

A Brief History of Paper

Papyrus gave the name to the word “paper”. The Egyptians pulped and pounded this plant in order to produce flat sheets. These sheets were then dried and decorated. The earliest paper can be dated to 2400 BCE.

But researchers have found ink that is 700 years older. Therefore writing existed before. The Chinese made paper some centuries before the common era. In 105 CE Ts'ai Lun invented paper.

Ts'ai mixed bark, hemp and rags with water, mashed it into pulp, pressed out the liquid, and hung the thin mat to dry in the sun.

The process of paper-making was slowly learnt in other countries.

The Arabs made writing paper in the 8th century.

Papermaking mills were built in Spain, France and Italy in the 12th century.

In the 14th century papermaking locations were built in England.

In Europe in the mid 14th century paper was made by pulping linen and canvas rags. In the 18th century cotton rags were added to the mix.

Demand for paper increased with the development of print technology, so around 1850 techniques were developed for making pulp from trees. White and smooth pulp was required for printing; wood was used as the source material.

The first machine for grinding wood to pulp was patented in 1844. An elaborate mechanical and chemical process breaks wood into usable pulp. Thermo-Mechanical Pulping (TMP) softens the wood chips with steam before they are ground to leave long fibres intact. Chemo-Thermo-Mechanical Pulping (CTMP) is used to reduce hardwood to pulp using sulphuric acid before steaming.

Making paper from wood

The process of making paper from wood started in Germany in 1883. Carl Dahl produced a stronger pulp by adding sodium sulphate to the soda used to process the wood. This “kraft” (strength) pulp is still used for cardboard and newsprint.

The kraft process helped eliminate the troublesome lignin and better still, the chemicals and much of the energy could be re-used.

This process improved the technology of making paper. Before the cellulose content of rags was almost 100% compared with wood which is about 50% cellulose by weight. Lignin was 30% of the

balance in wood pulp. Lignin caused wood-based papers to deteriorate when exposed to light. Carl Dahl solved this problem.

During the industrial revolution paper was mass-produced. The pulp was cast onto a moving belt of felt or on a fine wire mesh. This new technology gave the paper a “grain”. The strain is produced as the paper is quickly dried, trimmed and wound onto rolls while in tension. Handmade papers have the fibres at random and dried flat so do not normally have a grain. To determine the direction of grain, cut a piece of paper, then dampen one side with water. The grain runs along the “valley” formed when the paper curls. Most of the expansion takes

place across the grain as bonding is weaker. The likely cause is the relaxing of the strains trapped during the drying process.

Some powerful chemicals were used in the manufacture of paper pulp. Paper makers produce paper with a pH of between 6 and 7, which is considered acid-free. On the pH scale, which measures the degree of acidity-alkalinity, 7 is neutral and anything lower is acidic.

Acid-free paper

Paper has become a hi-tech product. Nowadays acid-free paper is vital for books and paper products which are intended to last. Acidic paper that has yellows and deteriorates. During production white wood pulp is treated with a base to neutralise the acids. Other materials are added to the pulp. Art paper, for example, is loaded with china clay in order to

provide a smooth and shiny surface suitable for images. Wood pulp papers are inferior in quality to rag-based papers and to vellum, which is derived from animal skin.

Therefore printers need to have a good knowledge of these processes.

Properties of paper

Paper consists of cellulose fibres. These fibres are hygroscopic; they “suck” moisture from the atmosphere. Water “plasticises” the cellulose fibres. It weakens them. Ordinary paper, when wet, has very little strength.

Toilet tissue has “wet-strength” when 15% of its strength remains.

High humidity normally makes the pages of a book swell and buckle.

Cockling is caused by non-uniform drying and shrinkage. When a book comes out from a printer, the pages can often have “waves” in the pages. A book normally adjusts within a week to domestic conditions and the cockling vanishes. However it is worth storing the book flat while it is making this adjustment.

Cockling is magnified if the grain of the paper is not parallel to the binding edge.

Paper expands more across the grain, and with machine-made papers the width to length expansion ratio can be 10:1. A typical piece of paper will expand by 1-2% when wet.

The content of moisture in paper varies from 2-12% depending on the type of pulp and processing used, the degree of refining and the chemicals used. A “normal” water content is between 5 and 7

percent by weight. A sheet of wet paper might contain 20% moisture.

Activities

True (T) or False (F)?

- T F 1) The word “paper” has its origin in the name of the papyrus plant.
- T F 2) Ts'ai mixed mulberry bark, hemp and rags with oil.
- T F 3) Around 1890 techniques were perfected for making pulp from trees.
- T F 4) It was not until 14th century that papermaking locations were built in England.
- T F 5) Lignin causes wood-based papers to green and improve when exposed to light.
- T F 6) Handmade papers have the fibres laid at random.
- T F 7) On the pH scale 10 means neutral and anything lower is acidic.
- T F 8) Acid-free paper is vital for books and paper products which are intended to last.

Tick the correct answer

1) The earliest paper has been dated to:

- a) 1400 BCE.
- b) 2400 BCE.
- c) 3400 BCE.

2) Ts'ai Lun, a Chinese court official, linked his name to the invention of paper:

- a) in 205 CE.
- b) in 105 CE.
- c) in 305 CE.

3) The Arabs were making writing paper:

- a) by the 6th century.
- b) by the 7th century.
- c) by the 8th century.

4) Spain, France and Italy built papermaking mills:

- a) in the 10th century.
- b) in the 12th century.
- c) in the 13th century.

5) The first machine for grinding wood to pulp was patented:

- a) in 1744.
- b) in 1844.
- c) in 1754.

Complete the sentences with the correct word

- 1) Thermo-Mechanical Pulping (TMP) softens the wood chips with before they are ground to leave long fibres intact.
- 2) Chemo-Thermo-Mechanical Pulping (CTMP) is used to reduce to pulp using sulphuric acid before steaming.
- 3) Carl Dahl discovered that adding sodium sulphate to the used to process the wood produced a stronger pulp.
- 4) The kraft process helped dissolve the troublesome and the chemicals; much of the energy was recovered for re-use.
- 5) In some print processes a fine is sprayed onto the surface of the paper to ensure the correct dimensions.
- 6) A typical piece of paper will by 1-2% when wet.
- 7) A “normal” content is between 5 and 7 percent by weight.
- 8) A sheet of wet paper might contain 20%

Keys

True (T) or False (F)?

- F** 1) The word “paper” has its origin in the name of the papyrus plant.
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- T** 3) Around 1890 techniques were perfected for making pulp from trees.
- F** 4) It was not until 14th century that papermaking locations were built in England.
- T** 5) Lignin causes wood-based papers to green and improve when exposed to light.
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Complete the sentences with the correct word

- 1) Thermo-Mechanical Pulping (TMP) softens the wood chips with STEAM before they are ground to leave long fibres intact.
- 2) Chemo-Thermo-Mechanical Pulping (CTMP) is used to reduce HARDWOOD to pulp using sulphuric acid before steaming.
- 3) Carl Dahl discovered that adding sodium sulphate to the SODA used to process the wood produced a stronger pulp.
- 4) The kraft process helped dissolve the troublesome LIGNIN and the chemicals; much of the energy was recovered for re-use.
- 5) In some print processes a fine MIST is sprayed onto the surface of the paper to ensure the correct dimensions.
- 6) A typical piece of paper will EXPAND by 1-2% when wet.
- 7) A "normal" WATER content is between 5 and 7 percent by weight.
- 8) A sheet of wet paper might contain 20% MOISTURE.