Modern Food Packaging Technologies: Regulatory Aspects and Global Trends

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Welcome to the NPTEL online certification course On modern food packaging technologies, regulatory aspects and global trends. Dear friends, in the last lecture we have seen the different cans manufacturing processes for example, 3 piece can and 2 piece cans. Now the can end making process. The topics of discussion in this lecture would be can end making process, can end or cover double seaming, seam components and metal coating. Can ends for mechanical double seaming are constructed for from aluminum tin plate or TFS that is tin free steel.

Aluminum and TFS are always coated on both sides with organic lacquer or film laminate whilst the metal is still in coil or flat sheet form. For tin plate these coatings are optional depending upon the product being packed in the container and the specified external environmental conditions. This is the typical can and the nomenclature is that this is the bottom that we have already discussed that this is the makers end and it is double seam. This is the body cylinder, these are the beads and this is welded side seam and this is the double seam on the canners end and this double seam we will be discussing in detail in the further slides.

The base of a 3 piece can will always be a plain end that is non easy open. For food cans the top may be either plain requiring an opening tool or full aperture easy open. Rectangular solid meat cans employ a key opening device to detach both the scored body sections and makers end. For drink cans the top is usually referred to as a stay on tap enabling the opening tap and pierce-open end section to be retained on the can. The stay on tap end has largely suspended in the traditional ring pull end.

All ends for processed food cans have a number of circular beads in the center panel area to provide flexibility. These allow the panel to move outwards as internal pressure is generated in the can during the heating cycle of the process and so, reduce the ultimate pressure achieved in the can. During the cooling process this flexibility permits the center panel to return to its original position. Ends for beer and carbonated drink cans do not require the above feature as the cans internal pressure is always positive. The plate thickness and temper have to be appropriate to the level of carbonation of the product and if applicable pasteurization treatment otherwise excessive internal pressure may cause can ends to peak or distort.

This is the pictorial diagram of the can lid or the can end making. It is initially it is a straight blank after that round blank cut out from the press tool this is the circular and the blank formed onto end in a press tool then it is slightly curved and then this is the curling with the help of curling tool it is curled. This is the straight here, but after it is curled slightly and after this will go on fix on the flanging during the seaming operation and this part is filled with the compound lining which will make a gasket for the hermetically sealed containers. The end curl sometimes referred to as cover curl is designed to provide sufficient metal to form a good cover hook. Important in this design are proper curl a proper base for sealing compound application and easy feeding of end units into the closing machine.

Sealing compounds to aid in forming a sound double seam a rubber based gasket or sealing material called sealing compound is necessary. Can manufacturers apply the sealing compound into the annular groups of the can ends. The amount of compound used depends upon the type of compound. The can diameter the type of sterilization method used and the style of the container. The type of compound depends upon the product and the method of sterilization.

Lack of compatibility between compound and product can cause softening, smearing and oozing resulting in reduced sealing efficiency. Although the application of sealing although the application of sealing compound to the ends is relatively precise operation equipment capability may provide variances in the placement and amount of sealing compound. As in the case of tin plate variability the amount of sealing compound in the ends must also fan with within a range of acceptability. A double seam is that part of the can formed by joining the body of the can and the end sometimes referred to as cover. The body flange and the curl of the end interlock during the double seaming operation to form a strong mechanical structure.

Each double seam consist of three thickness of the can and the two thickness of the can body with an appropriate sealing compound distributing through the folded metal to form a hermetic seal. This picture demonstrates a double seaming as we have discussed earlier that this is the cover or the lid which we have formed and this is the curl we have made and here in this part curl part the rubber gasket are some compounds are filled and this is the can body this is the can body where we have flanged and this curl will go unfit with the flanged material. And now we can clearly see that thickness that body can thickness are two times it is there in the double seam and there are three parts of the thickness of the can lid is there. So, total five, five times thickness of the original material is there. After the side seam has been welded the bodies are transferred to a flanger for the final metal forming operation.

Necking and flanging for beverage cans and beading and flanging for food cans. The can rim is flanged outward to enable ends to be seamed on. The top of beverage cans is necked to reduce the overall diameter across the seamed can to below that the that of the can body wall yielding savings in the cost of metal through the use of smaller diameter ends. This allows more effective packing and stacking methods to be adopted and prevents damage to the seams from rubbing against each other. Simultaneous creation of the neck and flange using a spin process is used.

Double triple and quadruple necking are also quite common. The latter reducing the end diameter from 68 to 54 millimeter for the common beverage can. For food products where the cans may be subjected to external pressure during retorting or where they remain under high internal vacuum during storage, the cylinder wall may be beaded or ribbed for radial strength. There are many bead designs and arrangements all of which are attempts to meet certain performance criteria. In essence circumferential beading produces shorter can segments that are more resistant to paneling or implosion, but such beads reduce the axial load resistance by acting as failure rings.

The end is then mechanically joined to the cylinder by a double seaming operation. This involves mechanically interlocking the two flange or hooks of the body cylinder and end. It is carried out in two stages. In the first operation the end curl is gradually rolled inwards radially so that its flange is well tucked up underneath the body hook. The final contour being governed by the shape of the seaming roll.

In the second operation the seam is tightened by a shallower seaming roll. The final quality of the double seam is defined by its length, thickness and the extent of the overlap of the end hook with the body hook. Rigid standards are laid down for an acceptable degree of overlap and seam tightness. The main components of a double seam are shown in figure. Finally the cans are tested for leakage using air pressure in large wheel type testers.

Leaking cans are automatically rejected. The process of double seaming is presented in this picture that red part is the body cylinder and which has been flange. This has been flange and this is the green part is the lead which has been curled initially and filled with the cementing material or the gasketing material of any type. This is the two stage operation. In the first seaming operation this is loosely tightened so that the flange and the curl is fitted and in the second operation it is pressed tightly so that it is hermetically sealed and the cementing material or the rubber gaskets are the chemicals which are filled here that acts or that helps in sealing the can hermetically.

This is also the same thing that it is presented in a another way that when the in the first stage this is the flange part and this is the lead part along with the this curl end which is filled with the lining compound or the cementing material. In the first stage it is just kept on the body and then in the first seaming operation is it is slightly pressed so that it is completely fit into the this flanged part and the curl part they are fit and in the then it is again pressed and this is the final stage where it is pressed. So this as in the last slide we have discussed this the tight regulatory things have been devised and that is the counter sink depth. This height is the counter sink depth. The counter sink depth is the distance measured from the top of the double seam to the end panel adjacent to the inside wall of the double seam.

The seam thickness the seam thickness is the maximum distance measured across the perpendicular to the layer of material in the seam. As previously mentioned there are three layers of the end metal and the two layers of the body metal or the plastic in the double seam. So this blue part is the end so there are three layers and this is the body cylinder which has got the two layer the total of five layers are there. So this whole thickness is seam thickness. The thickness is an indication of double seam tightness.

However, it should be emphasized that it is only one indication of seam tightness. Now seam width or length or the height. The seam width also referred to as seam length or height is the dimension measured parallel to the hook of the seam. This dimension is somewhat dependent upon the groove contour of the second operation seaming rise. So this is the seam width or seam height or seam length whatever you can say.

Now body hook and cover hook. The body hook whose origin was the body flesh and the cover hook which was formed during the double seaming operation from the end curl reflect the internal aspects of the double seam. These two structures observed in a cross section appear in the interlocking relationship to each other. So body hook it is from the that body cylinder part and the cover hook is from the lead part. Overlap the degree of interlock between the body hook and cover hook is known as overlap.

So this part is the overlap where the overlapping is there from this part to this part is the overlap. Now the metal coatings organic materials are used to provide barrier or decorative coatings to metal containers and closures. These may be in the form of liquid applied coatings and inks or film laminates for three piece cans, two piece drawn containers and can ends the metal is coated and printed while it is flat in coil or sheet form. Prior to the can or end forming operations for two piece drawn and wall iron containers all coating and decorations is carried out after the can body has been formed. The coating of metal coil or sheet is always done by roller coating.

For three piece welded cans with an internal coating it is usually necessary to apply a coating to the inside of the weld area after the body has been made. Container coatings provide a number of important basic functions. They provide the metal from the contents, they protect the metal from the contents, they avoid contamination of the product by metal ions from the container, they facilitate manufacture, they provide a basis for decoration and product identification, they form a barrier to external corrosion or abrasion. The different coatings which are used like a epoxy anhydride these are high molecular weight epoxy resins cross linked with anhydride hardeners, good fabricability with stand beading, very good chemical resistance and it is generally used for internal white coating for three piece cans and ends. The another type of can type is epoxy phenolic they are high molecular weight epoxy resins cross linked with phenolic resoled resins.

They provide good flexibility and very good packed resistance for aggressive acid products and these are most widely used coating, universal golden coating for three piece and shallow-drawn cans. The vinyl organosol the polyvinyl chloride dispersed in an appropriate solvent and stabilized with low molecular epoxy resin or epoxidized soya bean oil and polyvinyl chloride are used for vinyl, good fabricability, superior corrosion resistance and they are generally used for drawn cans, easy open ends often used over epoxy phenolic base coat. Thermoset polyesters, polyester resins cross linked with phenolic or amino resins they are maximum they may contain low molecular weight epoxy resins. They are very good chemical resistance, good fabricability and with stands beading.

They are mostly used in the internal and external coating for two piece and three piece cans and ends for meat, fish and vegetables. Thermoplastic polymer coat they are extrusion coated or laminated film of polypropylene, polyester, polyamide are combination thereof. They are generally used for shallow-drawn cans, easy open and standard ends. The epoxyamine epoxy acrylate they are high molecular epoxy resins cross linked with amino or acrylate resins. They are employed now in water bond coatings and they are usually universal lacquer for beer and beverage cans, side seam strip in high solid form for welded cans.

The phenolics this is the very low cost coatings and they are generally used for drums and pegs where flexibility is not a important criteria. Oleoresinous coatings poor flexibility, but excellent performance of the material resistance particularly for aggressive foods. They are naturally occurring oils and fatty acids with synthetic modification. They are used a general purpose golden colored inexpensive coating once very common, but now very limited use. Thank you very much for today.