

**Food Packaging Technology**  
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**Week – 07**  
**Lecture – 37**  
**Aseptic Packaging systems**

Hello everyone! Welcome back. We're going to continue with the different packaging equipments and machinery that we have been discussing this whole week. We've already gone through the vacuum packaging machine, CA and MA packaging machines, gas packaging machines. These were quite similar. We talked about another technology on seal and shrink-packaging machine, form fill seal machine and the last one we're going to discuss this week is the aseptic packaging machine. Now, you're already familiar with this topic because we've discussed this in the last module on aseptic packaging.

A quick recap. The definition is filling the product which is sterile in a packaging material which is again sterile and these two are brought together in a sterile environment. Naturally once you hermetically seal it, hermetically means you do not allow the gas to enter into the package. If it's hermetically sealed, you can increase the shelf life of the product to at least one to two years without any cold storage which is a great advantage in the case of aseptic packaging.

You're very familiar with the long shelf-life milk that is available today in the market and this is specially done with the aseptic packaging technology. So, the heating or the sterilization of the product, generally they use UHT which is Ultra High Temperature or the HTST which is the High Temperature Short Time method and both these methods helps in sterilizing a product and the advantage of this is taken by packing it in a sterile environment in a sterile packaging material. So, you also know there's nothing called 100 % sterility. You can only attain commercial sterility that is absence of organisms that can reproduce in the normal conditions. So, these organisms, suppose if they're present, they do not reproduce under normal conditions of storage.

When you come on to the packaging systems that are used, basically for the aseptic packaging systems are four important criteria that you have to meet. Number one, the system must be able to be connected to the processing system in a manner that enables aseptic transfer of the product to take place. It's not possible to keep changing your machinery all the time. So, see that the packaging system is compatible to the processing system. Number two, it must be able to effectively be sterilized before use.

The packaging system should be effectively sterilized. Number three, it should be able to carry out filling, sealing and any transfer operation in a sterile environment. It's not every package that you can seal and fill in the same machine. See that the packaging machine is compatible with the packaging material used. And number four, you must be able to clean it properly after use.

These are the categories of the systems that you use in aseptic packaging system. Cans, very commonly used when for aseptic packaging. Cartons, tetra packs are used for aseptic packaging. Bottles can be used for aseptic packaging. Pouches and cups.

These are the usual aseptic packaging systems that are used in the industry. When you come to the carton system that you have, there are four basic liners that you have in the package itself. These are four basic materials. Some of these materials are repeated so that you get even six layers. It only increases the barrier properties of the packaging material.

Paper board, which is unbleached or bleached. The paper board is the one that gives you the shape and the stability. You can shape it in anything, any way you want just because of the paper board. And it gives you the rigidity and the decorations that you need to add on to your tetra packs. The second layer is your PE.

The PE film is very important because that number one important is the heat sealing. Always remember in most of the packaging systems, it is the LDPE, which is the inner layer. So, once you heat seal, LDPE is heat sealable. So, it is always kept as the inner layer so that it can be sealed. It is also moisture barrier and it has got adhesive effects.

Aluminium foil is one of the most important layers that you can have in a tetra pack because that is one of the best gas barriers. So, once you have an aluminium foil, it prevents the gas from coming in or leaving the package, which is very important because a gas barrier property is one of the most important properties in a hermetically sealed container. And these can be repeated, like I said, to make six layers or more if you require. So, in the carton type, the first system that you have is a form fill seal carton. So, you are all familiar with the system where the carton is formed in the line itself.

It is sealed, filled with the product and finally open portion is sealed again. So, let's look at the flow chart. The printed and creased package material roll is taken. A longitudinal strip is made. Usually, they use PET or EVOH.

Sterilize the packaging material. Once it's sterilized and formed, the sterilized product

comes into it and it is finally sealed. Everything is done in a very sterile environment. How to create a sterile environment in a room? Generally, they use UV light. So, you would not have a person coming in and going out in a system where the aseptic packaging takes place.

It will be a room where UV light is produced to create sterile environment. The package, like I said, we sterilize separately and the product is filled in it in a form, fill, seal carton system. There are different ways in which you can sterilize the form, fill and seal cartons. One of the methods is called the wetting method and one is called a deep bath system. Both these cases you are sterilizing your packaging material.

In the wetting system, generally they use hydrogen peroxide as the containing wetting agent is used and that is applied on the inner layer of the material surface. And then pass the coated material through rollers and that will squeeze out the excess liquid and once it is sterilized with the hydrogen peroxide it is allowed to be heated. In a tubular heater, the hydrogen peroxide will be evaporated and this sterilized package can be used for filling. The second method of sterilizing the packaging material is called a deep bath system. Here the packaging material is passed through a deep bath.

It is just like a tub with the solution. You pass it through the bath which contains the hydrogen peroxide which is around 35% at a temperature of 70 degrees. Now at this temperature and this concentration the residence time is usually 6 seconds. So, you pass the packaging through the bath, keep it for around 6 seconds, bring it out and just like the wetting system allow it, there are squeeze rolls which will remove the excess hydrogen peroxide and both the sides are heated with air at a temperature of 125 degrees centigrade which evaporates any of the peroxide residues. And this sterilized packaging material is then used for filling.

So basically, two methods, wet method or the wetting system and the deep bath system. One you apply, one you pass through the bath. Now there are prefabricated cartons that are usually used or preformed. You must have seen the webs of cartons which have got the crease where you can fold it. This also comes in many of craft papers where the crease is formed and children just have to fold it.

Same way you have preformed cartons which are finely shaped in the filler. The top seaming is formed, top seam is the open ends are brought together, top seam is formed and sealing is done. It is sterilized in one of the methods that we just talked about. Again, it is filled with the product, the top portion is folded, top is then sealed and fold the protruding ears. Protruding ears are the two ends that you see in your tetra pack.

Any beverages that you see in your tetra pack you might have seen them protruding ears. That is done in the end. There are ways in which you can sterilize your preformed cartons also. This is done inside the surface; it is sterilized with 35% hydrogen peroxide and the delivery is through a fine vapor. You give hydrogen peroxide in the form of a fine vapor or spray in hot air and that gets condensed on the surface.

And then you need to remove the excess hydrogen peroxide after sterilization. That is done by using a hot air jet of around 170 to 200 degrees centigrade or another method if you do not want to use hot air is irradiation. You irradiate the sterilized carton for 10 seconds with high intensity of UV radiation and then you can finally remove it by hot air jets. This ensures that all the hydrogen peroxide residues are removed. Let's look at the can systems that we use.

The can system will use superheated steam at temperatures of 225 degrees centigrade for around 40 seconds for sterilization. So basically, there are three types of cans. You can have tin plates, you can have ECCS or the aluminum cans. The size is around you can have 125 milliliters to 22 liters. That is the range in which you can have you can system size.

And this superheated steam is used to maintain asepsis. Asepsis is absence of infection or microbes that cause infections. There is a less headspace because of this because they use the superheated steam and either sterile air or nitrogen is blown in this headspace. Why? To prevent excessive vacuum from developing there. And you can use composite cans also in this aseptic can system.

There are different can types based on the method of construction. You have a three-piece can, two-piece cans. I am not repeating the whole thing because the whole thing has been done in your second module already. In three pieces can, the body which is seamed in the centre and the top portion and the bottom portion which makes it a three piece can. while in the two pieces, actually it is made from a single body, a single sheet.

You can use a draw or redrawn method and you get a cup, you draw it and redraw it. So actually, this whole thing, the body and the bottom is one piece. And then you just have to cover it with the top piece. This is a two piece can.

So, it does not have a side seam. That you should remember. In a three piece can you have a side seam. In a two piece can you would not have a side seam. And the side seam if they have it in the three pieces can it is usually welded or it can be soldered with tin. So rigid aluminium cans that you see in your carbonated beverages that you will have.

So your aluminium cans that you use mainly for your carbonated beverages, Pepsis, Fantas or 7ups. Those are usually the two-piece cans. You might be very familiar that they do not have a side seam. They are drawn from the same sheet and then you have the top cover. So, this is usually they have drawn or redrawn.

It is called the drawing and the ironing technique. I am sure you all must have studied this in the other modules. And this is just a recap of it. So, this is a three piece can where you have a side seam. You can see that the seaming is important and you have the top portion.

The three piece can include the cylindrical body, top, a lid and bottom portion. These are the typical can sizes that we use in the food industry. And this is the types that you have. You have got an open top can.

You must have seen these are a pilfer proof. What are pilfer proofing? Tamper proof. That means if they are tampered with you will know if the can has been opened. These are easy to fill and handle. You have them as big capacities up to 100 grams to 4.5 liters used for vegetables and fruits and meat products.

You have a key opening can with the reclosure. Generally, you have the key there you can open the lid. At the same time once it is open you have these plastic lids that can be used for a reclosure and this is used for coffee and nuts. And after the key has been used once you cannot put the lid again. You need to have a second lid which is usually made of some kind of plastic and it is flexible so it can be closed. You might also have cans which are key opening cans without reclosure.

This is also very common that is seen in condensed milks where you can actually open it but at the same time you might not have your covers to it. You have to transfer it to another container. So, the can tins have to be removed without much damage to another container for storage. Another is called a slip lid can.

Generally, they use it for cocoa and other dry product. It is a simple reclosure method where you can open it and at the same time close it after it is used. The cans are one system that they use for aseptic packaging. Another system they use is bottles. Glass is the one that they use for your bottle system. Now sterilization here is either by saturated steam under pressure or dry heat.

You can either have it wet steam or under dry heat. Dry heat you need to have extended cooling to prevent breakage and thermal shock. This is not a very much accepted method. In the bottle system other than glass, you can also have the plastics. Now there

are four different systems that are in use.

One is you can have non-sterile bottles. These non-sterile bottles after they are bloomed, they are conveyed to the sterile chambers. Here they are sprayed with the hydrogen peroxide generally and the peroxide residues are evaporated. You can even use PAA for your sterilization and that is rinsed with sterile water. Or another method of having the plastic bottles sterilized, is sterile blown bottles.

Here the bottles are extruded and blown with sterile air. The whole system while you are forming your bottles itself, sterile air is used. It is sealed under sterile conditions and it is introduced to a chamber where hydrogen peroxide is sprayed on it. So, you can either have it as non-sterile and then make it sterile or while forming the bottle itself you can sterilize it and then form it. Third way is sterilization of preformed containers.

Here dry contamination is done without water. Here 5 to 15 mg of hydrogen peroxide is done per preform. And these vapors after sterilization is applied, they are finally heated to remove any residues. You can also have single station blowing filling sealing. That means all these operations like extrusion, blow molding, bottle filling, sealing, everything takes place in a single mode.

This is a very difficult one but it is a very efficient system. Sterility is maintained by high temperature and the sterile air that is there in the system itself. They use HDPE, PP or PETG for this kind of operations. So, we talked about cans, we talked about bottles and you can also have commonly used for aseptic packaging, sachets and pouch system. So, in this form fill seal system can be used.

Vertical system is used to operate in a sterile chamber. The packaging material is passed like we said, like we discussed earlier through 35% of hydrogen peroxide, drained and then it is dried in hot air to remove or it is irradiated under UV to remove the excess of the residuals. The laminate of LLDPE with EVOH is usually used for these kinds of systems. You should understand these are EVOHs added for the extra barrier properties that it can offer. And then fin sealing is done on all sides. Fin sealing, we have already discussed where the end seal protrudes out from the main body.

So, you can actually do, when you open your any packages that you all have, the fin seal helps in the opening. So, this sachet and the pouch system itself can be of different type. You can have bag in pouch systems. Here sterile enclosed product, the transfer part, the inner bag is completely sterilized using a fill process.

You have a bag system which is 1.5 to even 1400 liters. Now in the sachets and pouch

system itself, you got something called a bag in box system where you have the product filled in a bag and this is finally packed in a box which is printed for appeal. In this case what they do is, the sterilized enclosed powder is the transfer part and the inner bag is completely sterilized during the fill process. So, the product is put into the inner bag. The bag size can be 1.

5 to 1400 ml and the EVOH and metalized bed is the barrier in this case. It's very important like we said to have a good barrier inner layer because that helps in increasing the shelf life of the product. Sterilization with filling is accomplished by steam. When you are filling the product and you want sterilization to take place during the filling, you need to use steam. A double membrane in the bags will ensure it is completely tampered free. And after filling, this bag with the product is fitted into a paper board box.

You have another system which is called lay flat tubing system. Here the blow film polymer is found in the form of a lay flat tubing. Only transfer seal is required to form the bag. So, you have it in the tube system, you just need to have transfer seal. This is why it is sterile because of the high temperature of extrusion. And this tube is then filled from a reel to a sterile chamber and this ensures sterilization.

The chamber itself is sterile, then you can fill the product and seal it. But this is unlike a flat system, this is a lay flat tubing system. Cups are also used for aseptic packaging. In the cups, you have preformed plastic cups. Usually, it's made of HIPAs or PP, polystyrene or polypropylene.

You can even have your cup system as your aseptic packaging. I will show you a video of how cups can be sealed. So here you can use preformed plastic cups, usually made of high impact polystyrene which is HIPS and polypropylene, PP. Or you can use co-extruded multi-layered polymers. So, all these are good barrier properties films are used.

The cup is fed into the conveyor belt in a sterile tunnel. And generally, they spray hydrogen peroxide 35% for 3 seconds. Remove excess of the hydrogen peroxide by heating at 400 degrees by compressed hot air. And once the sterilization is complete, then the material is sterilized and you can go in for your filling of the sterilized product. In the form, fill, seal cups where the cups are formed in the system itself.

You fill it with the sterilized product and then you seal it aseptically. You fill it with the sterilized product and then you seal it aseptically. Here the material is fed from a roll into a thermofoamer. A thermofoamer as you know, you can have a web where a mold comes in and under heat you can get any shape of tray that you want. It's called a thermoformed tray or the thermoformed cups.

And these thermoformed cups can be even you can have multiple cups in a single web. So once this is done, there is a lot of advantage to this. One is there is less cost. Simplified handling, high output because you're creating multiple cups at the same time. You have high output, smaller storage requirements and maximum sterility. Now sterilization of the web is done throughout using this hydrogen peroxide bath of 35%.

Residence time generally 15 seconds and you can use air knives and heat. Everything that you need to cut off these cups have to be sterilized also. And the containers once they're formed, sterilized, they're cooled and the sterilization of lid is done separately. The sterilized cups come in filled in with the sterilized product and then the sterilized lids are placed on top of it and it is done in an aseptic condition.

Integrity testing. One of the most important things now is seal integrity. If the seal has even a small pinpoint hole formed, aseptic packaging system will fail. So, the seal integrity, if you want to see if every portion is completely sealed, there is no, it is always hermetically sealed, there is no ingress or gas at any point. So, there are different ways of doing this. One of it is by bio testing. You can use electrolytic testing, dye penetration or bubble testing to see if there are any pinpoint holes anywhere.

Another way is you can also use non-destructive. You don't have to open it or anything. These are all innovative techniques that are used where you can test if it is completely sealed or you can test the integrity of the seal without destruction. You don't have to break the seal or you break the product and check anything. This is based on a stimulus response technique. So, the stimulus they give is generally they give pressure or they can use the price of carbon dioxide or helium or ultrasound.

All this will help you to find out if their seal is not in place properly. You can easily find out. These are non-destructive tests to test for your seal integrity. Another one is you can use response. That is the package movement, pressure change or trace gas detection can be done.

And all this will help you to find out if your seal is properly in place. So, we have come to the end of the session where we discussed in detail on aseptic packaging. We know now that aseptic packaging, if done properly, can increase the shelf life dramatically, even up to one to two years. So that is actually helping to reduce the cost in terms of chilling or storage or refrigeration temperatures that is needed at this time.

I hope you got a fairly good idea of this technique. I will meet you in the next session. Thank you. Take care till then.