Food Packaging Technology
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Week – 07
Lecture – 34
Gas packing machine

We were dealing with some of the packaging machineries that are used and we have already discussed in the previous videos on vacuum packaging machine and the CA and MA packaging machine. Now the first three, the vacuum packaging machine, the CA and the MA and your gas packaging. The principles, the machineries are almost very similar. So, you will see an overlap in topics but I'm sure that you will be able to understand it better. There are very slight differences in these three from each other.

Now you must notice packages in the market that are puffed up. These are your gas packaged materials. And this gas packaged materials are usually filled with your nitrogen. So, your children love little hearts biscuits and things.

So, these are pillow packed and they have got these gases inside to protect them. So, a number of functions are there. We will go into detail in this session for that. Some of the gases that are used in this section are nitrogen like I told you, carbon dioxide, inert gases like your argon and helium. But the most commonly used one is your nitrogen.

One of the reasons is again it protects it from oxidation. Anything that can replace oxygen and fill in the packets, it can be used as a gas package. So, there are two things that are achieved by this way. One, replacement of air with a gas or a mixture mechanically. You have a gas composition that you want to introduce in your package.

You have to flush out your air and replace it with the gas of your composition. Another is by generating the atmosphere within the package either passively or actively. You don't have to actively put in your air and replace it but you will generate it actively and passively. We have already studied about active packaging and how different components are added to either increase or decrease the level of carbon dioxide or decrease the level of oxygen. So that is what is applied in this section.

So, for mechanically replacing your air in the packages, the first method is gas flushing. So, this you know you just involve, you continuously flush in gas into the packaging material. So, this is a very simple operation, very rapid. But what happens is there is a residual oxygen always remaining there. So as soon as you flush it, you expect most of the air to be replaced with the gas that you are flushing in.

And then you immediately seal it up. The advantage is speed and continuous operation. This is going to be a very easy method. The injected gas will dilute the air inside and the headspace and it will push out any air that is inside and replace it with the air gas that you want. But the problem like I told you is residual oxygen.

You cannot assure that 100% of the oxygen is going to be replaced out. You might have 2-5% still remaining inside the package. It's less effective at flushing out air as I told you. You cannot expect 100% removal of all the air that is in the package. Capacity is not as great but still very easy to operate and fairly efficient.

The second one of using a mechanical, replacing the air. Second one is compensated vacuum. Here are two stages. In the first stage, you have a vacuum which will pull out any air that is in the package. So, you can expect the package to crush out.

Once the air is flushed out, then you go in for gas flushing. The gas that you desire, the composition that you desire is then flushed into it. Now in this case, unlike your gas flushing case, you are assured that all the air inside the package has been removed and has been replaced with the gas composition of your choice. That is the difference. So, this is better suited for oxygen sensitive products.

You are almost assured that there is no oxygen remaining in the package. You are going to replace it with either carbon dioxide or nitrogen or a mixture of these. There is another way like these two were the mechanical ways of replacing your air and flushing in the gas. The other way is you allow the atmosphere within the package to build up either actively or passively. So, you are not going to have any direct role in changing the composition of the package.

You are going to allow the package itself to actively or passively change the composition. How is that possible? In the active packaging, you are going to displace or remove the gas in the package. For example, if you add components that can absorb your oxygen or release your carbon dioxide, this can actively keep the composition in the package the way that you want to. Better shelf life is a result of such a product. Again, sealing and barrier properties are important.

Passive packaging on the other hand, you are not adding any components, you are allowing the product whether it is respiring a horticultural product which is respiring. When it respires, it takes up the oxygen in the atmosphere of the package and it gives out carbon dioxide into the atmosphere. That itself is going to change the composition. It can build up the carbon dioxide in the atmosphere of the package. This is going to take a

longer time to achieve the displayed atmosphere unlike your active packaging.

So, the fastest method is your glass flushing or the vacuum method. Slower method is your active packaging method and very slow method but not very less efficient is your passive method. Advantages of gas packaging. The number one advantage like all the other technologies that we studied is prolonged shelf life compared to other conventional methods. Improvement in visual appearance of the packed product.

You can preserve your food nutrients in that gas atmosphere. You are sure that there is not going to be any rancid oxidation taking place. You can preserve the freshness of the food for a longer time without adding much of the preservatives. You are just modifying the gaseous composition inside. You can eliminate preservatives which is very important.

You can actually bring down the preservatives or even completely eliminate it if you are able to remove your oxygen for less oxygen sensitive products. For oxygen sensitive products, you cannot expect to remove all the oxygen inside. And the final advantage is the retention of the original food flavors. You know most of your flavors are volatile. If you can keep the gas inside intact with your gas impermeable packaging materials, the flavor will naturally be retained in the fresh foods.

Foods typically that are packed in your nitrogen gases. So, these are very popular snacks for children. Gas packed products, chips, popcorns, nuts and any other snack foods can be packed in your nitrogen filled packets. Fresh meat can be done.

Pre-packaged lunch meat. Similarly, you can have your vegetables also. Packages like your salad mixes, pre-cut apples and carrot sticks, bacons, wine bottles, emergency ration, berries, anything. If you can reduce your oxygen content and increase the nitrogen or carbon dioxide content to increase the shelf life, that has a big advantage by using your nitrogen filled gaseous packages. So, though the other gases are there, nitrogen is a commonly used gas because it preserves the color, flavor and the texture of the product.

Very important. It prevents the spoilage and extends the shelf life of the product. In case of chips and snack foods, the nitrogen also provides a padding. You see many of these snack foods or the chips that you have, they are very fragile. So, during transportation, any handling, they can easily crack and break into undesirable smaller pieces. But when you have a cushioning effect from the nitrogen that is there in the package, this can actually be protected.

So, it does not have a role in protecting against chemical deterioration but also against mechanical deterioration or breakage, which is also very important. You wouldn't want to open your snack box and see everything in powder. So that is where your nitrogen filled gas pouches play a big role. Moreover, if you just have to fill it with air, that's going to change the color. So, it's always important to fill it with an inert gas like nitrogen or any other inert gases.

So, like other food additives, every preservative has to have its own assessment of safety. So, nitrogen also has to have a rigorous safety assessment. It's usually ascertained as safe to use. The Joint Food and Agriculture Organization and the World Health Organization Expert Committee on Food Additives, which is commonly called JECFA, they have evaluated the safety of food grade nitrogen. And they have found that it is safe upon normal consumption when used in foods following the good manufacturing practices.

Another very important thing, there's no point in filling gas into your package and allowing it to stay if your packaging material is not the right one. So, if you want to have, see that your gas is kept intact, your packaging material should have been highly gas impermeable. So, for flexible and semi-rigid plastics and plastic laminates, they are the ones that I usually use. The glass-plaque plastic containers are most commonly used for as a flexible package. And the styles are you have pouches, pillow packs, top straps, rigid and semi-rigid structures like you know, you have your bottom trays, you thermoform trays along with your cover, which is sealed.

You can have plates and glasses and cups, any form you can have your gas packaging. And the material is what is more important. You can use P polypropylene, polyamide, which is nylon, polyethylene terephthalate PET, again not only a good barrier but also gives it mechanical strength. PVC, polyvinyl chloride, PVDC, polyvinyl dienyl chloride. A polyvinyl dienyl chloride is one of the packaging material or the plastic which is most impermeable to gases.

It's one of the best barrier properties is for polyvinyl dienyl chloride. EVOH is equally good, ethylene vinyl alcohol. These are usually laminated along with your PE or PET to give you a good structure and gas impermeability. Now the semi-rigid structures are usually made up when you have a semi-rigid, not really rigid but semi-rigid ones. They are used PP, PET, PVC or expanded polystyrene.

Any of these can be used when you are using a semi-rigid structure. Let's look at each of these one by one. Ethylene vinyl alcohol. Now if you look at polyvinyl alcohol, PVOH, it has got excellent barrier properties. But the problem is that PVOH in the

presence of moisture, this plastic can swell and can ultimately hamper the barrier properties.

The barrier properties are retarded. So, to provide an extra stability for this, PVOH is usually copolymerized along with the ethylene vinyl alcohol. The ethylene vinyl alcohol is less sensitive to moisture. So, its gas barrier properties are not as good as the PVOH but because it is not much affected by moisture, it is copolymerized with that. And this is used as a gas barrier both in MAP and in gas package fills. PVOH is always laminated in the form of a filler.

Usually you have 5-micron thickness sandwiched between your hydrophobic polymers. And this protects the polymers from moisture. Not only it protects against moisture, it has got good mechanical strength, high oil and organic solid resistance and it is fairly thermal stable also. So EVH is a very good candidate as a packaging material for gas packaged materials.

Second one is polyethylene. Most commonly used packaging material. LDP very familiar to you all by now. Density is around 0.910 g per cm^3.

And it is usually in the form of films. You know you should see most of your LDP is in the form of film. But HTP is usually used for your rigid and semi-rigid containers. Though HP has got you know less gas barrier but its hydrophobicity, it is very hydrophobic, does not allow moisture. It makes it a very good water vapour resistant barrier. Therefore, in gas and in MAP, I told you gas, MAP and vacuum, they are all correlated.

So both in gas and MAP packaging, you can use this as a good moisture barrier. It cannot be used alone. It has to be co-polarized with some other polymers like your, you can have ethylene vinyl acetate which has got a better healing sealing property than your LDP. The third material is your polyamide.

We talked about polyamides in retort packaging also. Because this one has got good puncture resistance also, tensile strength, good abrasion resistance and good air tightness. So, the moisture in the nitrogen structure, it breaks the bond between the chains, adversely affects its properties if there is moisture including the barrier properties. So, if you are keeping these packages which have got nylon as one of the materials, under high relative humidity, what happens is the gas transmission of nylon decreases drastically. But commercially available nylons, they are usually less affected and they have got relatively good strength and rigidity. So, they can be used for your vacuum package of meat and for gas packaging system also.

This can be relatively used. Fourth one is PET. So, these are all commonly used materials that can be incorporated into as a layer in your gas packaging. So PET is the most commonly used name for polyesters in food packaging. It has excellent gas barrier and water vapor barrier properties, high strength, good transparency and high temperature resistance. There is something called a crystalline PET, C-PET. This has got poor optical properties, that means it is not really see through, but it has better resistance to melting when it is heated to a particular temperature.

So, these are usually used as a top cover when you use your thermoform trays. It is excellent for those kinds of properties. Polypropylene, multifunctional. So, any map or gas packaging materials you can use your PP because it is a very good barrier against water, though it is a poor barrier against gases.

PP melts at 170 degrees centigrade. So, it can be used as a container for heating low fat foods in the microwave, but it should not be used to microwave fatty foods because that actually increases your temperature beyond a particular level and can finally result in the melting of the PP itself. The formed PP that is used, laminated with other materials and can be used in combination with EVOH, which is again a good barrier. Polystyrene, the ones that you see most of you thermoform trays. It is stiff and a brittle material used in your gas packaging material. The expanded polystyrene that is formed from low density blown particles, they have been used as a base tray for your fish, your meat, whichever is packed with the polyethylene film.

Now the formed polystyrene has also been used in thermoform trays which are gas packed or map packed. So, the high gas permeability of the formed thing is usually you prevent that by laminating it with EVOH, which is a good barrier property. Polyvinyl chloride, it has got relatively low softening in good barrier properties. So, it is an ideal material again. Not a great gas barrier property but unplasticized PV, it has got better properties.

So oil and grease resistance are excellent. But PVC problem is it can be softened by organic solvents. So usually when you use it in a thermoform tray where you pack in gas or in map, it is laminated to PE so that you can get a heat sealability. PVDC, I already mentioned is one of the best barrier properties both against gases and against water vapour or odour itself. So, unlike your EVOH, the gas barrier properties of PVDC, they are not significantly affected by the presence of moisture. PVDC effectively heat seals to itself and the high temperature can be used for packing, even for hot filling.

You can use sterilization processes; you can use your PVDC. Before we conclude, let's

look at the factors to be considered when you are selecting a gas packaging material. First and foremost, food contact approval. You see that your package will not contribute or migrate any monomers into your package. Number two, it should have excellent gas and water vapour barrier properties.

Three, desirable, not necessarily optical properties. If it is transparent, you can see the product that gives it a more aesthetic appeal. Fourth, anti-fogging properties. You know you have the vapour condensing in the inside portion and it may appear hazy. So, if your package is anti-fogging properties, that is a good property. Mechanical properties, good strength, it should not tear or break in transit or during handling.

And the last, heat-sealing properties, which is very desirable if you want to produce a product which is impermeable to gas and produces a seal which has integrity. Sealing is one of the most important steps in gas packaging. You should never have any leaks anywhere that ensures the gas that you have filled in the package is intact. So, when you talk about sealing, the material that you are using has to be thermoplastic so that once you heat it, it can stick together or join together.

And this heat sealing for joining is typically less than 0.5 mm thickness. The seal that you produce is usually less than 0.5 mm. Now when you heat seal, the two thermoplastic layers will join together, they melt on heating, they fuse and then they seal. So, care should be taken at this step to ensure that the gases that you are filling is still intact in the package.

Now what are the factors that affect the seal? One is the pressure. Another is the temperature. The dwell time, you know the time that you keep the jaws closed so that the package melts and fuses each other, that is important. Each thermoplastic has its own particular range of sealing. Depending on the material you are using, you have to adjust the turn pressure of the sealer.

As stress should not be applied, you see that it is sealed properly. We have already discussed in another section the different types of seals. I just wanted to show you the pictographic representation of a few of these. One is your lap seal. It is very clear from here that the opposite sides of the films are joined together.

Both of them are plastic coatings. So, they melt, they join together, you don't have any overlap. They stick to each other in such a way that they are part of the body. The second type of seal is the fin seal that you see in most of the biscuit packages. Here the two ends, they come together and join but you have an overlap which is not sticking to the body.

It may be crimped or corrugated along the seal for better strength. You must have seen the corrugations that you have on the fin seal and that gives you a better strength. So, when you open, you usually touch the fin seal to open your packages. That also you should ensure that there are no leakages in these fin seals also.

A third type is your bead seal. So, this is usually done at the end of the package. The edges are melted together to form a narrow weld. And this is usually made using a homogeneous thermoplastic. The first two are the most common that you use in the fur industry. We will end with the common defects during sealing.

Sealing I told you is a very important step and one of the defects is cloudiness. Now if you decrease due to the decrease in time of sealing caused by the reorganization of polymers. So, you do not give them enough time, they do not melt to the particular point, they form a cloudiness. It is not completely sealed. Second is the wrinkles in the seal. That again differing or depending on the amount of packaging materials you have on two sides and slipping of the bar if it is not carefully done, you will have wrinkles again through which the gas might pass through.

The third type of defect is a blister. Especially in the hot seal area, you might have an entrapment of water or grease or food particles. Again, the seal will not be proper and you will have a passage of gas which is not desirable in a gas packaging material. So reliable modified atmospheric packaging machines are an important asset in the fur industry. So, these modified atmospheric packages I told you includes your vacuum packaging also.

Gas packaging is another type of modified atmospheric packaging. But when you select the right type of machine, it has a lot of benefits to the food business. It can improve the production efficiency. Number two, it can save the material cost. It can prevent waste and reduce the labor cost.

So, we have gone through another packaging technology, gas packaging technology. But like I mentioned, it is very similar to the vacuum and the MA packages that we have learned in the last two videos. I hope this proportion is clear to you. The advantages of using a gas packaging machine, more important to see that your seal is properly done so that there is no leakage of gases once it is packed.

Lot of advantages to the industry. I hope you have a very good idea about this. I will see you in the next video with another session. Thank you so much.