Food Packaging Technology

Dr. Maya Raman & Dr. Jenny Ann John
Department of Food Science & Technology
Kerala University of Fisheries and Ocean Studies

Week – 02
Lecture – 08
Metal as packaging material – P2

Welcome back to Food Packaging Technology. So, in the last class we were discussing about 3 pieces can. So, it's a part of can manufacturing and we had seen 3 pieces can and what are the different steps that are involved in it. So, in today's session we will be discussing about 2 pieces can and what are the different steps involved in it. We will be also discussing about lacquers which are used to prevent the interaction of can contents with the can wall or the can material. Now coming to 2 pieces can, it is made from disc of metal.

We have thick metal strips are there. Using cupping machine, it is cut into small cups which is drawn and redrawing. The plunger is putting pressure on it, the walls they are drawn. If it is done twice, it is drawn and redrawn.

That is one method of doing and then after that the edges are trimmed. These are washed and then external coating is applied and dried and over which the printing can be done. We also apply varnish to give a finishing appearance and these are again dried or cured. Lacquers are applied on the internal surface. Lacquer is a barrier which prevents the contents from reacting with the metal ingredients. Then again it is dried and here a necking process is given which is almost similar to the flinging in 3 piece and then this is fallotized. The similar tests are done for the disc container also. We see whether it contains any pin holes or any fractures or dents or it can withstand the pressure and impact during storages.

Such tests are being done. After it has been cleared it goes to the packaging section. So, the operation of reforming sheet metal without changing its thickness is called drawing. The operation of reforming a 2 piece can into one smaller diameter that is greater height without changing its thickness it is redrawing. That is why it is called drawing and redrawing that is DRD.

The operation of thinning the walls of 2 piece can by passing through circular dies is called ironing. They have drawn ironed cans and drawn redrawn cans. So, these are the 2 processes by which 2 pieces can be developed that is drawn and ironed drawn and redrawn cans. And drawn and redrawn cans they have greater heights than diameter.

Then drawn and redrawn containers are made of steel or aluminium and they are mainly used for food like processed fish products.

During cutting the metals are coated with waxes. So, this gives lubrication. It enhances the lubrication. DRD process is used to form paper wall flanged cans. Also, it is used to develop into aluminium and steel tapered thin-walled trays and which has heat sealed foil lids which can be used in the food industry. DW cans that is drawn and ironed cans these are used in food industry, beverage industry. These are also used for aerosol cans and these are normally made of from uncoated aluminium or tin plates and drawn iron processed food cans. They are also made of tin plate and during the manufacture of drawn ironed cans the coils are uncoated because subsequent wall thinning is happening. Ironing is done so which is a severe process of coating may strip off. So, for this reason we don't do coating unlike the 3 pieces can where the lacquering is given prior to converting into cylinder and other forms. Here the lacquering or the coating is given in the end. It is not given in the beginning itself because it may strip off during the other processes and also it is a water-soluble material. So, it's synthetic material and it may come off when it is drawn and application of coating and printing it is done at a later part of the process. Now 2 pieces can it includes 14 steps in case of 3 piece can it is 12 steps and here it is 14 steps so we have strips that arrive in large coils. They are thick. These are cupped. They are cut into small pieces. Their cups are passed through series of tungsten carbide rings and they are drawn and ironed and which redraws the cup to a smaller diameter and thins the wall by increasing the height trimmers help to remove the irregular edges. This also helps in getting the precise height. These are washed, dried and these are coated with clear pigmented base which forms the surface for printing. Then it is passed through oven to dry the lacquer and then printing is done. We usually use 6 different colors for printing then we apply a coat of varnish to the base of can. It can be done by a rimmed coater and then again it passes through the oven for second drying and inside of the can is also sprayed with lacquer. It is dried in oven and then it passes through neck flanger where the neck is shaped and it is called necked in process and the tops of the cans are plunged outwards. It can accept the lid and finally it is a testing process where we check the defects and other properties of the can now if you look at the figure down. Here it's a two piece can which is used to develop the aerosol cans. Aerosol cans they have long body we have a plunger which stamps on the foil. So, there's a thick foil which is aluminum slag and it is kept on the mold and a lot of pressure is drawn. So, after successive drawings the cylinder becomes very thin. So, this kind of containers, they are used for aerosols again. It's a two piece can so can making it not only includes the development of body it also includes can ends or lids which are mechanical double stitch. We can also use aluminum or TFS lacquered on both sides and this is a generally a deformation behavior forming lid or forming the ends this is called deformation. It plays a very important role this deformation behavior of the lid it plays a very important role

during filling, seaming, heat treatment and storage. It depends upon the thickness of the metal sheet and the contour of the expansion ring and the milling depth what is to what level it has to be drawn and what is the ring size and the shape of the container. These are determining the deformation behavior. Now the edges of the lids they are stamped on the press from the sheet of tin and generally it is of high hardness and stamping. The edges are shaped to match the upper and lower edges of the body of the can. In the previous class, we had seen how the cylindrical body flanges. When it is passed through the flange, it has a bending which is called flanging and over which the lids come and fit based on the size of the flanging the lids are also designed and the coating is given or seal is applied around the curved region. This seal it can be natural or synthetic rubber which dissolves in water or solvent it is very important during crimping so without proper sealant it is not possible to develop a can lid. So, if you look at the figure here you have a hard metal sheet which is cut into round blank and this blank it is formed into ends. That is the start of curling and the ends. It gets curled and then in the finishing curl it is bent nicely towards inside and this finish curl it depends upon the flanging that has been developed on the body it. It has to fit correctly in position. This has to be in proper place with the flanging in the body and in between the finish curl we put the sealant and this sealant can be synthetic or natural rubber. Now let's see it once again in the demonstration so this is the lid which I was talking about. If you look at the lid, here there's a bend over here and this bend it will be in proper shape with the container so if this is a container the lid has to sit properly. This bend it will come and fit properly so how it is developed it is it depends upon the fringing this bend. This bend is very important and in between the bends you will find a rubber. This is a very thin layer. It's a very delicate layer of rubber which can be scraped off using a metal piece and it helps in sealing and maintaining the airtight container since the canning is also called hermetic container airtight container. This sealant plays a very important role there. When you're sealing it is sealed along the lining. This is a water-soluble material when the lid is placed on the body, we pass it through the seaming machine and it gets sealed here that process is called seaming. We don't add any welding or we don't do soldering, gluing or tapping is not done it is just pressing it and putting it in position and it forms a hook here that process is called seaming. It is also very important; the seam should be throughout and it should be proper for the canning product. Seaming is a mechanical assembly of two parts of rigid metallic sheets of oils without the use of welding, gluing or tapping the two sheets. They are folded or rolled so that they fit together and this technique it ensures air tightness of the closed metal package. The body flange and the curl of the end interlock during the double seaming operation to form a strong mechanical structure and each double seam consists of three thickness of can end and two thickness of can body with an appropriate sealing compound distributed throughout the folded metal to form a hermetic seal. Now, if you look at the figure here this was what I was telling you about so if this is they can lid then you have lining which is a rubberized lining and this is the fold. This is

the can body so this is the flange which has been developed. So, in the first press that is when first seaming is done it forms a hook like this this is a partial hook this is not sealed properly. When it is passed through the second roll it is pressed and it forms a proper hook. In the end of the seal, you will get a structure like this which will have two body parts. If you look at the light blue color. This is two pieces will be there this is from the body and this dark blue color it is from the can lid or they can end so in together. This is five pieces will be there so and in between you will get a rubber lining and this rubber lining ensures air tightness if rubber lining is not their air can easily enter into the container. It is more like a gasket in a pressure cooker or a gasket in a piping. It's a leak proof so that is why liner is important. These are the different parts of hook we have countersink and then body hook the just the hook part where the body is forming the hook then it is a cover hook cover hook is where the lid is forming hook and seam thickness is the entire thickness of the seam and seam height will be the entire height of the seams seam will contain two parts from body and three parts from the can lid so there are some defects which we can see and see first one is called V's it's an irregularity in the double seam due to insufficient or no overlap of cover hook with the body hook. Usually, it happens in small area so when we are doing seaming if there is the double seam is not formed properly that is cover hook and body hook, they are not sitting properly. Then it forms V's a jump seam is a portion of double seam that is adjacent to the juncture of the soldered side seam that is not rolled tight enough so jump seam. It is generally seen at the part where the can body is welded. So, there the thickness is high sometimes it happens that the seaming doesn't have properly so that part may jump over so that is called jump seam. We have deadhead it is an incomplete seam. It is caused by the Chuck spinning in the counter seam of the end during the seaming operation and this seam is also called spinner skidder or slip and we have another seam false seam. That is a seam or portion of seam that is entirely unhooked and which is folded cover hook compressed again the folded body hook. So it is that body has formed a separate hook and the cover has also formed a separate hook so this is again a defect that can happen in the seam now can surfaces it need to be treated with some coating so that it does not react with the contents inside. Sometimes this coating also given on the external surface. This is called lacquer and it increases the shelf life of the metal can as well as it prevents the solubility of cans under high pH or low pH and also in high concentration of sodium chloride then reaction with sulfur from amino acids so for these reasons a coating is given on the steel or aluminum coins. These are generally organic coatings but nowadays we go for synthetic resins and these resins these are more flexible and they help in high-speed manufacturing there are different types of synthetic resins oleoresin compounds which can be natural waxes natural oil-based coatings from fossil gums we can also have synthetic resins like acrylic epoxy phenolic polyester and vinyl resins. Now these resins they can be acid resistant or sulfur resistant that is AR or SR we select or we choose the lacquer based on the contents of the can so we use acid lacquer where the acidity of the

content is very high for example pickles or vegetables or fruits where the acidity is very high that is below 7 in such cases. We go for acid lacquer that is AR lacquer and we go for sulfur lacquer or sulfur resistant lacquer in case of food products where sulfur content is very high for example the fish and meat products where the amino acids contain sulfide this sulfur may react with the metal components and form iron sulfide and hydrogen sulfide the hydrogen sulfide will give the foul smell whereas the iron sulfides it will form the blackening of the contents of black layer will be formed on the surface of the can content so there we use sulfur resistant lacquer to prevent such kind of changes. Now these are different types of lacquers their application properties corrosion resistance ease of fabrication ease of application and their universality in food applications then organoleptic properties and appearance are discussed in this table so lacquers they are of different types epoxy these are synthetic lacquers epoxy acrylic phenolic vinyl organosol polyester laminates polyester coatings and oleoresins in epoxy lacquers. They are universal golden coatings. They are generally used in three-piece and shallow drawn cans and their most widely used coating even acrylic coatings they are universal coatings. They are generally used in beer cans or beverage cans then side seam strip in high solids form welded can so in such cans also the clicks are used as a lacquers phenolics are used as lacquers in drums and pails and vinyl organosol it is used as lacquer in drawn cans easy open ends and it is often used as a mixture of epoxy and phenolic base coat then polyester laminates. These are used in shallow drawn cans and easy open cans and standard ends polyester coatings it is given on internal and external coatings of two-piece and three-piece cans it is usually used in meat fish and vegetable industry and oleoresins lacquers. They have limited use and initially these were applied in all types of cans but then nowadays they are limited in use and coming to the properties epoxy lacquer it has high molecular weight and it is cross-linked with phenolic resins or anhydride hardeners and it's a very good chemical resistance and fabricability and even the acrylic lacquer it has high molecular weight epoxy resin and it can be cross-linked with amino and acrylate resists. It is a waterborne coating phenolic however it's a low-cost poor flexibility but it has excellent resistance to aggressive foods which is highly acidic and phenyl organazole it has PVC dispersed in an appropriate solvent and stabilized with low molecular weight epoxy resins and polyester laminates. It has extrusion coated or laminated film of polypropylene polyester or polyamide and it has good fabricability and it has resistance to corrosion polyester coatings. Similarly, it can be cross-linked with phenolics or amino resins. Again, it has very good chemical resistance and good fabricability and these are the reasons why it is adopted in food industry and whereas oleoresins these are synthetic modifications of natural oils and fatty acids and they are golden colored but these are cheap actually. But they have limited use. So, you can see the corrosion resistance here the first epoxy it is resistant to corrosion and again we have phenolics which is resistant to corrosion and the other lacquers. They are not resistant to corrosion but then polyester it is medium type is not a very good resistance but then it can resist some of the corrosion

and ease of fabrication phenyl organizable. It is easy to fabricate even polyester laminates it can be easily fabricated polyester coatings. Oleoresins can be easily fabricated. Then ease of application, epoxy acrylic; they can be easily applied and polyester laminate polyester coating also can be easily applied and we can use epoxy and polyester laminates or polyester coatings in food industry. When it comes to sensory properties and appearance, epoxy is very good-looking and it is widely accepted phenyl organazole and polyester laminates are also wide acceptance because of its good appearance and organoleptic properties. So, with this let's wind up for this session. In this session we had discussed about 2piece can and what are the different methods by which 2-piece cans can be developed. We had seen the different steps and we have also seen how the lids can be developed from the metal sheet and what is the hook formation? What is a seaming and how important seaming is? Then we ended with lacquering and different types of lacquering and their properties. So, let's wind up for today. Thank you!