Modern Food Packaging Technologies: Regulatory Aspects and Global Trends

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Dear friends, welcome to NPTEL online certification course on Modern Food Packaging Technologies, Regulatory Aspects and Global Trends. We were discussing the manufacture of paper boards and we have done up to the dewetting process. Now, the drying the moisture is reduced to less than 10 percent depending on grade by pressing the sheet over a steam heated cylinders. Some machines include in their drying section a very large heated cylinder with a polished steel surface. This is an machine glazing cylinder also known as a Yankee cylinder.

Paper can be produced with a glazed surface on one side and on some board machines the machine glazing cylinder is used to produce a smooth surface whilst preserving thickness thereby giving higher stiffness for a given grammage. A starch solution is sometimes applied towards the end of the drying section to one or both sides of the sheet. This is known as surface sizing. It improves the strength and finish of the sheet and anchors the fibers firmly in the sheet.

Squeezing the sheet through a series of steel composition rolls can enhance smoothness and thickness uniformity. This is known as calendaring. Paper may be calendared at high speed in a separate process known as supercalendaring. Now the coating white pigmented coatings are applied to one or both sides of many types of paper and board on machine.

The coatings comprise mineral pigments such as china clay and calcium carbonate and synthetic binders that is adhesives dispersed in water. Excess coating is usually applied it is smoothed the excess removed. A number of techniques may be used metering bar, air knife or blade coating. One, two or three layers of coating may be applied.

Coatings are dried by radiant heating and by passing the sheet over steam heated drying cylinders. This may be burnished or polished depending on the required appearance, color, smoothness, gloss and printing properties. Coatings can be applied offline. In the cast coating process, the smooth wet coating is cast against a highly polished chromium plated heated cylinder. When dry the coating separates from the metal surface leaving the coating with the high smoothness and gloss.

Reel up finally, the paper on board is reeled up prior to finishing. The finishing, the large diameter full machine width reels of paper and board are then slit into narrower

reels of the same or smaller diameter are cut into sheets to meet customer and market needs. Sheets may be guillotined, piled turned, counted, ream wrapped, palletized, labeled and wrapped securely usually with moisture resistant material such as polyethylene coated paper or polyethylene film. Appearance, appearance relates to the visual impact of the pack and can be expressed in terms of color smoothness and whether the surface has a high or low gloss that matte finish. Color depends on the choice of fiber for the outer surface and also where appropriate the reverse side as described above the choice is either white, brown or grey.

Other colors are technically possible either by using fibers dyed to a specific color or coated with a mineral pigment colored coating. The performance, the performance properties are related to the level of efficiency achieved during the manufacture of the pack in printing, cutting and creasing, gluing and packing operation. Performance properties are also related to pack compression strength in storage, distribution at the point of sale and in consumer use. Specific measurable properties include stiffness, short span compression that is rigidity, tensile strength, weight strength, percent stretch, tear strength, fold endurance, puncture resistance and ply bond strength. Other performance properties relate to moisture content, air permeability, water absorbency, surface friction, surface tension, ink absorbency etc.

Chemical properties include pH, whilst chloride and sulphate residues are relevant for aluminum foil laminations. Additional barrier and functional performance for food packaging needs can be imparted to paper and paper board by one or more of the following processes. The treatment during manufacture that is hard sizing. Sizing is a term used to describe a treatment that delays the rate at which water is absorbed both through the edges that is wicking and through the surface. It is achieved by the use of chemical shaded during the stock or pulp preparation stage prior to forming in manufacture.

This is known as internal sizing. Traditionally alum a natural resin derived from wood was used. Today several synthetic sizing materials are also available. Paper board used in packaging of frozen and chilled food and for liquid packaging needs to be hard sized. Sizing with wax, sizing with wax on machine.

The acrylic resin dispersion, acrylic resin dispersion that is water based coating. Heat sealable moderate moisture and oxygen barrier available as one side coating on machine. Fluorocarbon dispersion coating high fat resistant one side coating on machine. This term on machine and off machine are commonly used in the paper industry. The machine in question is the paper or paper board machine.

An on machine process takes place as the paper or paper board is being made and off machine is a subsequent process carried out on a machine designed especially for the process concerned. Now, the lamination this process applies another functional or decorative materials in sheet or reel form to the paper or paper board surface with the help of an adhesive and examples are aluminum foil applied to one or both sides provides a barrier to moisture, flavor, common gases such as oxygen and UV light. Aluminium foil laminated to paper, and paper board is also used for direct contact and easy release of foods that will be cooked or reheated in radiation or convection ovens. Aluminium foil is also used to provide a decorative metallic finish as for example, on curtains for chocolate confectionery. Grease proof paper laminated to paper board, the good grease resistance for fat containing products, temperature resistance to 180 degree Celsius for cooking reheat table packs.

If additionally the grease proof paper has a release coating, this product can be used to pack sticky or tacky products. Glassine paper laminated to paper board, grease resistance for products with moderate fat content such as cakes or bake in box applications. If the glassine is colored the pack should not be used in reheatable applications, but food contact approved grades can be used for direct contact with for example, chocolate. The adhesive used for lamination include PVA that is polyvinyl alcohol type emulsions, starch based resin solvent based cross linking compounds, molten wax or polyethylene depending on the needs of the particular laminate. The presence of wax and polyethylene also improves the barrier to water vapor.

When polyethylene is used as an adhesive the process would be described as extrusion lamination. The plastic extrusion coating and lamination, polyethylene heat sealable moisture variable. Low density polyethylene is widely used in the plastic extrusion coating and laminating of paper and paper board. Easier heat sealing results when polyethylene is modified with EVA that is ethyl vinyl acetate medium and high density polyethylene has a higher temperature limit, better abrasion resistance and higher barrier properties than LDPE. One and two side coatings are available.

Polypropylene heat sealable moisture and fat barrier, it can withstand temperatures up to 140 degree Celsius and is used for packing foods to be reheated in ovens up to this temperature. One or two side coatings are available. Polyethylene terephthalate that is popularly known as PET heat sealable, polyethylene terephthalate heat sealable moisture and fat barrier. It can withstand temperatures up to 200 degree Celsius and is dual ovenable. microwave and conventional ovens. It is coated only on the non-printing side. Polymethyl pentane PMP moisture and fat barrier and not heat sealable. It is therefore, used as fat sheets deep drawn trays and trays with mechanically looked corners. Polymethylene pentene PMP moisture and fat barrier are not heat sealable. It is

therefore, used as fat sheets deep drawn trays and trays with mechanically locked corners.

It is coated only on the non-printing side. Ethylene vinyl alcohol and polyamide heat sealable fat, oxygen,and light barrier. EVOS is moisture sensitive and needs to be sandwiched between hydrophobic materials such as polyethylene, it can be used as a non-metallic alternative to the aluminum foil layer. Plastic extrusion coating and lamination. Ionomers resin a polyolefin with high resistance to fat including essential oils in citrus fruits and moisture with very good sealing properties is used as a tie layer on aluminum foil when applying polyethylene to foil.

Bioplastic extrusion coatings are now available as a PE alternative. This starch based material is sustainable and meets the EN 13432 standard for compost stability. The process of extrusion is often extended to include extrusion lamination so that a structure such as paper or paper board polyethylene by aluminum foil and polyethylene can be produced one in one operation on an extruder with two extruding units. The picture gives the production of that lamination paper or paper board manufacturing process.

Printing and varnishing. Usually printing and varnishing are associated with the appearance of the pack with respect to the visual impact of the pack through color, information, text and illustration. There are also important functional aspects of printing and varnishing that are important for food packing. All the main printing processes are used. Gravure, flexographic, letter press, silk screen and lithographic paper and paper board can also be printed by the recently introduced digital process. Choice is influenced by the appearance and performance that is the functional needs and commercial aspects such as order size, lead time and price.

The vehicle which transports the pigment and resin from the ink to varnish reservoir to the substrate via the printing plate, varnish pickup roll etc may be an organic solvent, water or drying oil. In recent years inks and varnishes cured by UV radiation have also become popular and these materials are extremely inert. They give good rub resistance in wet and dry conditions and are resistant to product absorption. The ink contains pigment, cross linking resins and a photo initiator they are 100 percent solid and are dry immediately after printing. The functional requirements include adherence to color standards, light fastness, rub resistance, print to print and print to pack registration and stability within the conditions of use.

For some food products where the print is in close proximity to the food for example, chocolate confectionery it is important that no residual solvents from the inks and varnishes or any other interaction between print and the product affects the food product. Post printing roller varnishes are coating or laminating. Post printing roller varnishing

and coating is usually associated with high gloss and can involve UV cured varnishes. The process can also be used for the application of functional varnishes to meet specific end use needs. The most common example of this is the application of heat shield coatings for blister pack.

Another example of coating is the application of wax. This can take a variety of forms dry waxing where molten wax is applied to one or both sides of a printed paper or a printed cut creased, cotton blank the appearance is a matte finish. Wet or high gloss waxing immediately after coating the printed paper or cotton blank is conveyed through very cold water. This causes the wax to set immediately producing a very high gloss finish. Wax paper board provides water and water vapor resistance.

It can be heat sealable the first liquid packing cartons approximately in 1920 were waxed. Wax is also a good gas barrier and can therefore, protect food products against flavor and therefore, protect food products against flavor loss or ingress of contamination. The main food applications today are for bread wrap, items of sugar confectionery, frozen food and ice creams, cartons and fresh produce corrugated board. Cellulose acetate laminated to paper board enhance appearance after printing. Thank you very much.