What is Paper?

Paper is an aqueous deposit of any vegetable fibre in sheet form. If you tear a piece of paper you will see a number of minute ‘whiskers’ sticking out from the line of the tear. These are the fibres, they are very small in size (not much more than a millimetre in length) and there are millions of them in any piece of paper.

Paper is made from cellulose, trees being the main source of cellulose fibre (or woodpulp). Besides woodpulp, paper can be made from other materials such as cotton, flax, esparto, straw, hemp, manilla and jute. Some of the pulp properties depend upon the process used to separate the fibres from the timber. The main processes are called mechanical and chemical. (See Making Paper from Woodpulp).

If the pulp mill is close to the paper mill, i.e. it is part of an integrated mill, the liquid pulp is pumped direct to the paper mill. Otherwise, after straining, the pulp is dried and packed into bales. The trees used in papermaking are mainly grown in Scandinavia, North America and Canada. They are cone-bearing, for example, spruce, pine or fir softwoods), and leaf-bearing trees such as birch, beech or eucalyptus (hardwoods).

Recovered paper is a very important source of fibre for the papermaking industry. It is called secondary fibre to distinguish it from the fibre obtained directly from wood (sometimes called primary fibre). Before Recovered paper can be turned into pulp it must be collected, sorted, graded and baled. (See Making Paper from Waste). It is then transported to the mills where further processes are carried out to remove unsuitable materials (contraries) e.g. paperclips, staples and plastic. It is then broken down into pulp and sometimes printing ink is removed from the slurry. (See De-Inking).

In the Paper Mill

The bales of dry pulp are broken up in a hydrapulper (a large circular metal tank in which a mixture of pulp and water circulates). The liquid pulp, looking a little like porridge, is then pumped to machines known as refiners. These modify the fibres by passing them between sets of fixed and rapidly moving metal bars. As the fibres undergo this treatment they are chopped or bruised to varying extents. This operation, sometimes referred to by its older name of ‘beating’, is extremely important as it mainly controls the type of paper being made.

The pulp is now known as stock. It is at this point that the size and colours are added. Size consists of starch or resin whose particles settle on the fibres, producing a surface that does not blur when inked. Dyes are added to colour the paper. Even if the paper is to be white, some colouring is added, as without it the paper has a slightly yellowish look. Quite frequently mineral matter such as china clay is added to the stock, to make the paper less transparent. Such materials are known as fillers.
The Papermaking Process

Now the actual process of changing stock into paper begins. A typical paper machine is approximately 100m long and 4m wide, and can cost over £200 million to build. The machine has a ‘wet end’ and a ‘dry end’. At the wet end, the stock is diluted to 200 parts water and 1 part fibre. The diluted pulp, looking a little like milk, is pumped through a horizontal slit, from where it lands on a fast moving plastic mesh called the wire. The wire is made to vibrate and it has suction equipment below it so that water drains rapidly, leaving the fibres as a mat on top of the mesh. The wire can travel at speeds of up to 2000m/minute. By the time it reaches the end of this section the fibres have become a sheet of paper, though very moist and having little strength. It then passes to the press section. This consists of a number of sets of heavy rollers through which the moist paper is conveyed, on thick felts. Even at this stage the paper ‘web’ is still weak and moist.

It then passes to the dry end which consists of a large number of steam heated drying cylinders, up to 100 or more on large paper machines. Part of the way down the bank of drying cylinders is the size press. It is here that a solution of water and starch can be added to the sheet in order to further improve the surface. Beyond the drying cylinders comes the calender, which consists of a stack of polished iron rollers mounted one on top of the other. Its function is to polish or glaze the surface of the paper as it passes between the rollers.

Still travelling at up to 2000m/minute, the paper now comes off the machine ready for ‘kindling’ into large reels, each of which may contain up to 20 tonnes of paper. These reels are later either cut into sheets or slit into smaller reels according to the type of paper and the customer’s requirements.

A separate process is the coating of the paper with china clay and then polishing it through the calender. This makes art paper, the glossy kind used for pictures. There are 3 main kinds of modern coating processes: blade coating, air knife coating and roll coating. Blade coating is normally done off the paper machine, as is air knife coating. But roll coating is done on the paper machine and can either be a complete coating or a first coat followed by ‘off-machine’ coating by the blade or air knife process.