

Food Packaging Technology
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Week – 07
Lecture – 32
Vacuum Packaging Machine

Hello everyone. Welcome to the last module of our course on Food Packaging Technology. We have completed six weeks into this course and we are entering into our seventh week. And this week and the fifth module, we will be dealing with the packaging equipment and machinery mostly. We will be going through vacuum packaging machinery, CA which is Control Atmospheric and Modified Atmospheric Packaging machinery.

We are going for the Gas Packaging Machine, Form Fill Seal packaging machines and the Aseptic Packaging Machine. So, basically before I start with today's topic on Vacuum Packaging, let's look at packaging machineries in a whole. So, because there was this development of packaging machinery, it is now possible to efficiently produce packaged goods in large quantities. The packaging industry is growing in such a fast pace, there are a lot of new packaging machinery.

There are a number of new packaging materials available, forms available. If you need to bring them into a particular form, the very most important thing is your packaging machinery, if it has to be done in bulk quantities. So, many operations are involved in the preparation of a package as you know. All the operations that are involved come under the packaging lines. And the packaging line involves a number of machinery and the operations that are usually done is, as you can imagine, you need to measure and fill the product into your package which is most important.

Seal the package which is another operation. Apply the label onto it, then check for the weight and inspect it and prepare each of these individual packages for your shipment which includes putting them in secondary packages and then again in the tertiary, applying your ancillary packaging equipments, applying adhesives and labels and then finally preparing it for your shipment. So, all this comes in the packaging line. So, the packaging line consists of a group of packaging machines with control that can make them work together as one. So, they are actually, these machines are made from different producers.

So, you bring them in a packaging line and put them in order in a sequence so that the package can be in the final form for shipment. In many plants, the packaging line is physically attached to the production line. Okay, so that is easy. So the product that is formed is directly fed into your packaging line. It goes through the conveyor, packaged properly, goes through all the processes that has to be done and prepared for shipment.

So, this is actually an integrated system. But most of the time that is not what happens.

Most of the time, the production and packaging lines are separated and some operators, they ship the bulk quantity to a contract packager in another area. And it is a contract packager who packages it and prepares it for the final shipment. So, the package line receives the products, the containers, the lids, the adhesives, wrapping material, everything that is needed for packaging.

And the different machinery in this integrated system brings them together. So, in the form, fill and seal and delivers the complete package. And one of the first machinery that we are going to deal with is the vacuum packaging. We have already touched on this method of vacuum packaging, when in the fourth module when we went through MA and CA packaging. And in that module, we discussed how Vacuum Packaging is actually a form of modified atmospheric packaging.

Here the food is taken, you completely remove the air and seal it. So, the package actually takes the shape of the product. So, why would it be a modified atmosphere packaging also? Because you are modifying the atmosphere inside the package. Now there it is in the absence of oxygen. A lot of advantages in a Vacuum Packaging.

The most important is shelf-life extension. As your oxygen level comes down, many of your oxidation reactions do not take place. Microbes cannot grow. A lot of reactions are not going in the same pace or the reactions have reduced drastically. Naturally, it all ends up in increasing the shelf life of the product.

Number two, it reduces the volume. You know something that is bulk. Once you remove the air inside it, it shrinks to get the shape of the product. So, the volume that each of the product occupies with the package is drastically reduced. And this all again helps in the shipment process because it reduces the cost, prevents microbial growth as we already discussed because there is less oxygen.

But there is a flip side of this. Because there is a reduction in oxygen, anaerobic organisms which do not need oxygen can grow in vacuum packages. So, that is one of the biggest disadvantages of vacuum package. There is a problem of anaerobic organisms growing if you don't look in for the hygiene. Another advantage of vacuum packaging is prevention of evaporation of volatile compounds.

Everything is inside. One thing that we have to remember is once vacuum packaged, the package will be impermeable to gas. What's the point if you remove the air from the package and still have it permeable? The package is actually going to be impermeable. So, if the package is impermeable to gas, that means your volatile components are also intact inside the package. It will not be allowed to escape from the package.

Another thing is storage for long periods, they use vacuum packages for cereals, nuts, cured meat, cheese, smoked fish, coffee, potato chips. You will recognize that many of the products which are high fat or even products which have got volatile flavors that need to be kept in like coffee can be vacuum packaged to increase their shelf life. For storage for short periods, you can use them for foods like fresh vegetables, meat and liquids.

With that introduction, let's go on to the equipment that are used for your vacuum packaging. There are two types actually, there is something called a nozzle vacuum packaging machine and a chamber vacuumizing packaging machine.

In a nozzle vacuum packaging machine, as you see in the picture, the package is introduced into a nozzle, which actually draws out the air from the package completely and then immediately seals it up. The chamber vacuumizing packaging machine, here they do not have a nozzle, you keep it in the chamber, the chamber is under vacuum and that removes all the air from the package. So, there you can put a number of packages in the same chamber at one time, which is different from your nozzle packaging. So, the applications of your nozzle vacuum packaging can be for your whole fresh frozen poultry number one, for processed meat, for nuts and for bulk packaging of cut vegetables. On the other hand, for chamber you can use a number of other products like your fresh primal is your meat cuts, your smoked and processed meat, natural juices, anything which is in a block and which is solid can be put in your chambers.

One disadvantage is that you will not be able to vacuum package powders materials because that can be sucked in and block the nozzle and other chambers. There is another picture taken from these sources on your nozzle vacuum packaging. Here, you can see that it can be foot operated, so that leaves your hands free in your nozzle packaging machine, while in the chamber it has got one or two chambers. Depending on the design of the machine, you can have a number of chambers where a number of products can be vacuum packaged. This chamber packaging itself, you will have two types.

You will have vacuum skin packaging and thermoforming. In skin packaging, the top and the bottom will be a multi web plastic film. So, both of them are plastics, you introduce your product inside the plastics and then you draw out the air from the package and immediately seal it. While on the other hand, in thermoforming you have these thermoform trays. You already studied the manufacture of thermoform trays, which can be made either by vacuum or by pressure or even by mechanical means.

So, once you have your thermoform trays, these trays are filled with the product, you have a web of your packaging material, flexible film that is kept on it and then you draw out the air again from the package and seal it immediately. So, it's just the way in which they are packed that you have two types which is called a skin packaging, vacuum skin packaging or a vacuum thermoformed package. Again, depending on the number of chambers, you can have a single vacuum chamber machine. So, here again like we said, this is most common and they use plastic bags here, typically used for low and medium volume packages. Small packages, small production line, you can go in for your single vacuum chamber machines.

And this is able to seal your liquids also. If you look at the flow chart, the product is taken in the chamber, you close the lid, the vacuum is developed, it is sealed inside the chamber and you get your vacuum patch product. We will now see a video which demonstrates the working of a single vacuum chamber machine. This video shows the vacuum sealing of products in a vacuum packaging machine. The product is first filled

into the package and introduced into the machine.

A vacuum compressor creates vacuum by evacuating the air in the package and then it is sealed securely. The package collapses taking the shape of the products. This is used especially for fatty foods which have a firm texture as nuts. Now coming to the second one which is a double vacuum chamber machine. The working of a double vacuum chamber machine is just similar to your single except they will have two chambers instead of one.

So, they usually have a spring weighted lids or fully automatic lids. They have usually used it for your medium volume packaging. Again, it is able to vacuum and seal liquids. They are only used to pack fresh meat, processed meat, cheese, candy, chocolates and empty cans. As you see in this picture here, there are two chambers and both of them can be used at the same time or you can use one depending on the volume of product that you have for your packaging.

Again, you have something called an automated belt vacuum chamber machine. So, in the previous two cases, this was batch type. You do use one product; you seal it and you take the next product. In automated belt vacuum chamber, it is a continuous process. One after another the packages are vacuumed, sealed.

The next package is an inline process. This increases the speed and the automation. Usually used in large production areas or industries. It helps to accommodate large products, not just the smaller ones. Larger products can be done in your automated belt vacuum chamber machine.

High speed packages are done of large items. It is able to vacuum, seal your liquids and it is used for fresh meats, processed meat, sausage logs and cheese. If you notice these are the products that are generally vacuum packaged in the market also including your nuts and dates. So, this is a pictographic representation of your automated vacuum chamber machine which is a continuous process. We talk about a thermoforming vacuum packaging machine which is a roll start.

Here, instead of your skin packaging, like I said we have a thermoform trays. This again is for large facilities. Continuous process, unlike your batch process where you don't have to have one package after another it is a continuous process but here instead of using continuous flexible wear, your bottom portion will be a thermoform tray and your top portion will be a flexible film. So, it is a form, fill and seal style. You form the packaging material, you form the thermoform tray, you fill the product inside the thermoform tray, loosely cover it with your top flexible film, vacuum packet and seal it immediately.

And the process is explained here in this flow diagram. Product of the thermoform pockets, top web is laid, vacuum is developed, sealing under vacuum and the vacuum product is produced. This is a pictographic representation of a continuous thermoforming vacuum packaging machine. So, you can see that here unlike the other one it is a

continuous process. What are the advantages of the thermoform vacuum packaging machine? It helps to increase your packaging production speed.

It helps in easy customization for size, color, clarity. From batch to batch, you want to change the color, you can do that for a particular batch and then again change the role to get another color. That can be customized even if you are having a large-scale facility. You have a consistent appearance and it is used to pack fresh marinated meat, sausages, cheese, chocolate, candies and pharmaceutical and medical products.

Look at the structure of a vacuum bag. So, as I said before the material should be impermeable to your gas. So, once your vacuum package, no gas should be allowed to enter or leave the package. Vacuum should be maintained or there should be no gas inside the package. The materials are usually impermeable ones like your polyamides, polyethylene, polyvinylidene chloride and the ethylene vinyl alcohol. So, these are one of the best barrier plastics that are available in the packaging industries.

Property wise these are puncture resistant, good sealing properties and they are oxygen barrier which is the most important property of these materials. And, if this picture is clear, the outer layer is the impermeable layer of polyamide. It has thickness of around 20 micrometer and inside that polyamide layer you will have an inner layer of polyethylene which has a thickness of around 80 micrometers. This can also be an inner ribbed layer of polyethylene itself of thickness 100 micrometer. Now, if you remember inner layers are usually made of polyethylene because polyethylene is heat sealable.

So, it is not the others cannot be heat sealed. So, if you want your package to be heat sealed, your inner layer is usually a polyethylene layer and again an outer impermeable layer of polyamide. This polyamide impermeable layer is an oxygen barrier. You can also incorporate an aluminium foil layer also in case you want it to be a better barrier. Because shelf-life indication, if you want to measure how efficient your vacuum package is, you go in for measuring how many cubic centimeters of oxygen can permeate through one square metre of a material in 24 hours. So, basically, they will not once you have, as you have learnt in the test, they will not take one square metre itself.

They will take smaller layers and see how impermeable or permeable it is to your oxygen in 24 hours and then convert it to one square metre. Look at the permeability for different materials. Your polyamide and polyethylene package if you use, volume is 100 cc of gas is permeable through it. If you use PVDC, more than 10 cc.

That means it is a better barrier property. Ethylene vinyl alcohol, EVOH, 1 cc. So, this is one of the best barriers and one of the packaging materials, that is used for the vacuum packages. These are just pictures from the internet taken for different products as we have mentioned. For poultry, fish, red meat, cheese, nuts and vegetables. So, I hope you have got an idea of the different machinery that are used for vacuum packaging of food products.

This is a very important technology used for a wide variety of products. The next class

will move on to other packaging machineries like your MA and CA packages and gas packages. So, I hope to see you in the next class. Thank you.