Modern Food Packaging Technologies: Regulatory Aspects and Global Trends

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Dear friends, in the last lecture we have seen different metals for manufacture of packaging materials. Welcome to the NPTEL online certification course on modern food packaging technologies regulatory aspects and global trends. In the last lecture we have seen different metals for manufacturing of packaging materials especially the can making processes. In this lecture we will dealing with the can making process. In can making process we will be discussing 3 piece can, 2 piece can and aluminium beverage can and 1 piece cans, draw and wall iron cans, draw and redraw cans advantages of 2 piece can over 3 piece can. Food and drink cans may be constructed either as 3 piece or 2 piece containers.

3 piece cans consist of a cylindrical body rolled from a piece of flat metal with a longitudinal seam usually formed by building together with 2 can ends which are seamed on to each end of the body. The 3 piece can making process is very flexible as it is possible to produce almost any practical combination of height and diameter. This process is particularly suitable for making cans of mixed specifications as it is relatively simple to change the equipment to make the cans of different dimensions. Container size flexibility facilitates the use of pack promotions offering free extra product.

2 piece cans are made from a disk of metal that is performed into a cylinder with an integral end to become a seamless container. To this is seemed a loose end to finally, close the can. Drawing is the operation of reforming sheet metal without changing its thickness. Re-drawing is the operation of reforming a 2 piece can into one of a smaller diameter and therefore, greater height also without changing its thickness. Draw and redrawn containers are often referred to as DRD cans.

Ironing is the operation of thinning the wall of a 2 piece can by passing it through hardened circular dies. The draw and wall ironing process that is DWI is very economical for making cans where the height is greater than the diameter and is practically suited for making large numbers of cans of the same basic specification. 2 piece draw and wall iron aluminium cans are typically used as beverage containers, but may also be used to contain food and non-food products. 2 piece steel and aluminium draw and redraw cans which are shallower than draw and wall iron cans are used as containers for food products including pet foods, tuna, salmon and snack foods and also

for non-food products such as car wax, shoe police and sterno fuel. They also include metal ends for composite can bodies such as frozen fruit juice cans which have bodies made of cardboard or other non-metal materials.

This table 1 shows different types of cans and their typical use in packaging of various food and non-food products like for example, 3 piece cans they are generally made up of steel and products which can be packaged or food juices, spices, aspirin and other non-food items such as paints and glues which includes decorative tins includes aerosols etc. The draw and iron cans are generally made up of aluminium in the form of 1 and 2 piece cans and they are generally used the 2 piece cans primarily used for beer, carbonated beverages, juice whereas, the 1 piece can that is used for aerosol and pump products for example, perfume, air freshener, saline solution and fuel additives. When this draw and wall iron cans are made up of steel so, they are made up only 2 piece cans and that is used for food and other non-food items. The 2 piece draw and redraw cans are made up of both steel and aluminium and it can be used for food, shoe polish, sterno fuel, car wax other non-food items. The can ends are also made from this steel and aluminium and all ends can be made except for 1 piece draw and iron.

Crowns and closures that is generally made up of steel and that is used for food and non-food items. Can manufacturing processes can be broadly grouped into 2 piece and 3 piece can body manufacturing and can end manufacturing and can end manufacturing. 2 piece can manufacturing includes cans manufactured by the draw and wall ironing and draw and redraw processes. Can manufacturing processes are described in detail in further slides. The 3 piece can, 3 piece can bodies are made from flat sheets cut from coils of tin plated or tin free steel depending on the end use.

The tin plating is applied to prevent rust. Tin free steel is electro coated with a layer of metallic chromium covered by a layer of chromium oxide. Before the bodies are formed coatings are usually applied to the interior and exterior surfaces with a roller on to the flat sheet. This picture denotes the various parts of a complete can generally the beading the when this lower end is fixed that is generally called as the makers end. This is the body cylinder these are the rips and this is the seam that side wall seam and then this is the canners end which is generally opened and this whole portion is called the canners end component.

The interior coatings are applied to protect the can from corrosion by the contents and are to protect the contents from being contaminated by dissolved metal from the can. Occasionally however, pigmented interior coatings are applied to enhance the visual appearance of the inside of the can. After the can is fabricated some facilities spray the interior with additional coating to cover any defects in the roller applied coating.

Exterior coatings are applied for decoration to protect the can from corrosion to protect the printed designs from marring or abrasion or to reduce friction on the bottom of the can to facilitate handling. Typical exterior coating operations are base coating, size coating, decorative ink and over varnish application, bottom coating, side seam strip application and repair coating.

The making process of 3 piece cans the flow charts is like this. The steel sheets are fed to a conveyor by a sheet feeder. Then the sheets are transferred to the coater where the coating is transferred from a tray to the roll coater by a series of rollers then is applied to the sheets. After passing horizontally through a short flash of flash of area the sheets are picked up by wickets and conveyed through a wicket oven. The curing oven operates at temperature of up to up to 218 degree Celsius.

The typically multiple heating zones are required to achieve the temperature profile that results in proper curing of coatings. The heating zone is followed by a cooling zone that cools the sheet using ambient air from inside or outside the plant. Line speed range from 60 to 110 sheets per minute depending on the design and age of equipment and the type of coating used. This is the pictorial diagram for making the 3 piece can. From here the sheet enters that sheet is cut into pieces and then it it is passed through the coater where the lacquering is done.

After lacquering is done it is passed for the thermal coating and after thermal coating it is divided into the actual size of the cans and then the printing is done as per the actual size of the cans and that printing is again cured with the UV light and then it is cut to the that body cylinder size. Then the cylinder is made and the side seam is welded. After that it is decking and flanging. Flanging is required for the seaming operation where the lead can be fixed and after fixing the bottom that is the makers end it is beaded and after beading the product is filled inside the bottom is fixed that is the makers end then it is stored for the palleting and from here it will send to the filling area where the product is filled and then it is double seamed and then it is transferred to the mass for sale. And after sale product is consumed the empty tins are again recycled and sent to the industry where the rolls are formed and this process is repeated n number of times.

For food cans the can body now passes through a flanging machine where the top and bottom of the can body are flanged outwards to accept the can ends. For drink cans the top and bottom edges of the can body are necked in to reduce the diameter prior to the creation of the flanges. This permits ends to be fitted which are smaller in diameter than that of the can body. reducing the cost of the end and the space taken up by the seamed cans. For both food and drink cans one end is then mechanically seamed on to the bottom of the can body.

This end is commonly referred to as the makers end where easy open ends are fitted to three piece cans. It is common practice for this end to be fitted at this point leaving the plain end non easy open to be fitted after filling. This practice allows the seamed easy open end to pass through the finished can testing process. The end applied by the packer or filler after can filling is commonly referred to as the caners end or CE. At this stage tall food cans height to diameter ratio more than one pass through a beading machine where the body wall was circumferentially beads formed into it.

The beads provide additional hoop strength to prevent implosion of the can during subsequent heat process cycles. All cans finally, pass through an air pressure tester which automatically rejects any can with pin hose or fractures. This completes the manufacture of empty three piece food and drink cans. Now the two piece can the two piece cans are made by forming a cup shaped container with one piece of aluminum or steel and attaching an end to it. Two piece cans are manufactured either by the draw and redraw process or by draw and wall iron process.

After the fabrication process various coatings are applied and cured. A classification of two piece can draw and wall iron process that is aluminum beverage can and one piece cans. Two piece draw and wall iron steel food cans and draw and redraw process that is a DRD process. The making process flow chart includes that a metal coil is continuously fed into a copper that stamps shallow metal cups from the coil. In the draw and iron process each cup is stamped placed on a cylinder and forced through a series of rings of decreasing annular space which further draws out the wall of the can and iron out folds in the metal.

After the draw and iron step the can bodies are trimmed to the desired length and washed to remove lubricants used in the draw and iron step. Beverage cans are typically conveyed directly to the printing and varnishing area after washing. However, about 10 percent of beverage cans first receive an exterior base coat due to customer preference. The base coat is transferred from a feed tray through a series of rollers and on to the can which rotates on a mandrel. The base coat is cured at 176 to 205 degree Celsius in single or multi pass continuous high production ovens at a rate of 500 to 2000 cans per minute.

The DWI cans are constructed from uncoated tin plate or aluminum. However, DWI cans are processed food are only made for tin plate as thin wall aluminum cans do not have sufficient strength to withstand the heat process cycles. For this purpose the coiled metal as it is unbound is covered with a thin film of water soluble synthetic lubricant before being fed continuously into a cupping press. This machine blanks and draws multiple shallow cups for each stroke. The cups are then fed to parallel body making

machines which convert the cups into tall cans.

This is the drawing and ironing process where the cups are first redrawn to the final can diameter and then rammed through a series of rings with tungsten carbide internal surfaces which thin the can wall whilst at the same time increasing the can height. This is the pictorial diagram for making draw and wall ironed cans. Here the blank is taken and then it is pressed and press three times here three times that pressing operation or ironing operation is done and the which makes the base of this and then that trimming is done when it achieve the desired length then trimming is done then necking and then flanging. For food cans which will ultimately receive a paper label and external coating is applied by passing them under a series of waterfalls or clear lacquer which protects the surface against corrosion. After all the mechanical forming operations have been completed every can is tested by passing through a light tester which automatically rejects any can which any cans with pin holes are fractures.

Pre coated laminated and printed tin plate or TFS is fed in sheet or coil form in a reciprocating press that may have single or multiple tools. At each tool station the press cycle cuts a circular disc blank from the metal and whilst in the same station draws this into a shallow cup. During the drying process the metal is reformed from flat metal into a three dimensional can without changing the metal thickness at any point. After this single draw the can may be already at its finished dimension. However, by passing this cup through a similar process with different tooling it may be redrawn into a can of smaller diameter and greater height to make a draw and redraw can.

This process may be repeated once more to achieve the maximum height can. At each of these steps the can base and wall thickness remain effectively unchanged from that of the original flat metal. This is the pictorial diagram of draw and redraw processes where the single or the different tools are used for making the cans without changing the thickness of the can. Following this body forming operation necking flanging and beading operations follow according to the end use and height to diameter ratio of the can as for the three piece welded cans. For all two piece cans pin hole and crack detection on finished cans is carried out in a light testing machine.

This measures the amount of light passing across the can wall using high levels of external illumination. One advantage of two piece cans is that there is only one can end instead of two meaning that one measure critical control hazard point is eliminated. The single drawing process is also used to make aluminum or steel tapered shallow trace for eventual heat sealing with coated metal foil. The container bodies are constructed from metal laminated with organic film. The single drawing process is also used for the manufacture of folded aluminum baking trays and take away containers.

In this process the aluminum is allowed to fold as the metal is converted from a flat sheet into a shaved container. These are the advantages of two piece can over three piece can. It has got good sealing to ensure product quality, beautiful and generous, high production efficiency, safe raw materials. The typical can of three piece and two piece are given in this. This is the seamed base, this is the body cylinder and this is ribs or the beads are formed and, this is the welding that side seam and this is the top or the canners end which can be fitted the easy open ends and this is the two piece cylinder are the cans where there is no makers end there is only one the canners end. Thank you very much.