

## Basics on newsprint manufacture and newsprint types

1995

Basics on newsprint manufacture and newsprint types. (1995). In Newsprint and Newsink Economy and Quality in the Face of Rising Prices : Workshop, Hong Kong 13-14 June 1995. Singapore: Asian Media Information & Communication Centre.

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**Basics On Newsprint Manufacture  
&  
Newsprint Types**

## *Session 2:*

### **Basics on newsprint manufacture**

Overview of the modern  
technology used to make  
newsprint

### **Newsprint types**

Standard newsprint

Improved newsprint

Directory paper

Bulky paper...

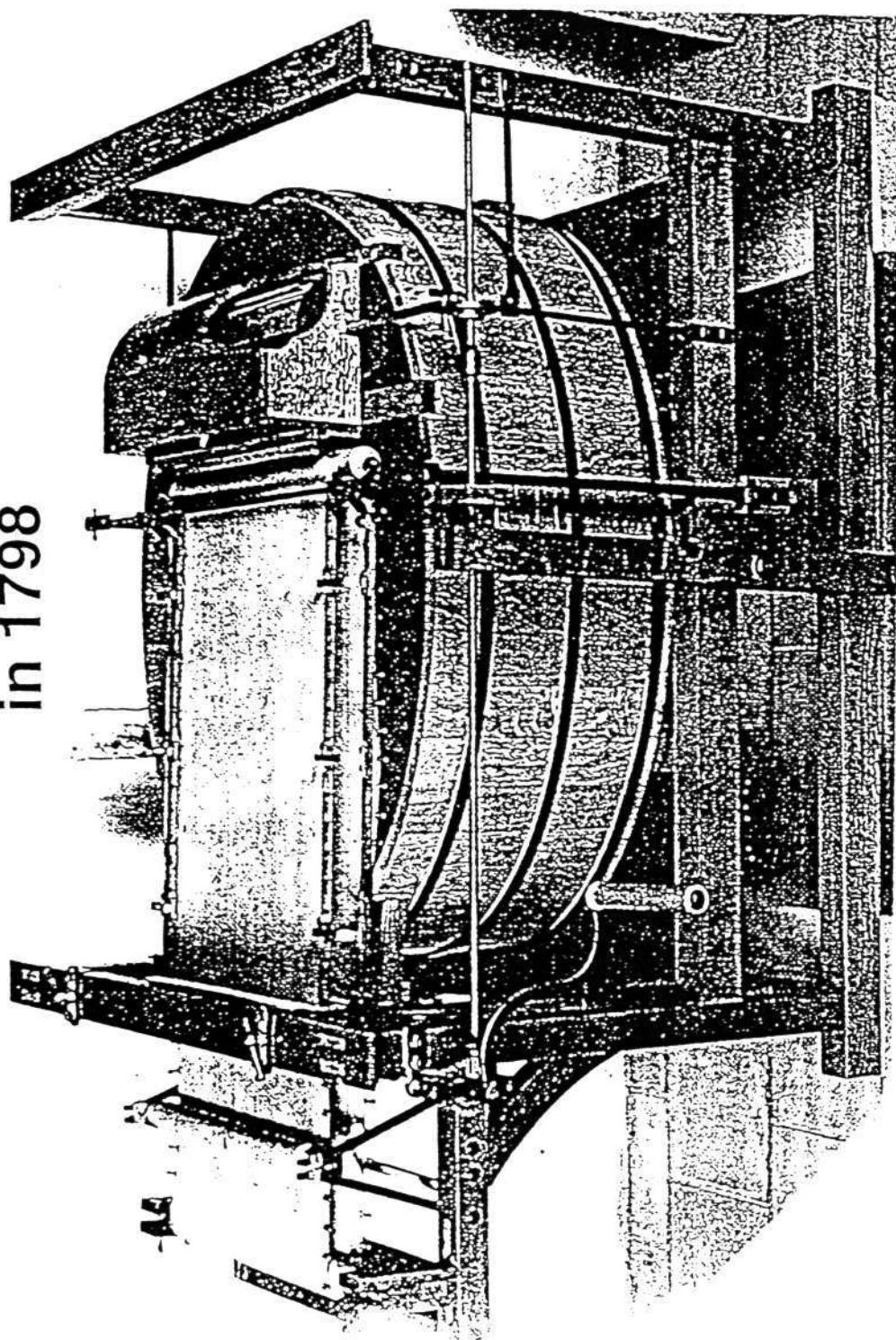
# **Basics of newsprint manufacture**

- Paper and paper industry historical data
- Evolution of the width and speed of the paper machines
- Papermaking basics
- Different types of fibres
- Papermaking operations
- Different types of pulps
- Better technology: better newsprint
- Introduction to paper recycling and deinking
- Soft calendering: a new way to optimize paper properties
- Comparison of newsprint types: standard, improved,...

# Paper and Paper Industry Historical Data

- 1000 BC:** Paper in some Chinese graves.
- 105 AD:** In China, Tsai Loun  
First paper made with textile fibres.
- 610 AD:** Technique introduced in Japan.
- 751:** Technique in the Middle-East.
- 1450:** Gutenberg's Bible.
- 1798:** First paper machine by Nicolas Robert.
- 1800-1860:** Mechanisation of the processes.
- 1840:** First wood mechanical pulp (Keller).
- 1840-1880:** Wood pulp is used  
(both mechanical and chemical).
- 1860-1950:** Speed and width increase of the paper machines.  
*1820: Speed 5 m/min, Width 85 cm*  
*1930: Speed 500 m/min, Width 770 cm*
- 1950-Today:**  
Further increase of PM speed and widths.  
New pulps and additives: TMP, DIP, new filler material, new additives and chemicals.  
New sheet formation: twin wire formers.  
Further automation.  
Environmental concerns.

The First Paper Machine  
by Nicolas Robert  
in 1798



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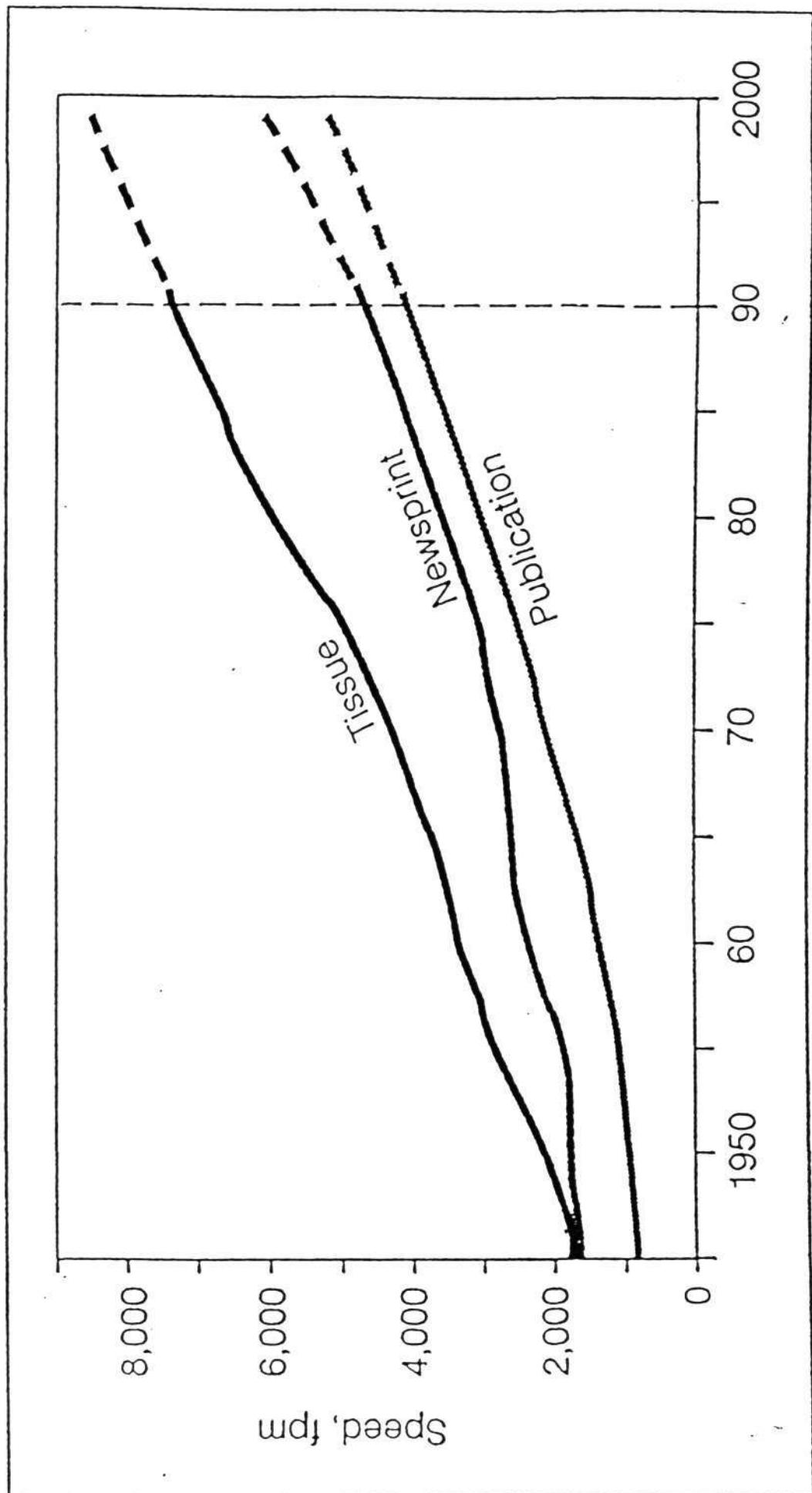


FIGURE 1: The best-effort speeds of tissue, newsprint, and publication paper machines generally tend to double about every 30 years.

Operating speed is the average sustained speed  
during 24 hrs of continuous operation.

Maximum operating  
speed (m/min)

1600

1400

1200

1000

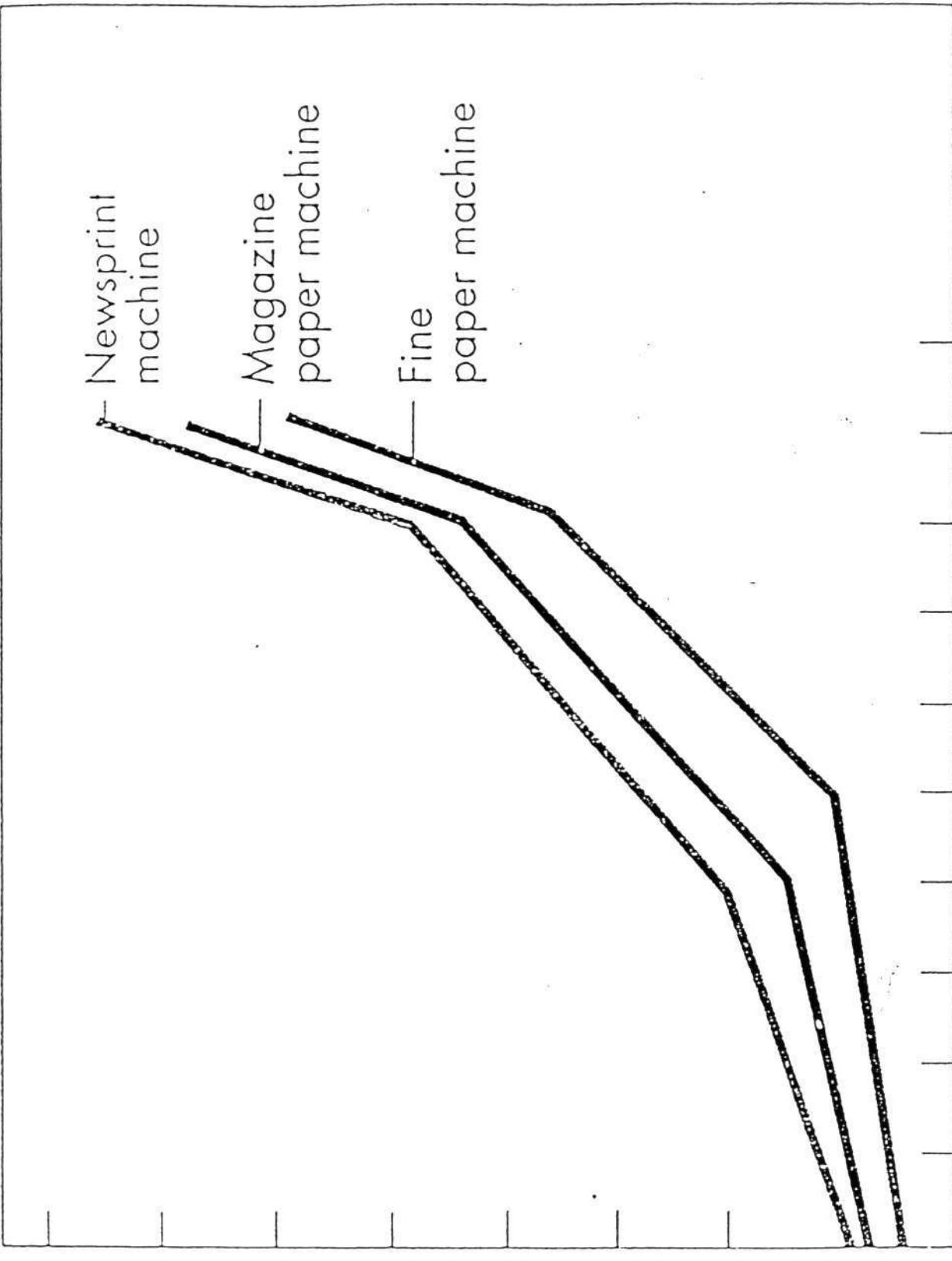
800

600

400

200

1900 1920 1940 1960 1980 2000 year



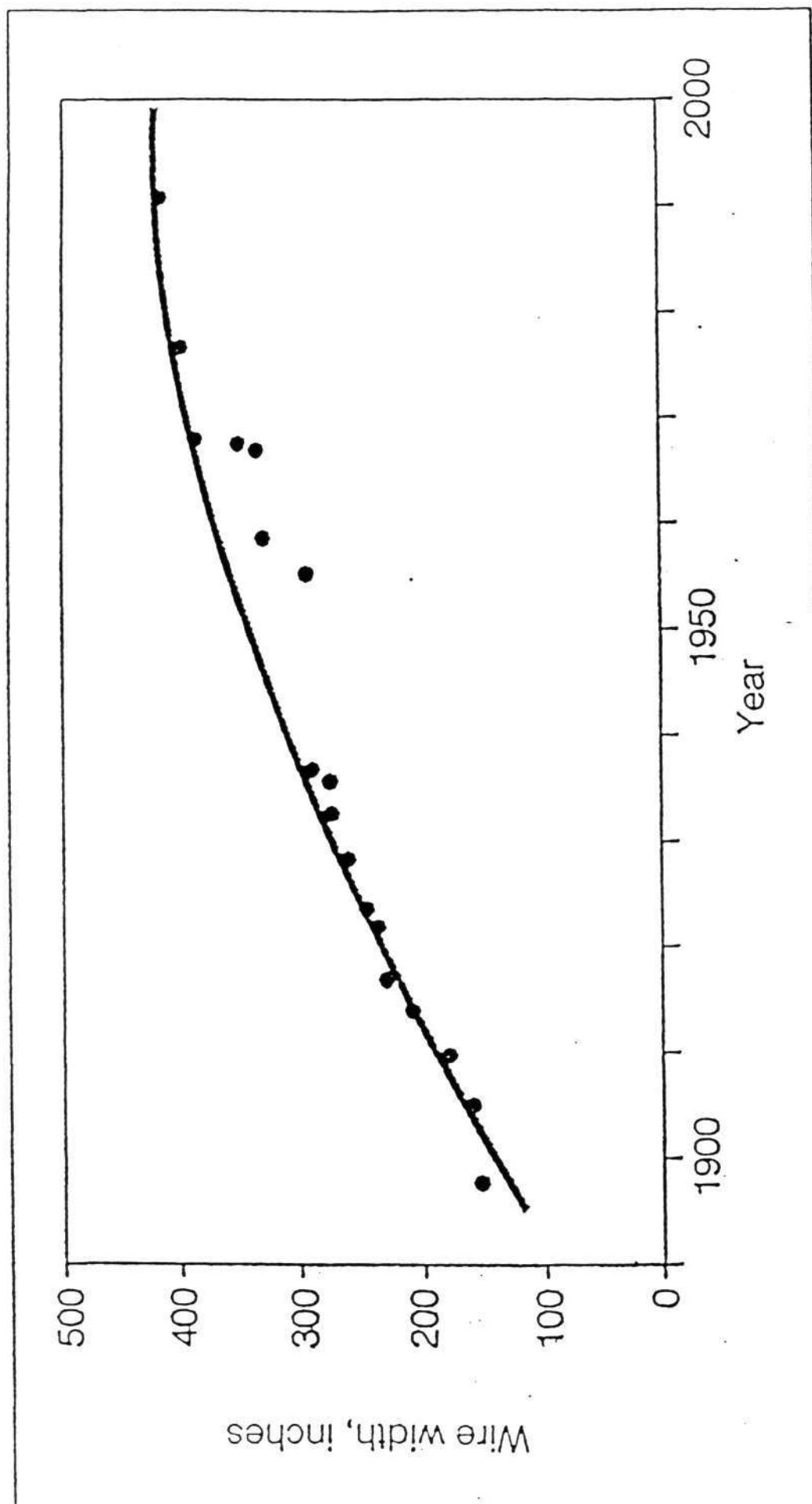
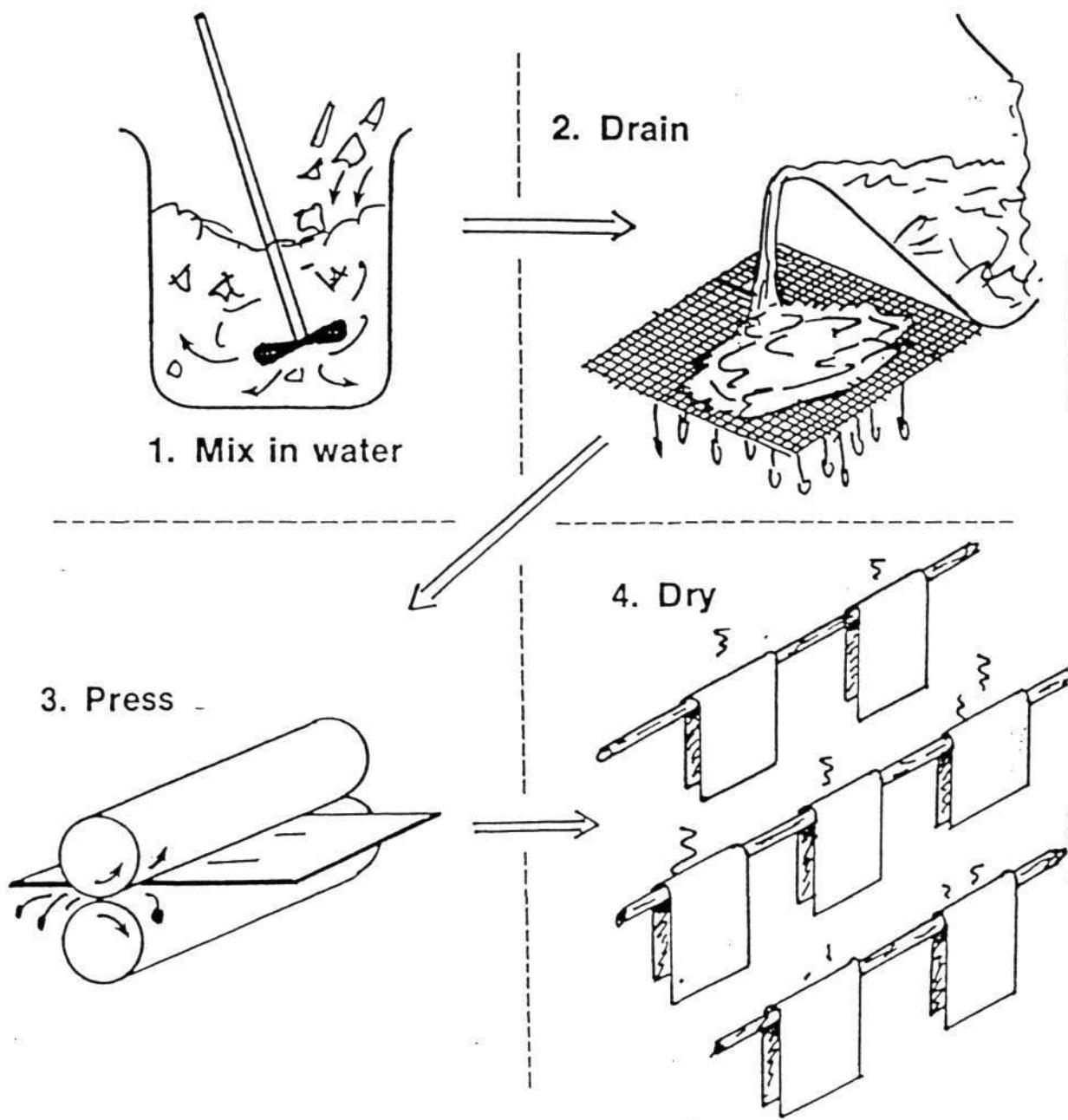
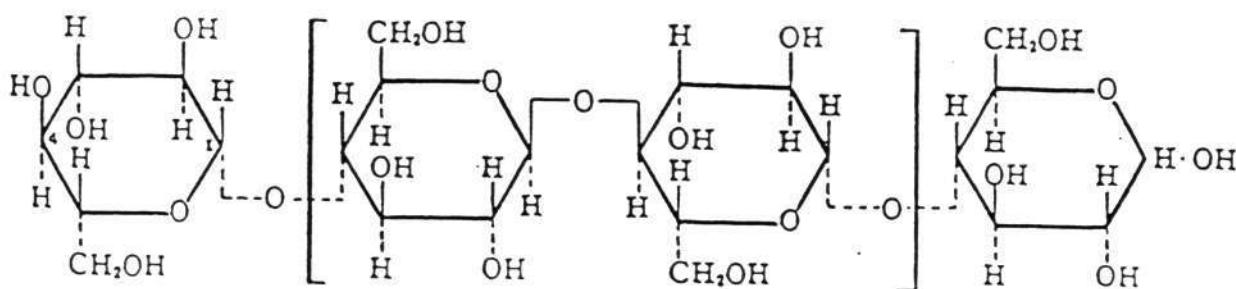


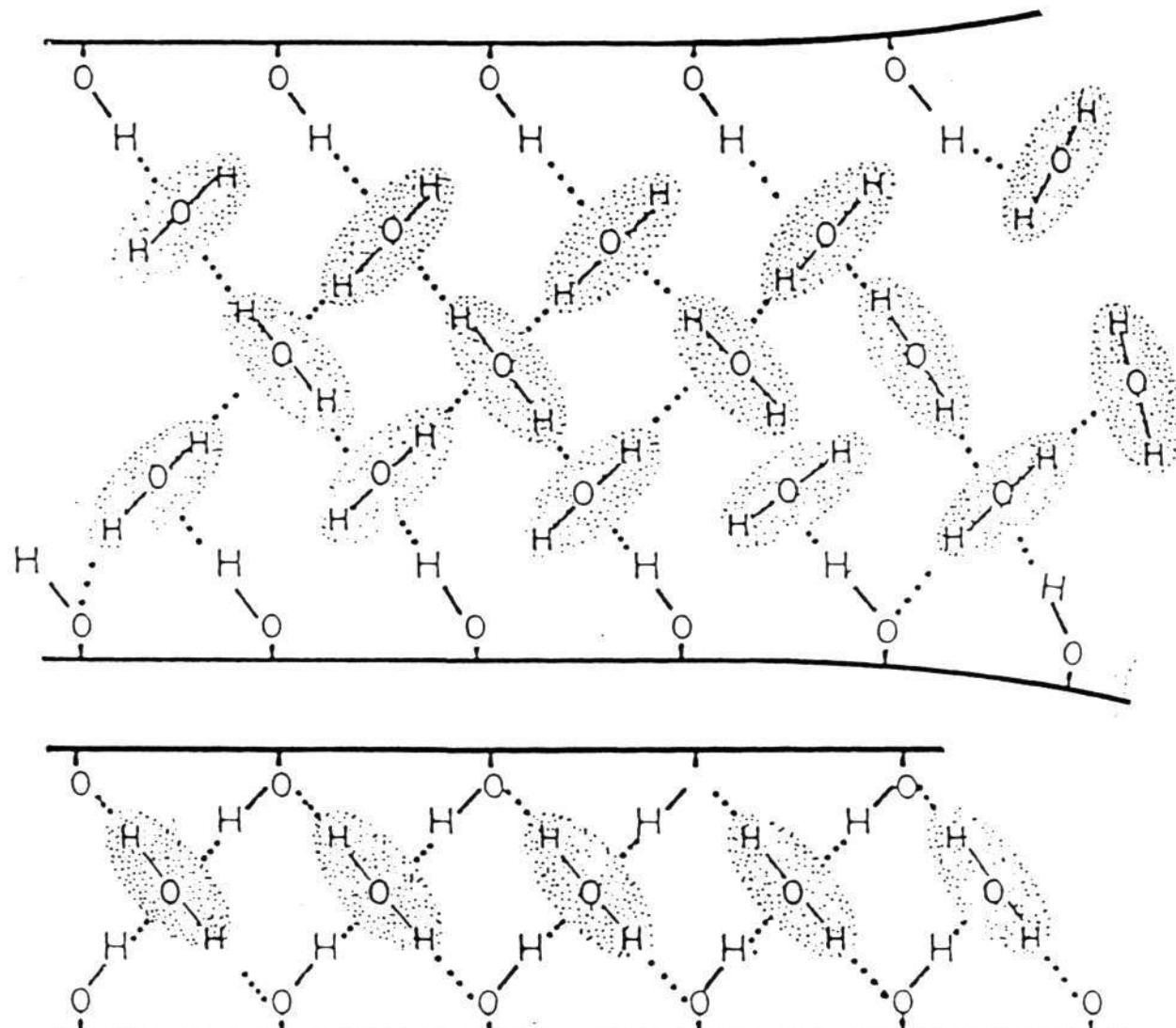
FIGURE 2: The widths of paper machines have steadily increased during the past century, but there have been periods of 20 to 30 years when no width increases occurred.

# Papermaking Basics





Schematic representation  
of the structure of a cellulose molecule



Formation of hydrogen bonds  
between two cellulose molecules

THREE-DIMENSIONAL STRUCTURE OF WOOD

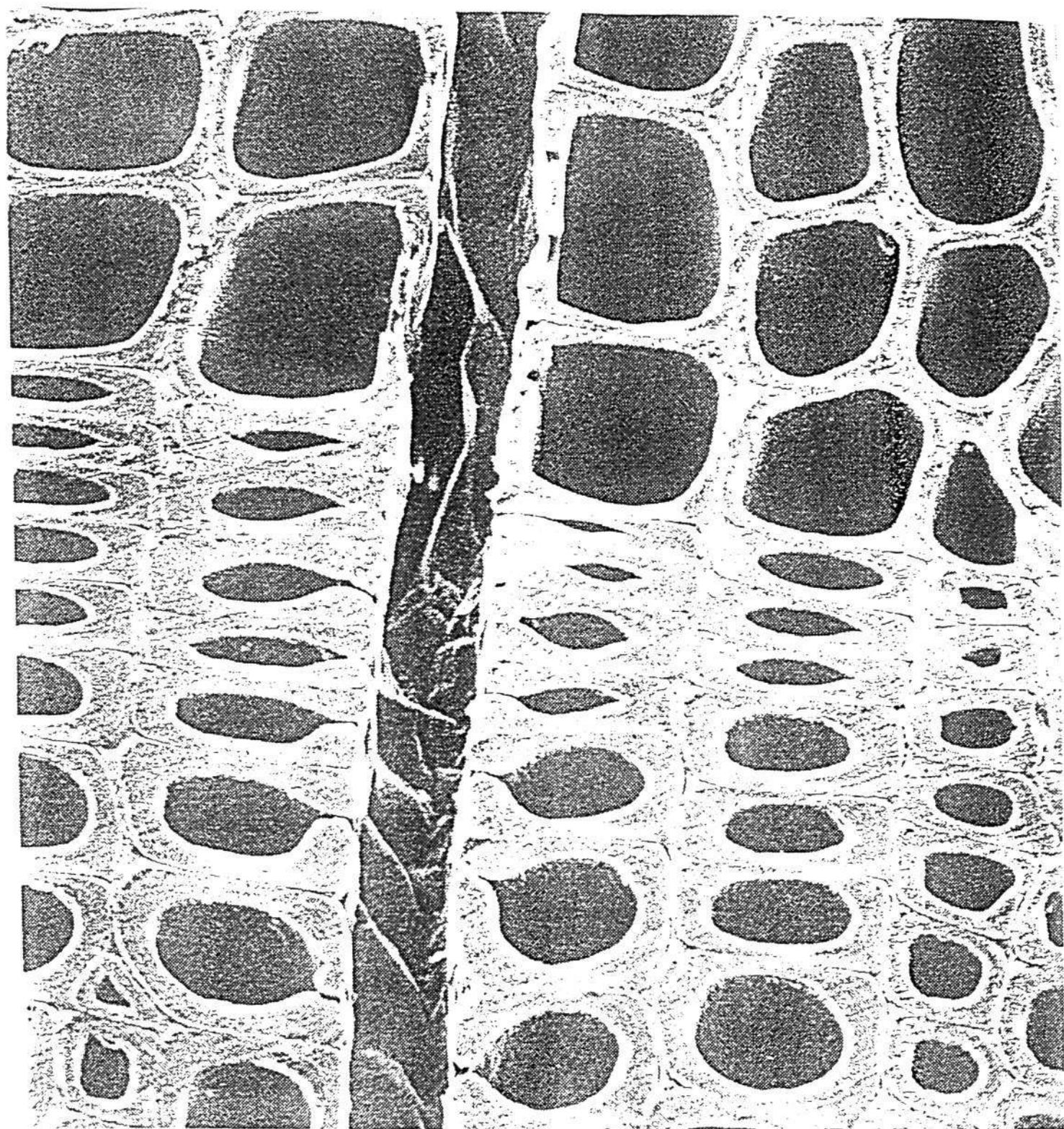


Figure 38. An annual growth ring is clearly illustrated in this transverse section of *Pinus radiata*. In the lower side small, thick-walled tracheids of the latewood can be seen. Beyond the ring boundary the cells are larger and have thinner walls. The cells become so large in late radial file after being cut off from the vascular cambium. A few rays are seen passing the ring at right angles to the ring boundary. ( $\times 550$ )

DISTRIBUTION AND PATTERNS OF WALL PITTING

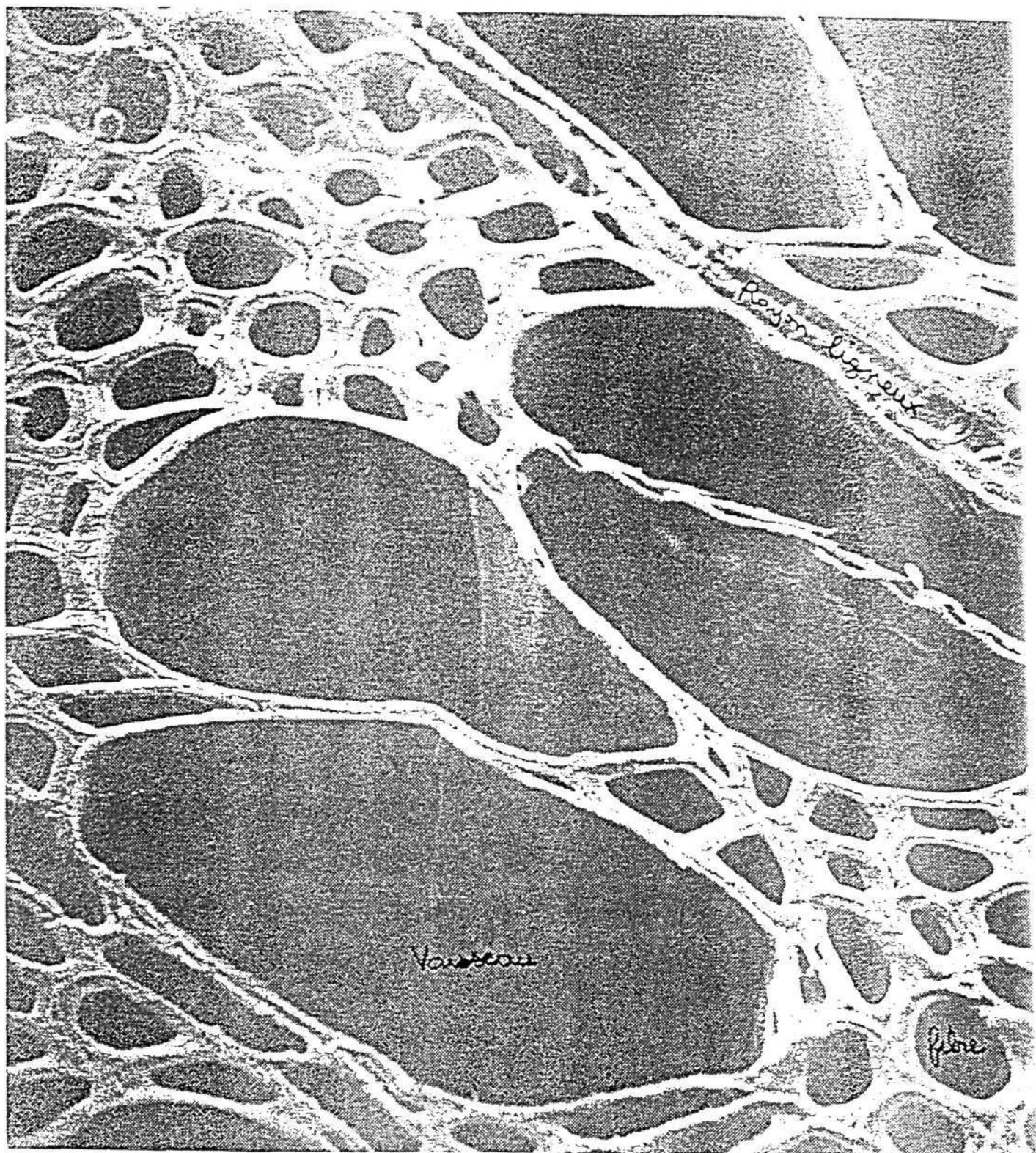


Figure 20. Vessel member walls are not always covered in pits. In this view of a cluster of vessels in red beech, some walls show prolific vessel to vessel pitting while others are completely devoid of pits. (x 1250)

Annesperme dictyolecone

THREE-DIMENSIONAL STRUCTURE OF WOOD

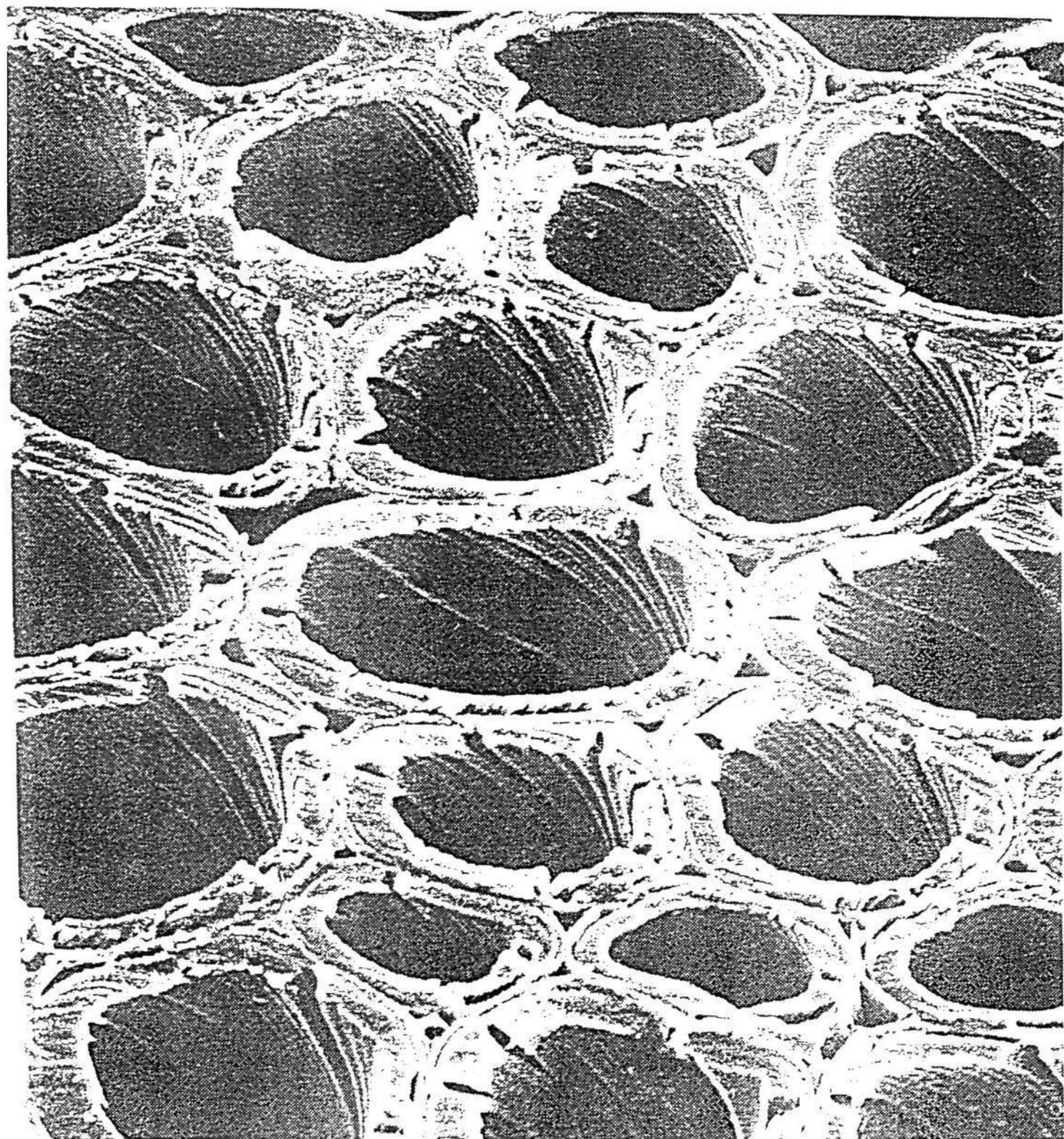


Figure 56. Transverse section through compression wood in *Pinus radiata*. Note the helical checks and finer striations in the cell walls. ( $\times 1650$ )

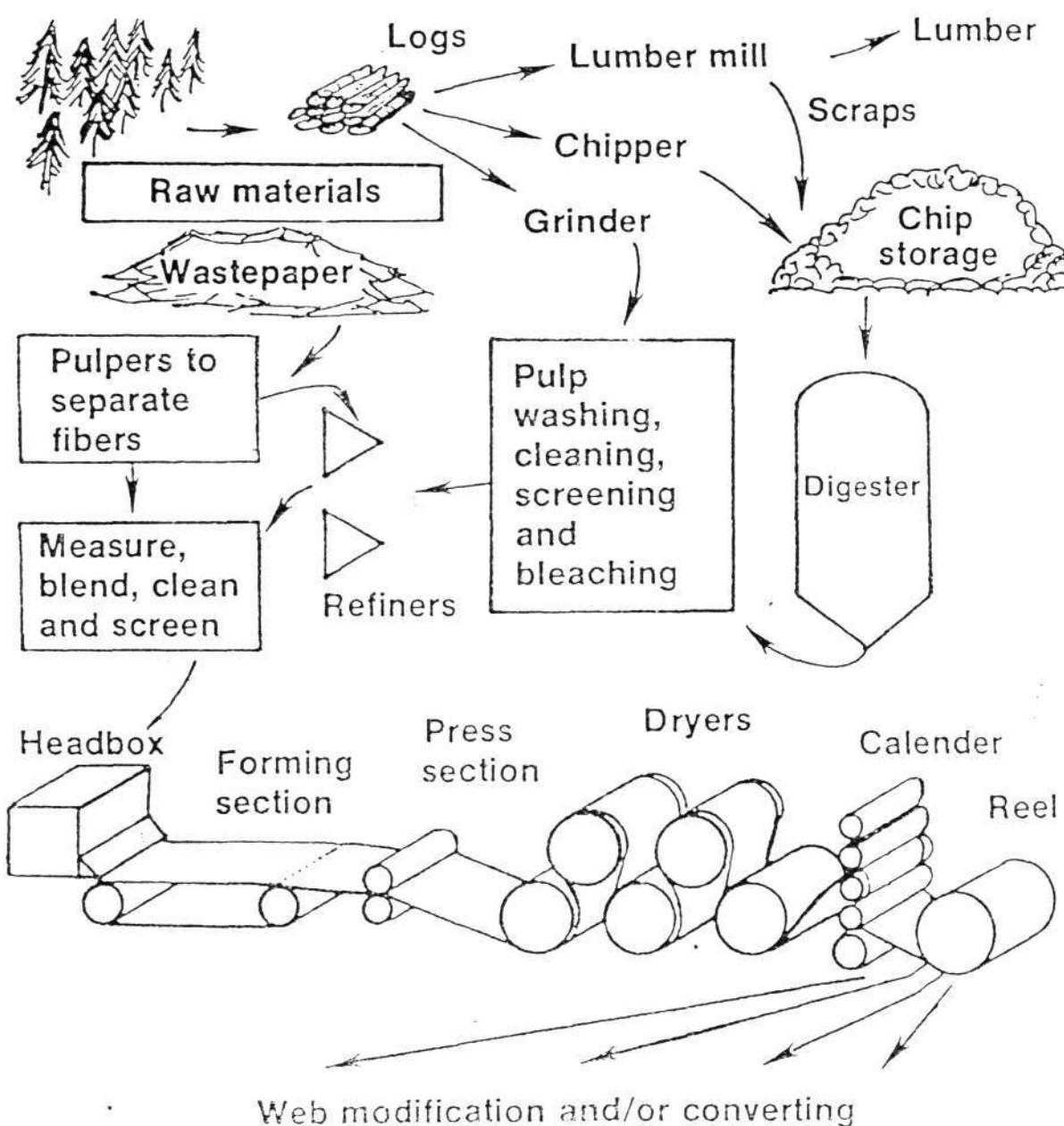


Softwood fibers magnified about 50 times.



Hardwood fibers magnified about 50 times.

# Overview of papermaking operations



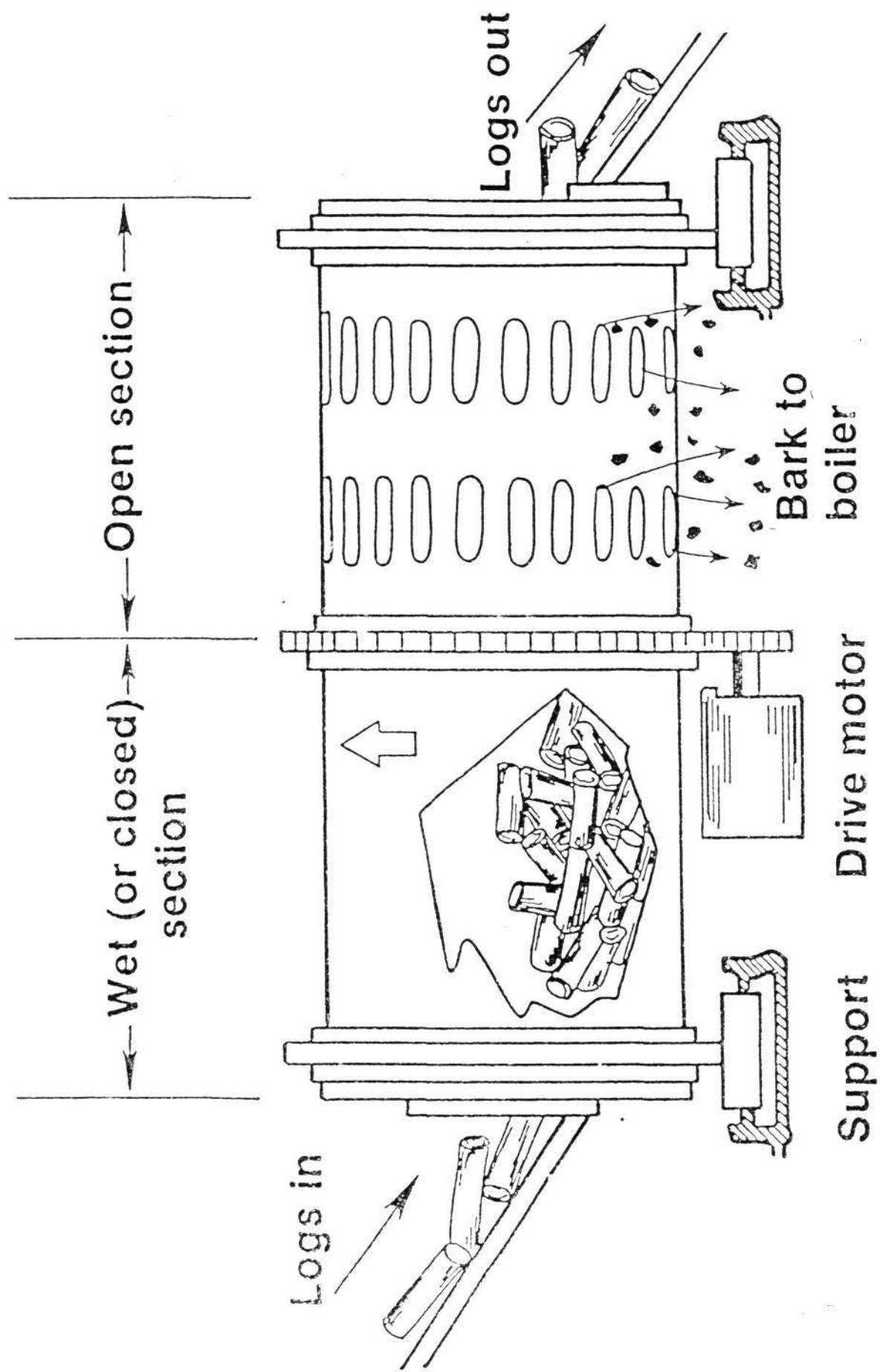
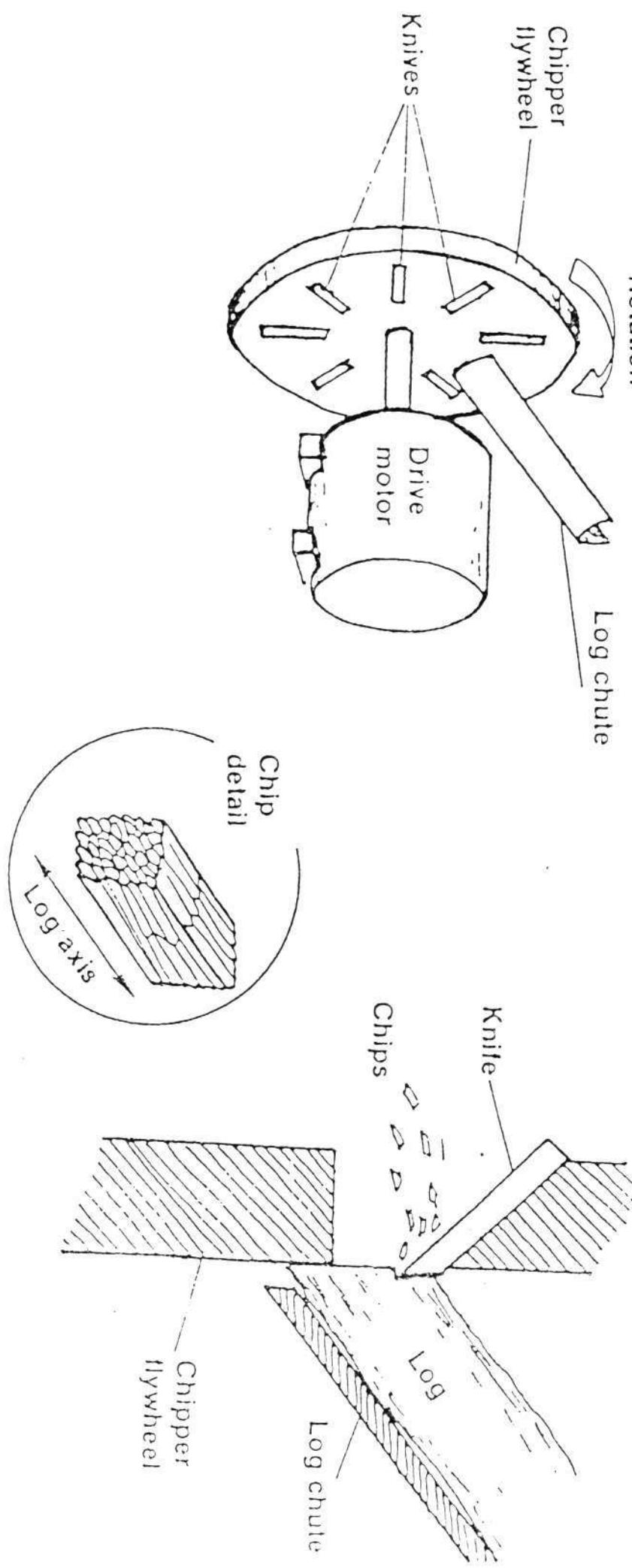


Figure 4.2. Drum barker

Figure 4.4. Chipper and chipper detail



## **BASICS OF NEWSPRINT MANUFACTURE**

### **DIFFERENT TYPES OF PULP**

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#### **- Mechanical pulps (1):**

##### **- Stone Ground Wood pulp (SGW)**

- Rotary stone to grind the wood.

Addition of water (cooling effect)

Advantages: yield ( $\approx 98\%$ ), opacity, dim. stability, printability

Disadvantage: poor mechanical prop., yellowing, high energy consumption

In decline since 1970.

##### **- Pressurised Ground Wood Pulp (PGW):**

- Same as for SGW but with high pressure (3-4 bars) and high temperature (120°C).

Same advantages.

Better mechanical properties

Disadvantages: higher energy consumption, lower brightness



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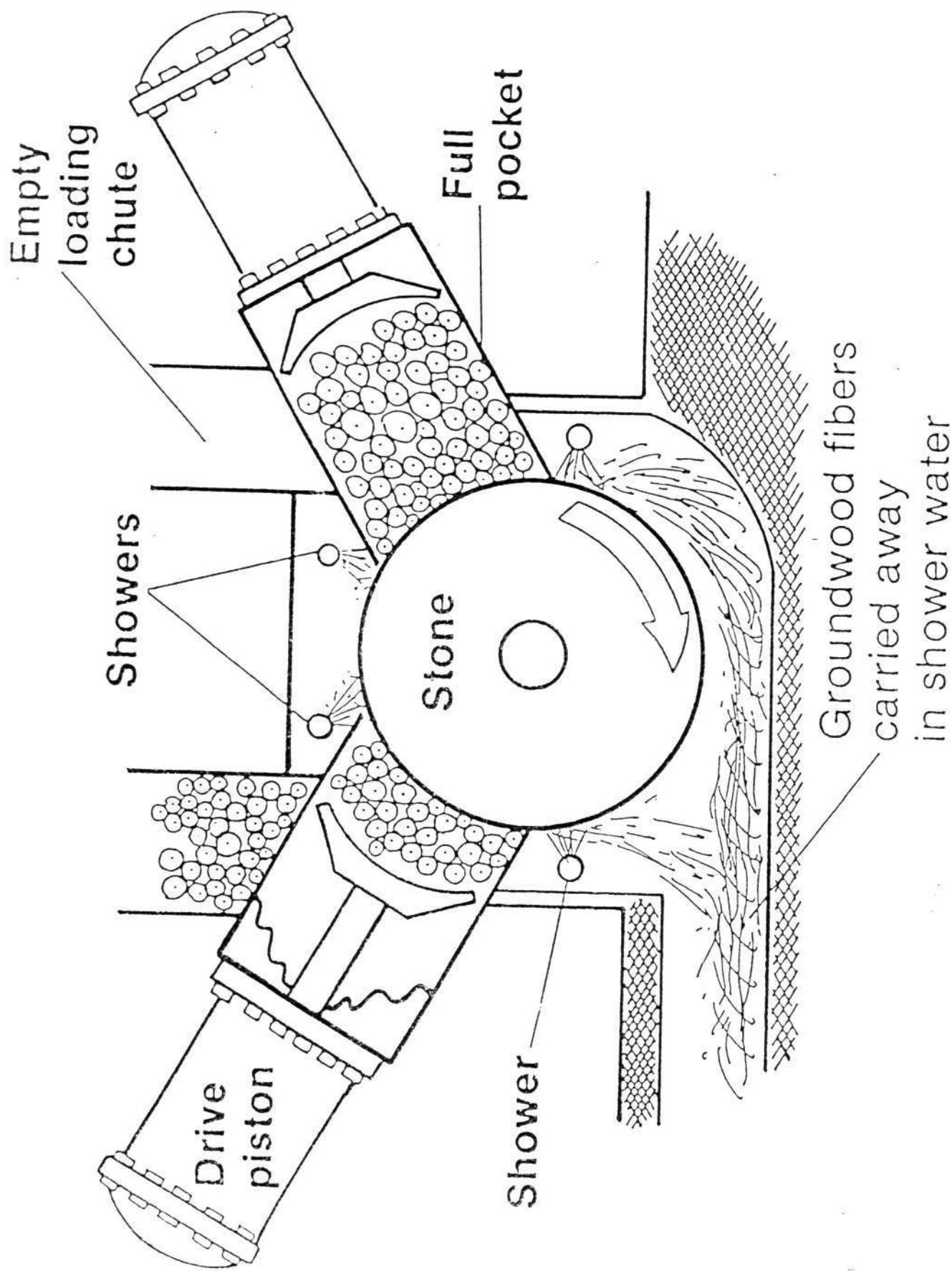


Figure 4.6. Two-pocket grinder

## **BASICS OF NEWSPRINT MANUFACTURE**

### **DIFFERENT TYPES OF PULP**

#### **- Mechanical pulps (2) :**

- Refiner Mechanical Pulp (RMP)**
- Wood chips go through a refiner (two discs rotating in inverse directions)  
Advantages: better mechanical properties and better bulk factor

#### **- Thermo Mechanical Pulp (TMP):**

- Same as for RMP but with pressure  
Very popular today  
Adv.: good mechanical properties  
Disadv.: high energy consumption

#### **- Chemi Thermo Mechanical Pulp (CTMP):**

- Same as TMP but with chemicals (Ex: sodium monosulfite)

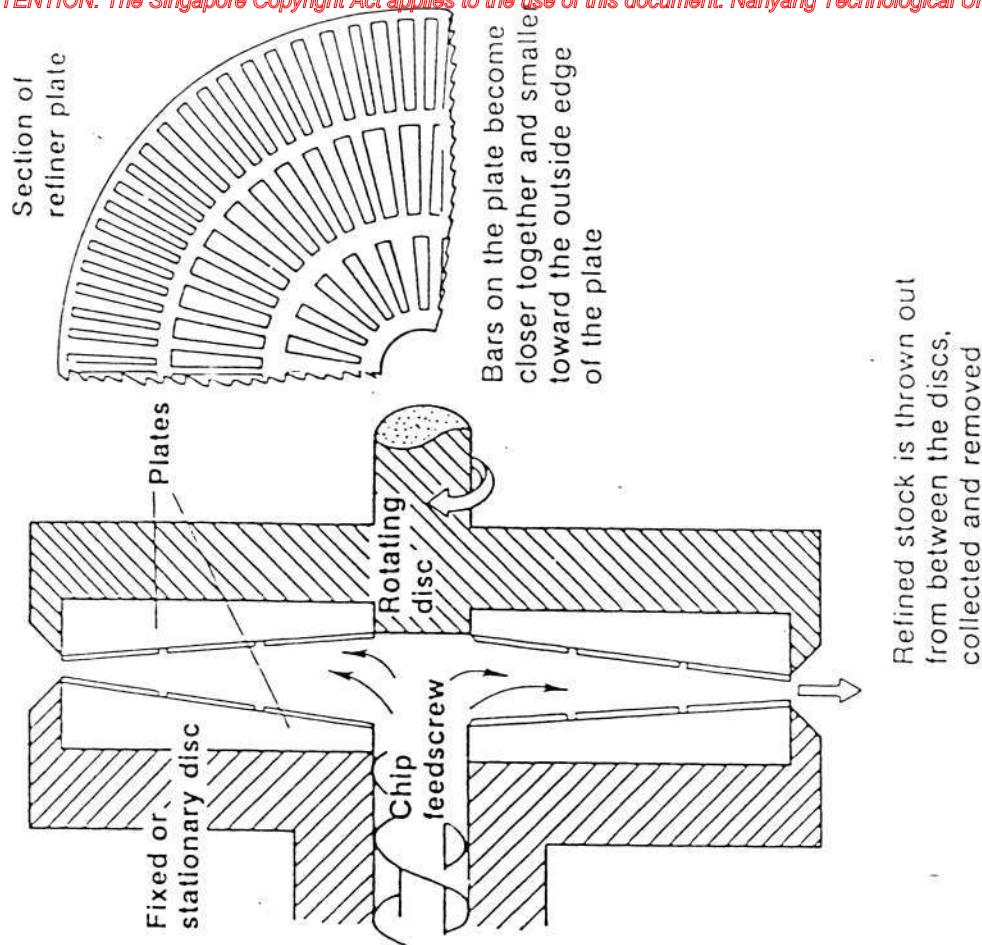


Figure 4.12. Disc refiner detail

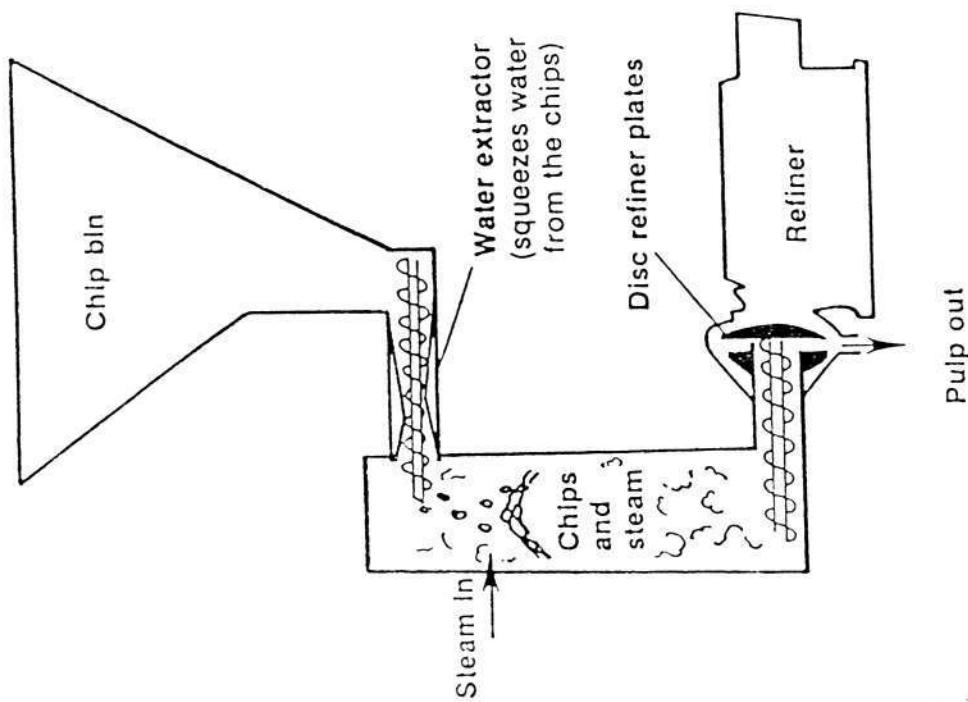
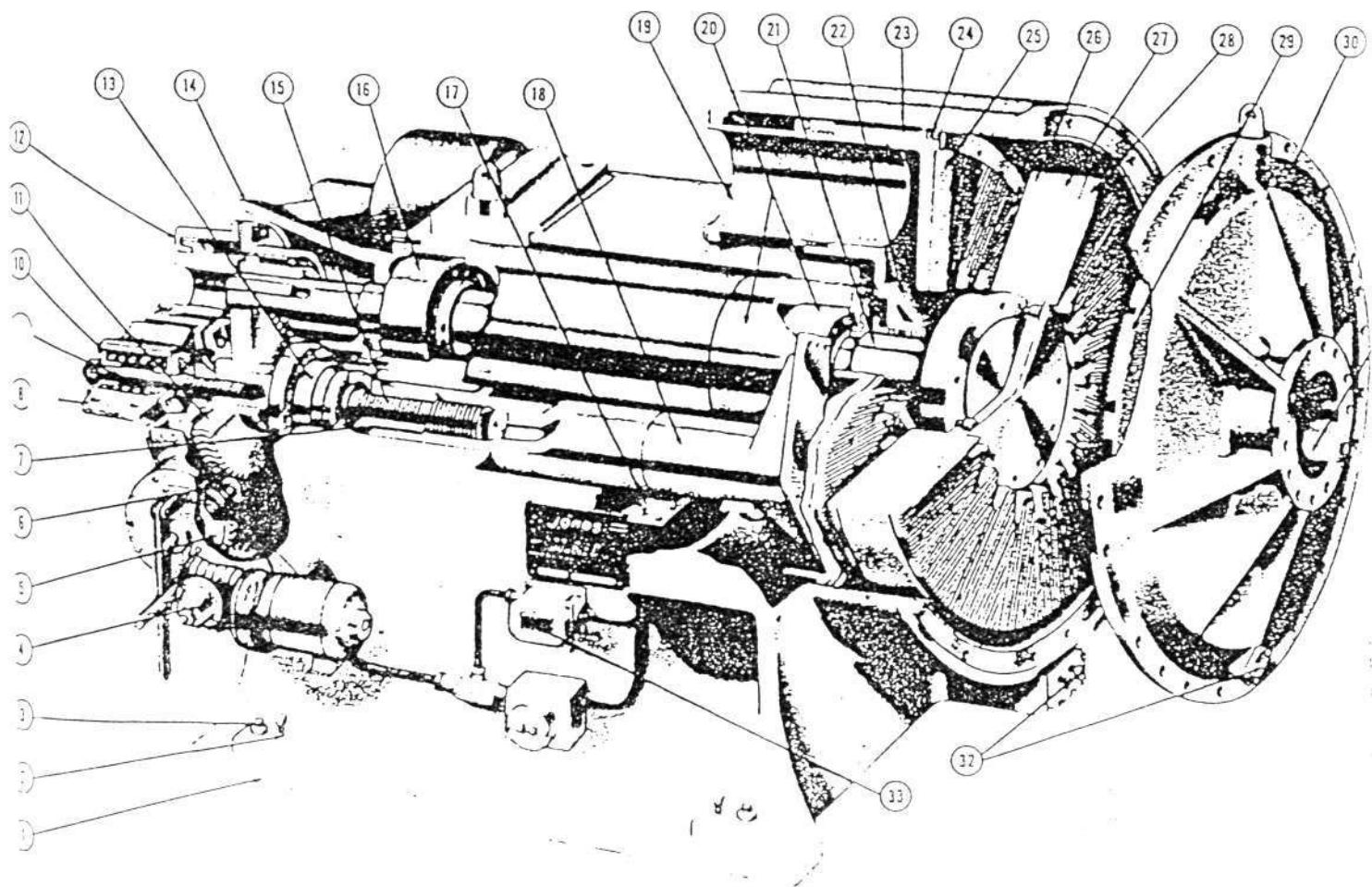


Figure 4.11. High-yield mechanical pulp process

# Refiner used for Thermo-Mechanical Pulp (TMP) Production



## **BASICS OF NEWSPRINT MANUFACTURE**

### **DIFFERENT TYPES OF PULP**

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#### **- Chemical pulp:**

Two processes:

- kraft or sulphate process
- sulphite process

The kraft process is the most used.

Process: Wood chips treated at high temperature and pressure with chemicals (liquor) to eliminate the lignin components of the wood.

Yield: about 50%

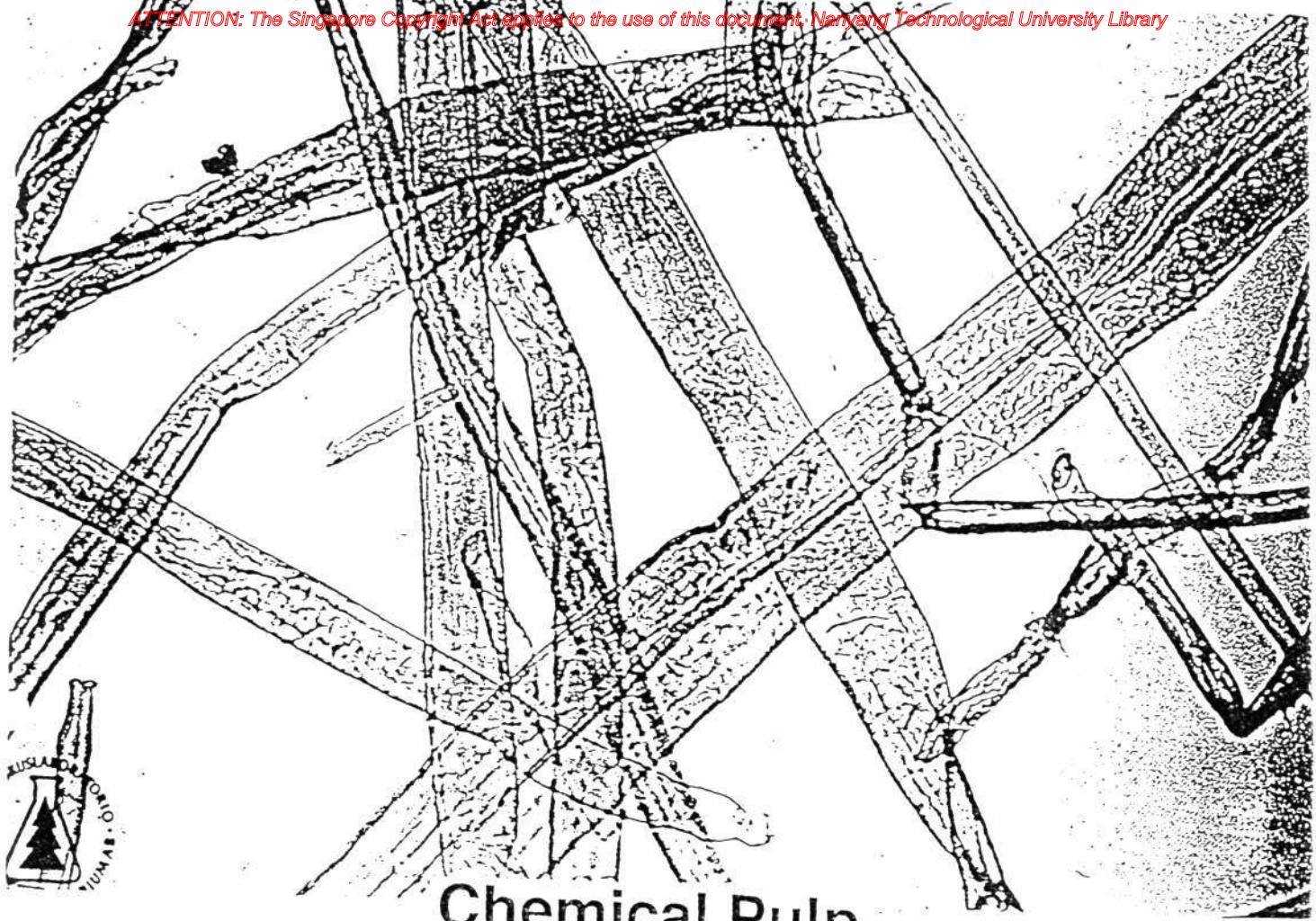
Advantages: nice strong fibres

Disadvantage: yield

Less and less used for newsprint (cost)

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**Chemical Pulp**

## **Groundwood Mechanical Pulp**



## **BASICS OF NEWSPRINT MANUFACTURE DIFFERENT TYPES OF PULP**

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### **- Deinked pulp:**

Raw material: recycled waste paper (old newspapers and magazines)

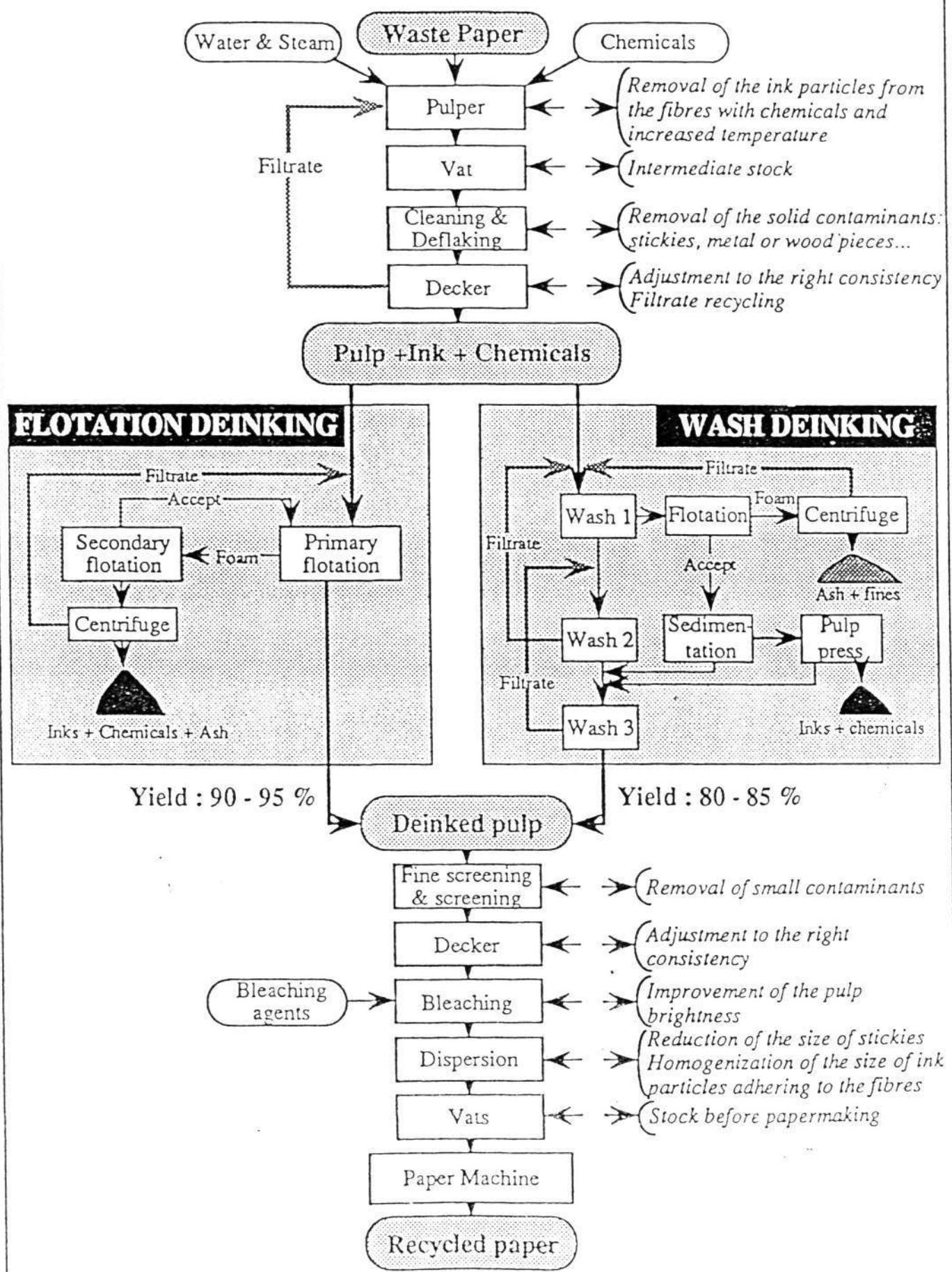
Advantage: cheap raw material, less energy required

Disadvantage: a lot of experience is needed to manufacture a good-quality newsprint out of deinked pulp.

Bid trend today to manufacture newsprint with recycled content (ecological image)

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## Waste paper treatment with the flotation or the wash deinking process



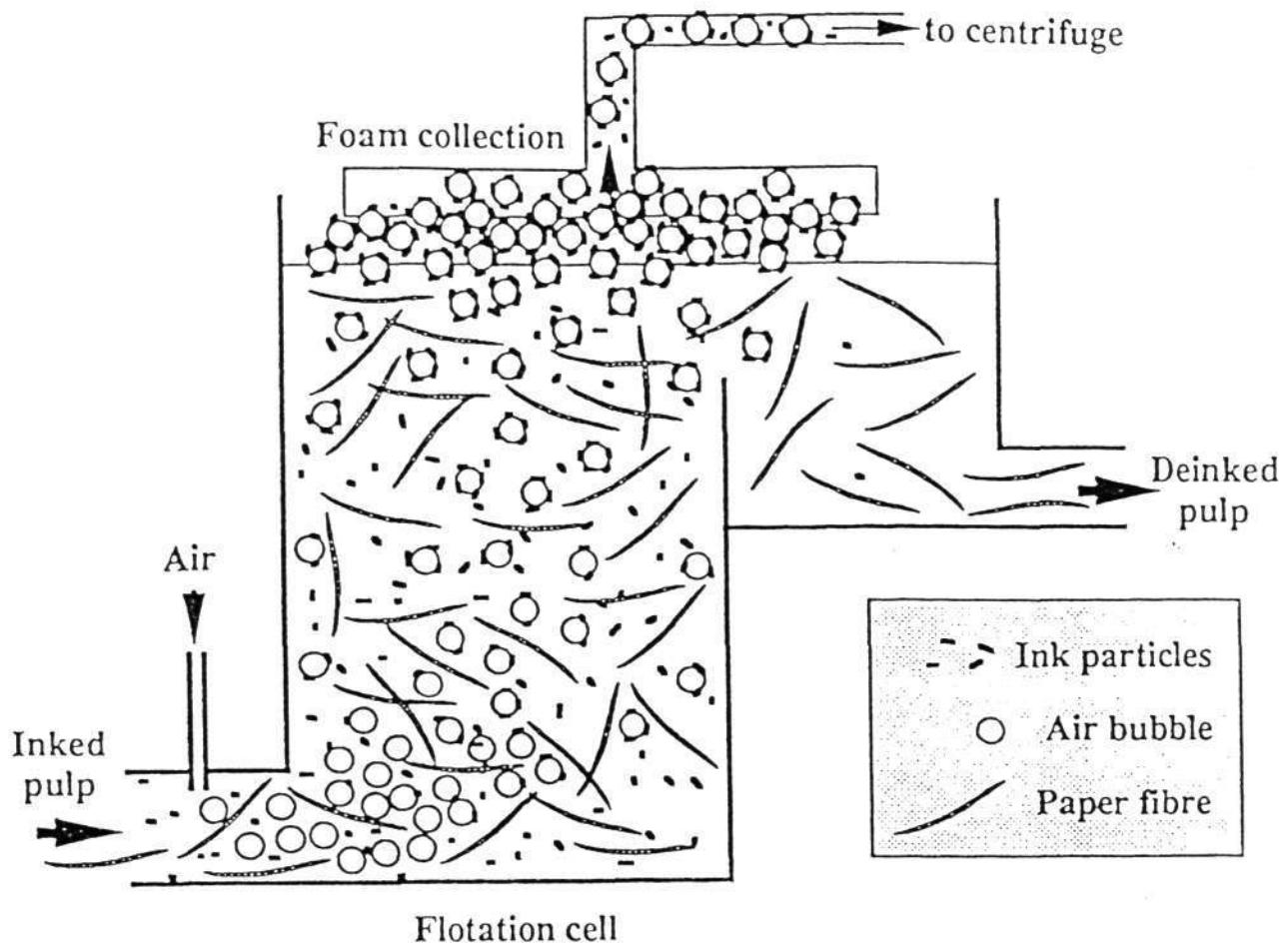


Diagram 11

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### Simplified mechanism of the wash deinking process

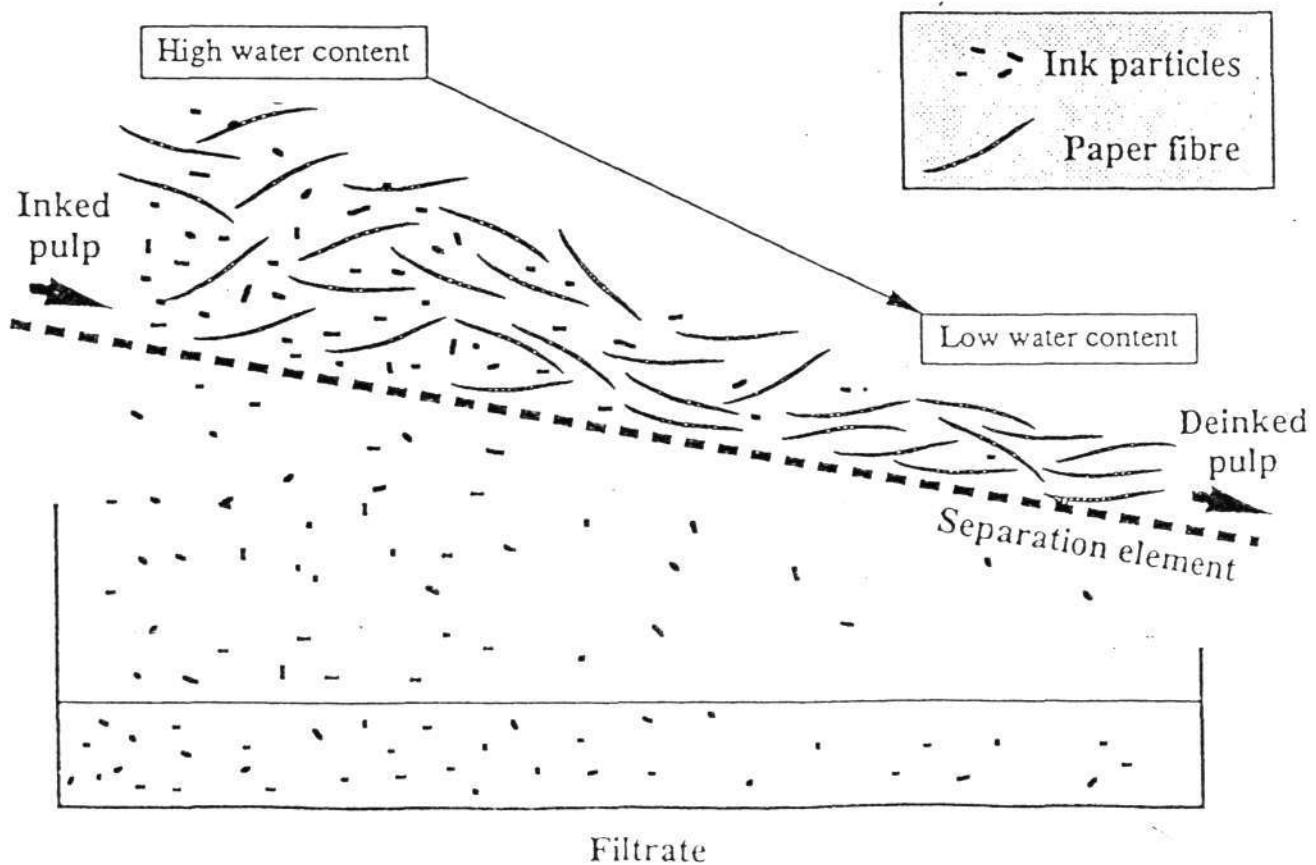
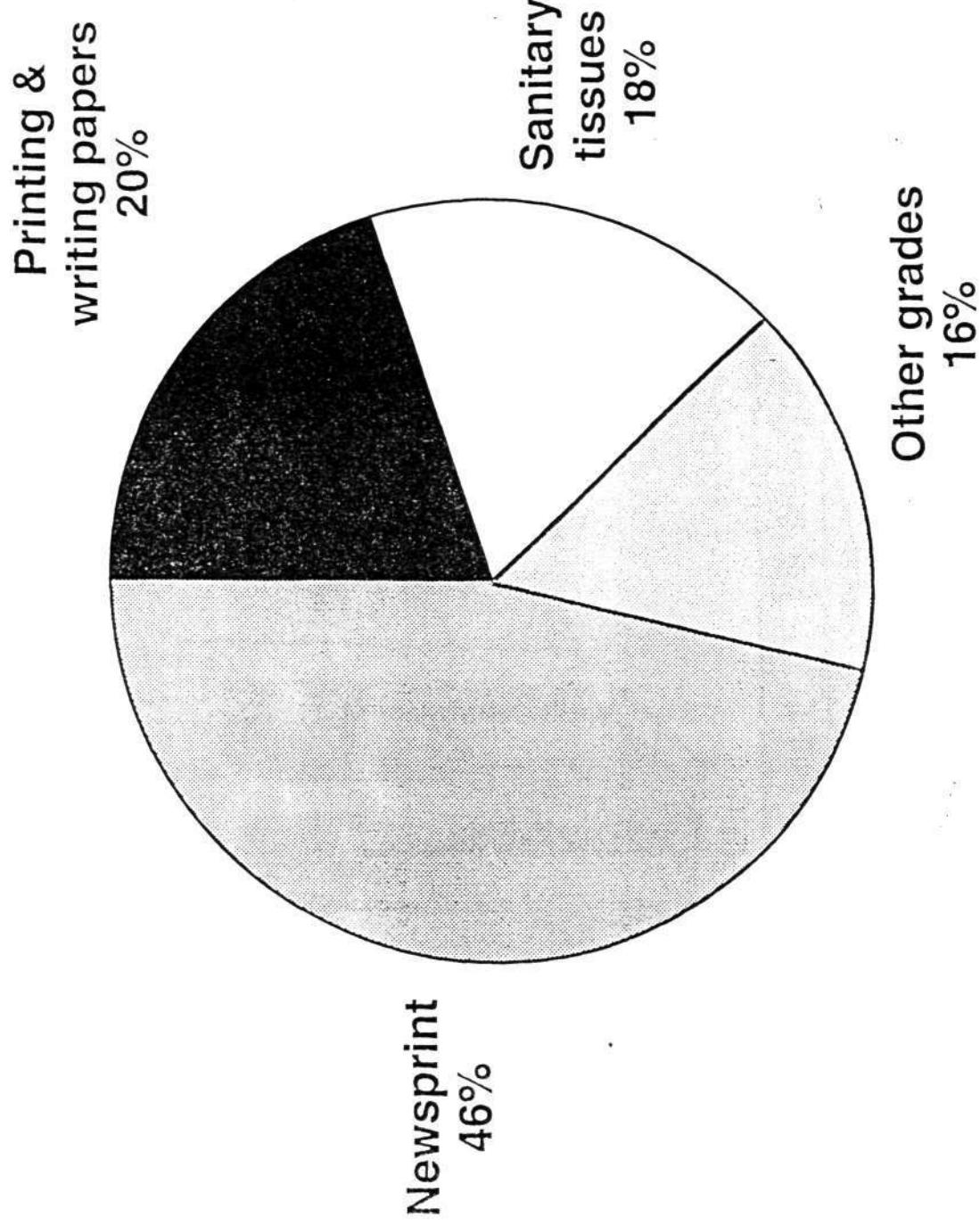


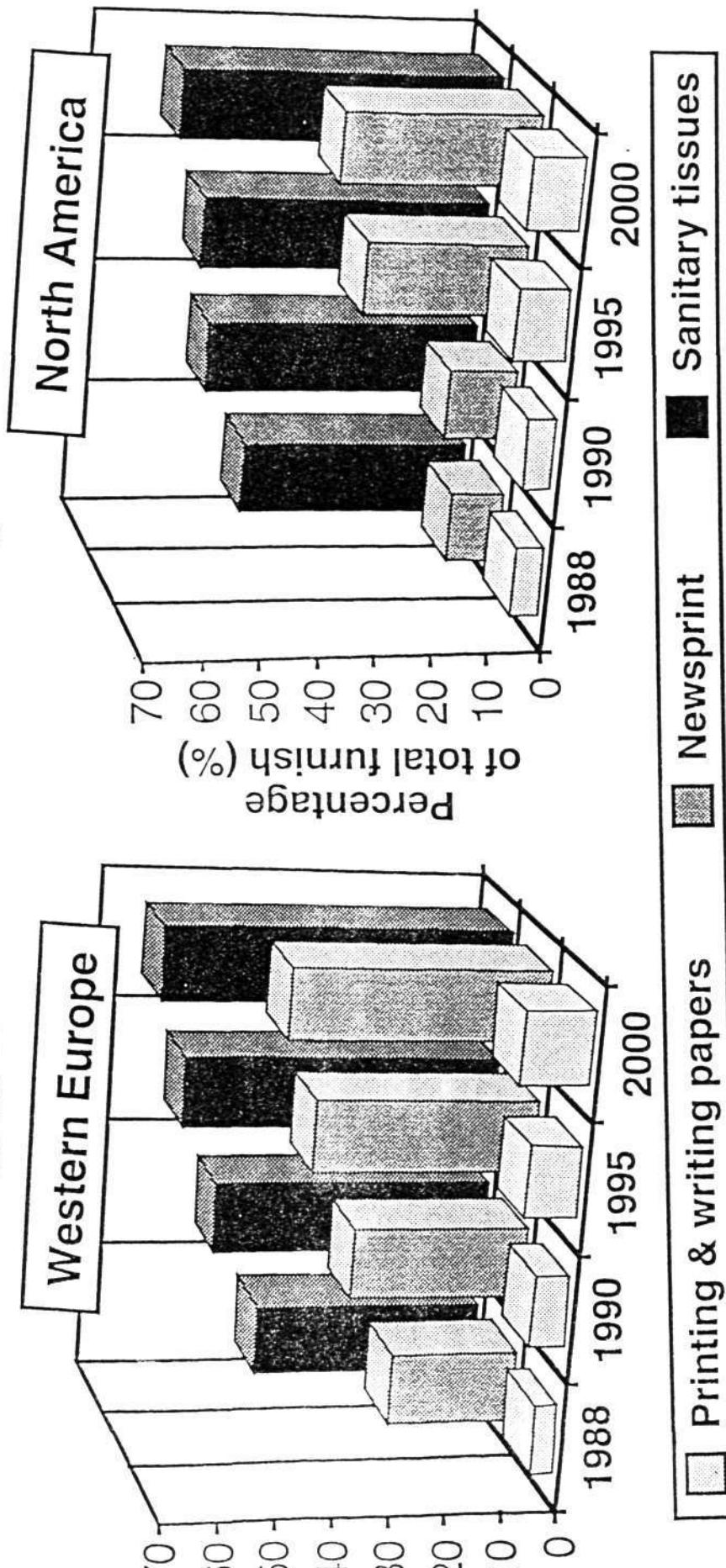
Diagram 12

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## Use of deinked pulp in West Europe (1992)



### Estimated use of deinked pulp as a percentage of total furnish for the main grades



Source: Jaakko Pöyry

Figure 5.5. Centrifugal cleaner

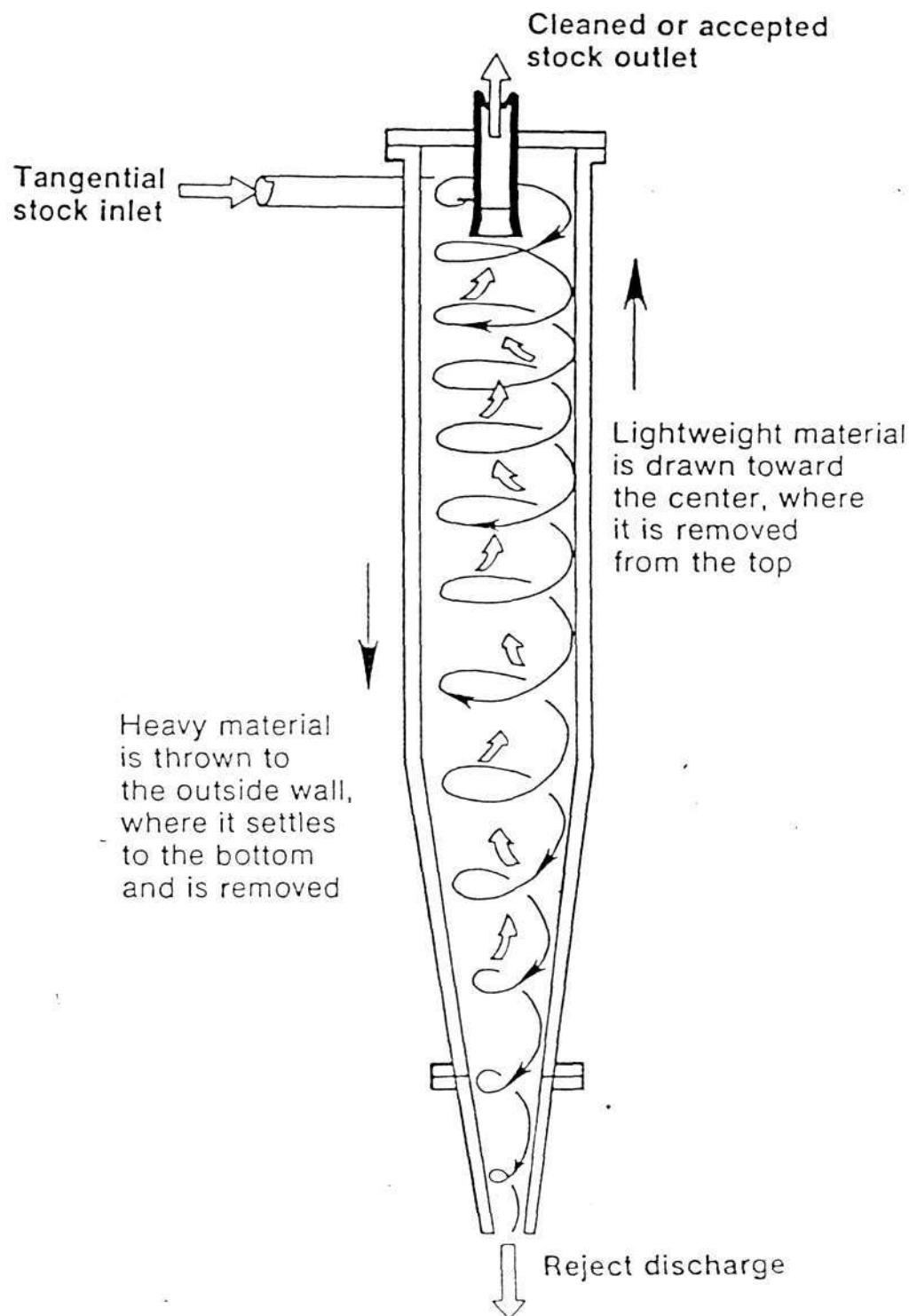
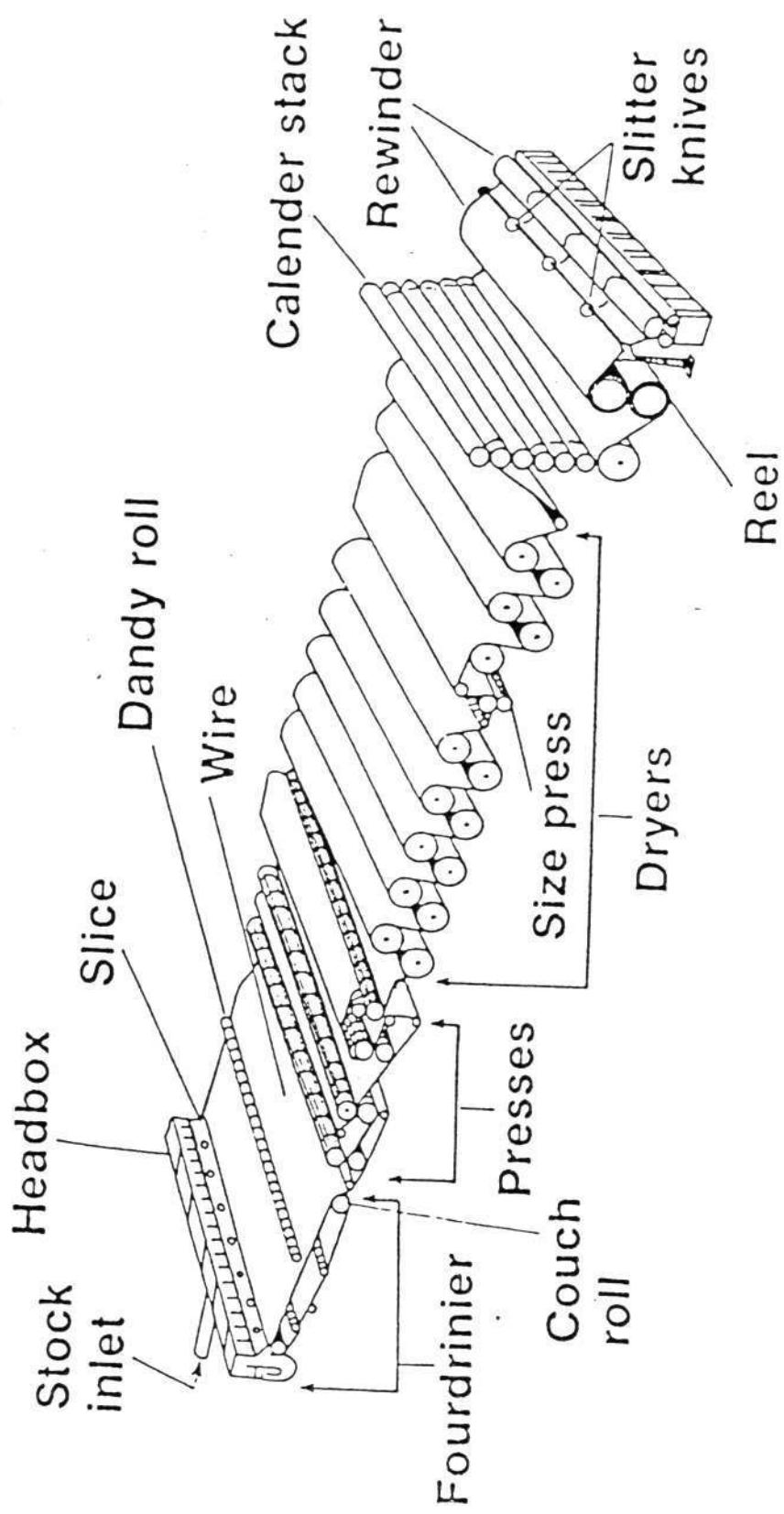


Figure 6.1. Fourdrinier paper machine



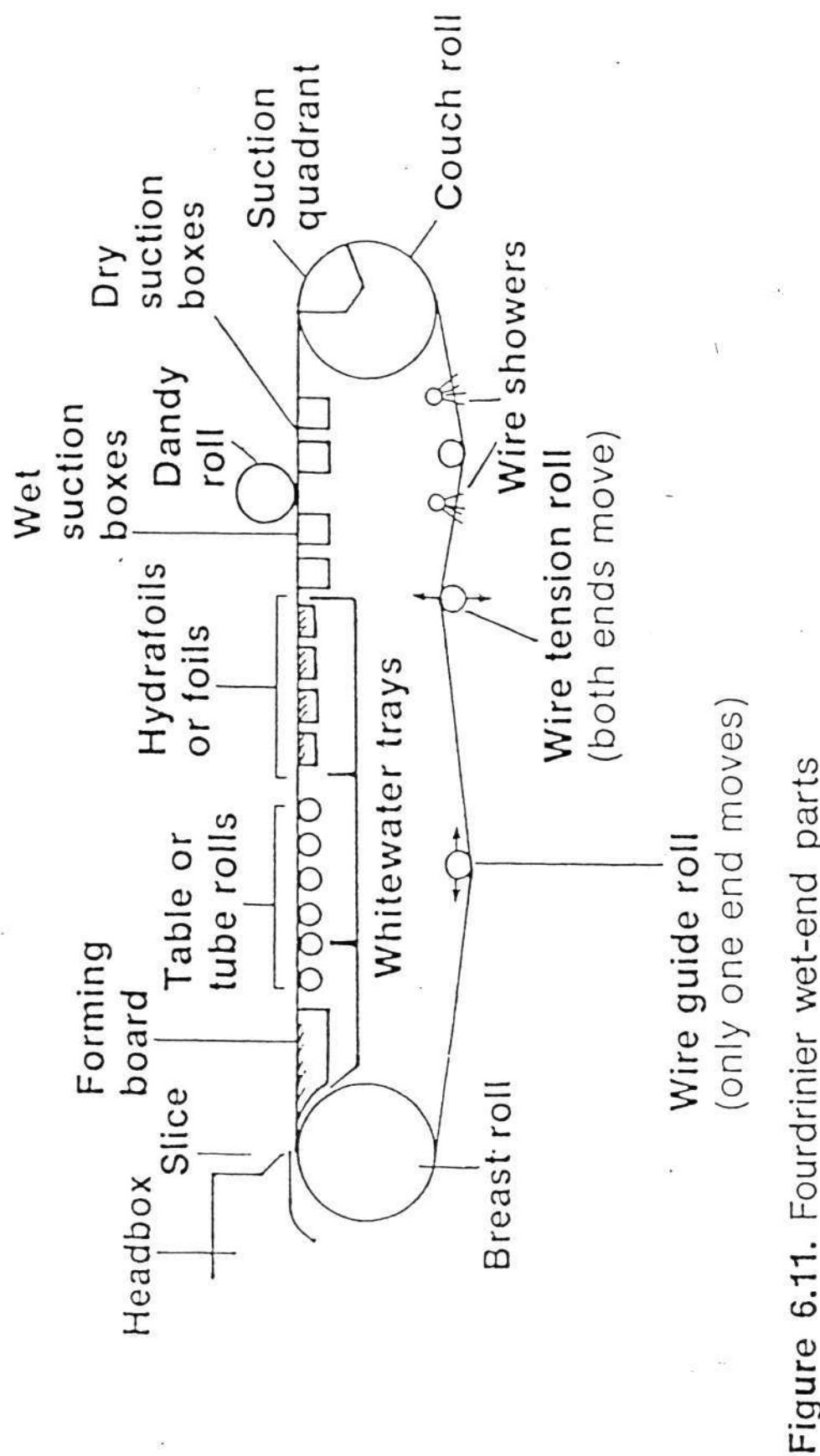


Figure 6.11. Fourdrinier wet-end parts

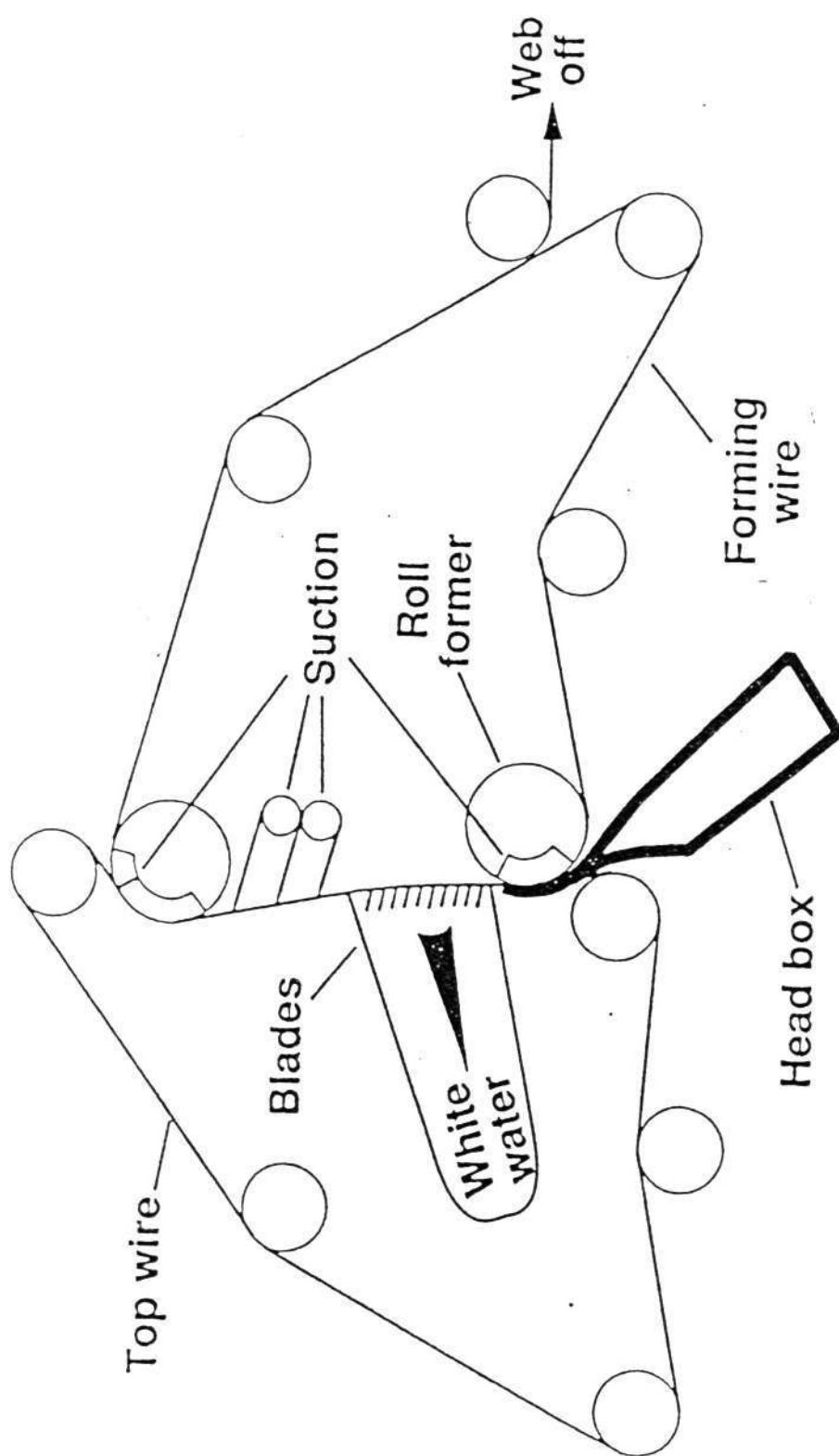


Figure 6.21. Roll and blade-type twin-wire former

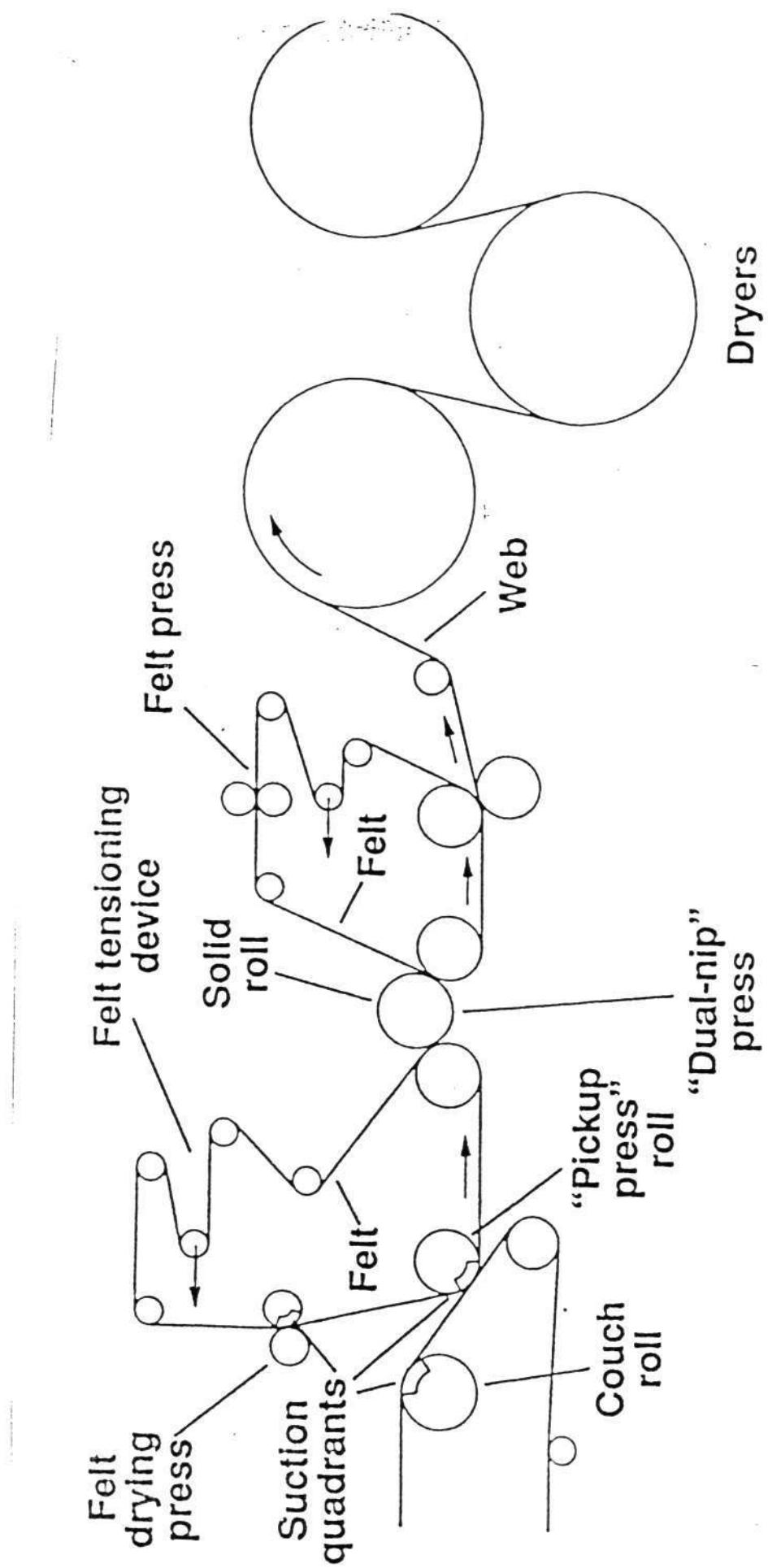
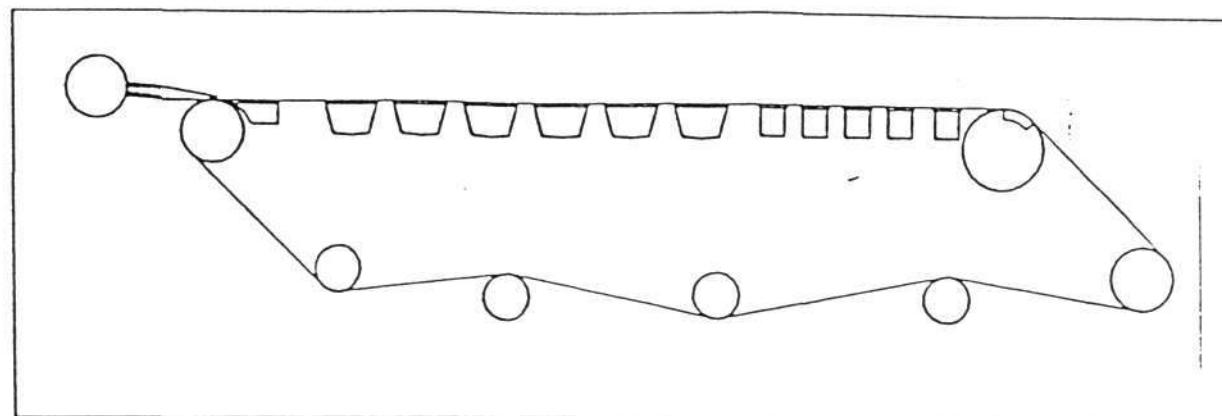
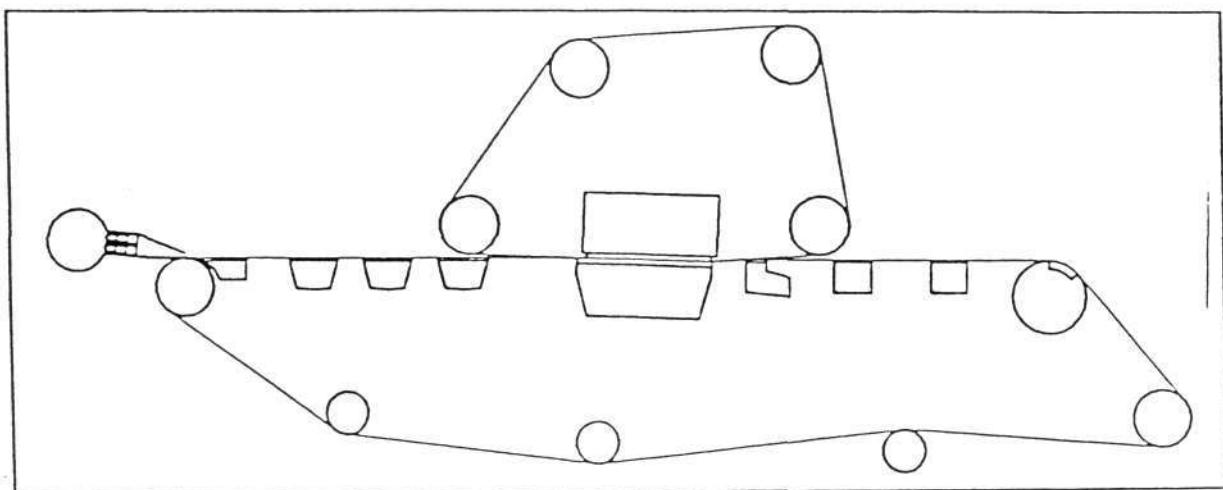


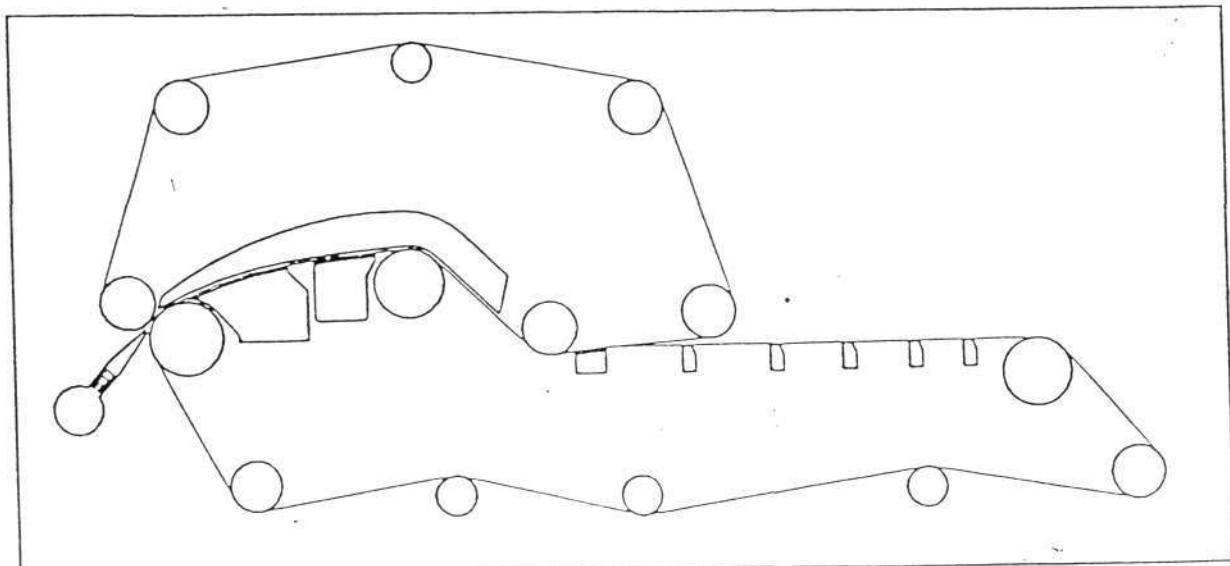
Figure 6.25. Press section design



Fourdrinier (single-wire) paper machine



Hybride former



Double-wire paper machine  
(Gap former)



## *Basics of papermaking* **SHEET FORMATION**

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- One of the basic characteristics
- Can be checked visually by transmitted light --> appearance of light and dark areas.
- On the wet part of the paper machine, fibres tend to cling together to form flocculations. The purpose of the headbox is to break these flocculations.  
Bad formation may be compensated by a good compressibility
- Wire marking: depends on the type of wire. Can have a visual effect on printed solids and halftones.

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## **BETTER TECHNOLOGY: BETTER NEWSPRINT**

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### **Newsprint composition:**

In 1950, newsprint = 70% SGW + 30% chemical pulp

Today's trend: very few chemical pulp, use of TMP and deinked pulp

### **Width and speed of the machines:**

typical today: 8.5m and 1500 m/min

(needs less personnel than an old 3.6 m wide machine running at 500 m/min and produces 7 times more)

### **Twin-wire formers:**

better drainage capacities (water elimination) --> greater speeds

### **Better press sections:**

Better paper surface --> printability, compressibility, absorption

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## **BETTER TECHNOLOGY: BETTER NEWSPRINT**

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### **Twin formers + better furnish:**

No linting --> offset process possible for newspapers (up to 4+4)

Better dimensional stability

Better mechanical properties

### **New process control systems:**

uniformity of the properties (MD and CD)

### **Problem: different grammages, reel diameters and reel widths**

--> problems to optimize at the winding station

### **A lot of different possible raw materials and equipments to manufacture newsprint**

--> a lot of different newsprints but general improvement of the quality

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# Soft-calendering

## History of the process:

- In the 70s: first use for board and wood-free grades.
- In the mid-80s: alternative to hard-nip calendering in newsprint manufacture, because of the rapid progress being made in hot roll technology and soft roll covers.

## Advantages:

- improved print quality
- improved strength
- higher moisture contents
- suitability for recycled fibres
- good control of two-sidedness

After **hard-nip** calendering:

paper **thickness constant**

paper **density varies**

After **soft-nip** calendering:

paper **thickness varies**

paper **density constant**

--> Constant paper density means better print quality because the ink will penetrate evenly into the paper (without mottling)



# Soft-calendering

## Hard or soft nip?

A **hard-nip** crushes fibres and breaks inter-fibre bonds

--> reduction of the strength of the paper.

In a **soft-nip**: "soft" treatment of the paper fibres and better fibre bonding because of the use of thermo rolls

--> the tensile index can be increased by up to 15%.

--> the amount of chemical pulp and virgin fibres can be reduced, which pays back.

## Parameters:

The following parameters influence the quality of the final paper:

- speed (generally fixed by the paper machine)
- temperature (generally 130-140°C, great influence on roughness)
- linear load (up to 350 kN/m for a TMP furnish)
- moisture level of base paper
- external moistening
- dimensions of calendering rolls
- type of soft roll covers



Fig. 1: Comparison of calendering effects.

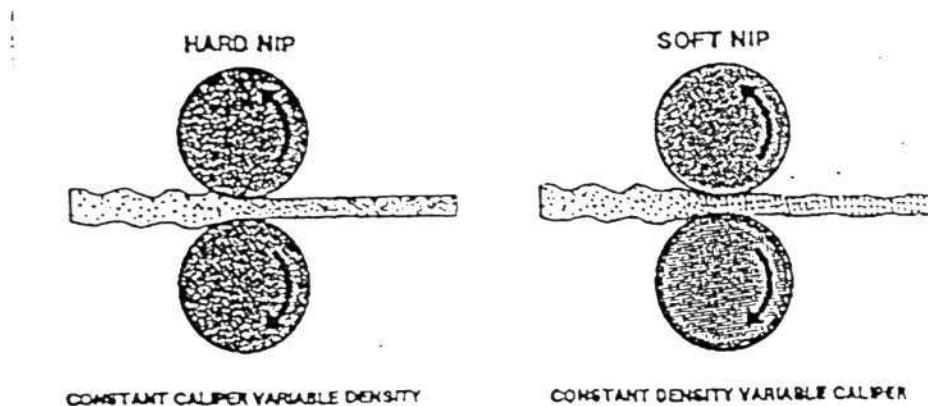


Fig. 2: Nip pressure at 1000 kN/m, Ø 1000 mm.

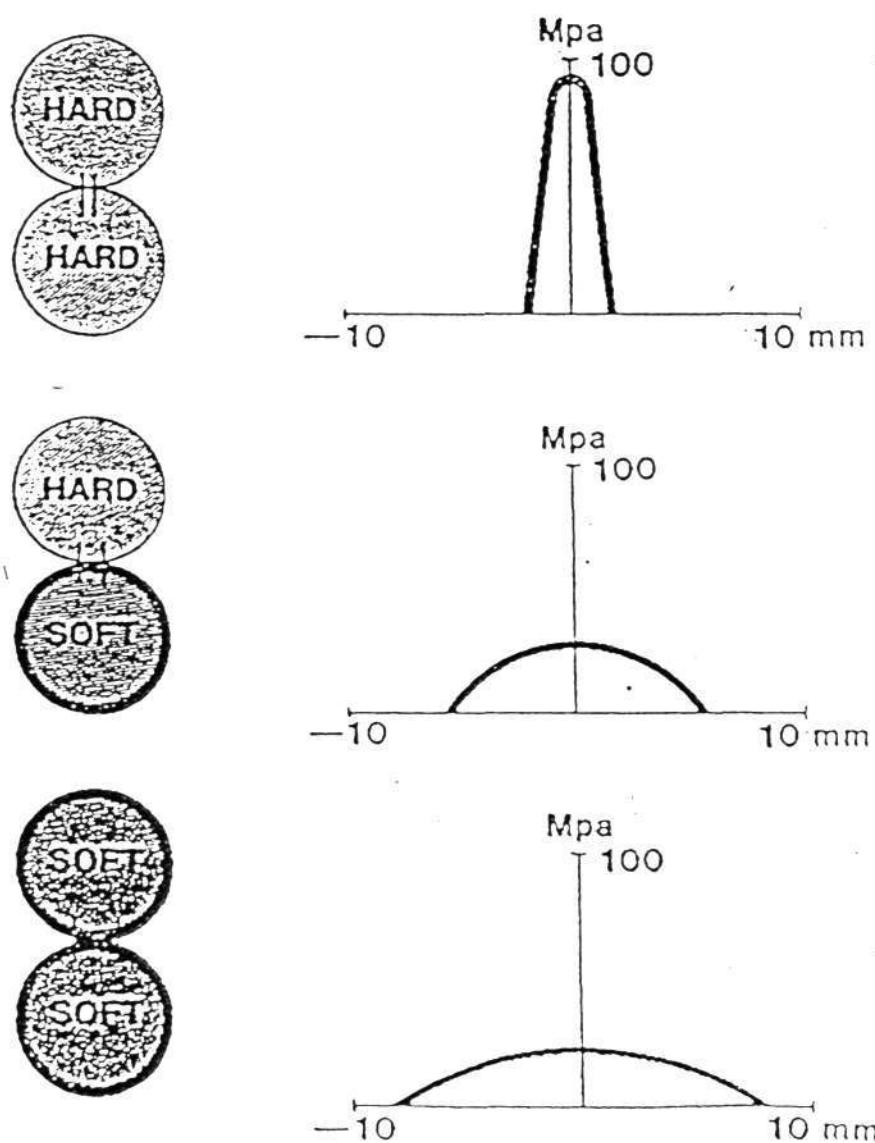
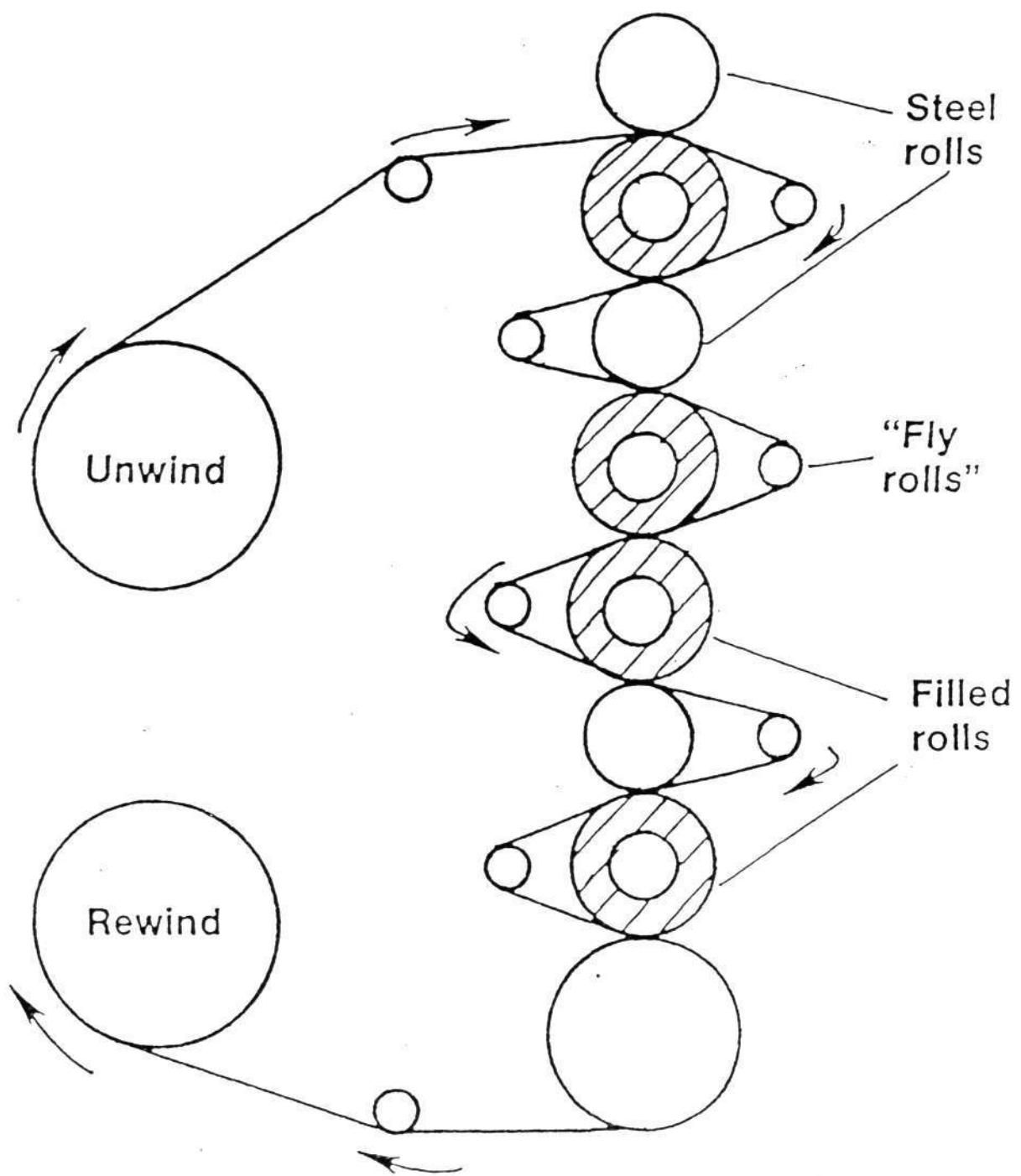


Figure 7.14. Supercalender design



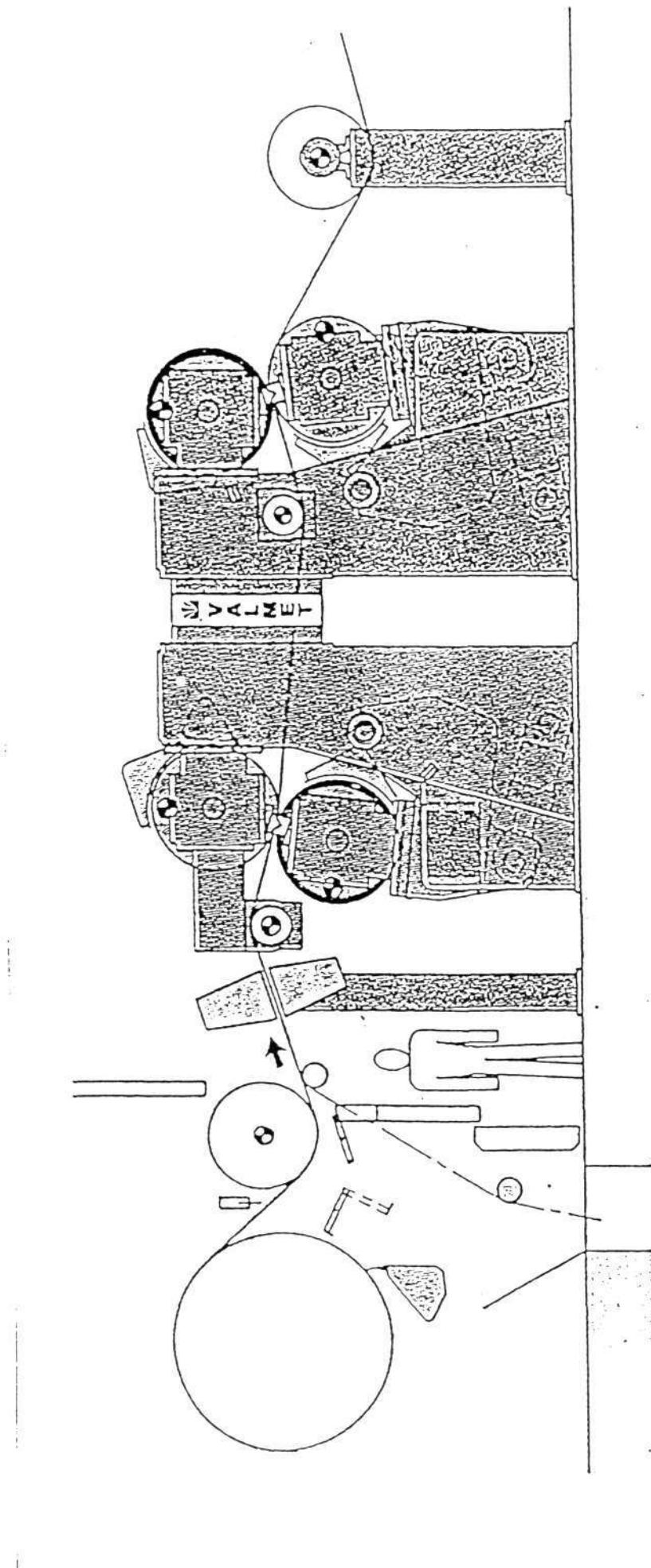
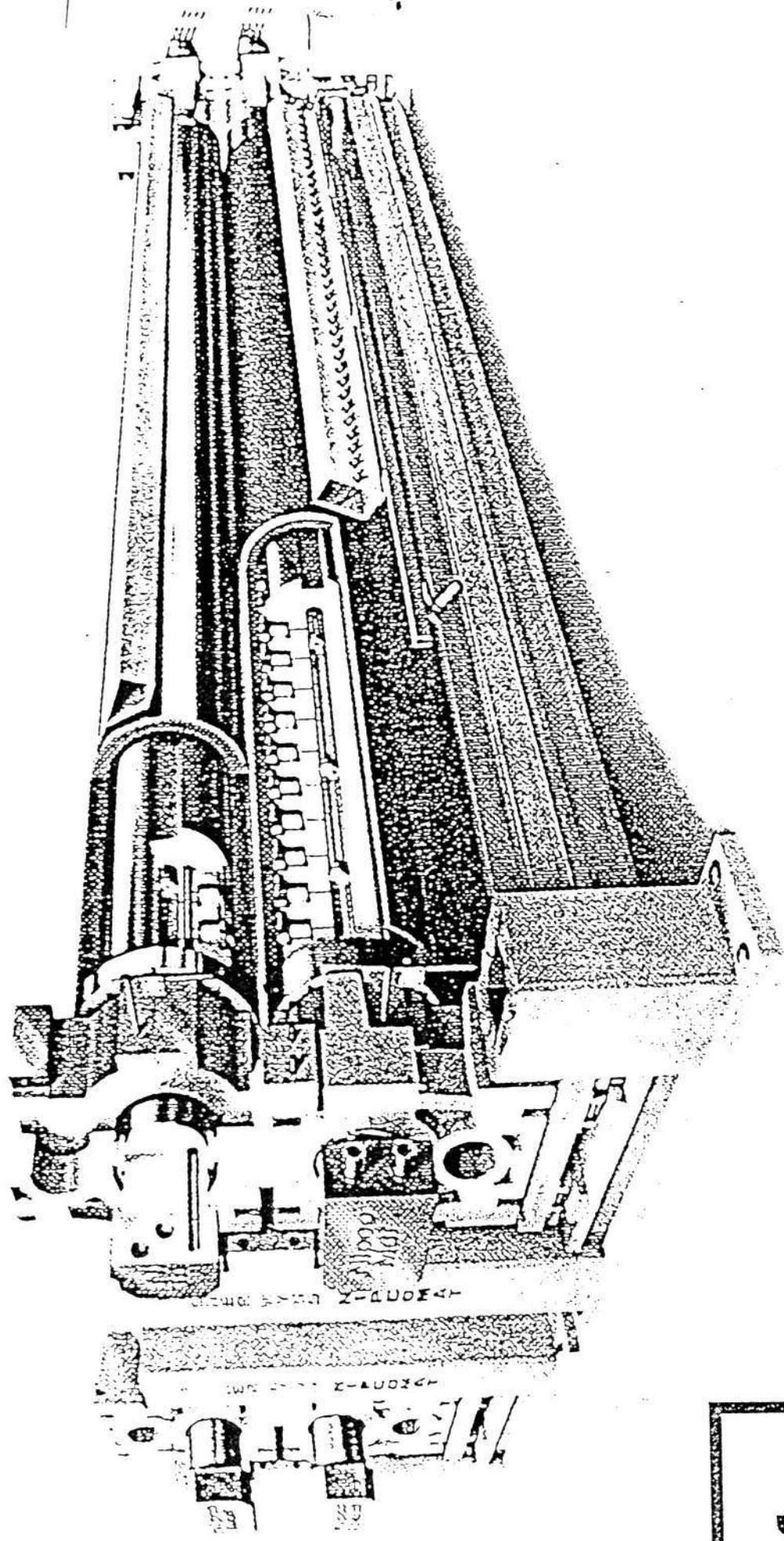


Fig. 3: Soft calender, newsprint.

# NipCoMat Soft Calender



ifra

# Different types of newsprint

## Standard Newsprint:

- Generally produced on twin-wire machines and is machine-finished.
- Adjusted to a suitable smoothness for all newspaper printing methods (offset, letterpress, flexo).
- Main components: TMP, Deinked pulp, groundwood pulp and small amounts of chemical pulp.
- Main grammages: 40, 45 and 48.8
- Basic use: Daily and weekly newspapers, periodicals, catalogues and magazines printed in coldset offset, letterpress or flexo.

PROPERTY VALUES

NORNEWS, STANDARD NEWSPRINT			
Grammage, g/m <sup>2</sup>	40 *	45	48.8
Brightness, % ISO	57	58	58
Luminance, % (Y-value) **	63.5	64.5/63.5	64.5/63.5
Dominant wavelength, nm	576.5	576.5	576.5
Excitation purity, % ***	7.5	7.5/5.5	7.5/5.5
Opacity, %	90.5	92.5	93.5
Roughness Bendtsen 0.1 MPa, ml/min	80/120 (letterpress/offset)		
Moisture content, %	9		

Utv,Pag

1994-04-11

Pl 11/94

**STORA FELDMÜHLE KVARNSVEDEN**  
**PM 11**  
**STORA NEWS 49g/m<sup>2</sup>**

Grammage, g/m <sup>2</sup>	48,4		
Apparent Density, kg/m <sup>3</sup>	645		
Thickness, µm	75		
Roughness Bendtsen, 0,1 MPa, ml/min ts/ws	89/99		
Roughness Bendtsen, 0,5 MPa, ml/min ts/ws	32/34		
Roughness PPS, 1 MPa, ml/min ts/ws	3,28/3,40		
Air permeance, ml/min	196		
Tensile strength, kN/m, MD/CD	2,70/0,87		
Stretch at break, %, MD/CD	1,05/3,14		
Tearing strength, mN, MD/CD	174/263		
Brightness, ISO, %, ts/ws	58,0/58,3		
Y-value, %	64,7		
Opacity, %	93,9		
Lightscatt.coeff. m <sup>2</sup> /kg	52,8		
Lightabs.coeff. m <sup>2</sup> /kg	5,1		
Excitation purity, %	7,6		
Dom. wave-length, nm	576,2		
Oil absorbtion, Cobb Unger g/m <sup>2</sup> , ts/ws	15,3/18,7		
Surface strength, ts/ws	1,0/1,2		
X-value, letterpress, ts/ws	2,8/3,8		
Printability properties, Prüfbau-test evaluated at:	1,5 g/m <sup>2</sup> ink on paper	Print density 0,90	
	*) 0,92/0,93	**) 1,31/1,27	
Print through x 1000, ts/ws	48/52	45/49	
Strike through x 1000, ts/ws	23/27	25/26	
Set-off x 100, ts/ws	32/29	27/25	
Rub-off x 1000, ts/ws	27/28	21/24	

\*) Ink hold-out

\*\*) Ink requirement, g/m<sup>2</sup>

Kvarnsveden 1994-04-11

Nordenfjelske Treforedling  
PAPER LABORATORYDate : 15/03/94  
Sign : M.LEINSVANG.

Mill : NSI  
 Quality : AVIS STANDARD  
 Grammage : 48.8 g/m<sup>2</sup>

Comment: PRODUSERT FOR GUARDIAN, TILSATTE FYLLSTOFF.

PM : 1  
 Tambour No : 2269  
 Peel No : 11131618

Grammage		g/m <sup>2</sup>	48.9	
Sheet thickness		μm	77.9	
Sheet density		kg/kbm	628	
Roughness Bendtsen	0,1 MPa	Ts/Ws	ml/min	91 / 89
Roughness Bendtsen	0,5 MPa	Ts/Ws	ml/min	29 / 29
Hardness		Ts/Ws		32 / 32
Roughness P.P.S		Ts/Ws	μm	3.2 / 3.3
Porosity Bendtsen			ml/min	175
Friction		Ts/Ws		0.35 / 0.36
Tensile Strength		MD/CD	kN/m	2.47 / 0.81
Tensile index		MD	Nm/g	50.5
Tensile ratio CD/MD				0.33
Elongation		MD/CD		0.94 / 3.12
Tearing resistance		MD/CD	mN	180 / 273
Tear index		CD	mNm <sup>2</sup> /g	5.58
Tear ratio CD/MD				1.52
Ash content		%		1.10
Lightness ISO		%	60.2	
Y - value		%	64.5	
Excitation purity		%	5.40	
Dominant wavelength		nm	576.7	
Opacity		%	94.7	
Spesific light scattering coeff.		m <sup>2</sup> /kg	54.9	
Formation			5.86	
Furnish	TMP	%	100	
	Chem.pulp	%		
	Broke	%		
Dip:	Yes/No	Starch:	Yes/No	

# Different types of newsprint

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## Directory paper:

- Main use: telephone books and various catalogues
- High pagination: lower grammage  
--> 40 g/m<sup>2</sup> and below.
- To go below 40 g, requires well-refined mechanical pulp and high-quality filler addition to maintain opacity.

## Bulky Newsprint:

Mainly used for pocket books printed in offset or letterpress. Also for newspaper supplements and advertising inserts.

Bulk factor = C(μm) / G(g/m<sup>2</sup>)

with C: caliper and G: grammage

For standard newsprint: ≈ 1.5

For bulky: ≈ 1.8-2.4

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# Different types of newsprint

## Improved Newsprint:

Basic properties:

- high brightness
- good opacity
- better printability (can be used in heatset offset)
- high bulk and stiffness
- good runnability and low linting

Differences with standard grades: better brightness and surface

Major use: daily newspapers with high quality colour printing, newspaper supplements, advertising inserts and direct mail, books and comics

PROPERTY VALUES

NORBRIGHT and NORBRIGHT SUPER							
Grammage, g/m <sup>2</sup>	45	48.8		52		55	60
Brightness, % ISO	66	66	71	66	71	66	71
Luminance, % (Y-value)	69.5	69.5	73.5	69.5	73.5	69.5	73.5
Dominant wavelength, nm	573	573	568	573	568	573	568
Excitation purity, %	4.5	4.5	3.0	4.5	3.0	4.5	3.0
Opacity, %	89	90.5	89	91.5	90	92.5	91
Roughness Bendtsen 0.1 MPa, ml/min	95	95		105		105	105
Moisture content, %						8.9	

The preferred diameters for newsprint reels are as follows:

- 1000 mm
- 1070 mm
- 1150 mm
- 1250 mm.

## Recommendations for reel core and chuck specifications

### 4.1. Core properties for a reel up to 1.7 m in width

1. Inner diameter:  $76.2 + 0.4$  mm; – 0.0 mm.
2. Outer diameter: maximum 107 mm (to enable fixed splicing).
3. Weight:  $\leq 4$  kg/m (to avoid heavy waste).
4. Moisture content: 6 ... 9 percent.
5. Crush strength (compression strength):  $> 2000$  N/100 mm (other strength properties also important, though less common in practice due to lack of standard measuring methods).
6. Elasticity modulus:  $> 2700$  N/mm<sup>2</sup>. Not critical at normal web widths (1.6 m), but becomes critical at web widths of 2.5 m.
7. Linearity (warpage):  $\leq 2$  mm/m.
8. Out-of-roundness: maximum 0.5 mm.
9. Deformation on core: Acceptable on inner diameter to a certain extent without major fibre damage, not on outer diameter. The reel must be demountable and replaceable.
10. Before the reuse of a reel, core damage must be evaluated.
11. Information to be listed inside core: manufacturer, type of core, identification code.

### 4.2. Chuck properties

#### *Expanding chucks*

1. Nominal diameter: preferable 75 mm.
2. Expansion movement: high, preferably 82 ... 85 mm in diameter.
3. Contact surface: 5000 mm<sup>2</sup>, central drive; 2000 mm<sup>2</sup>, belt drive.

#### *Conical chucks*

1. Contact surface: Long type of chucks recommended.

### 4.3. Information needed for core selection

In order to enable an optimum choice of core the following data concerning the reel and the reelstand should be given to the core manufacturer. This is of utmost importance in more problematic cases, such as extremely short conical chucks, big reel diameters or widths.

1. Maximum web width (cm)
2. Maximum reel diameter (cm)
3. Maximum reel weight (kg)
4. Paper caliper ( $\mu$ m)
5. Chucking thrust force (kp/cm<sup>2</sup> or kPa)
6. Maximum press speed (m/s)
7. Maximum deceleration rate (m/s<sup>2</sup>)

Tunc Max 5 05 : 20 : 13 1994

# WOODCONTAINING PAINTING PAPERS

**NORNEWS**

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