Modern Food Packaging Technologies: Regulatory Aspects and Global Trends

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Week – 02
Lecture – 07

Dear friends, welcome to the NPTEL online certification course on modern food packaging technologies, regulatory aspects and global trends. In the last lecture, we have seen about why packaging is required and how it has originated from the time of civilization. In the present lecture, we will discuss about different types of packaging materials and in the first, we will be discussing about the paper. In this the point topic of discussion is introduction pulp and pulping methods paper which includes the paper preparation, beating and refining types of paper, then paper board what are the different types of grades of paper and types of paper boards, then corrugated paper boards. In that we will be discussing about the history, how it originated, then composition, then types of flutes, then paper and paper board manufacturing and properties of the paper and paper board.

The food processing industry selects the packaging material according to food product requirement. Various materials like paper, plastic, glass, aluminum, wood are combination of any of these are used for food packaging depending on their pros and cons. Paper and paper boards encompasses 31 percent of the global packaging market. Paper has environmentally friendly tag attached to it which makes it first choice for food industries.

Paper and board alone are associated with other materials has been used in food packaging or food contact for many years. Paper and board are indeed an essential part of our lives and satisfies many human needs. Pulp, pulp is the fibrous raw material for the production of paper, paper board, corrugated board and similar manufactured products. Paper derives its name from the reedy plant papyrus. The first authentic paper making which is the formation of a cohesive sheet from the rebounding of separated fibres has been attributed to Shih Lun of China in 105 AD who use bamboo, mulberry bark and rags.

About 97 percent of the world's paper and board is made from wood pulp and about 85 percent of the wood pulp use is from spruce, firs and pines. Today an increasing quantity of wood pulp is being sourced from sustainably managed forest defined as the stewardship and use of forests and forest lands in a way and at a rate that maintains their biodiversity, productivity, regeneration capacity, vitality and their potential to fulfill now

and in the future relevant ecological, economical and social functions at local, national and global levels and that does not cause damage to other ecosystems. The pulping, the cell wall of soft woods which are preferred for most pulp products typically contain 40 to 45 percent cellulose, 25 to 29 percent hemicelluloses and 25 to 31 percent of lignin by weight. Compared to hard woods, soft woods have fibres that are generally up to 2.5 times longer.

Pulping refers to the process wherein wood or other fibrous raw materials are reduced to a fibrous mass. The purpose of pulping is to separate the fibres without damaging them so that they can then be reformed into a paper sheet in the paper making process. The intercellular substances primarily lignin must be softened or desorbed to free individual fibres. Pulping is accomplished by either mechanical, thermal, chemical or a combination of these treatments. The most prevalent process is chemical pulping which amounts for more than 70 percent of the worldwide production of pulp of which craft pulping is the most prevalent at about 80 percent.

Now, the mechanical pulping, ground wood pulp is produced by forcing wood against a rapidly revolving grind stones. In the picture it is given that the wood pieces are forced for the grinding of the wood. Ground wood pulp contains a considerable proportion about 70 percent to 80 percent of fibre bundles, broken fibres and fines in addition to the individual fibres. Most ground wood pulp is used in the manufacture of newsprint and magazine papers because of its low cost and quick ink absorbing properties. Thermochemical pulping that is TMP pre steams chips between 110 degree Celsius and 150 degree Celsius so that they become malleable and do not fracture readily under the impact of the refiner bars.

Chemithermochemical pulping that is CTMP increases the strength properties of TMP pulps even further by a mild pretreatment with sodium sulphite. Now, the chemical pulping, the primary goal of chemical pulping is to selectively remove as much as lignin as possible especially from the middle lamella without degrading the carbohydrate components and negatively affecting pulp properties. The pulp and paper industry uses kappa number to express the lignin content of a pulp, a high kappa number indicating a high lignin content. For the production of chemical pulps the bark is removed and the logs are passed through a chipper. This figure depicts how the pulp is made here the bark is removed and which is fed for the energy production and then it is fed to the that chipping and then chips are chemically treated where it is cooled and then it is washed and after washing the bleaching is done and after bleaching again washing is done then we get the pulp.

That different types of chemical pulping is there like alkaline processes which include

soda process and sulphate processes and the another type of chemical pulping is sulphite process. The semi chemical pulping, semi chemical pulping combines chemical and mechanical methods in which wood chips are partially softened or digested with conventional chemicals such as sodium hydroxide, sodium carbonate or sodium sulphate after which the remainder of the pulping action is supplied mechanically most often in disk refiners. The objective of this process is to produce as high a yield as possible commensurate with the best possible strength and cleanliness. The hemicelluloses mostly lost in conventional chemical digestion processes are retained to a greater degree and result in an improvement in potential strength development. Although less flexible semi chemical pulps resemble chemical pulps more than mechanical pulps.

The neutral sulphide semi chemical that is NSSC process applied mainly to hardwood chips uses sodium sulphide and a small amount of sodium hydroxide or sodium carbonate to give a slightly alkaline liquor. The NSSC pulp is obtained in higher yield, but with higher lignin content than in the other sulphide processes. It is used mainly for the manufacture of corrugating medium. Now, the paper and in this section we will be discussing different types of uses of papers that is for the paper, paper board and fiber board. Paper, paper board and fiber board vary in thickness and use.

Paper are thin, flexible and used for bags and wraps. The paper board is thicker, more rigid and used to construct single layer cartons and the fiber board is made by combining layers of strong papers and used to construct secondary shipping cartons. The paper and paper board packaging, the main example of paper and paper based packaging are the paper bags, wrapping, packaging papers and infusible tissues. For example, tea and coffee bags, sachets, pouches, over wrapping paper, sugar and floor bags, carrier bags etc. The multi wallpaper sacks, folding cartons and rigid boxes.

The fourth one is corrugated and solid fiber board boxes that is shipping cases, the paper based tubes, tubs and composite containers. The sixth is fire drums, liquid packaging, molded pulp containers, labels, sealing tapes, cushioning materials, cap liners that is sealing wads and diaphragms that is membranes. Paper and paper board packaging is used over a wide temperature range from frozen food storage to the high temperatures of boiling water. The paper is made from cellulose fibers which is obtained from trees, recovered papers and annual plant fibers like cereal straws. Today about 97 percent of the world's paper and board is made from wood pulp and about 85 percent of the wood pulp used is from spruce, firs and pines.

Preparation, stock preparation is the interface between the pulp mill and the paper making process. In the paper making process utilizing purchased pulps and waste paper which are received as dry sheets, the first step is the separation of all the fibers from one

another and their dispersion in water with a minimum of mechanical work to avoid altering the fiber properties. This process is known as slushing or re-pulping and is carried out in a machine such as the hydra pulper. Beating and refining, stock is prepared by two chief processes commonly referred to as beating and refining. Both processing operations are fundamentally the same.

In many situations the two terms are used simultaneously. Beating and refining are used to remove the strength and other physical properties of the finished sheet and to influence the behavior of the system during the sheet forming and drying steps. The object of beating is to increase the surface area of the fibers by assisting them to imbibe water. The beating also makes the fibers more flexible causing them to become relatively mobile and to deform plastically on the paper machine. The quality and characteristics of the finished paper depend to a great extent on the treatment in the beater.

A sheet formed from an unbeaten pulp has a low density and is rather soft and weak whereas, if the same pulp is beaten then the resultant paper is much more dense, hard and strong. If taken to extreme beating produces very dense translucent glassine type sheets. Now the different types of paper the craft paper, bleach paper, grease proof paper, glassine paper, vegetable parchment, tissue paper, wax paper. Now let us go on the details of each and every paper types of paper. There is the craft paper.

Craft paper is typically coarse with exceptional strength often made on a Fourdrinier machine. The craft paper is typically coarse with exceptional strength often made on a Fourdrinier machine and then either machine glazed on a Yankee dryer or machine finished on a calendar. It is sometimes made with no calendaring so that when it is converted into bags the rough surface will prevent them from sliding over one another when stacked on pallets. Bleached paper, bleached paper is manufactured from pulps which are relatively white, bright and soft and receptive to the special chemicals necessary to develop many functional properties. It is generally more expensive and weaker than the unbleached paper.

Its aesthetic appeal is frequently augmented by clay coating on one or both sides. Grease proof paper, grease proof paper is a translucent machine finished paper which has been hydrated to give oil and grease resistance. Pro long beating or mechanical refining is used to fibrillate and break the cellulose fibers which absorb so much water that they become superficially gelatinized and sticky. This physical phenomena is called hydration and results in consolidation of the web in the paper machine with many of the interstitial space filled in. Glassine paper, glassine paper derives its name from its glassy smooth surface, high density and transparency.

It is produced by further treating grease proof paper in a super calendar where it is carefully dampened with water and run through a battery of steam heated rollers. Vegetable parchment, vegetable parchment takes its name from its physical similarity to animal parchment which is which is vellum which is made from animal skins. Because of its grease resistance and wet strength it strips away easily from food material without defibering thus finding use as interleaver between slices of food such as meat or pastry. Parchment paper with great shock absorbing capability can be produced by wet creeping resulting in extensibility combined with natural tensile toughness. Tissue paper, tissue papers range from semi transparent to totally opaque and can be waxed.

They are generally either machine finished or machine glazed. Machine glazed papers may also be machine finished to improve the smoothness on both sides. Wax paper, wax papers provide a barrier against penetration of liquids and vapors. The major types are wet waxed, dry waxed and wax laminated. Wet wax papers have a continuous surface film on one or both sides which is achieved by shock chilling the waxed web immediately after application of the wax. Dry wax papers are produced using heated rollers and do not have a continuous film on the surface wax laminated papers are bonded with the continuous film of wax that acts as an adhesive. Now, the paper boards, paper is generally termed board when its grammage exceeds 250 gsm that is gram per square meter. Boards can be manufactured in a single fold linear wire. A single cylinder former or on a series of formers of the same type or combination of types.

Multiply boards are produced by the consolidation of one or more web piles into a single sheet paper board which is then subsequently used to manufacture rigid boxes, folding cartoons, beverage cartoons and similar products. One advantage of multiply forming is the ability to utilize inexpensive and bulky low grade waste materials mostly old newspapers and other post consumer waste papers. In the inner plies of the board where low fiber strength and the presence of extraneous materials for example, inks, coatings etc have little effect on board properties. Now the paper boards and their grades and their description. The liner board this type of board having at least two plies the top layer being a relatively better quality usually made on a four driner machine with 100 percent virgin pulp furnace.

Food board this type of board used for packaging having a single ply or multiply construction usually made from 100 percent bleached virgin pulp finish. Folding box board multiply board used to make folding boxes middle piles are made from mechanical pulp sandwiched between two layers of virgin chemical pulp. Chipboard multiply board made from 100 percent recovered that is secondary fiber. Baseboard Board that will ultimately be coated are covered.

Thank you very much. In the next we will be discussing about the types of different paper boards.