Materials

Paper

Introduction

Paper is described as a homogeneous sheet of cellulose fibres, which has been formed by the removal of water from a pulp mixture.

Paper is commonly grouped into the following five main grades as presented below:

- Newsprint
- Printing & Writing paper
- Sanitary and Household paper
- Paper-based Packaging Materials and Products
- Specialised paper

Paper is made by drying and compressing either wood pulp or cotton fibre pulp to provide a material with a wide variety of properties depending on the manufacturing and finishing processes. Some processes commonly used to satisfy different performance criteria include impregnating, water-proofing, sizing, fire-proofing, waxing, sensitising, colouring, laminating and coating.

Pulp

Most paper is described in terms of the type of pulp used. The term 'mechanical' for example, refers to paper made from wood pulp which has been ground mechanically to release the fibres whilst 'wood free', (a term meaning 'free from mechanical wood pulp') refers to papers made from pulp broken down by chemicals. The chemical process produces only about half the original weight of wood in useful fibre, but, the resultant paper is superior in strength, brightness, fastness to light and long-term durability to that produced by the mechanical process. Both types of pulp are bleached to remove impurities and give the required brightness.

Pulps for the manufacture of printing and writing grades can come from a variety of fibres such as wood, cotton, hemp and recovered paper, although wood is the main source. Hardwood pulps (chiefly eucalyptus) are used mainly to obtain the required optical properties, such as sheet formation and opacity. Softwoods (mainly conifers) are used to provide strength. The type of pulp used very much relates to the type of paper product produced.

Mechanical Pulp

Mechanical pulp is produced by mixing water to chipped and ground wood. No chemical solutions are added to this pulp and so there is a high content of lignin. Lignin is a natural polymer that binds the cellulose fibres together like an adhesive.

Thermo-Mechanical Pulp (TMP)

Thermo-mechanical pulp is produced by grinding wood chips in a high temperature, high pressure environment without the addition of chemicals.

Chemi-Thermo Mechanical Pulp (CTMP)

Chemi-thermo mechanical pulp is produced the same way as TMP, but with the addition of chemical solutions to reduce the lignin content of the pulp.

Chemical Pulp

Chemical pulp is produced by mixing wood chips with chemicals in order to remove the majority of the lignin. Paper produced from this pulp does not suffer from degradation. The quantity of the lignin remaining within the paper is measured and used to grade the quality of the paper. Papers produced from chemical pulp are very strong.

Recycled Pulp

Pulp made by shredding paper or board that has been previously processed. Recycled pulp is often used to manufacture paperboard and newsprint as well as papers used industrially and in households: toilet tissue, paper towels, facial tissue, paper napkins, etc.

Paper Types

As previously stated, paper is usually grouped into five main classes dependant upon its grade and intended use. Each 'grade' of paper is now discussed in detail.

Newsprint

Newsprint is uncoated paper, made out of mechanical pulp or waste paper, which is used to produce newspapers. Newsprint is an environmentally sound, renewable resource which comes from managed softwood coniferous forests, mainly in North America and Europe. Here, for every tree cut down, two or three more are planted. It is important to realise that newspapers are not responsible for rainforest devastation, as the hardwoods from tropical rainforests are simply not suitable for newsprint production.

In the late 1960s, the de-inking process was developed which allows newspapers to be recycled. This breakthrough provided an extra raw material resource and the chance to alleviate the problem of disposal. However, newsprint cannot be recycled indefinitely because, each time the paper is recycled, wood fibres are broken down until the paper finally loses its strength. Individual fibres can only be recycled four or five times before they break up and become useless. Therefore, a continuing supply of 'virgin' fibre will always be needed to replace them.

In 1991, UK publishers set a target of achieving 40% recycled content in newspapers by the year 2000. The industry met this target four years ahead of schedule. The national average recycling figure now appears prominently in all major newspapers, national and regional, along with the industry's recycling logo. The average recycled content of UK newspapers for the whole of 1998 equalled 52.42% (compared with 46.03% in 1997).

Reference: The Newspaper Society, Bloomsbury House 74-77, Great Russell Street, London WC1B 3DA.

Printing & Writing

Papers used for communication purposes are commonly known within the industry as Printings and Writings. Newsprint, however, is regarded as an important but separate industry sector. Printings and Writings papers span a diverse range in terms of their use, texture, weight, colour and the technical requirements that they must meet. Within the range, there are four categories depending on whether the papers have been made with chemical pulp or mechanical pulp and whether or not they are coated.

Coated papers made from chemical pulp are predominantly used for illustrated books, glossy magazines like Vogue and also for much advertising material. Coated papers made from mechanical pulp are used for the large circulation magazines (Hello, OK!, etc.). One-sided coated papers are largely used in label and poster production. There are non-graphic applications such as silicone-based papers used in the backing paper for sticky address labels.

Uncoated papers are used in a broader spectrum of products with the largest volume being in business stationery, copier paper, computer print-outs and education. Stamps, security papers (e.g. banknotes) and drawing papers are also included in this category. The lightweight papers, typically weighing less than 45g/m^2, are used for airmail stationary products, compact diaries and bibles.

Sanitary and Household

Sanitary paper towels, toilet tissue and household tissue are mainly produced from recycled pulp.

Paper-based Packaging Materials Products

The material known as 'corrugated board' is made by a conversion process in which three or more layers of paper (or paperboard) are laminated together. The middle ply, which is called fluting, is corrugated during the process and the outer layers, called the liners, are glued to the peaks, thus making a liner-fluting-liner sandwich. The resultant material is light but strong, with particular resistance to pressure applied to the vertical line of the corrugation. This gives the finished case a high 'stacking strength'. The paper components comprising corrugated board are discussed briefly below.

Fluting Medium

Fluting paper is actually corrugated and forms the filling between the two liners. Waste-based fluting is made wholly from recovered paper and given the required characteristics through impregnation with starch.

Kraftliner

Kraftliner is a strong paper made predominantly from virgin fibre. All of the UK's requirements are imported from forest-rich countries where the material is produced at integrated pulp/paper mills.

Testliner

Testliner is made entirely from recovered paper and was introduced originally as a substitute for kraftliner. Testliner may be either single-ply or multi-ply and although by far the greater proportion has a brown top layer, it can also be made with a white or mottled surface to give superior printing characteristics. As with kraftliner, testliner is produced in a wide range of weights from 125g/m^2 through to 300g/m^2 and above.

Fourdrinier Chip
Is the lowest quality material and may be used either as a fluting or a liner where strength and appearance are less important. Unlike the other materials, it is not dyed brown and retains a greyish colour reflecting its origins as mixed recovered paper. The grade is much in use in fitments and pads and also in single face corrugated paper.

Converting

Converting is the process of using paper to manufacture paper-based products, such as packaging or consumer products. A converting plant may produce corrugators, paper or corrugated board converters, corrugated box and/or boxboard manufacturers.

Paper Recycling

Research continues to establish the outer limits of recycling but, when those limits have been attained, there will still be paper waste that requires disposal. The three main methods of waste disposal are recycling, landfill and incineration. A tree converted into paper, which then rots into the ground or is burned releases no more carbon dioxide into the atmosphere than if the tree decayed naturally in the forest. Many countries new regard waste incineration as more environmentally friendly than landfill because it can be used for energy recovery. Alternative uses for waste paper are also being explored including waste newsprint being used as bedding material for farm animals.

Internet Resources

The Paper Federation of Great Britain provides a vast variety of data pertaining to the paper industry.

The Department of Paper Science at UMIST provides education and conducts research into all aspects of paper production. The department also houses the Paper Testing Laboratory to analyse paper performance.

The Paper Industry Technical Association provides its members with information on paper and it's associated activities

Technical Association of Pulp and Paper Industry

Pulp and Paper Resources on the Web provides links to information on pulp and paper materials and suppliers of these materials.

The PIRA net Paper and Board Section provide testing and consultancy services on all aspects of paper manufacture, printing and manufacture.