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Technology of pulping and paper making

This section presents an overview of the technology used in pulping and paper-making in Australia and New Zealand. It is designed to provide basic and generalised information to assist those readers not familiar with the processes.

A glossary of commonly used terms is also provided in this section.

Pulping & paper making technologies

Details of the pulping technologies and steps in the paper-making process in Australia and New Zealand are presented in this section along with a glossary of terms commonly used in the industry. A basic illustration of a chemical pulp mill and integrated paper machine is shown in Figure 7.

Figure 7 An illustration of an integrated chemical pulp mill and paper machine. Pulp mills can vary considerably, however the paper-making process is relatively constant across all grades of paper. Image: www.gunter.wordpress.com

Fibre treatment

The Australian and New Zealand paper industries have some fundamental differences and these, to a large extent, determine both the end products and the technologies used in processing.

Cellulose fibres make up most of the woody mass of a tree. It is these fibres that are used in paper-making. In its simplest description, the fibres are 'glued' together by lignin, a complex organic polymer of varying composition, and this makes up wood (Fig. 8).

Almost all the fibre used in both countries originates from wood, either long-fibred softwood (generally pine) or short-fibred hardwood (generally eucalypt) trees. A very small amount of 'non-wood' fibre — bagasse from sugar cane — has been used in one tissue mill in Australia in the past. It is far more common for non-wood fibre to be used in mills in Asia, as shown in the statistics in the section on the global industry.

To make paper, the fibres must first be extracted from the wood, breaking the lignin bonds to free the fibres in the pulping process. Trees are harvested, sawn into logs and then chipped, either in the forest or at the pulp mill. The chips are screened to remove fines and oversize material that would adversely affect the pulping operation. In many mills, much (or even all) of the pulpwood is derived from sawmill off cuts and residues, together with logs too small for sawn timber production.

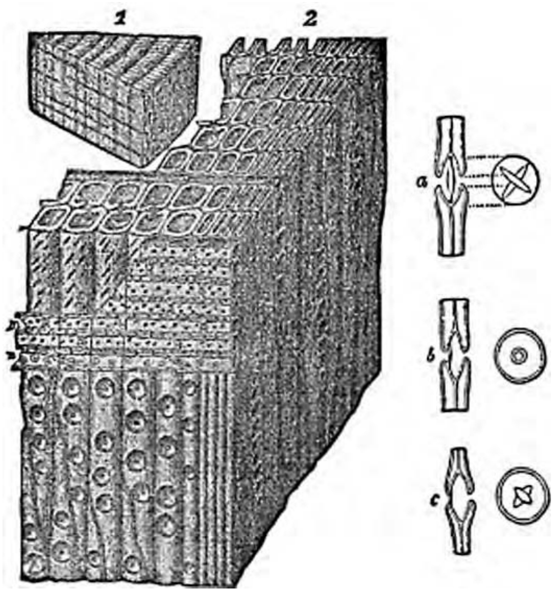

Figure 8 Structure of wood. Individual cellulose fibres are held together by lignin. Image: www.gutenberg.org

Pulping

The properties required of a paper product will often determine what type of pulp can be used and this in turn affects the choice of pulping process. Some pulping processes are suitable only for certain wood types.

Separation of fibres requires energy. This can be either mechanical energy or chemical energy, or a combination of both, together with heat.

Apart from water, wood is typically composed of about 45% cellulose, 25% hemicelluloses, 25% lignin and 5% extractives (other organic matter). Cellulose and hemicellulose are the desirable materials for paper-making and are found in the fibres.

As various materials are removed by pulping, a definition of yield is required before describing the pulping processes. Green wood is roughly 50% water, thus yield is defined as the mass of dry pulp obtained as a percentage of the dry mass of wood used to make the pulp. Commercial yields range from 45% to 99% depending on the method of pulping.

Mechanical pulping

In this process wood is reduced to pulp by mechanical means such as grinding or refining. Fibre breakage is common and lignin remains in the fibre, so the pulps are of limited strength and are not lightfast, but are suitable for use in newsprint and some catalogue grades with limited useful life. It is usually limited to softwoods.

Traditionally, mechanical pulping used grindstones to grind the fibres off the surface of wood billets at either atmospheric or elevated pressure to produce stone ground wood (SGW). This process was used for many years but high energy requirements per tonne of pulp obtained and excessive fibre damage have seen the process largely replaced.

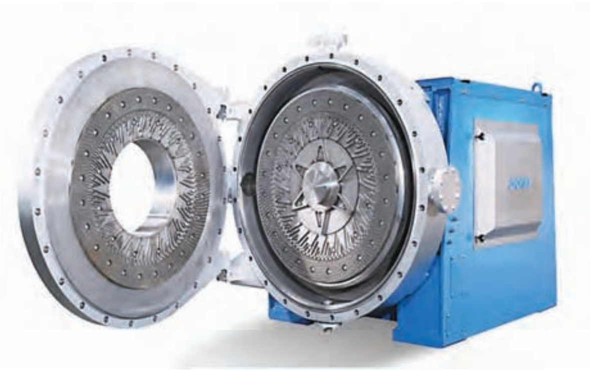

Figure 9 Shows a typical refiner, opened to show the plates. Image: Andritz.

Today, mechanical pulping is generally carried out in refiners, in which woodchips are centrally fed between two parallel circular plates, one of which is rotating. The plates, which are only a few fibre thicknesses apart, have radially grooved surfaces, with the grooves spaced closer together towards the circumference of the plate. The chips are forced from the centre towards the circumference of the plates, during which time the grooves ‘roll’ the fibres from the chip surface. The fibres then pass along the grooves towards the circumference and exit the refiner.

Refining is usually carried out in two stages to achieve the desired pulp properties. The process is called RMP – refiner mechanical pulping. In a modification of the RMP process, the wood chips can be heated with steam prior to and during refining, which softens the lignin and makes fibre separation less energy intensive, but reduces yield slightly. This is called thermomechanical pulping (TMP).

The lignin and other non-fibrous components of the wood are retained in the pulp and the yield is typically 95% to 98%. Mechanical pulps are thus often referred to as high-yield pulps. The process is more suited to pulping long-fibred softwoods than short-fibred hardwoods.

RMP and TMP pulps are suitable for newsprint and certain tissue grades and for some types of packaging grades. Because of the retained non-fibrous materials, they are not suitable where high strength, high whiteness, lightfastness and/or high sheet smoothness are required.

Norske Skog uses the TMP process in all three of its Australian and New Zealand mills, using radiata pine as the wood resource. Pan Pac Forest Products in New Zealand also makes TMP from radiata pine, though they have recently modified their plant to make bleached chemi-thermomechanical pulp (see below). Whakatane Mill Ltd also has a small SGW plant.

Chemi-mechanical pulping

To further reduce electrical energy costs, sodium sulfite or sodium hydroxide in aqueous solution can be added to the chips prior to refining. This is referred to as chemi-mechanical pulping (CMP). The chemicals can also be added to the steaming tube in a TMP process, which is then called chemi-thermomechanical pulping (CTMP). Adding the chemicals dissolves some lignin, thereby reducing yield and also reducing the brightness of the resulting pulp. However, the pulp strength is increased by virtue of more fibres per unit weight and increased fibre bonding potential. Yield is typically 90% to 92%.

Bleaching chemicals such as hydrogen peroxide can be used to increase the pulp brightness. The pulp is then called bleached chemi-thermomechanical pulp (BCTMP). BCTMP yield is typically 85% to 90%.

Amcor’s Petrie cartonboard mill has a pine CMP plant, which closed in 2013. There are currently no CTMP or BCTMP mills in Australia, although there was a BCTMP mill planned for Penola in South Australia, which would have used eucalypt as its wood source. In New Zealand, Winstone Pulp International makes CTMP and BCTMP market pulps. Pan Pac has upgraded its facility to be able to make BCTMP.

Semi-chemical pulping

Where increased strength is required, such as in certain packaging grades, it is important to remove more of the non-fibrous material from the pulp. In semi-chemical pulping, increased quantities of chemicals are used, followed by a mechanical refining stage. The most common process is neutral sulfite semi-chemical pulping (NSSC), where the chips are impregnated with sodium sulfite and sodium carbonate in aqueous solution then 'cooked' at elevated temperature and pressure. The softened chips are then passed through one or two stages of refining to complete the pulping process.

Yield is reduced compared to mechanical pulps – typically 70 to 75%. The chemicals dissolve some of the lignin and other organic materials. The spent chemical liquor is rich in organic matter and could pose a significant waste disposal challenge. However the organic matter has a calorific value, so the liquor can be evaporated and burnt with the heat being used to make steam for the process. The spent chemicals are regenerated for reuse in the process.

Because fibre separation is more chemical than mechanical, hardwood species, such as eucalypts, can be pulped in this process, as well as softwoods. NSSC hardwood pulp is commonly used in the production of corrugating medium. NSSC pulp is used at Australian Paper Maryvale and at Carter Holt Harvey Kinleith.

Chemical pulping

Chemical pulping uses only chemicals to separate fibres and no mechanical energy is required. The most common process is the kraft process, in which chips are impregnated with a solution of sodium hydroxide and sodium sulfide then cooked at elevated temperature and pressure for a period. This process can be used for hardwoods and softwoods and the yield is between 45 and 55%, depending on end use. Kraft pulps are brown in colour, darker at higher yield and lighter at lower yield where there is less residual lignin.

Following pulping, the spent chemicals are removed by washing and the pulp may be bleached (effectively eliminating the remaining lignin) for production of white papers. The main chemical for bleaching is chlorine dioxide (elemental chlorine free – ECF bleaching), which has replaced the elemental chlorine commonly used in the past. Ozone and oxygen can also be used, along with hydrogen peroxide, for a bleaching stage that is totally chlorine free – TCF.

The kraft process produces strong fibre with little lignin and is the process of choice for strong paper and paperboard for packaging (softwood kraft) or printing papers (bleached hardwood kraft).

A major benefit of the chemical pulping process is that it recovers the lignin as 'black liquor', which is concentrated and burned to produce heat energy. In the kraft process the spent pulping chemicals are recovered by a 'recausticising' process. This can make modern kraft mills close to energy neutral, especially if enough heat is available to power a cogeneration plant (Fig. 10).

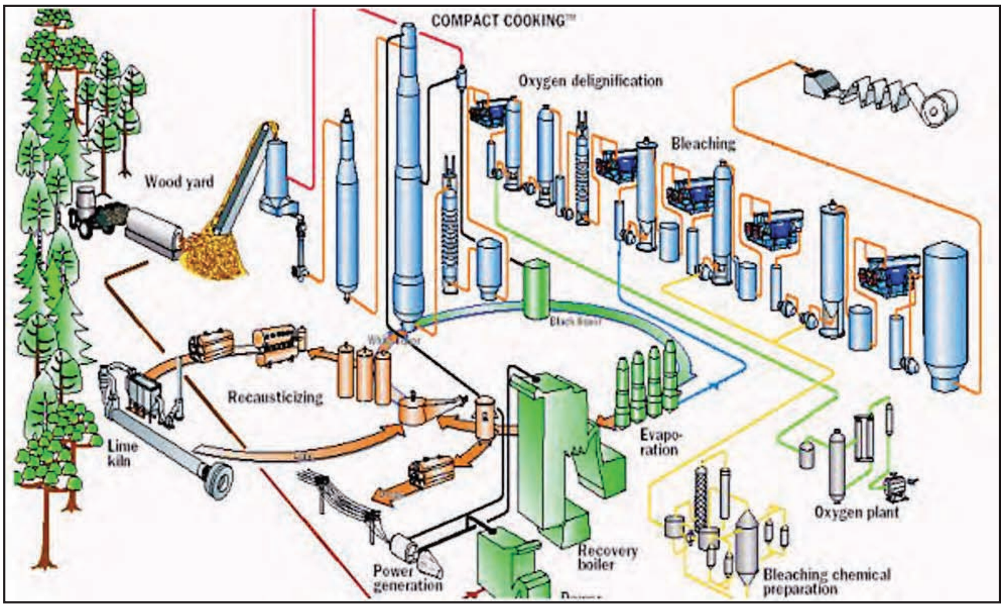

Figure 10 The kraft pulping cycle. Pulping is carried out in the digester. Black liquor is evaporated and burnt in the recovery furnace, and the heat utilised in the process. Spent pulping chemicals are recovered in the recausticising process. Image: Metso.

Comparison of pulping processes

Table 11 compares pulping processes. Moving from mechanical pulping to chemical pulping removes more lignin, thereby decreasing yield, and at the same time reduces the refining energy demand. Strength improves, but at the expense of opacity. Freeness, a measure of the ability to drain water from the pulp, increases. The fines produced in mechanical pulping lead to lower freeness due to fine materials trapping water in the pulp.

Lignin removal from the pulp means there is a potential wastewater disposal issue. This can be quantified as BOD - biochemical oxygen demand. This is a measure of how much oxygen is needed to biologically decompose organic matter in the resulting effluent. As lignin and extractives are removed from the pulp, the BOD released into the pulping system increases. The standard test is usually conducted over a five-day period. The figures in Table 11 are in kg BOD per tonne of dry pulp made.

Recovered fibre

Australian and New Zealand mills make extensive use of recovered paper from the waste streams. Virtually all paper grades, with the notable exception of post-consumer tissue, can potentially be recycled. However, it is noteworthy that in the European Union it has been estimated that about 19% of total paper and board consumption (e.g. sanitary and archival papers) cannot be collected or recycled, limiting recycling potential to about 81%. In many cases the use of recovered paper is limited to the grades from which the paper came – for example, newsprint and printing grades – while some packaging grades can utilise old newsprint and printing papers as well as returned packaging.

Recovered paper processing is defined by the end use, and may be simple slushing for some packaging grades, through to the need to include deinking, screening and cleaning, and refining for printing grades. The utilisation of recovered fibre, in Australian paper and paperboard manufacturing, is approximately 52% of the total fibre used, with approximately 80% of that volume being used in the manufacture of packaging and industrial paper grades. The utilisation of recovered fibre, as a proportion of total fibre use, is similar in New Zealand. In both countries, the balance of recovered paper is exported.

Table 11: Comparison of pulp types and certain properties

	Mechanical RMP, TMP	Chemi-mechanical CTMP, BCTMP	Semi-chemical NSSC	Chemical Kraft
Yield %	97 ◄──► 94	90 ◄──► 80	80 ◄──► 60	60 ◄──► 40
Refining energy kWh/t	2400 ◄──► 2000	2000 ◄──► 1000	500 ◄──► 200	
Freeness,	100 ◄──► 200	200 ◄──► 400	400 ◄──► 600	600 ◄──► 800
BOD, kg/t	10 ◄──► 20	20 ◄──► 50	50 ◄──► 100	200

Paper-making

The fundamental process of paper-making is very simple – take diluted slurry of wood fibres in water, filter it through a fine mesh so that the water drains away, press the wet mat of fibres to remove most of the remaining water, and then allow it to dry. Paper has been made this way for nearly 2000 years following its invention in China in 105 AD, but it was not until about 200 years ago that the process was mechanised.

Today's paper machines follow exactly the same processing steps as did the ancient Chinese – filter the fibre slurry, press it, and dry it. This can be done in plies or individual layers to produce papers with different properties. The technological challenge for paper makers is to produce a commodity product with very high quality standards that is fit for purpose on a consistent basis. This can be quite arduous for what is essentially a natural and fragile product.

In a paper sheet, the cellulose fibres are held together by hydrogen bonds. Cellulose and hemicellulose are covered with hydroxyl (-OH) groups and the oxygen atoms in these are able to bond to the hydrogen atoms on adjacent fibres to 'glue' the fibres together. The bonds can only form when the atoms are close enough, so the aim of paper-making is to develop as many sites as possible for hydrogen bonding to occur; this means collapsing fibre walls to flatten the fibres and 'fibrillating' them by refining to create more surface area for bonding.

Removing water from the fibres can occur in three ways – filtration to remove 'free' water; pressing to remove water on the surface of the fibres; and, finally, heating to drive off water that is hydrogen bonded to the cellulose molecules. Whatever the grade of paper being made, all modern paper machines consist of three sections: forming, pressing and drying (Fig. 11) on the next page.

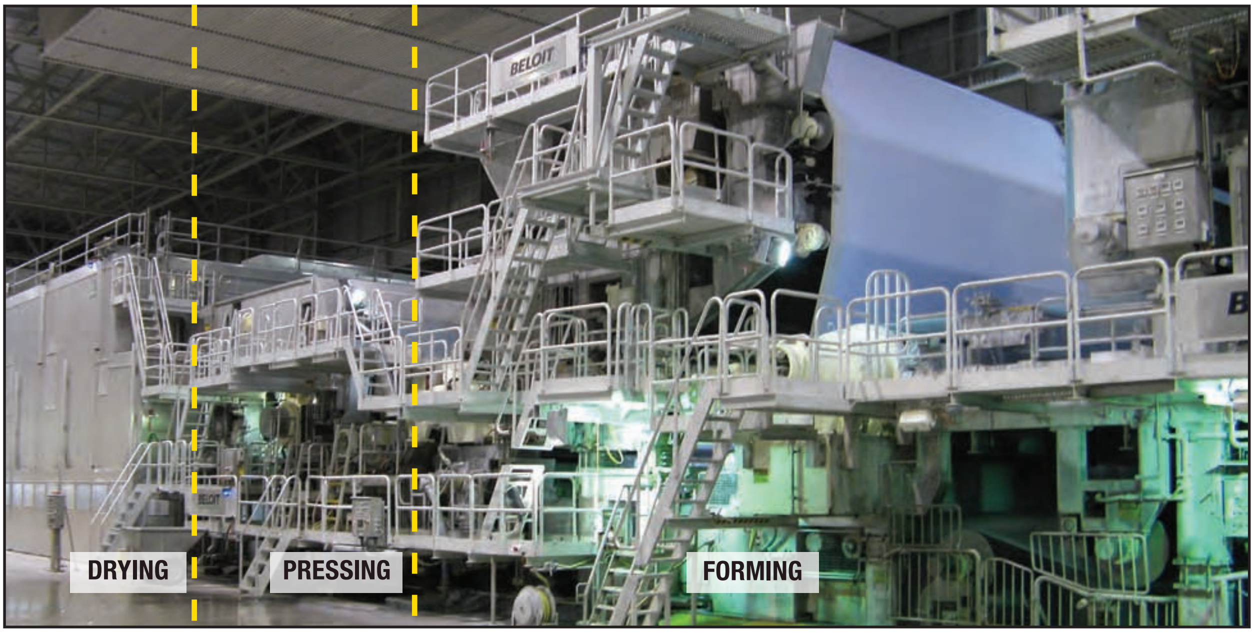

Figure 11 Maryvale Number 5 machine, showing the three principal sections. The machine predominantly makes copy paper. Image: Australian Paper.

Forming

The purpose of the forming section is to form a continuous fibrous mat on a moving fabric belt, following the steps below:

- Dilute the fibre suspension enough to allow free fibre movement
- Distribute fibre suspension uniformly across the machine width
- Keep fibres dispersed
- Distribute fibre suspension uniformly across the machine width in a jet delivered onto (or between) moving fabric(s)
- Compact fibre mat for close fibre-fibre contact
- Remove as much water as possible

There are three main sections to this part of the machine – the headbox, forming table and vacuum foils. In a modern machine the latter two are so closely integrated as to be almost indistinguishable.

The headbox controls the thickness or depth of the jet across the width of the machine, and controls the trajectory of the stock on to the forming table. Controlled turbulence is generated in the headbox to ensure even distribution of fibres across the forming table, while minimising air entrapment when the jet hits the fabric.

The forming table supports the filter mesh (forming fabric), which in turn retains the fibres while allowing the water to drain through. Hydrofoil blades underneath the fabric create controlled turbulence to keep the fibres dispersed and 'scrape' the water from the underside of the fabric. A vacuum can be applied to assist water removal. Turbulence and vacuum pulse intensity can be adjusted by varying the blade angle to the fabric.

Forming sections vary widely in design, depending on the the grades being made. They can be a simple Fourdrinier type (Fig. 12), where water drains vertically from one side of a fabric; a twin-wire type, where water drains from the fibre mat in two directions, either horizontally or vertically through a fabric on each side; or hybrids of these two major types. Other forming sections can have multiple headboxes and/or wires to produce layered sheets, particularly for packaging grade papers.

Pressing

Pressing removes water still held in the fibres but not hydrogen bonded to them. Pressing is carried out by passing the wet sheet, supported by a press felt, between two rolls (Fig. 13). Water passes from the sheet into the press felt, from which it can be removed by vacuum through a drilled or grooved suction roll. Increasing the nip pressure between the rolls or increasing the time of application of the pressure increases water removal. It also compacts the fibre mat, increasing the sheet density and fibre-to-fibre bonding.

Press sections come in many designs, from simple single nip to two or three nips (Fig. 13). A modern development is the shoe press, in which an elongated 'shoe' presses against a roll. This increases the time of application, thereby increasing water removal. Soft rubber covering on the shoe can minimise densification if it is not a desirable property in the paper grade being made. Tissue machines do not have a separate press section.

Drying

Drying appears to be the simplest of the paper-making processes so it is often overlooked. However, it is in this section that the majority of the energy used in paper-making is consumed and there is often great scope for cost reduction by reducing energy use.

Thermal energy for drying is transferred to the paper by wrapping it around a series of large diameter, rotating, steam-filled cylinders. The paper is supported by a dryer screen (fabric) that is designed to hold the sheet against the cylinder surface and promote efficient heat transfer (Fig. 14). The dryer section is the largest part of a paper machine.

Steam from the evaporated water in the sheet is collected in 'pockets' above the dryer sections and vented to the atmosphere, normally via a heat exchanger in order to preheat the incoming air and boost efficiency. Condensed steam is removed from the drying cylinders by siphons inserted through their support shafts.

The dryer section for a tissue machine is significantly different from other machines – it consists of a single large cylinder, known as a 'Yankee dryer'.

Size press and film coater

Papers and paperboard for packaging in particular often have a surface application of starch to improve sheet properties in use. This is applied by passing the nearly-dry sheet through a flooded nip formed between the rotating size press rolls. Since the starch is applied as a solution the paper must be re-dried, so the size press is located after the main dryers, but with an extra bank of dryer cylinders following. Coatings with limited amounts of pigments, such as clay, can also be applied at the size press.

A more sophisticated coater than the size press is the film coater, where controlled weights of coating can be applied to the sheet to improve properties for printing or for other specific end uses.

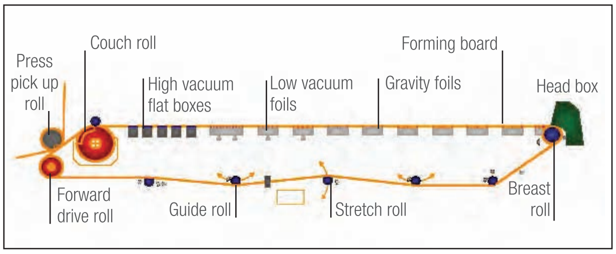

Figure 12 Fourdrinier forming section, showing the major components.

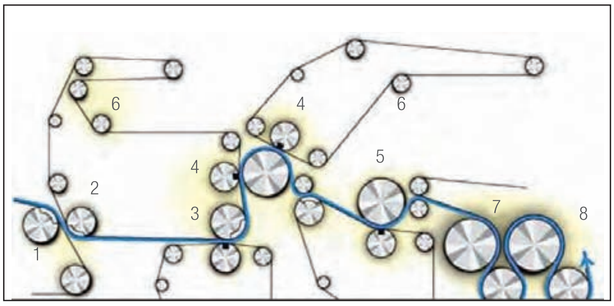

Figure 13 A three-nip press schematic. Locations labelled 3, 4 and 5 are the press nips. The suction rolls are the smaller diameter rolls of each nip. The press felts are shown in black and the paper path is in blue.

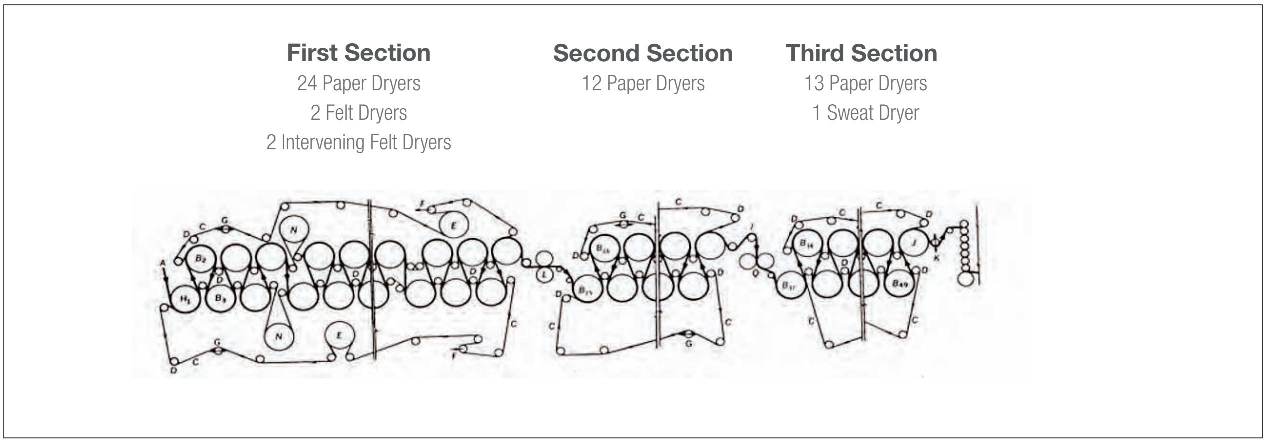

Figure 14 Schematic of a typical dryer section. The diagram shows a size press between the second and third sections and a calender stack after the third section.

Calender

The purpose of a calender stack is primarily to give the paper sheet a smooth surface finish especially for printing or writing end uses. The calender evens out sheet thickness and increases sheet density and helps control profile uniformity across the sheet (Fig. 15).

Not all paper grades require calendering. Calender stacks are usually found on newsprint and printing paper machines and for packaging grades where a smooth, even finish is needed, such as for printed packaging.

The calender stack consists of a number of polished steel rolls with high-pressure nips between them, through which the sheet passes. Nip pressures can be controlled across the sheet to ensure uniformity. Some specific packaging grades, such as high-finish linerboard, are made with a 'soft-nip' calender, where one face of the sheet is calendered against a hard steel nip, while the other is supported by a softer material surface. Supercalendering is carried out as in calendering except that the set of rolls is of alternating steel and fibre-covered rolls and this produces a smoother finish.

Figure 15 Inclined calender on Resolute Forest Products printing paper machine at Catawba, USA. Image: www.resolutefp.com.

Finishing

After drying and possibly calendering, the finished paper is wound on to a 'jumbo' or 'parent' reel before being transferred to a winder, which slits and winds the paper into rolls of the required size(s) on fibre cores (Fig. 16). The core ends are usually plugged to reduce the risk of handling damage and the rolls wrapped and strapped for dispatch to customers.

Other finishing activities may be undertaken, depending on the grades of paper and end use.

These activities can include:

- **Sheeting**, where the paper is cut into sheets and packed; for example, copy paper in A4 reams
- **Offline coating**, where specialised coatings may be applied; for example to improve printing, moisture barrier or abrasion resistance
- **Pre-printing**, for packaging such as beverage cartons

Figure 16 Paper winder. The parent reel is shown mounted on the unwind stand on right and customer rolls on left. Image: Metso Paper.

Glossary of additional terms used in the pulp and paper industry

Air dry weight (air dry tonnes)
By convention, market pulps are traded on the basis of their equivalent mass at 90% bone dry pulp and 10% moisture content, and this is referred to as 'air dry (AD) weight'. This comes about because cellulose absorbs or loses moisture when exposed to the air, depending on its moisture content and the humidity of the air, and because pulp, when it is traded, always contains some moisture. The air dry weight is calculated from the actual weight and moisture content measured at the same time. While an arbitrary choice, at a moisture content of 10%, pulp will be in equilibrium (i.e. will neither gain nor lose moisture) in a 'typical' atmosphere of around 65% relative humidity.

Brightness
Brightness is a measurement, on a scale of zero to 100, of the amount of light reflected from the surface of a paper. For example, a 98 bright paper reflects more light than does an 84 bright paper. Brightness measures only the blue (short wavelengths) end of the visible spectrum and ignores shade. As a result, two samples with identical brightness values can look very different.

Broke
This refers to all paper produced within a paper mill that does not meet required specifications, either on the paper machine or on finishing equipment such as sheeters. It is re-pulped and returned to the fibre furnish, either directly ('own broke') or in the subsequent manufacture of appropriate products. Broke does not count as recycled fibre when expressing the recycled content in paper products. Broke is used in nearly every paper product.

Capacity
Theoretical maximum output for a production unit on a standard product mix. The actual production for a given period reflects the output on a different product mix for the machine hours of operation available for the period.

Coated woodfree (papers)
Papers manufactured from bleached chemical pulps (containing not more than 10% mechanical pulp), typically with 15gsm coating of clay or calcium carbonate applied to one or both sides of the sheet and which may be put through a supercalendering (SC) process to yield gloss coat printing papers for quality magazines, brochures and books.

Corrugating materials
Liners and medium or fluting used to form a corrugated box.

Corrugating medium or fluting
The inside paper, and usually the lightest of the three components, in a normal (single wall) corrugated board. The medium is corrugated (fluted) by passing the sheet between heated profiled rolls and glued between the inner and outer liners to provide a rigid board from which to fabricate shipping containers (corrugated boxes). Typically mediums are made from recycled fibre, often enhanced by adding starch, or from semi-chemical hardwood pulp for superior performance under moist conditions (e.g. in a cool-store). Several flute sizes are available, which can alter the strength and appearance of a box according to end use requirements. Double-lined boards (three liners combined with two mediums) or laminated mediums are used to produce strong grades of board for heavy-duty boxes.

Deckle
This is the maximum or useable width of the paper sheet on the paper machine. Orders of the same product but of differing ordered size must be combined to utilise as close to the full deckle of the paper machine as possible in order to maximise efficiency. For orders for reels, this requires winding to standard diameter sizes. Side run that is remaining that cannot be sold is returned to the papermaking process and classified as broke.

Deinking
This is the process of removing printing ink from re-pulped printed paper in order to reuse the fibrous material of the paper in white grades. By removing the ink, the brightness of the pulp derived from recovered paper is enhanced. Deinked pulp is used for providing a white top liner for board and for blending with virgin pulp for selected tissue and uncoated woodfree paper products.

Embossing
Embossing is typically accomplished by applying heat and pressure to a paper sheet between mating male and female dies or rolls, usually made of copper or brass, which squeeze the fibres of the substrate into the embossed surface pattern. The combination of pressure and heat deforms and 'sets' the pattern in the sheet. Examples of embossing are commonly seen in greeting cards and, with roll stock, wallpaper.

Freeness
Property of the pulp prepared for paper-making indicating rate of drainage. A rapidly draining stock is termed free, or having high freeness.

Furnish
The specific mixture of raw materials, both pulp and chemicals, from which a particular grade of paper is manufactured.

Grammage (gsm or g/m^2)
The common measure of paper weight is expressed in grams per square metre. This is sometimes referred to as the basis weight.

Kraft pulp
Pulp produced by cooking wood chips at elevated temperature and pressure with sodium hydroxide (caustic soda) and sodium sulphide to dissolve the lignin that holds together the cellulose fibres. It is described in more detail in the section on the technology of pulping and paper-making.

kt-pa
The measure of production or capacity in kilotonnes (kt) per annum.

Linerboards (or liners)

- **Kraft linerboard (KLB)**
  Linerboard made predominantly from virgin softwood kraft pulp to provide maximum strength for a corrugated box and yielding superior performance in cool stores.

- **Testliners and kraft top linerboards (KTL)**
  Testliners are made from recycled paper, typically old corrugated containers (OCC), while kraft top liners incorporate a top ply of virgin kraft on a recycled paper base. Although inferior to kraft linerboards, these lower cost materials have adequate strength for many packaging end uses,

especially outside of the most demanding applications (such as cool-stores) and make a significant contribution to resource conservation. The name 'testliner' refers to a requirement to meet certain test criteria for box certification purposes in the USA.

- **White linerboard or white top liner**
  Liners are frequently made of two plies bonded together and the top liner can be virgin bleached pulp or deinked pulp to provide a white finish suitable for high grade printing and enhanced market appeal in corrugated packaging for goods such as pharmaceutical products and beverages, especially for shelf-ready display packaging.

Long fibre pulp
Chemical pulp produced from softwood that is made up of longer fibres, thus possessing greater natural strength, such as is required for packaging grades.

Mechanical papers
Papers made mainly from mechanical pulp, either uncoated or coated. Coated mechanical papers are usually coated with clay or calcium carbonate (plus binder), usually less than 10gsm. It is applied to each side of the sheet to produce lightweight papers typically less than 55gsm with a gloss finish, often used for mail-out catalogues. Lightweight coated (LWC) and supercalendered (SC) papers dominate this market segment with film coated offset (FCO) also in use. In higher quality finish this type of paper is used for glossy magazines.

NCC
Fibre from new corrugated clippings (NCC or CC) from box plants that do not qualify as post-consumer waste.

OCC, ONP and OMG
Recovered paper derived from old (post-consumer) corrugated containers (OCC), newspapers (ONP) and magazines (OMG), respectively.

Opacity
Property of a paper which prevents 'show-through' of printing from one side of sheet to the other. The opposite of transparency.

Oven dry (OD) weight
Not to be confused with air dry weight, this is the equivalent weight of paper, pulp or wood if it were dried to zero moisture content. Pulp, paper and wood all contain moisture and the OD weight is the dry fibre content of the material, usually determined by drying a sample at 105°C to constant weight in an oven. It is also referred to as bone dry (BD) weight. Market pulp typically contains about 15% moisture, so one tonne would contain 850kg OD pulp; a 100gsm sheet of paper containing 8% moisture would have an OD weight of 92gsm. See also Air Dry Weight.

Paper coating
The process of applying a coating, either of pigments in a starch/polymer binder or of plastic, to the paper surface in order to obtain special properties, to improve appearance and printability or confer specific functionality.

Packaging papers
A broad group of segments which includes corrugating materials, cartonboard and lightweight papers for sack, bags and wrapping.

Recycling
The process of reuse of the fibres from paper and paperboard recovered from the consumer market (post-consumer waste; e.g. old corrugated containers and old newsprint) or from recoveries from the converting or printing process.

Sack kraft
Sack paper is a porous kraft paper with high resistance to tearing and with stretch properties for paper sacks, which can be single or multi- ply depending upon the weight and nature of the product being contained.

Semi-chemical corrugating medium
A medium or fluting made from a blend of NSSC pulp and recovered paper.

Sheeter (cut size)
A machine that converts paper rolls into sheets in end-use sizes such as A3, A4 and foolscap. It is equipped with a packing line for ream wrapping, carton filling, labeling and palletising.

Sheeter (folio sheeter)
A sheeting machine used to cut rolls into larger size sheets such as A1 and SRA1 for commercial printing. The folio sheets are stacked on pallets with sheet count marked by flags or wrapped in reams, usually 250 or 500 sheets.

Short fibre pulps
Chemical pulps made from hardwoods, such as eucalyptus.

Stone ground wood pulp (SGW)
Mechanical pulping process involving physically tearing the fibres from a wood 'billet' using a grinding cylinder.

Strength

- **Tensile**
  The force parallel to the plane of the sheet required to produce failure in a specimen of given width and length under specified conditions of loading.
- **Tear**
  Strength test of paper designed to show how much force the paper will stand before it tears.

Stretch
This is the amount of distortion paper undergoes under tensile stress before failure. High stretch paper properties assist paper sacks, such as those filled with cement, to survive the handling and transporting process.

Virgin pulp
New pulp without the addition of recycled fibre.

Woodfree papers
White papers made from bleached chemical pulp and limited by definition to a fibrous furnish containing not more than 10% mechanical pulp.

Sources: Appita Inc. and Shoalhaven Mill glossary