



## **Unit I - Topic 3**

### **Manufacturing types Paper and paper board - characteristics**

#### **Introduction**

Pulp is the raw material for the production of paper, paperboard, corrugated board and similar manufactured products. It is obtained from plant fiber and is therefore a renewable resource. 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 spruces, firs and pines – coniferous trees that predominate in the forests of the North Temperate Zone. There are three main constituents of wood cell wall:

- Cellulose

This is a long chain, linear polymer built-up of a large number of glucose molecules and is the most abundant, naturally occurring organic compound. Cellulose is moderately resistant to the action of chlorine and dilute sodium hydroxide under mild conditions, but is modified or dissolved under more severe conditions. It is relatively resistant to oxidation and therefore bleaching operations can be used to remove small amounts of impurities such as lignin without appreciable damage to the strength of the pulp.

- Hemicelluloses

These are lower molecular weight mixed sugar polysaccharides consisting of one or more of the following molecules: Xylose, mannose, arabinose, and galactose. Hemicelluloses are usually soluble in dilute alkalis.

- Lignin

This is highly branched, thermoplastic polymer of uncertain size, built up largely from substituted phenyl-propane units. It has no fiber forming properties and is attacked by chlorine and sodium hydroxide with formation of soluble, dark brown derivatives. It softens at about 160°C.



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The principal differences between paper, paperboard and fiberboard are thickness and use. Paper are thin, flexible and used for bags and wraps, paperboard is thicker, more rigid and used to construct single layer cartons, fiberboard is made by combining layers of strong papers and is used to construct secondary shipping cartons. Paper from wood pulp is bleached and coated or impregnated with waxes, resins, lacquers, plastics and laminations of aluminum to improve its strength, especially in high humidity environments such as are often found around foods. Acid treatment of paper pulp modifies the cellulose and gives rise to water and oil resistant parchments of considerable wet strength. These papers are called greaseproof or glassine papers and are characterized by long wood pulp fibers which imparts increased physical strength.

Kraft paper is the strongest of papers and in its unbleached form is commonly used for grocery bags. If bleached and coated, it is commonly used as butcher wrap. The word Kraft comes from the German word for strong. Acid treatment of paper pulp modifies the cellulose and gives rise to water and oil resistant parchments of considerable wet strength. These papers are called greaseproof or glassine papers and are characterized by long wood pulp fibers which impart increased physical strength.

Papers and paperboards used for packaging range from thin tissues to thick boards. The main examples of paper and paperboard based packaging are:

1. paper bags, wrapping, packaging papers and infusible tissues, e.g. tea and coffee bags, sachets, pouches, overwrapping paper, sugar and flour bags, carrier bags
2. multiwall paper sacks
3. folding cartons and rigid boxes
4. corrugated and solid fiberboard boxes (shipping cases)
5. paper based tubes, tubs and composite containers
6. fire drums
7. liquid packaging
8. moulded pulp containers
9. labels
10. sealing tapes
11. cushioning materials



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12. cap liners (sealing wads) and diaphragms (membranes).

Paper and paperboard packaging is used over a wide temperature range, from frozen food storage to the high temperatures of boiling water and heating in microwave and conventional radiant heat ovens.

Whilst it is approved for direct contact with many food products, packaging made solely from paper and paperboard is permeable to water, water vapor, aqueous solutions and emulsions, organic solvents, fatty substances (except grease resistant paper grades), gases, such as oxygen, carbon dioxide and nitrogen, aggressive chemicals and to volatile flavors and aromas. Whilst it can be sealed with several types of adhesive, it is not, itself, heat sealable.

Paper and paperboard, however, can acquire barrier properties and extended functional performance, such as heat sealability for leak-proof liquid packaging, through coating and lamination with plastics, such as polyethylene (PE), polypropylene (PP), polyethylene terephthalate (PET or PETE) and ethylene vinyl

alcohol (EVOH), and with aluminum foil, wax, and other treatments. Packaging made solely from paperboard can provide a wide range of barrier properties by being overwrapped with a heat sealable plastic film such as polyvinylidene chloride (PVdC) coated oriented polypropylene (OPP or BOPP).

### **Properties of paper and paperboard**

The features of paper and paperboard which make these materials suitable for packaging relate to appearance and performance. These features are determined by the type of paper and paperboard – the raw materials used and the way they have been processed. Appearance and performance can be related to measurable properties which are controlled in the selection of raw materials and the manufacturing process.



## **Appearance**

Appearance relates to the visual impact of the pack and can be expressed in terms of colour, smoothness and whether the surface has a high or low gloss (matte) finish. Colour depends on the choice of fibre for the outer surface, and also, where appropriate, the reverse side. As described above, the choice is either white, brown or grey. In addition some liners for corrugated board comprise a mix of bleached and brown fibers. Other colors are technically possible either by using fibers dyed to a specific colour or coated with a mineral pigment colored coating.

## **Performance**

Performance properties are related to the level of efficiency achieved during the manufacture of the pack, in printing, cutting and creasing, gluing and the 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 (rigidity) strength, tensile strength, wet strength, % 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 lamination. Flatness is easily evaluated but is a complicated issue as lack of flatness can arise from several potential causes, from the hygroscopicity characteristics of the fibre, manufacturing variables and handling at any stage including printing and use. Neutrality with respect to odor and taint, and product safety are performance needs which are important in the context of paper and board packaging which is in direct or close proximity to food.

## **Types of paper**

Paper is divided into two broad categories: Fine papers, generally made of bleached pulp, and typically used for writing paper, bond, book and cover papers, and coarse papers, generally made of unbleached Kraft softwood pulps and used for packaging. Main types of packaging papers are:



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### **Kraft paper**

This is typically a coarse paper with exceptional strength, often made on a fourdrinier machine and then either machine – glazed on a Yankee dryer or machine.

### **Bleached paper**

These are manufactured from pulps which are relatively white, bright and soft and receptive to the special chemicals necessary to develop many functional properties. They are generally more expensive and weaker than unbleached papers. Their aesthetic appeal is frequently augmented by day coating on one or both sides.

### **Greaseproof paper**

This is a translucent, machine finished paper which has been hydrated to give oil and grease resistance. Prolonged beating or mechanical refining is used to break the cellulose fibers which absorb so much water that they become superficially gelatinized and sticky.



### **Glassine paper**



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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.

### **Vegetable parchment**

Vegetable parchment takes its name from its physical similarity to animal parchment, 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 an interleaver between slices of food such as meat or pastry. It was first used for wrapping fatty foods such as butter.

### **Tissue paper**

Tissue papers range from semitransparent to totally opaque, and can be waxed. They are generally either machine – Finished (MF) or machine – Glazed (MG). MG papers may also be machine finished to improve the smoothness on both sides.





### **Waxed paper**

Waxed papers provide a barrier against penetration of liquids and vapors. Wet waxed papers have a continuous surface film on one or both sides achieved by shock-chilling the waxed web immediately after application of the wax. This also imparts a high degree of gloss on the coated surface. Dry waxed papers are produced using heated rolls and do not have a continuous film on the surfaces. Wax-laminated papers are bonded with a continuous film of wax which acts as an adhesive. The primary purpose of the wax is to provide a moisture barrier and a heat sealable laminate.



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### **Types of paper boards**

Paperboards are made from the same raw materials as papers. They normally are made on the cylinder machine and consist of two or more layers of different quality pulps. The types of paperboard used in food packaging include: Chipboard

Chipboard is made from a mixture of repulped waste with chemical and mechanical pulp. It is dull grey in colour and relatively weak. It is available lined on one side with unbleached, semi or fully bleached chemical pulp. A range of such paperboards are available, with different quality liners. Chipboards are





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seldom used in direct contact with foods, but are used as outer cartons when the food is already contained in a film pouch or bag e.g. breakfast cereals.

**Duplex board**

Duplex board is made from a mixture of chemical and mechanical pulp, usually lined on both sides with chemical pulp. It is used for some frozen foods, biscuits and similar products.

**Solid white board**

In Solid white board, all plies are made from fully, bleached chemical pulp. It is used for some frozen foods, food liquids and other products requiring special protection.