Milk is pasteurized.

You go to the market, take pasteurized milk and yeah, you consume at least in many, many cold countries, I should not say developed countries, many, many cold countries, they do not even, as you, in our country, you bring it from the, or not only our, in some warm countries, you bring from the market and then you boil, Right? Why do you boil? Because, from the point of view of pasteurization, when it was packed and pasteurized,

for your consumption, if the time is very very high and if the temperature is also not well maintained, then, there is a chance that the milk might be spoiled. So, in order to avoid any contamination from the milk and milk is a very good source for all microorganisms because it contains everything. So, it is a very good source of food for microorganisms.

So, they can invade and proliferate, but it may cause diseases. That is why pasteurization is done. And as I said, in cold countries they do consume directly after pasteurization because it is in the cold chain, but in warm countries like ours we do heat it before consumption. So that, if there is any pathogenic organisms, that is the prime reason why pasteurization is done, that pathogens are killed, right? or destroyed, ok. This is one example, some others could be, pickling, smoking etc.

At house also, you might have seen, your seniors are doing some pickling of different fruits and vegetables, right? So, that is another means by which you are extending the storage life for consumption. So, these come under the semi-perishable food material. Then, third one is self-stable food material. Of course, nowadays most of the areas are getting urbanized.

So, those early days concepts that in our childhood we had seen or our parents or seniors they were buying lot of quantity of rice when it was available at low price and keeping in home, maybe down below the cot and many other places, where it is available, right? So, those materials are called shelf stable food materials. So, these are nonperishable at room

temperature for example, cereals, grains, nuts etc., or they might have received some preservation treatment for example, canning.

or process to reduce moisture content. For example, drying, dried food material, lot of food materials are available in the dried condition, right? And they can be said as self-stable, they do not need any additional care to be taken, right? Like as I said rice, your seniors, or even today also, you don't go and buy 100 grams of rice.

Generally, you buy for a month, maybe 5, 10, 15 kg depending on your size of the family and consumption and keep it. And you don't keep it in different condition, in room temperature, room condition only. So, it is called shelf stable food material, unlike perishable or semi-perishable food materials. We gave an example like cereals, grains, nuts, etc., from the natural source. From the artificial or we should say not artificial exactly, processed food material,

so, it could be said, canning. Canning is a heat treatment process, right? Maybe fluid flow could be useful there, because, in canning, if you know the process, what is done? You have a can depending on what type of food you are using, you make a lacquering, means a layer on the inside of the can.

Now, generally cans are made of tin, but, tin is very very fragile material. So, to give a strength it is generally, tin coated on, maybe, some iron sheets, right? It is thin coated and even some food material depending on whether it is acidic or non-acidic etc. We are not going into this deep, because that is not part of the course.

So, for those materials, some layer is given, called lacquering. Then in the canned food material, for example, you might have consumed canned pineapple, right? Like circular disc type of things are available in canned foods, right? Many other canned foods are available, right? So, in this case, another thing may not be out of place, if we mention, because that information we have said canning, you are not going to do much more on this, right?

So, how the cans are prepared? Cans are prepared, say, if this one is the can sheet that is tin coated, maybe mild steel, or something like that, right? good tin plated tin coated material sheet like this and you cut depending on your can size. So, you have two ends, one this and another say this, right? you have two open ends and you want to make it a form like this, ok. So, what you do?

You make round of it So, you have those two ends, now they are to be, they are to be sealed. Now, this sealing is done if this sheet, if we make end of it, a fold like this and the other end say this fold like this, right? then you have two layers here, two layers here, right? And then they are interlocked like this and then pressed heavily. So, there is no join like you are joining with any other materials.

It is not. It is just by pressing and this is called seaming, right? This way you form the can and then bottom part also in a similar way, you seal and the top part also in a similar way, you seal and then it is heated at 121 degree centigrade for 15 minutes that is the definition of canning, right? retorting, ok.

Same is true for the dried material, or similar, it should not be said same, by the application of hot air or any other heating medium. So, the food material is dried and this becomes shelf stable food material. Then there are different storage conditions for example, dry storage right. What do we understand by the term dry storage? It is storage at 20 degree centigrade and 50 percent RH.

Another new thing has come up, RH. I hope you know, right? If you do not know, so, what is Rh? Rh is relative humidity.

Now, relative means, with respect to something, with respect to someone that is what is relative, right? This is relative to this, right? So, with respect to this, what is this? That is called relative. So, with respect to this, it is relative.

So, in that case also relative humidity. So, humidity with respect to 100 percent, how much is now? That is your relative humidity. Now, it is 50 percent as we see that in dry storage is storage at 20 degree centigrade and 50 percent RH, right? So, that means, 50 percent relative humidity is there.

What it means again? It means that if it is, 100 percent is the limit, then, we have another 50 percent which it can accommodate, that is why, it is said relative. Now, it is 50 percent with respect to 100 percent it is another 50 percent is able to accommodate humidity. So, with respect to another 50 percent it may be accommodatable.

So, that is why relative humidity, ok. Then, cool storage, obviously, that storage in our country, 20 degree centigrade is there moderately good temperature may not be high, but it is a moderate temperature, but it is not that good for the food material. Since the relative humidity is low, so you are able to store it for some time, right? like the cereals grains, what we had said earlier. So, if they are also stored at

this condition, dry condition, then, their life could be extended, right? Similarly, another way of storing is cool storage, right? That means, it is stored below 12 degree centigrade. 12 degree centigrade is a, we do not say it is a low temperature. Yeah, it is lower than normal hot or normal temperature, right?

So, some food materials could be stored even at below 12 degree centigrade. Again, it will not be out of place to mention that, you know, potato is stored in cold room at around plus minus 2 degree centigrade. But, those people who make potato chips and many other products, they find that the potato obtained from the cold store at 2 degree centigrade, they become brownish when they are processing it. So, that variety, or that condition of storage of potato is not suitable for them.

What do they do? They do take typical variety, they produce that and that is stored at plus minus 10 degree. Now, why this difference? Because, at lower temperature, like 2 degree centigrade, because, potato is again starch, so that some of these starch is getting converted into sugar.

Though, it is not part of this course, but still when they are processing, there is a reaction, that is called sugar amine, right? Amine from the potato, sugar from the potato they make reaction or amine from the oil, where it is being processed. So, they make some reaction called Browning reaction and this is called Maillard reaction, not required obviously in this course, but for your information or for your knowledge. Now, there are refrigerated storage right.

So, this is storage between 0 to 8 degree centigrade. Yeah, storage between 0 to 8 degree centigrade, it will not be again out of place to ask you. Do you know that at your home, you have a refrigerator, right? I do not know, whether, you know or not, but since it has come, my duty is to make you clear that that refrigerator works under vapor compression refrigeration system.

So, there is a compressor, there is a condenser, there is an evaporator and an expansion valve. So, compressor, condenser, expansion valve and evaporator, this is a cycle and that is called refrigeration cycle. If you have the old type of refrigerator at home, not the frost free, recently, which are somehow, if you have seen or if you have, you might have seen that, on the back of the refrigerator, there is a jali or coil, right? There is a coil and this is called extended surface heat exchanger.

Extended surface heat exchanger, you are extending the surface area for exchanging heat. That is the condenser. There is one compressor down below, black kind of thing. And by its size, there is one expansion device. And the whole refrigerator is known as evaporator.

And this evaporator, other than the top, where you are keeping your fish, meat, etc., etc., which is normally at minus 10 degree centigrade, down below, there are some copper coils, right? So, those are called evaporator coil, but evaporator is the whole refrigerator, because, it is taking heat and giving it to the evaporator coil, where the expansion or the refrigerant is getting evaporated giving or taking the heat from the evaporator, right? So, there, as I said, the top one,

where, you are freezing ice or cubes like that or keeping fish, meat, poultry etc., they are at minus 10 degree, generally plus minus 10 degree. Down below that, where you are keeping your processed food, seniors or parents or mummy is preparing food, after service the leftover is kept in the refrigerator. That refrigerator from the top cabin to the bottom, it varies between roughly 4 to 8 degree centigrade. Again, depending on, how much you are, you are loading etc.

So, that storage, between 0 to 8 degree centigrade, it may come under similar condition. Again, I gave the example of potato storage at plus minus 2 degree centigrade. So, it comes under this. So, storage between 0 to 8 degree centigrade. Then, freezer storage, I hope a very very good product of frozen material, you like very much, that is called ice cream.

Hope, you like it very very much and you consume also. Ice cream, I do not know whether you have seen any softy? Softy, may be available in different, different, different nowadays, nowadays, you have malts and other things. So, there it could be that the softy materials are available, that they are giving in a cone or cup some ice cream, which is flowing through some pipe, right?

It is flowing generally its temperature is around plus minus 5 degree centigrade right, but the other one which you take from the freezer cabinet, there, the temperature could be somewhere plus minus minus 20 degree centigrade, because, it is frozen there. After this ice cream comes, it goes into hardening room, it gets hardened and that hard ice cream you are consuming, right? So, that comes under this storage condition, between 0 to minus 23.

Again I told you just now that in the household refrigerator, the freezer cabinet that works around plus minus 10 degree centigrade minus 10 degree centigrade plus minus, where I am saying it could be little lower or little higher depending on the condition of the freezer.

So, that comes between 0, sub 0, it is called sub 0 temperature storage or freezer storage. Why? Because, we know that water freezes at 0 degree centigrade. So, anything lower than that, that means that water is frozen.

Similarly, in that, in ice cream, ice cream contains roughly 36 percent solid and 64 percent water or liquid, right? It may be from water or from any other liquid, right? So, this comes under storage below 0 to 23 degree centigrade. Again, you see, the previous one is 0 to 8 degree centigrade that is plus 0 to 8.

Here, there is no phase change. The temperature is getting lowered, but there is no phase change. It is lowering the temperature 8 to 0 degree that is called sensible cooling like or sensible heat. Whereas, in the next case it is storage between 0 to minus 23 degree centigrade.

So, this is latent heat, right? Because, you need to convert water into ice, and water to ice you need some energy. So, that energy to be extracted is the latent heat and then water gets solidified, right? This is again another chapter that is called freezing we are not going into that. Shelf life, what we understand, this is very much in food industry, that shelf life of this material is this much,

under these conditions it is written. In many many packages also it is written. Self-like means where the expiry date is written. So, this was produced on this date and it is expiring on this date, right? So, this is the time duration, between processing and consumption, right?

This is the time duration between processing and consumption. So, that is called the shelf life, like I told you that ice cream, it is say, if it is prepared and if we do the storage experiment and find out its storage time under normal condition, then we will write that it is expiring on such and such date. So, that expiring date and this production date the time between these two are called the shelf life, right? So, shelf life, which is very commonly used in food industries, is the time duration between processing and consumption, right?

Light protected. There are some food materials, which are light protected, they are very much sensitive to light. This is, more than food, you have seen that, many medicines, they are in colored bottle, so that light is not penetrating. So, they are called light protected. So, these food materials, they are kept in the dark or protected from visible light or wrapped with Aluminium foil, that prevents light reactions, right?

So, to protect from light, or dark conditions are prepared, dark conditions are maintained to protect from the visible light or maybe something wrapped, maybe with Aluminium foil or many others, so that it prevents light for reactions, right? So, if we look at the storage condition of food materials, then there are different conditions which arise. Number one, in presence of air that is called aerobic bacteria or yeast or mold they can grow in presence of air.

Now, in absence of air or if in presence of air, that category, let us first complete that, in presence of air, aerobic bacteria yeast and molds, they do grow. Even in presence of air, there could be conditions like high moisture. Air is there as well as moisture content is also very high. So, in that condition, again all three, that is aerobic bacteria, yeast and mold, all three will grow, right? but, if you lower down the moisture content, you remember, sometime back, we said 50 percent RH.

So, you have reduced the moisture content. So, if you lower the moisture content, the chance of bacteria or yeast invasion or bacteria infection is minimized. Only there is condition, where molds may grow. You have seen at home also.

When you are going for a long period of time out of home, your mummy and others, seniors, they are tightening the cap, typically for oil or such liquid foods, primarily oil, because at home it is primarily that they make it here that the cap is tightened. That means, you are not allowing moisture from outside to inside to go. So, that the growth of mold also is minimized.

Yes, bacteria or yeast will not grow, but the moisture at low condition, molds will grow. This is within presence of air. So, what is in absence of air? So, in absence of air, it could be anaerobic bacteria, it could be yeast and these two are primarily in absence of air, it is grown, right? and under that, again, there are two conditions, one is high moisture where anaerobic bacteria and yeast may grow.

and low moisture on the right side which is not visible here, right? On the right side, here, it is low moisture and the low moisture condition where none of these, that is yeast or bacteria or mold will grow. So, this is called the unique condition where you can keep the food material away from the microbes, that is yeast, bacteria and mold, ok. So, again today time is up.

So, let us thank you for listening to this. Thank you all.