3 Notes on packaging materials

Paper-based packaging

*What is wood?*

The outer and inner layers of bark in a tree conceal a layer which contains the plant's food, and it is by means of this layer that the tree itself grows. The main woody part of the tree consists of bundles of cellulose fibres running vertically up the trunk, held together by a material called lignin.

The woody part of the tree consists of about 50% cellulose fibres, 30% lignin, 16% carbohydrates and some 4% of other materials such as proteins, resins and fats. It is principally the cellulose which is eventually made into paper. This is composed of individual fibres which are finer than human hairs and are a few millimetres in length at the most. These fibres are about 100 times as long as they are thick. Lignin is the chemically complex substance which holds the fibres together. It is useful, perhaps, to think of it as the glue holding the tree in one piece.

*Pulping*

To be useful to the papermaker, the raw material must be reduced to a fibrous state. This operation is called pulping, and there are two basic methods: mechanical and chemical pulping. In both processes, the bark is stripped from logs cut to a suitable length at the appropriate stage in their growth. Logs for mechanical pulping may be used directly in 1.2 m (4ft) lengths or, alternatively, they may be chipped, i.e. converted into pieces of uniform size about 15–20 mm long.

Two methods of mechanical pulping are employed. In one, the logs are pressed against the surface of a large revolving grindstone, kept wet by a stream of water which also removes the fibres. In the other system, the wood chips are passed between the two plates of a disc refiner with specially treated surfaces, very close together and rotating at high speed. In this way the wood chips are reduced to individual fibres, but the water-soluble impurities only are removed, and most of the lignin still remains; many fibre bundles and some damaged fibres are also left in the pulp. Much grinder and disc-refined wood pulp is used for newsprint, although substantial quantities are employed as a mixture with chemical pulp for making certain kinds of board. Mechanical pulp is normally made from softwood, typically spruce.
Chemical pulping starts from chips, and removes all materials other than the cellulose fibres by chemical action and solution. The chemicals convert the lignin to a soluble form which is removed by washing. This produces cellulose fibres of a higher purity than those produced by the mechanical processes—they are generally much less damaged and the fibre bundles are fewer. Several different chemical pulping processes are used, and the quality of the pulp depends upon the process, as well as the kind of wood. For packaging purposes, three chemical processes are of major importance. These are the ‘kraft process’ which retains most strength in the fibres, the so-called ‘sulphite’ process which is less strong, and the ‘semi-chemical’ process.

The kraft process. In the kraft or sulphate process, wood chips are digested in a solution of caustic soda and sodium sulphate for some hours, which dissolves out the lignin, leaving the cellulose fibres to be washed. The name comes from the Swedish word ‘kraft’, meaning strength. In its early days, kraft paper was always associated first with a brown colour and second with long fibres and what was called a ‘wild look through’. Because the fibres were long, they did not form a uniform sheet and, when held up to the light, the paper had an uneven density.

Sulphite pulps. The sulphite process uses sulphur dioxide and calcium bisulphite, which are mixed with the chips in aqueous solution and heated to about 140°C. Once again the lignin is dissolved out, leaving the fibres, and after digestion the mass is washed with water and then bleached with another chemical, such as calcium hypochlorite, before pressing into pulp sheets. This gives a very pure cellulose fibre, although the resulting pulp is not as strong as that from the kraft process.

Semi-chemical processing. In the semi-chemical process the wood chips, which are usually from beech or birch trees, are treated partly by chemicals and partly mechanically to reduce them to fibres, hence the name semi-chemical. This semi-chemical pulp is often used for the manufacture of the fluting medium for corrugated board.

Beating

Once the pulp has been produced, it may have to be bleached to make it white, or coloured, or treated in other ways. One of the most important processes in the pre-preparation of fibres for paper making is the so-called beating process. The object here is to rub and brush the individual fibres, and cause them to split down their length in such a way as to produce a mass of thin fibrils which will enable them to hold together in the matted paper more strongly. This process is called fibrillation. The greater the degree of fibrillation we can induce, the higher the strength of the paper can be. Different pulps respond