Newsprint and newsink economy and quality : workshop, New Delhi 1-2 August 1994, Madras 5-6 August 1994 : [contents]

1994

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AMIC-IFRA WORKSHOP ON NEWSPRINT AND NEWS INK, NEW DELHI, AUG 1-2, 1994 & MADRAS, AUG 5-6, 1994

AMIC IFRA Workshop on Newsprint and News Ink, New Delhi, Aug 1-2, 1994 and Madras Aug 5-6, 1994 . - Singapore : Asian Mass Communication Research and Information Centre / IFRA, 1994.
1v (various pagings)

The topics covered in this workshop dealt with the newsprint - a buyers' market; basics of newsprint manufacture; newsprint properties; efficient use of newsprint; newsinks; fountain solution; printing processes in newspaper production; quality parameters; what is print quality and how to evaluate it.

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Newsprint and Newsink
Economy and Quality

DEHLI

1-2 August 1994

Holiday Inn Crowne Plaza

In cooperation with Indian Newspaper Society

MADRAS

5-6 August 1994

Ambassador Pallava

In cooperation with Research Institute for Newspaper Development

Programme

Day 1

Newsprint - a buyers market?
Basics of newsprint manufacture
Newsprint properties
Efficient use of newsprint
Newsinks

Day 2

Fountain solution
Printing processes in newspaper production
Quality parameters
What is print quality and how to evaluate it
Clinic session

Day 1

Newsprint - a buyers market

- Evolution of the total paper & board consumption in the World
- World pulp production by type
- World paper production by grades
- The main producers of newsprint
- The main consumers of newsprint
- The importance of newsprint as information carrier
- Case study: the United States of America
  - evolution of the newsprint consumption
  - price development
  - the major newspapers
  - newsprint as an element of total publishing cost
- Example of newsprint prices in different countries

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,...

Newsprint properties

- Basic characteristics
  - Grammage
  - Moisture content
  - Ash content
- Structural characteristics
  - Sheet thickness
  - Sheet density
  - Surface roughness
  - Compressibility
  - Porosity
  - Oil & water absorption
- Optical characteristics
  - ISO brightness
  - Shade
  - Opacity
- Mechanical characteristics
  - Tensile strength and elongation
  - Tearing resistance
- Newsprint quality control
  - Why quality control?
  - ISO 9000
  - Establishing purchasing specifications
  - How to establish a quality control programme?
  - Which properties to test?

Efficient use of newsprint

- Newsprint reel transport
- Reel handling in the printing plant
- Storage: different types of warehouses
- Classification of newsprint and reel defects
- Newsprint waste control
    - Waste definitions
    - How and where to measure waste?
    - Setting waste targets
    - Useful equipment and tools
    - How to reduce waste?
- Web break control
    - Web break as a cost factor
    - Web break recording
- Case studies on efficient waste management

Newsinks

- The role of ink
- Composition of inks: newsinks, heatset inks,...
- Drying mechanisms
- Properties of newsinks
- Testing methods: viscosity, ink length, ink tack, surface energy, water acceptance, print density, ink requirement, print-through, set-off, rub-off, monitoring of ink quality
- Handling of newsinks
- New developments:
    - Vegetable oil based inks
    - High-pigmented inks

Day 2

Fountain solution

- Tap water characteristics
- Additives
- Concentration, pH, Conductivity
- Surface tension
- Wetting

Printing processes in newspaper production

- Offset - conventional:
    - ductor inking
    - film inking
    - undershot
    - overshot
    - pump inking
- Offset - keyless
- Flexo
- Brush damping
- Spray damping
- Plates - offset, letterpress, flexo
- Computer-to-Plate
- Blankets - requirements and effect on quality

Quality parameters

- Inking levels - how to optimise and keep consistent
- Dot gain - how to minimise and keep consistent
- Ink setting, rub-off, set-off: what are they, how to measure and how to optimise
- Print through, show through - common problems to be solved
- Linting and fan-out - paper properties that have to be taken into account in offset printing
- Register control - manual or automatic, nevertheless - a must

What is print quality and how to evaluate it

- Visual assessment
- Densitometric assessment
- Colorimetric assessment

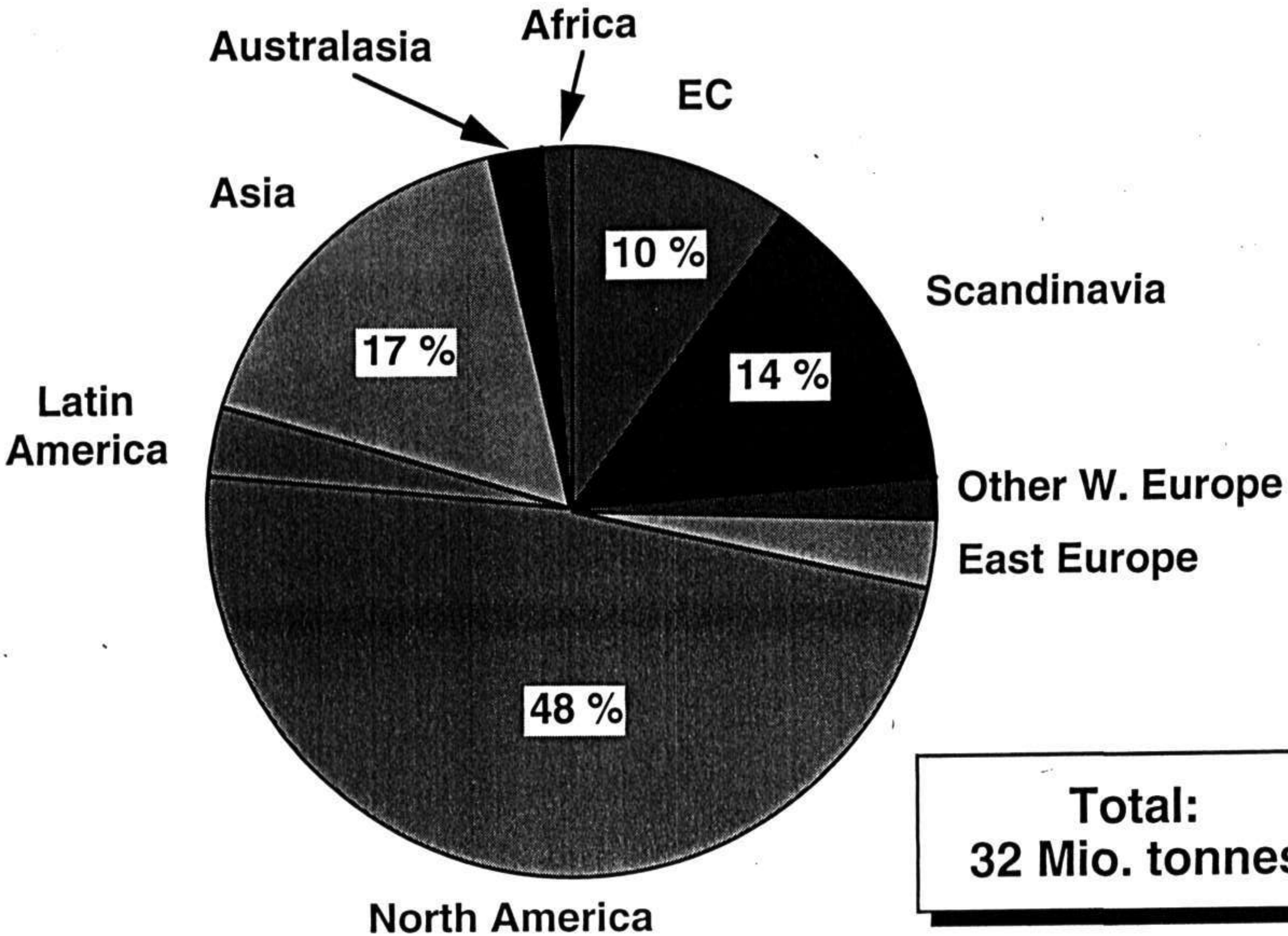
Test printing

- Laboratory scale - IGT, Prüfbau
- Pilot scale - small presses
- Full scale - normal production conditions
- Correlation between these methods
- What can be concluded and how to bring the results into practice?
- The IFRA Colour Testforme

Newsprint - a buyers market

- Evolution of the total paper & board consumption in the World
- World pulp production by type
- World paper production by grades
- The main producers of newsprint
- The main consumers of newsprint
- The importance of newsprint as information carrier
- Case study: the United States of America
    - evolution of the newsprint consumption
    - price development
    - the major newspapers
    - newsprint as an element of total publishing cost
- Example of newsprint prices in different countries

World Newsprint Production 1992



Total:
32 Mio. tonnes

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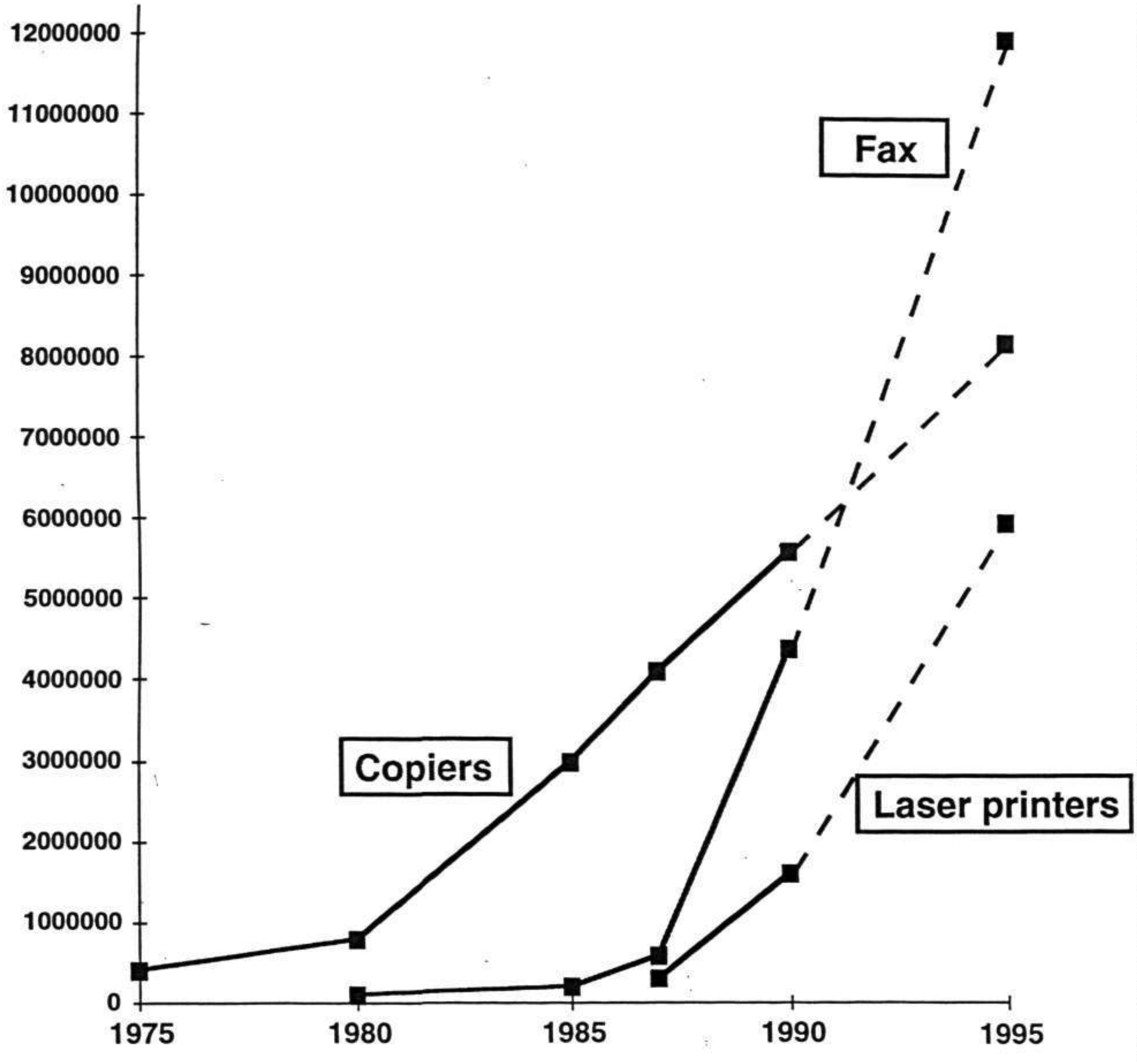
The Paperless Office?

Copiers, fax machines and laser printers in Western Europe



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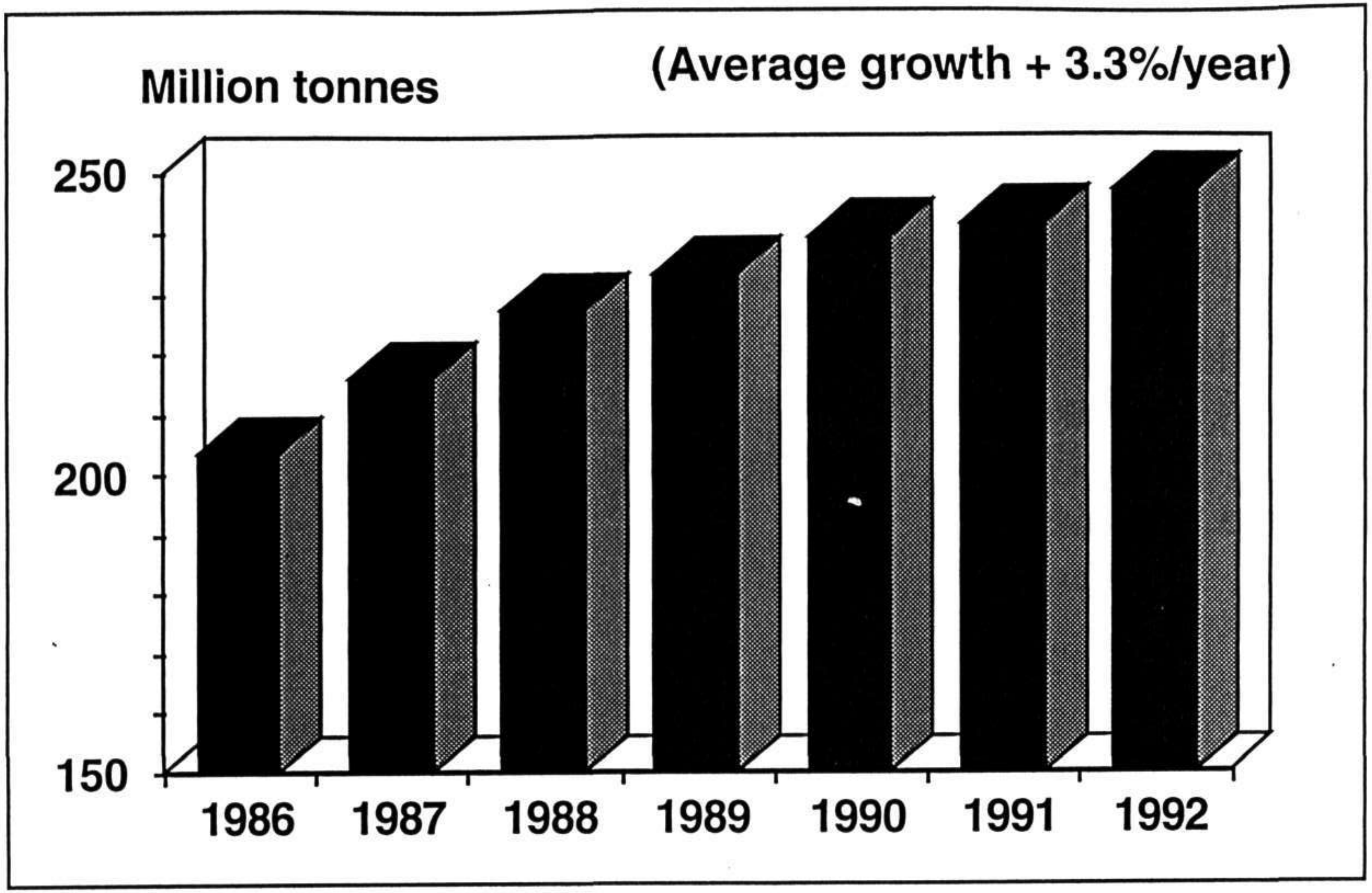
Evolution of the Total Paper & Board Production in the World



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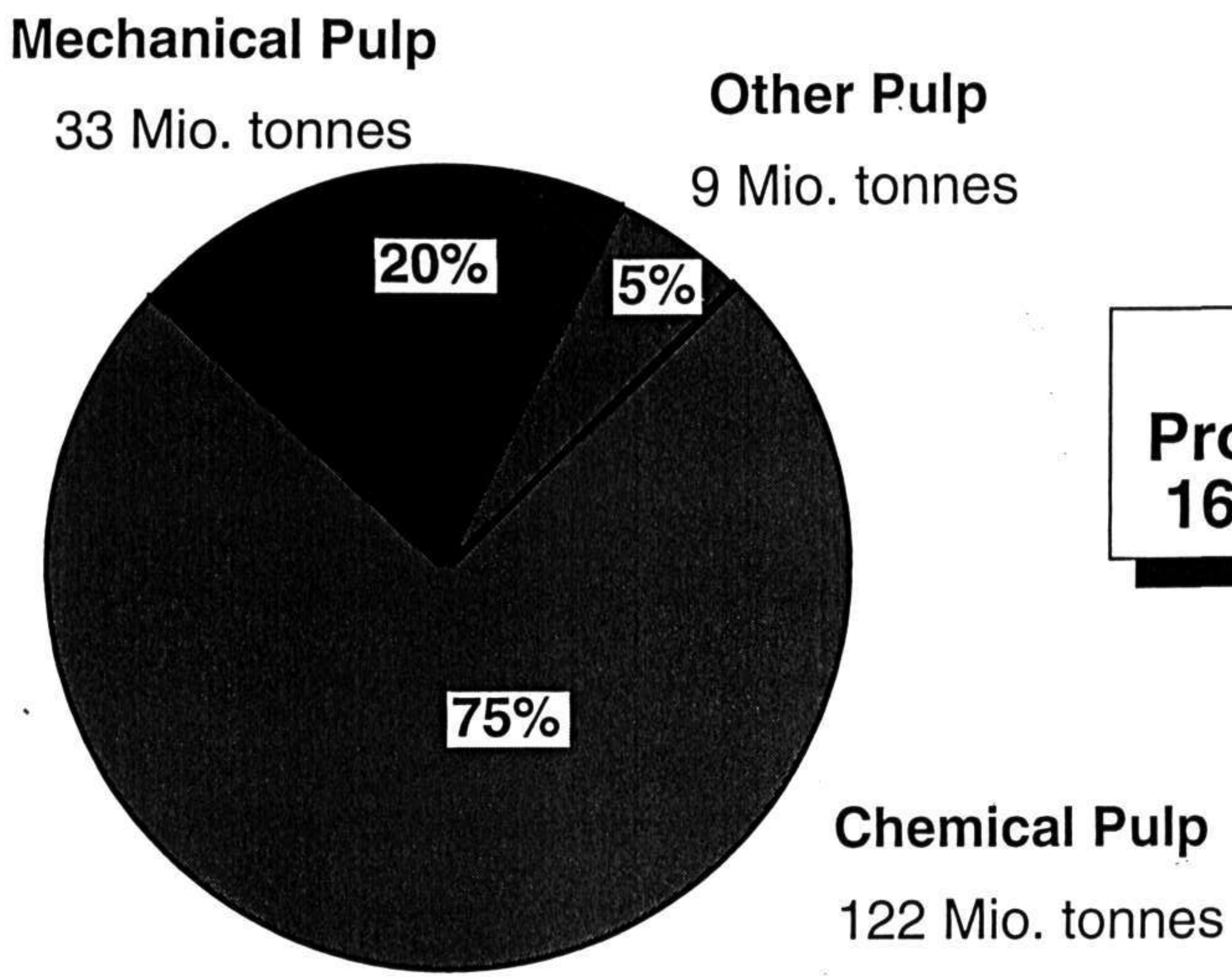
World Pulp Production in 1992



Total Pulp Production 1992: 164 Mio. tonnes

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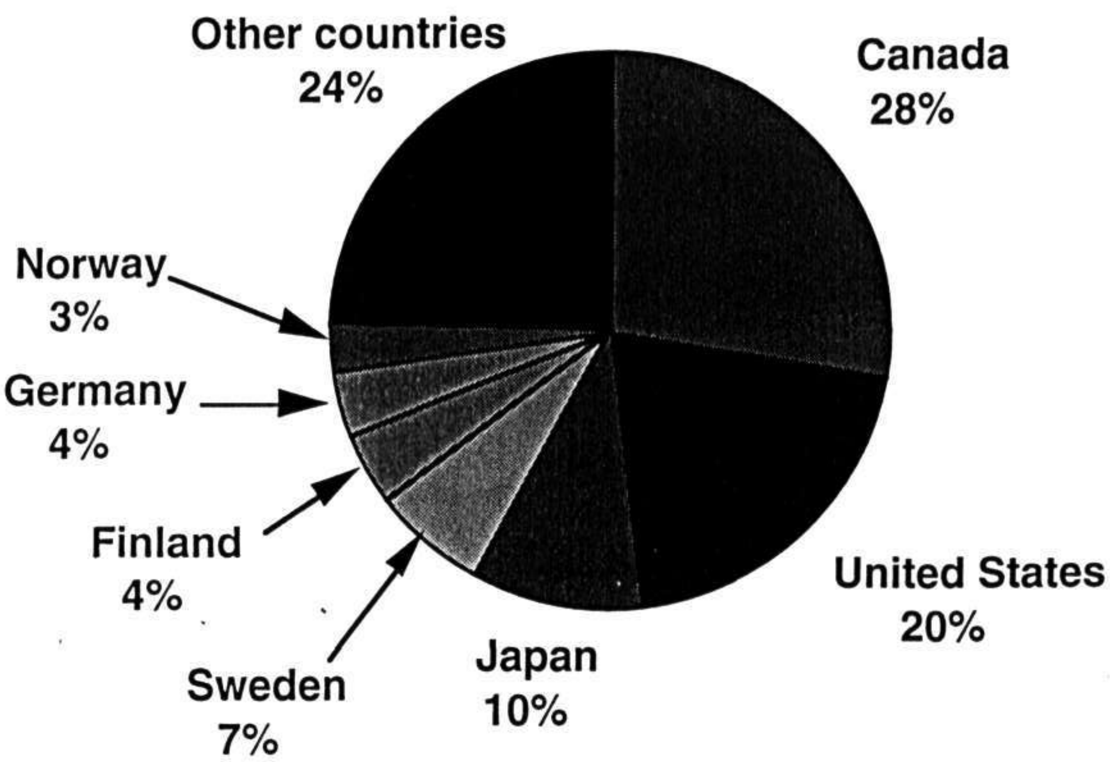
The Main Producers of Newsprint in 1992



Canada	8.9 Mio. tonnes
United States	6.4 Mio. tonnes
Japan	3.2 Mio. tonnes
Sweden	2.1 Mio. tonnes
Finland	1.2 Mio. tonnes
Germany	1.2 Mio. tonnes
Norway	0.9 Mio. tonnes
Other countries	7.7 Mio. tonnes

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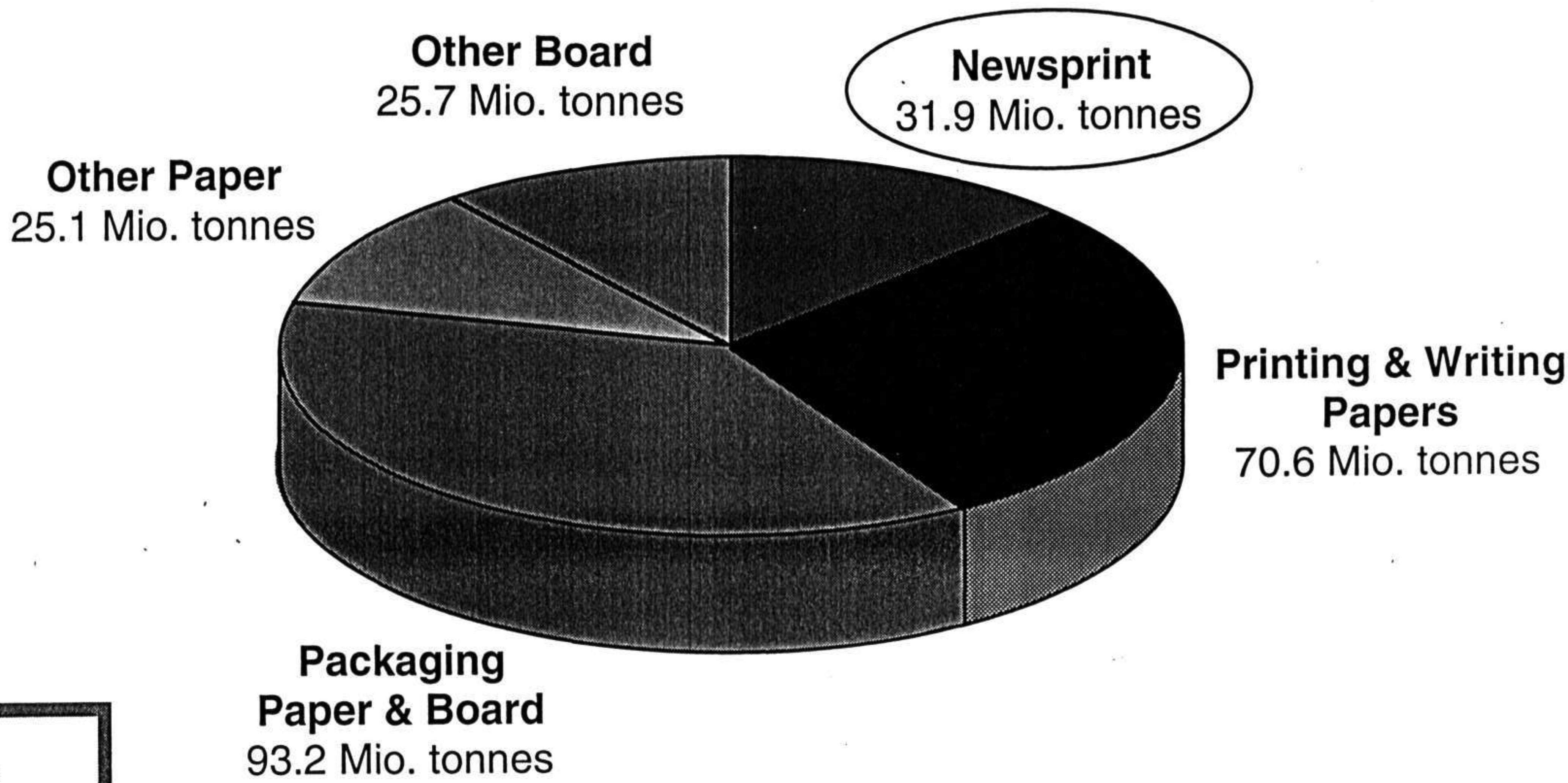
World Paper and Board Production by Grade (1992)



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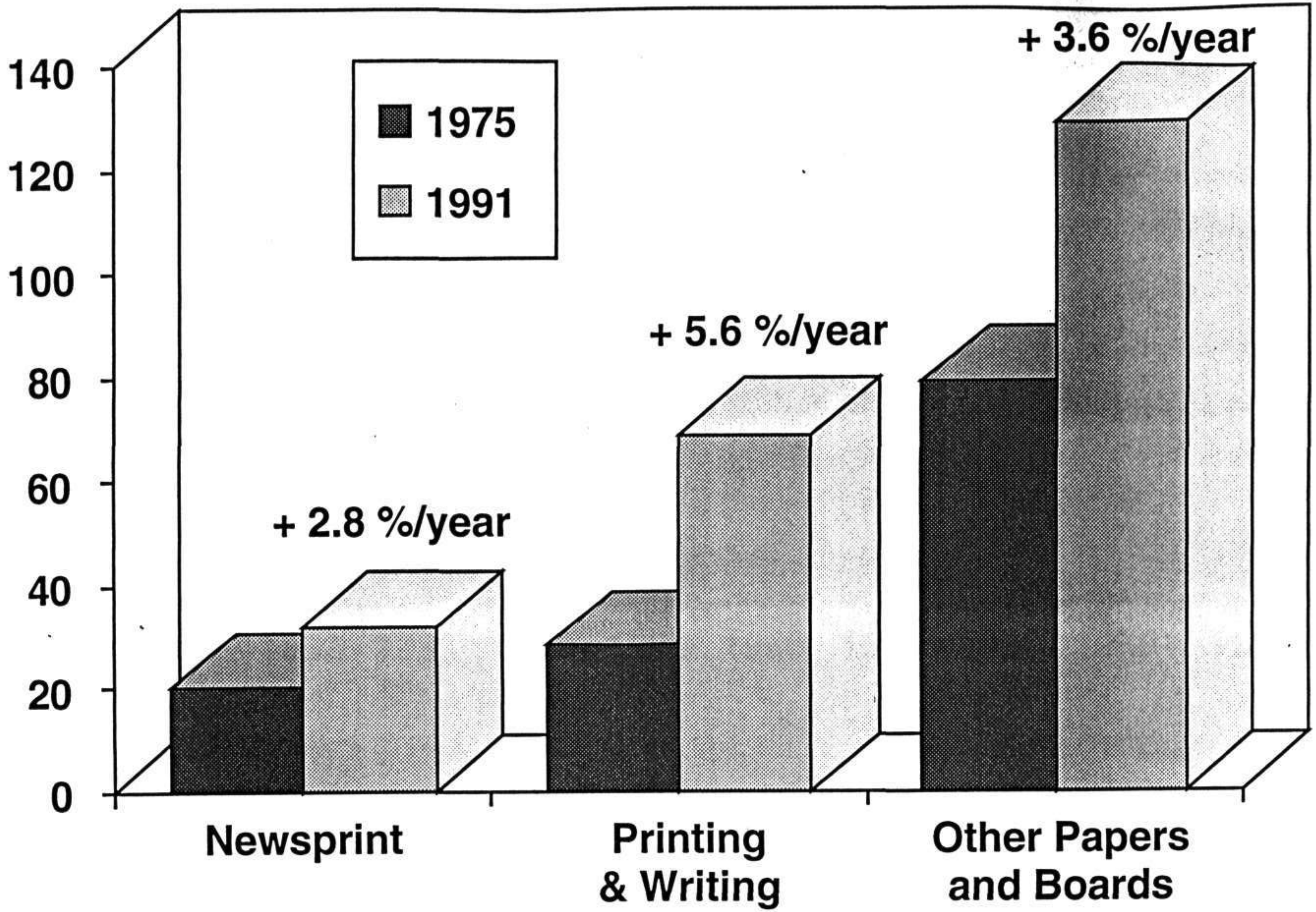
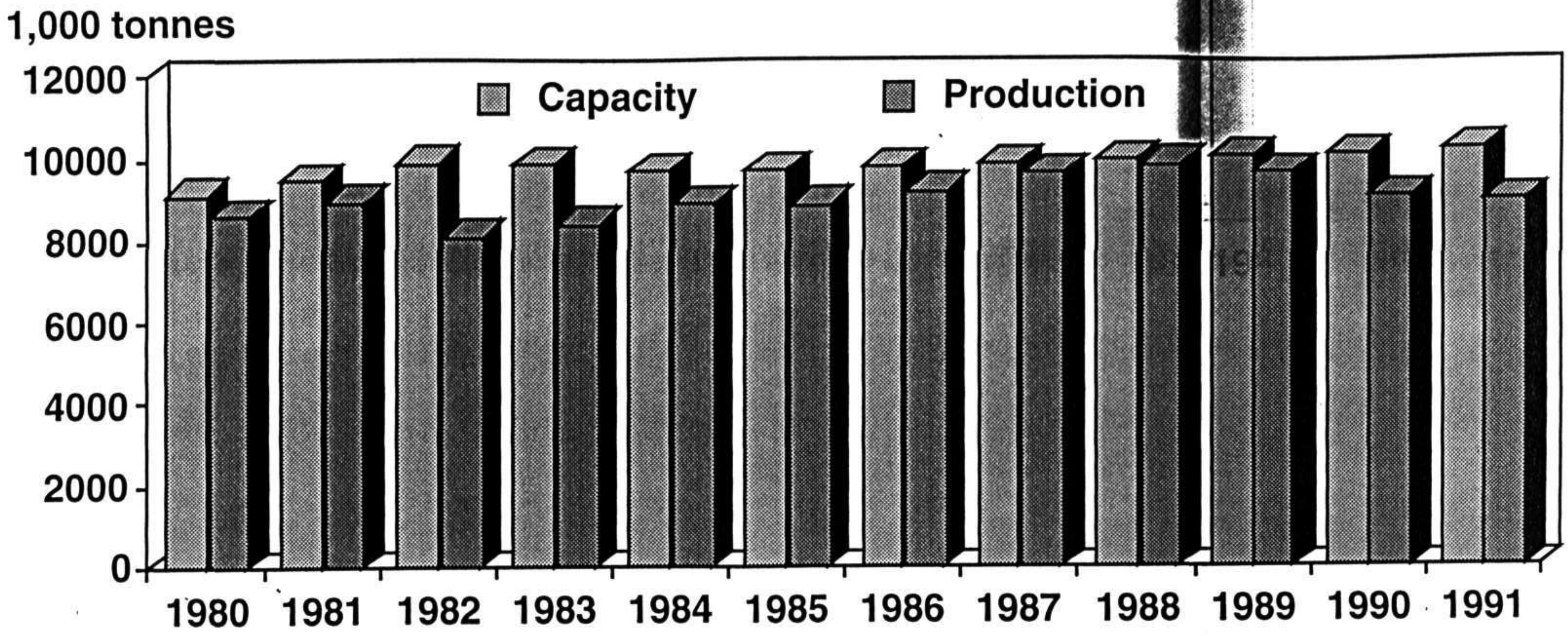
World Demand by Grade 1975-1991

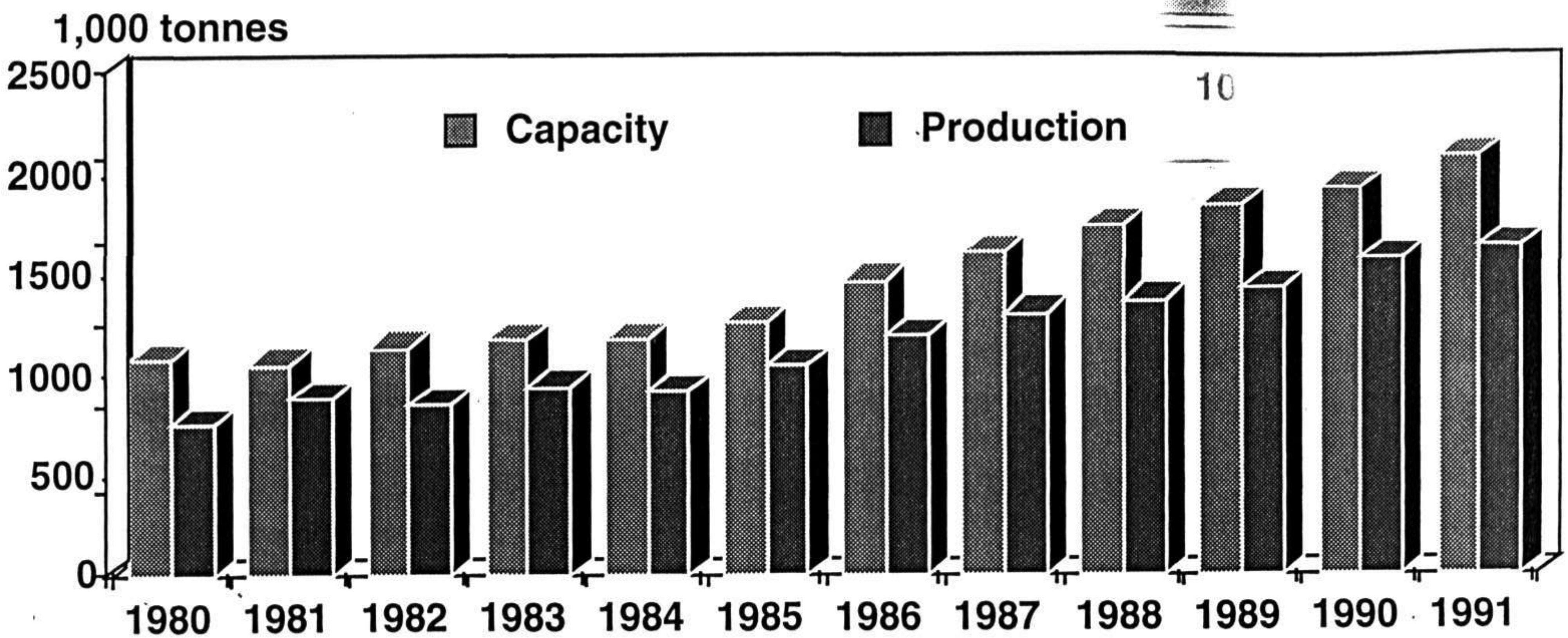
(millions of tonnes)



Comparison between newsprint production capacity and real production in Canada



Comparison between newsprint production capacity and real production in Asia



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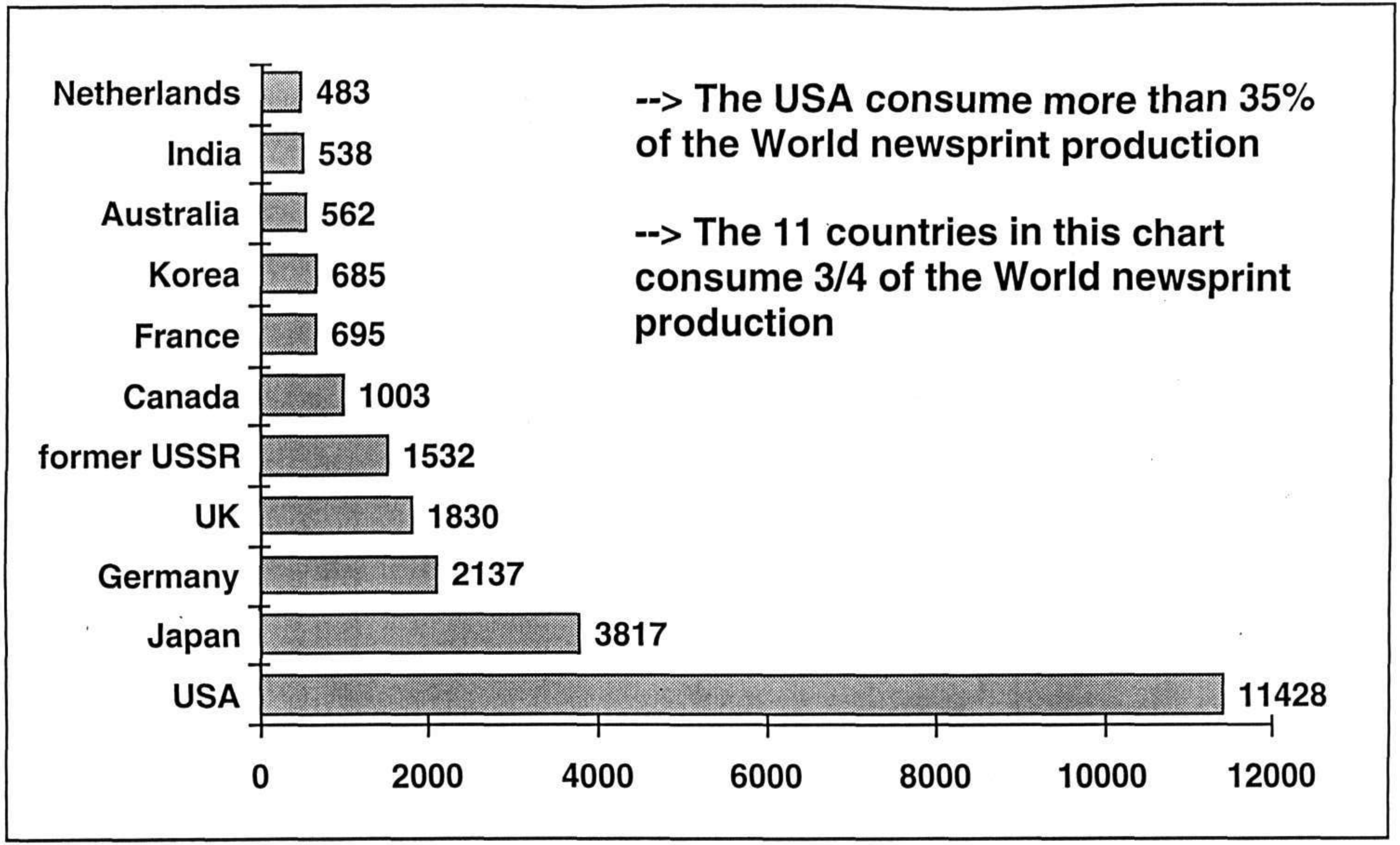
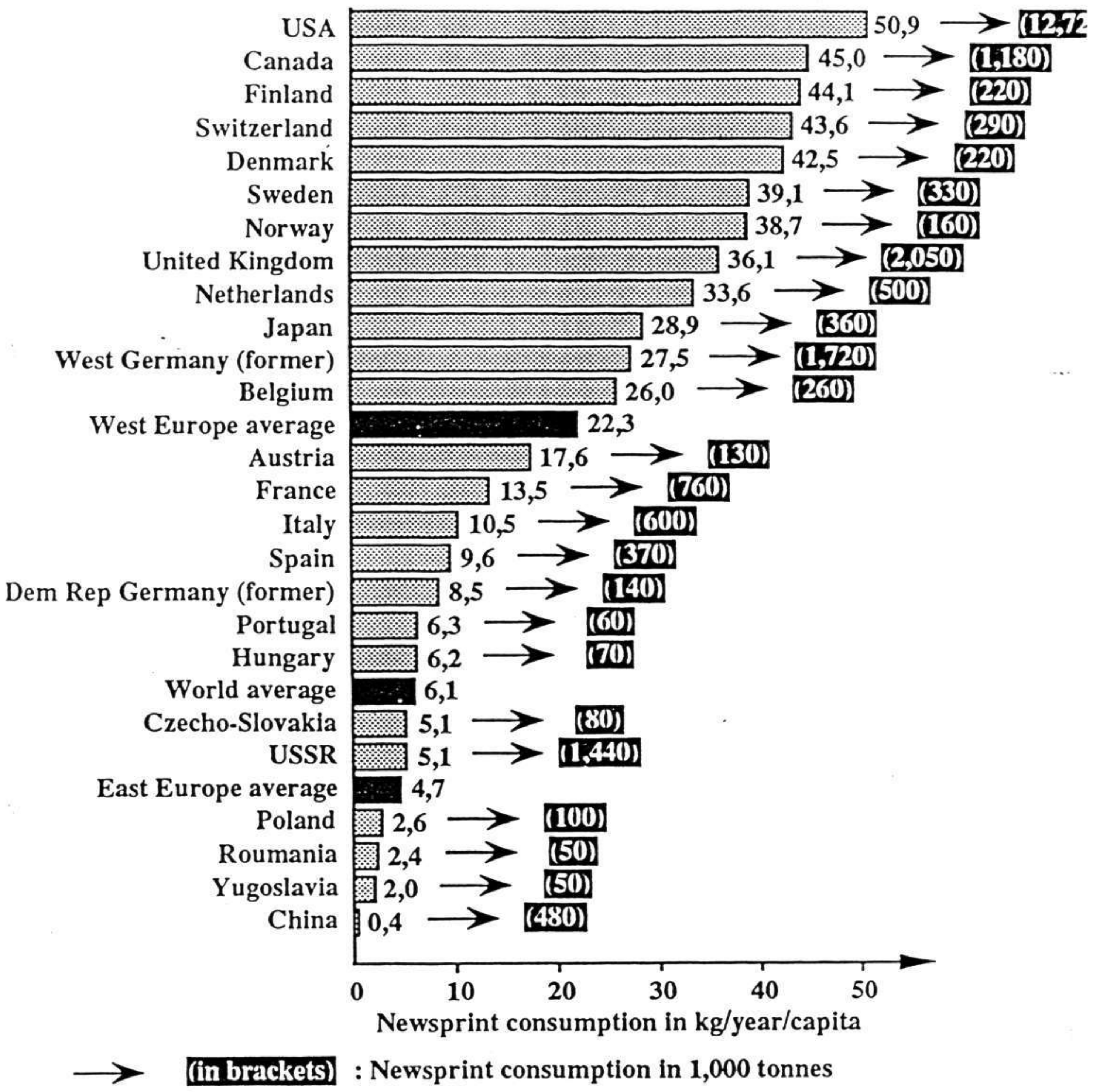
Newsprint Consumption for Selected Countries in 1991



Newsprint consumption for selected countries in 1989

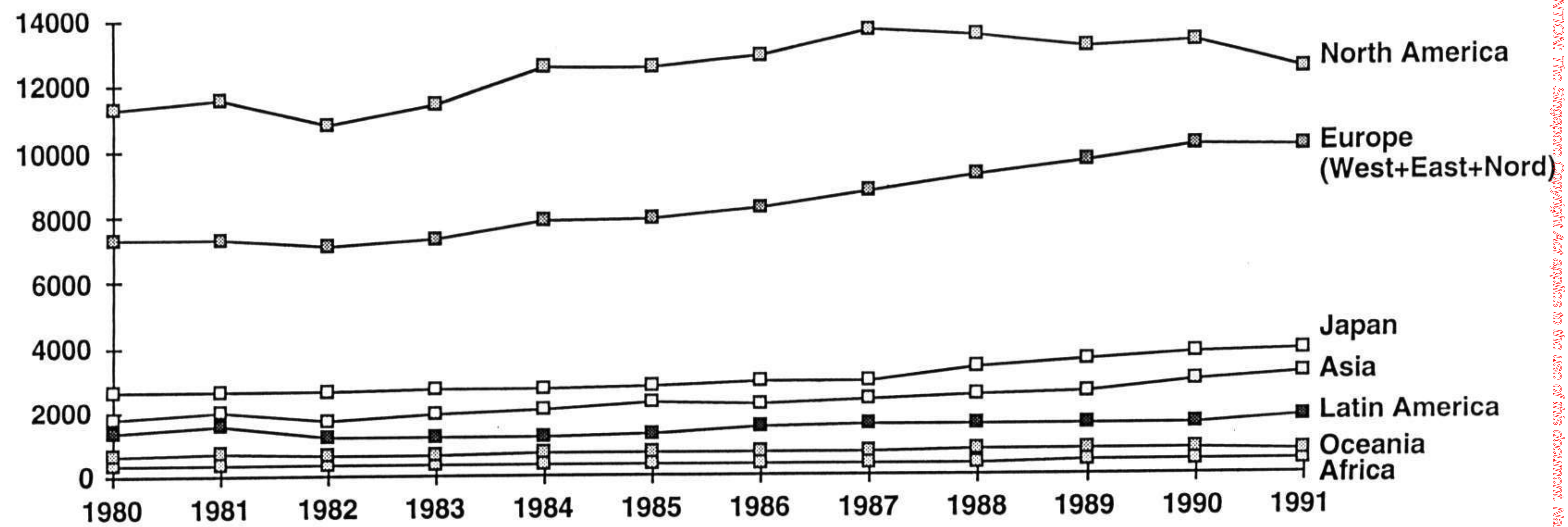


(Source : Pulp & Paper International, July 90)

Diagram 5 © ifra, Marc

IFRA, Darmstadt

Recent Trends in Newsprint Demand by Region



What is happening?

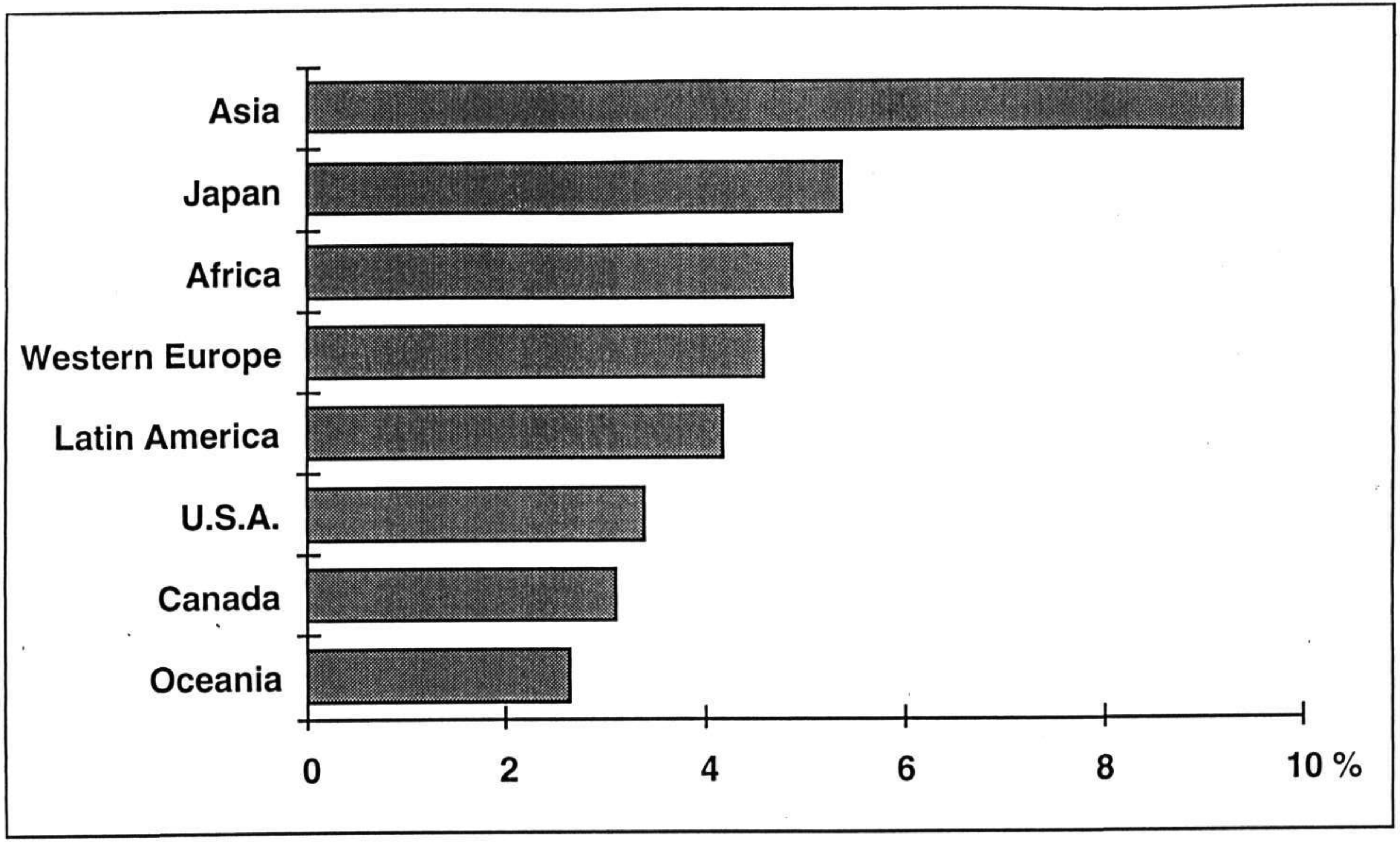
- In the last ten years, worldwide newsprint demand ≈ + 3%/year
- North America: +1.6 %/year. Today's consumption at the level of 1986
- Elsewhere, growth over the World average

Newsprint Demand Forecasts 1992-2000

Region	1992	Estimation 2000	Difference	% p.a.
North America	12733	13788	1055	1.0
Western Europe	8025	9778	1753	2.5
Eastern Europe	1323	1811	488	4.0
Japan	3699	4686	987	3.0
Asia/Africa/Oceania	4654	6876	2222	5.0
Latin America	1760	2409	649	4.0
TOTAL	**32194**	**39348**	**7154**	**2.5**

Growth in World Demand by Region 1975-1991

Average Annual Growth Rate for Paper & Board Products)



Remarks on the newsprint market

--> Worldwide consumption in 1992: 32.2 million tonnes.

--> 80% of this was used in three main markets: North America, Europe and Japan.

--> There is a correlation between the "degree of development" of a country and its newsprint demand. There are other influencing factors (cultural characteristics, traditional readership, alphabet used,...)

--> The developing countries only account for 18% of world newsprint demand today.

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Newsprint is an essential component in the freedom of expression:

- Just having ideas is not enough.
- One must be able to express and spread them.
- The only true vector of these ideas is paper.
- Even with the competition of TV and radio, paper has a better "reaching effect".

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Importance of advertising on newsprint demand

--> Circulation in markets such as USA, Western Europe or Japan are static or declining

--> The driver for newsprint demand is advertising: 1/3 of newspaper pages and 40% of revenue are attributable to advertising.

--> Different forms: printed in the newspaper, ROP advertising, new supplements with heavy ad. content.
More and more non-newspaper applications: up to 10% of the newsprint market in certain regions.

--> Advertising directly influences the half of newsprint demand.

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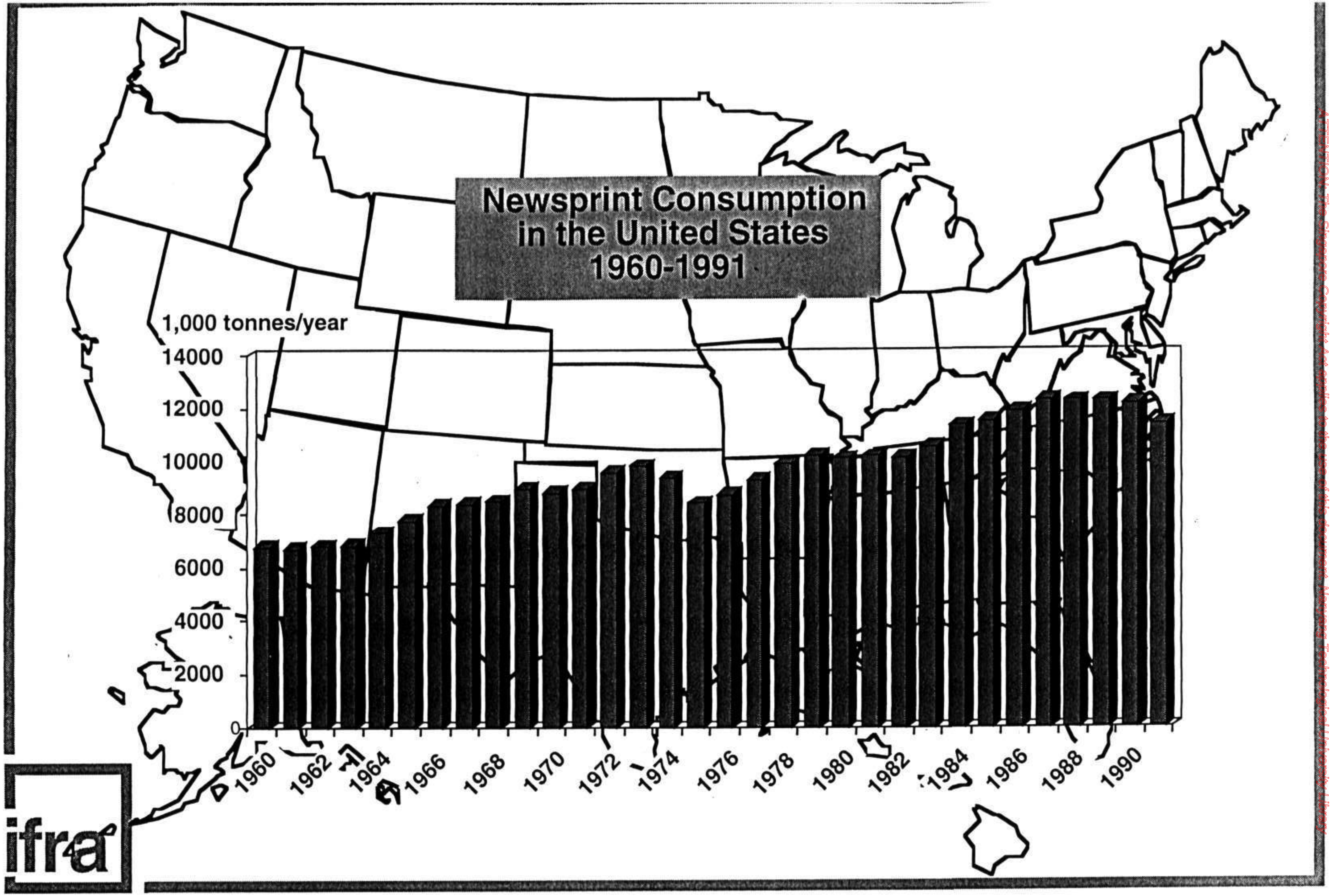
Newsprint Consumption
in the United States
1960-1991
1,000 tonnes/year
14000
12000
10000
8000
6000
4000
2000
0
1960
1962
1964
1966
1968
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
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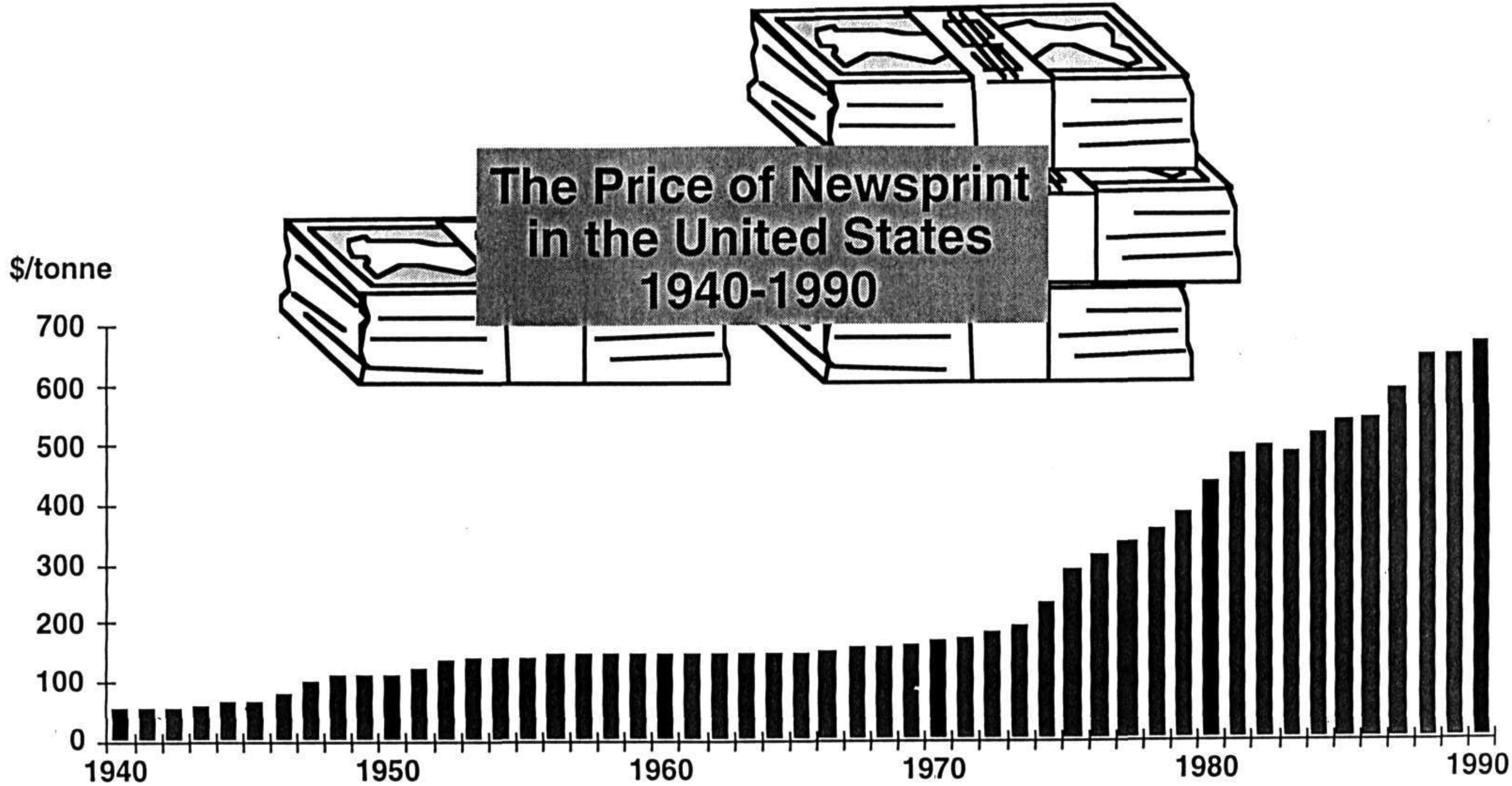
The 10 Largest U.S. Daily Newspapers

	Newspaper	Circulation	Neswprint Usage (tonnes)
1	The Wall Street Journal	1 852 000	139 000
2	USA Today	1 541 000	145 000
3	The New York Times	1 202 000	288 000
4	Los Angeles Times	1 164 000	410 000
5	The Washington Post	847 000	225 000
6	New York Daily News	782 000	76 000
7	Newsday	766 000	142 000
8	Chicago Tribune	734 000	201 000
9	Detroit Free Press	588 000	153 000
10	San Francisco Chronicle	558 000	122 000


The Price of Newsprint
in the United States
1940-1990
$/tonne
700
600
500
400
300
200
100
0
1940
1950
1960
1970
1980
1990

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NEWSPRINT AS AN ELEMENT OF TOTAL PUBLISHING COST IN THE UNITED STATES

Typical dailies	1990	1991
Daily of 1,000,000 + circulation	22,4%	19,3%
Daily of 250,000 circulation	26,3%	25,6%
Daily of 50,000 circulation	19,3%	18,8%
Daily of 9,000 circulation	22,6%	23,3%

(84% of all dailies have less than 50,000 circulation)

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Example of Newsprint Prices for Different Countries in Western Europe in 1993

	Price (DM/t)	Price (US$/t)
Norway	840	509
North Germany	810	491
South Germany	750	455
Sweden	700	424
Austria	750	455
Italy	780	473
France	780	473

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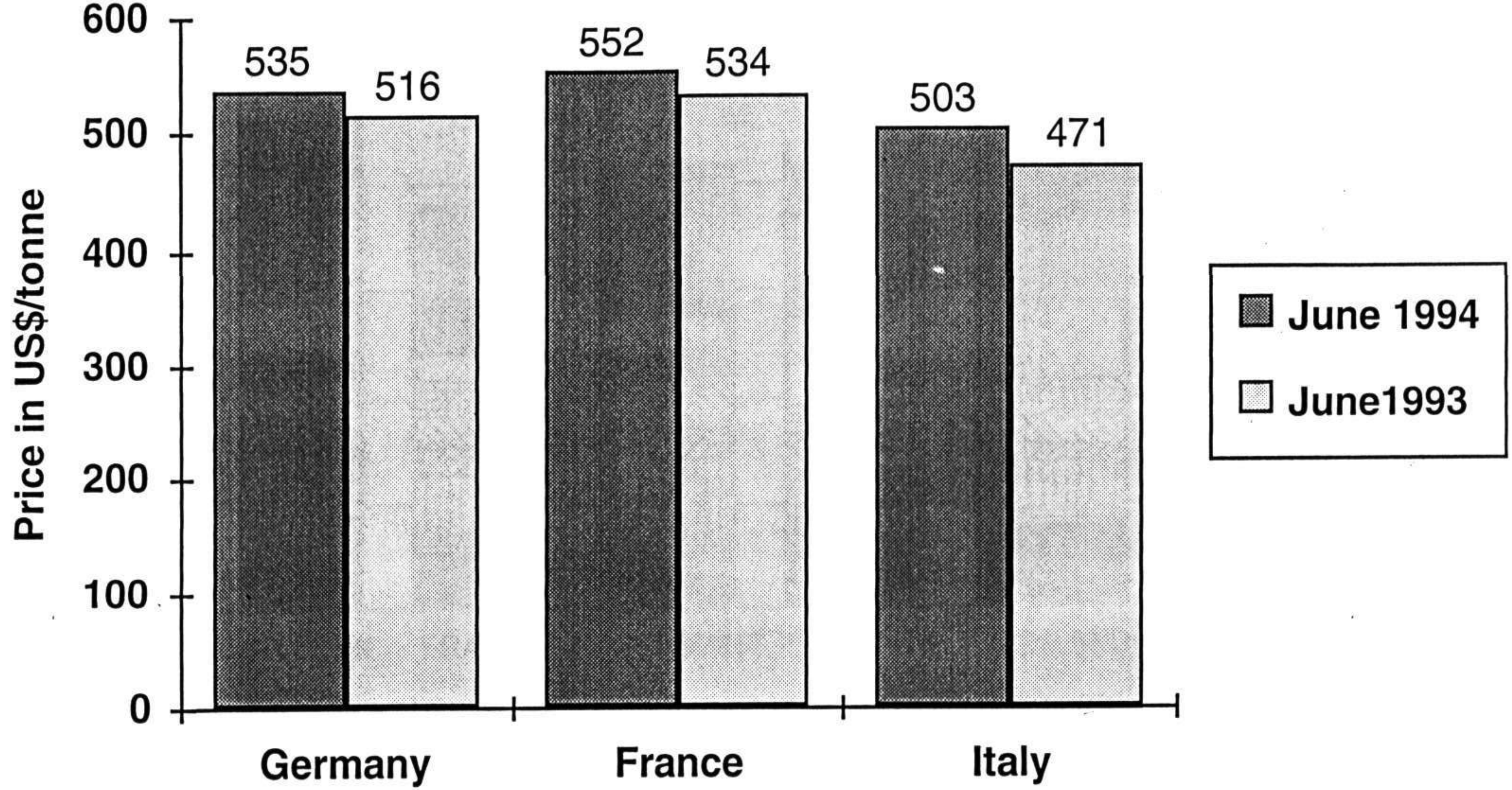
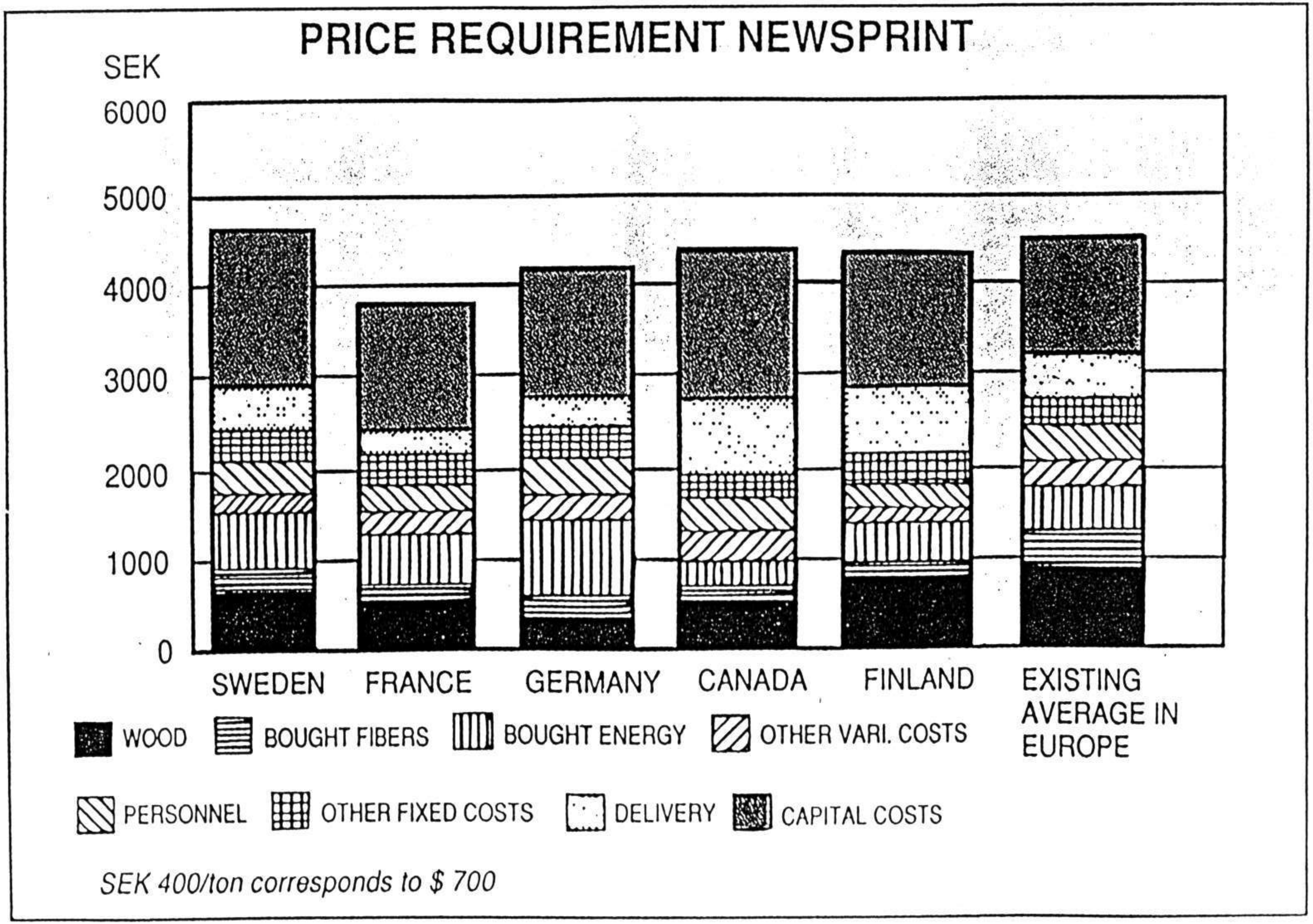
Average newsprint prices in different countries (45 g/m2)




PRICE REQUIREMENT NEWSPRINT
SEK
6000
5000
4000
3000
2000
1000
0
SWEDEN
FRANCE
GERMANY
CANADA
FINLAND
EXISTING AVERAGE IN EUROPE
WOOD
BOUGHT FIBERS
BOUGHT ENERGY
OTHER VARI. COSTS
PERSONNEL
OTHER FIXED COSTS
DELIVERY
CAPITAL COSTS
SEK 400/ton corresponds to $ 700

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
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- 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.

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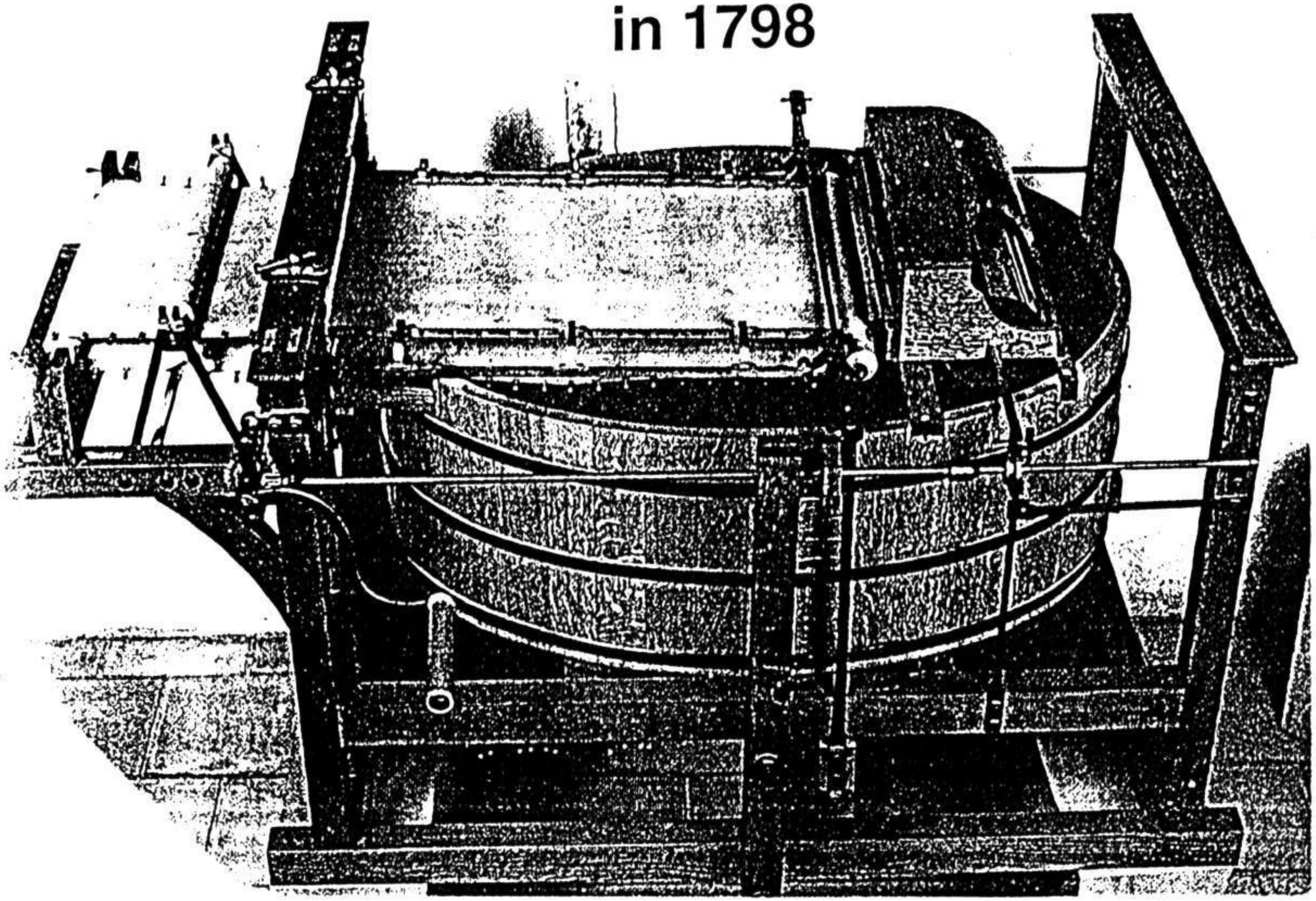
The First Paper Machine by Nicolas Robert in 1798



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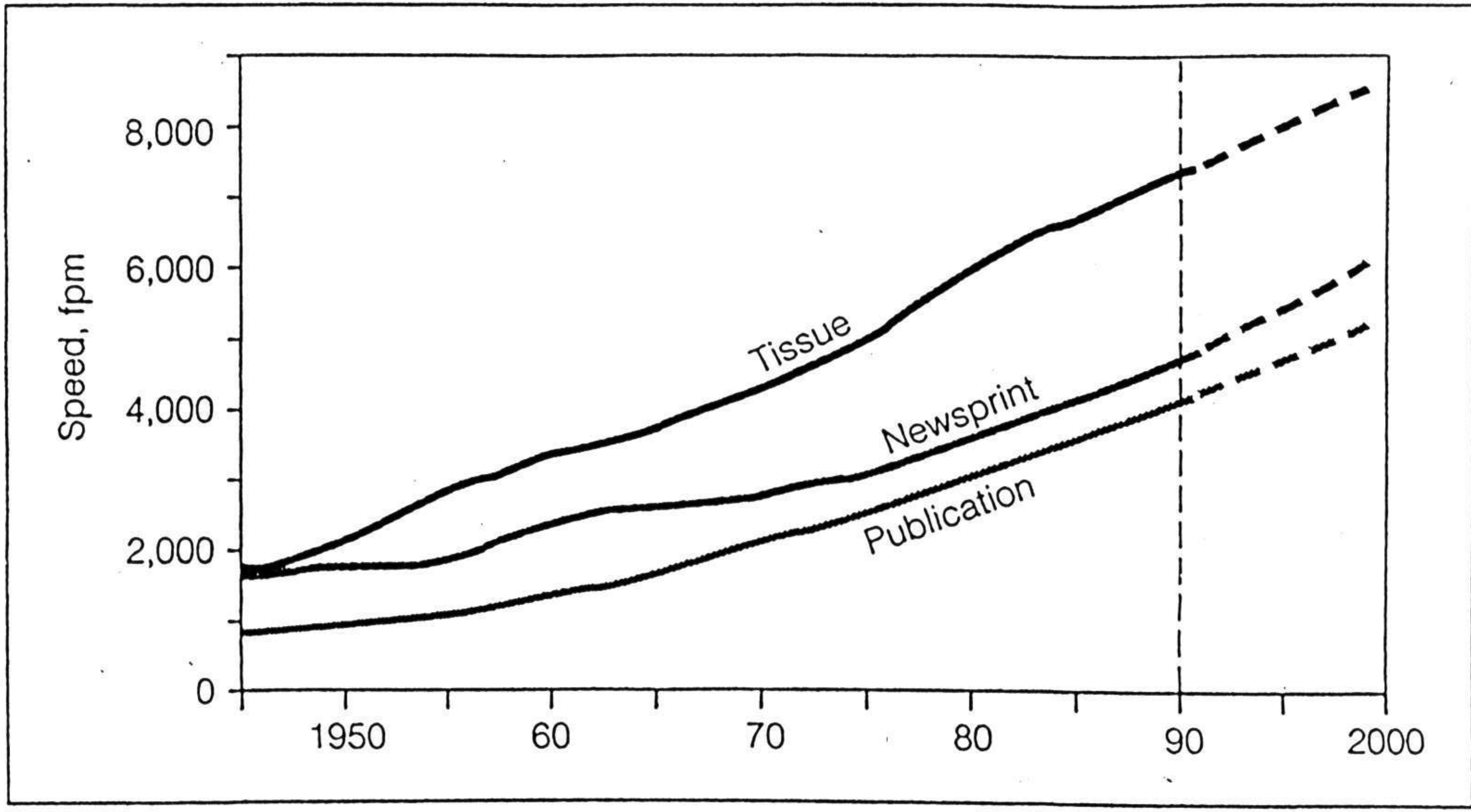
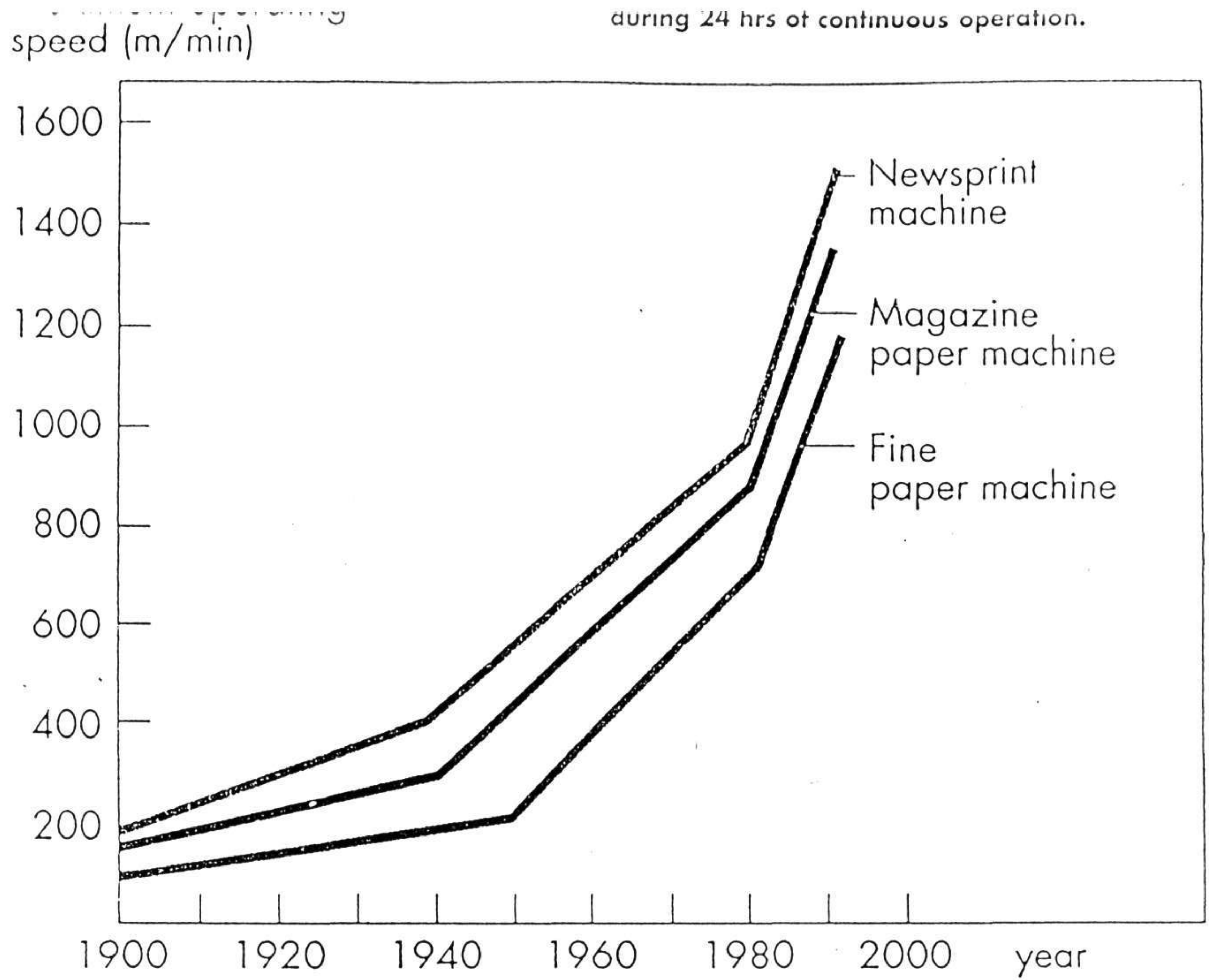


FIGURE 1: **The best-effort speeds of tissue, newsprint, and publication paper machines generally tend to double about every 30 years.**

during 24 hrs of continuous operation.



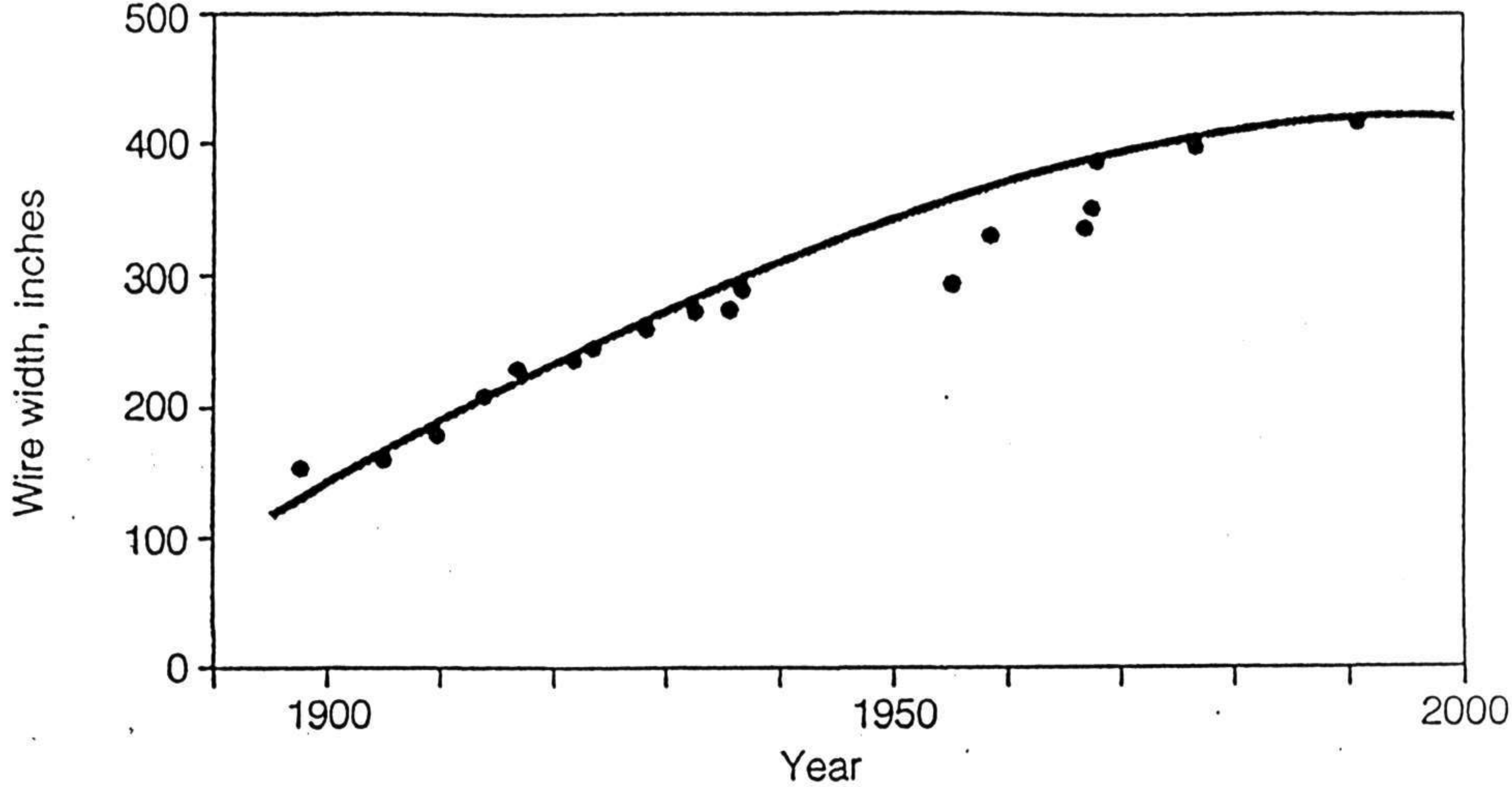
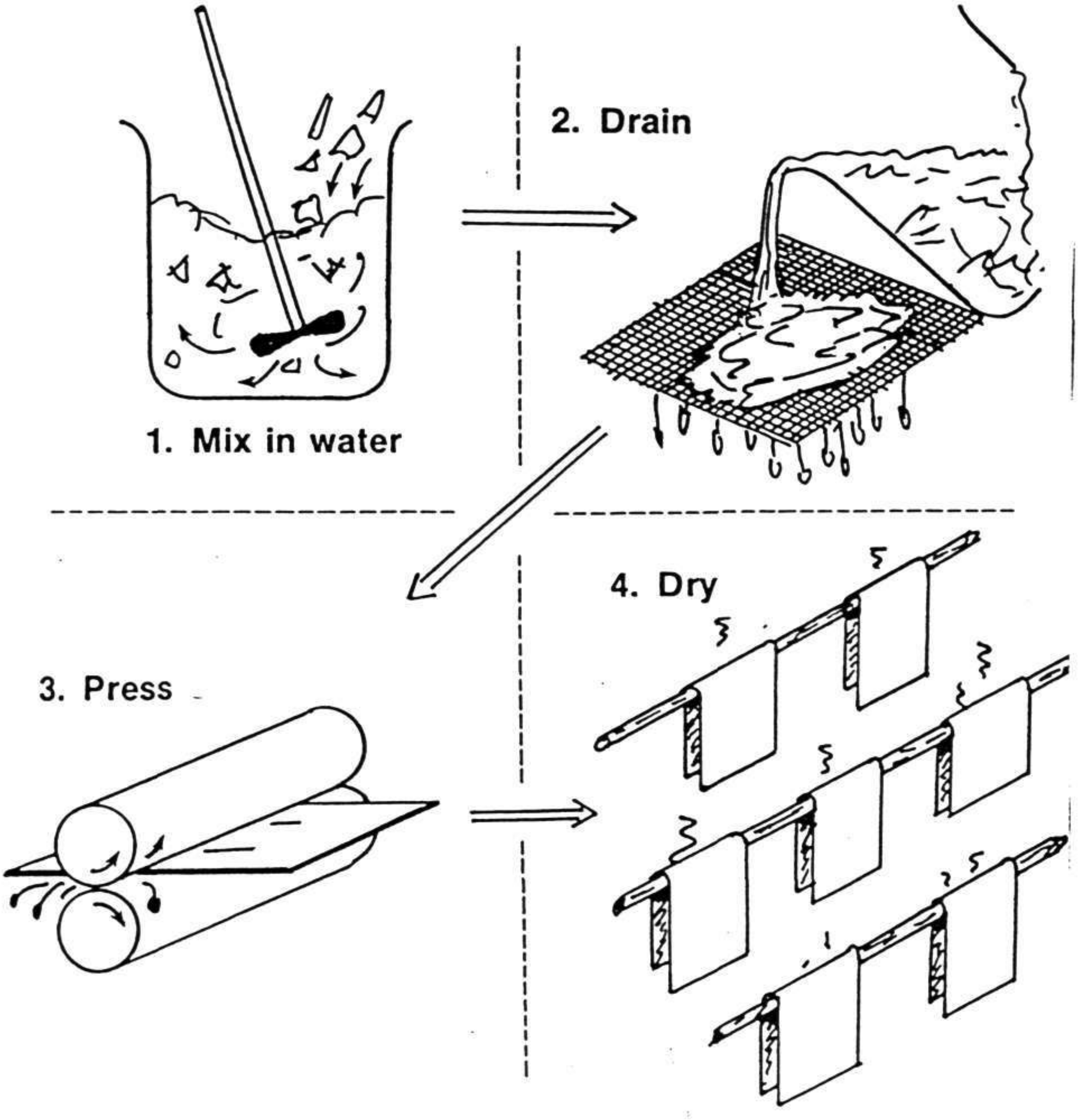


FIGURE 2: **The widths of paper machines have steadily increased during the past century, but there have been periods of 20 to 30 years when no width increases occurred.**

Papermaking Basics



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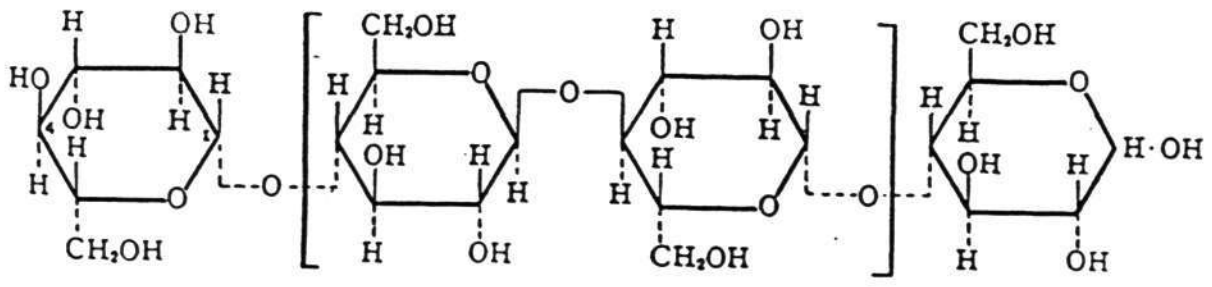
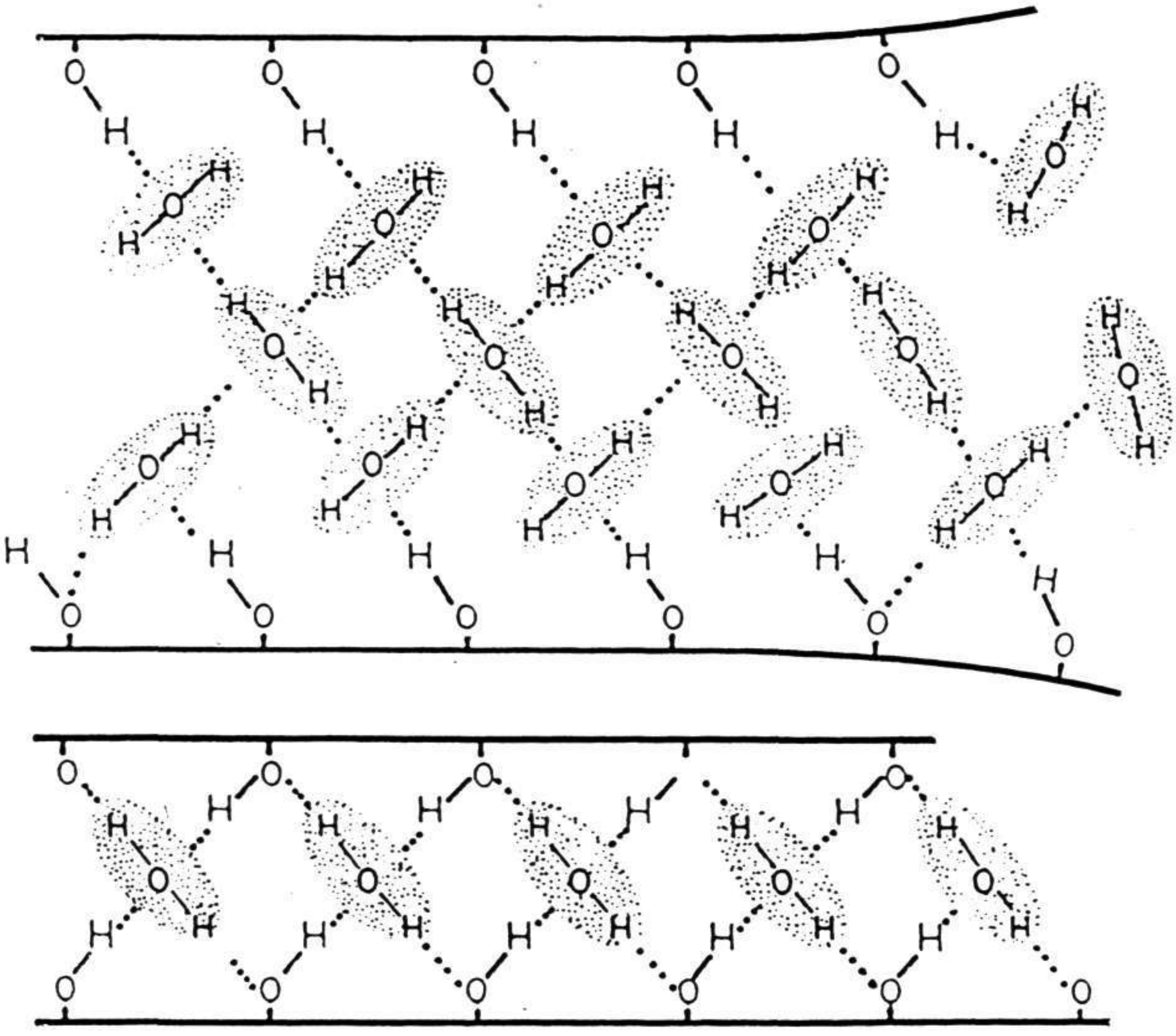


Schematic representation
of the structure of a cellulose molecule



Formation of hydrogen bonds
between two cellulose molecules

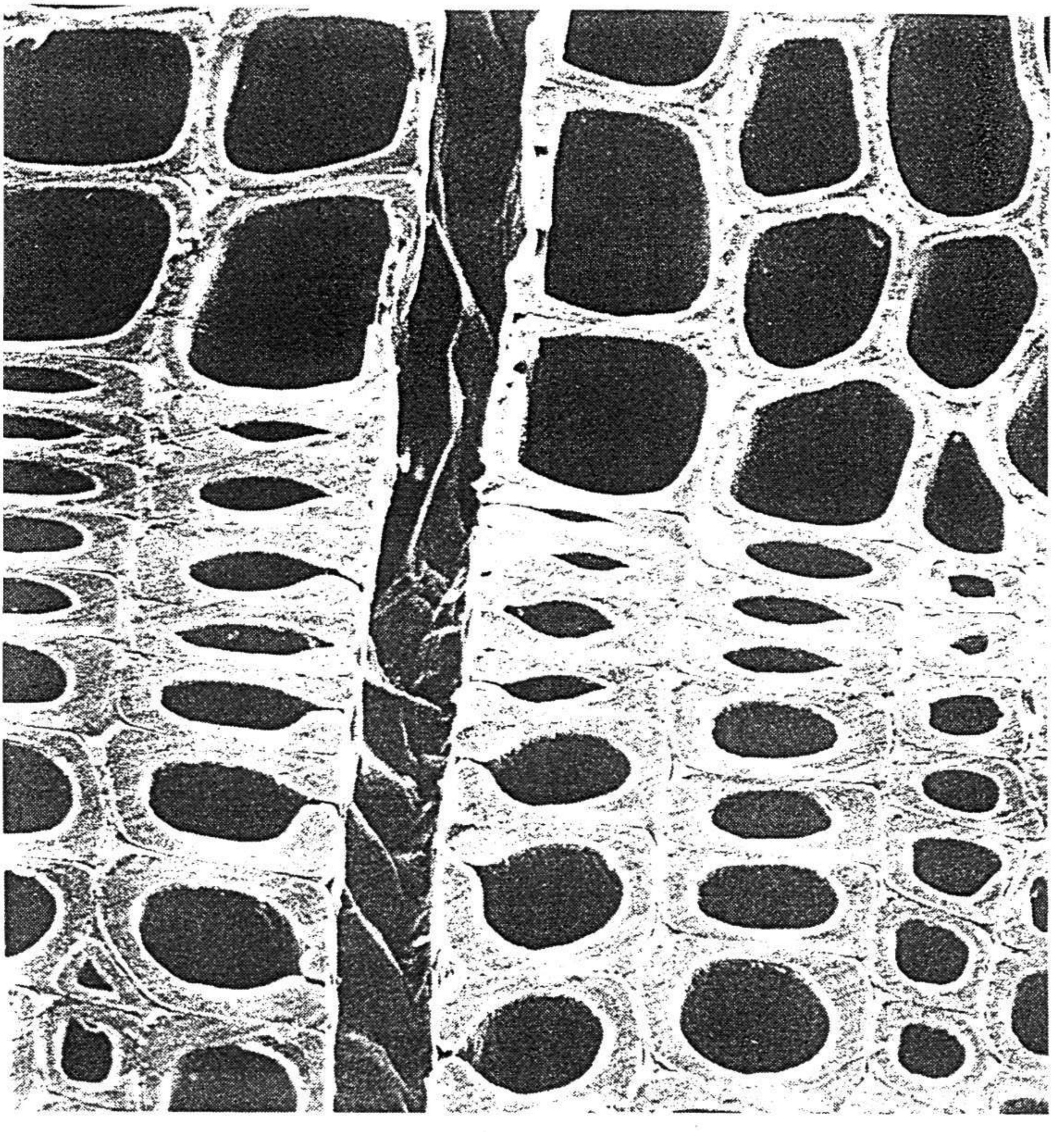


Figure 38. *An annual growth ring is clearly illustrated in this transverse section of* Pinus radiata. *To the lower side small, thick walled tracheids of the latewood can be seen. Beyond the ring boundary the cells are larger and have thinner walls. The cells remain in more or less radial files after being cut off from the vascular cambium. A ray can be seen traversing the wood at right angles to the ring boundary.* [× 330]

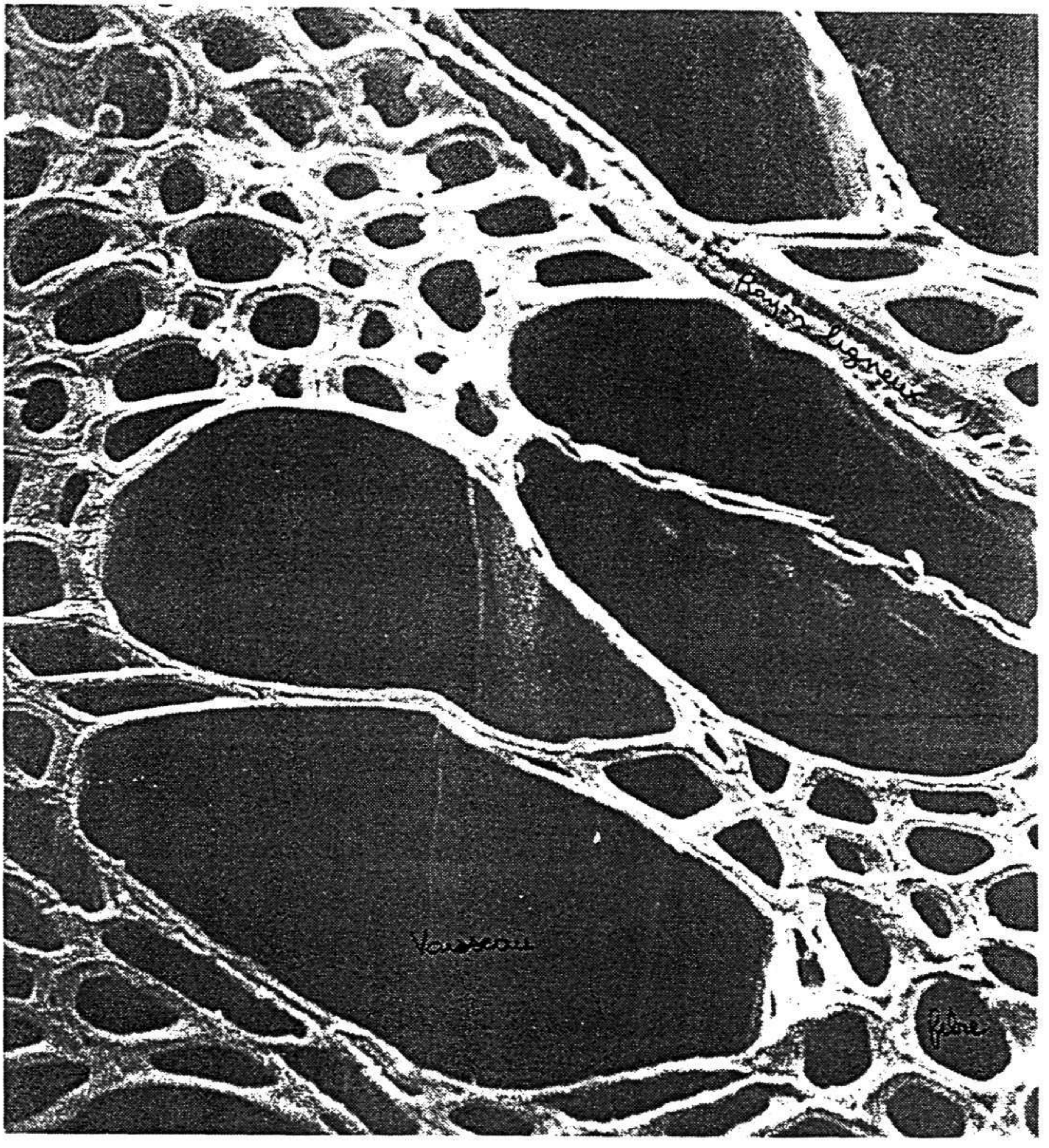


Figure 20. *Vessel member walls are not always covered in pits. In this view of a cluster of vessels in red beech, some walls show prolific vessel to vessel pitting while others are completely devoid of pits.* (× 1250)

Angiosperme dicotylédone

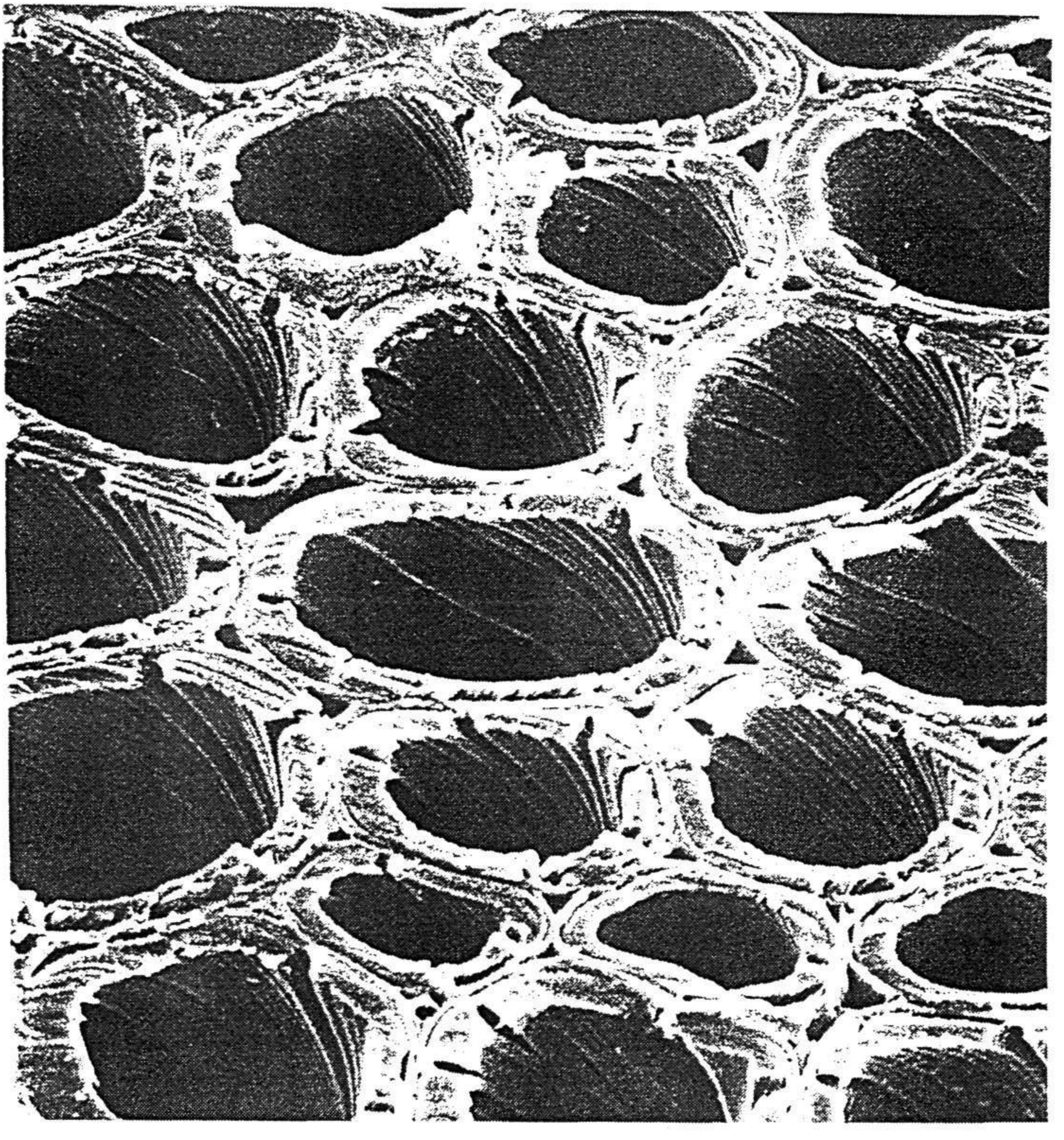
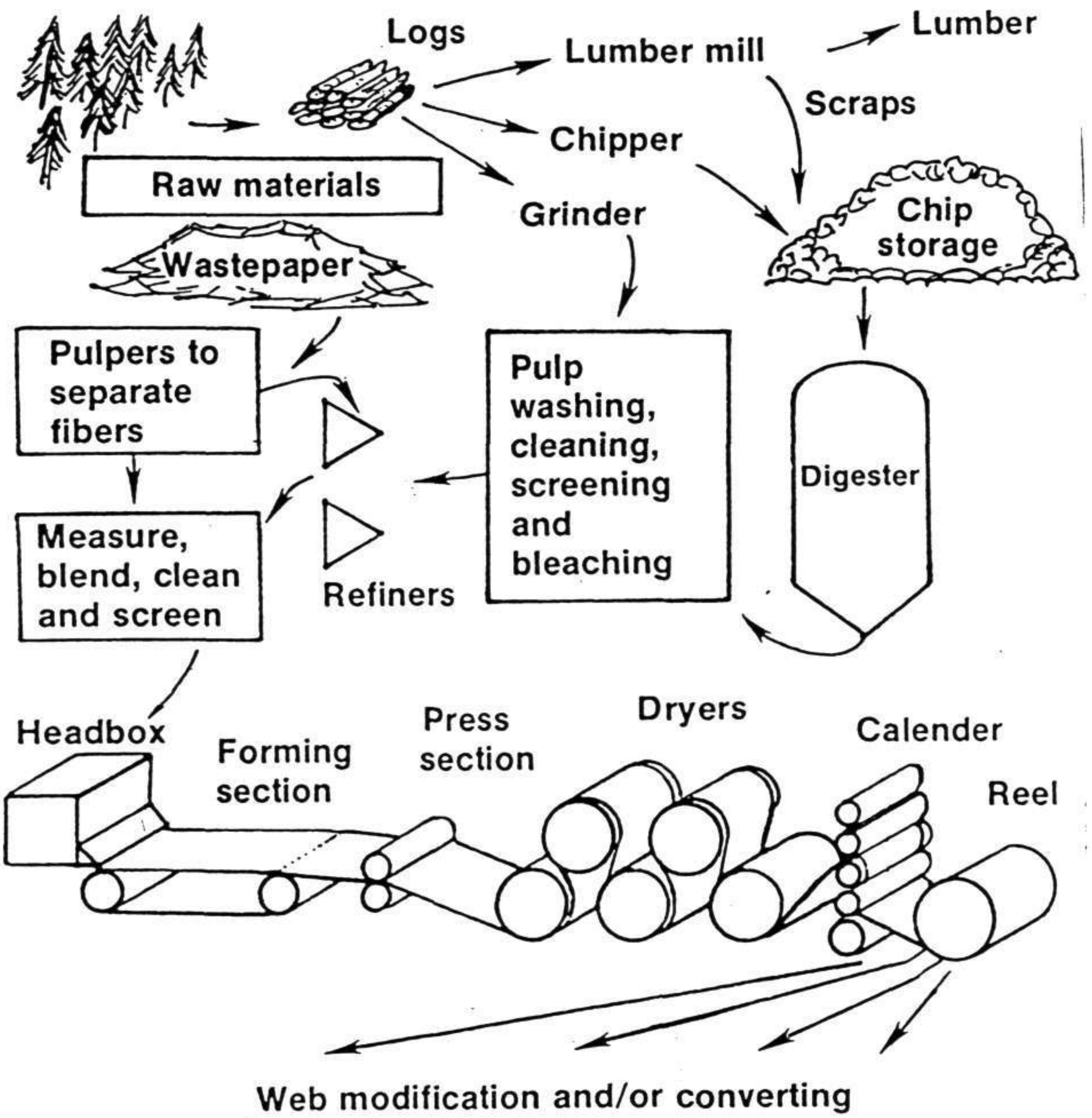


Figure 56. *Transverse section through compression wood in* Pinus radiata. *Note the helical checks and finer striations in the cell walls.* (× 1650)

Softwood fibers magnified about 50 times.

Hardwood fibers magnified about 50 times.

Overview of papermaking operations



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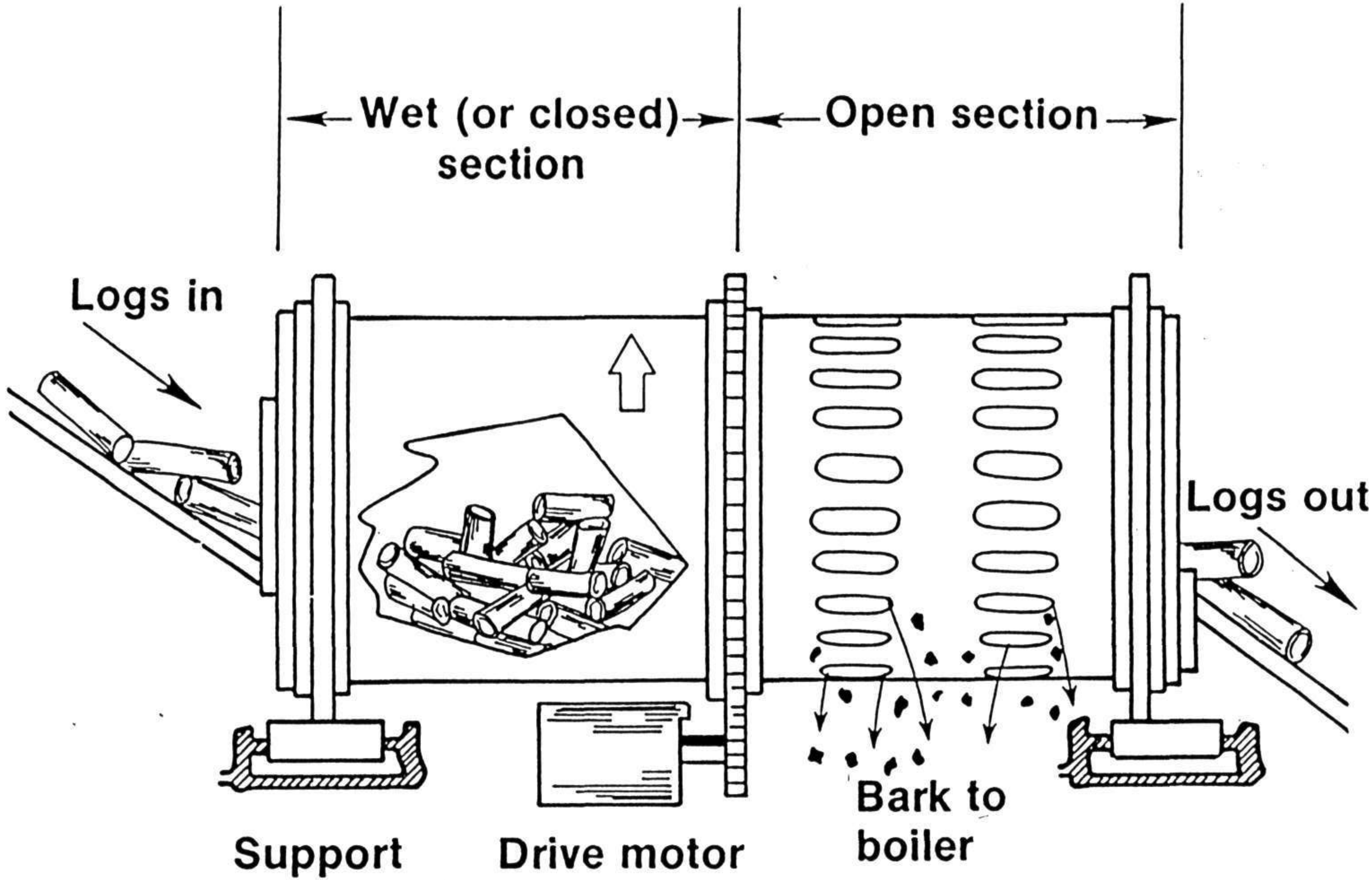
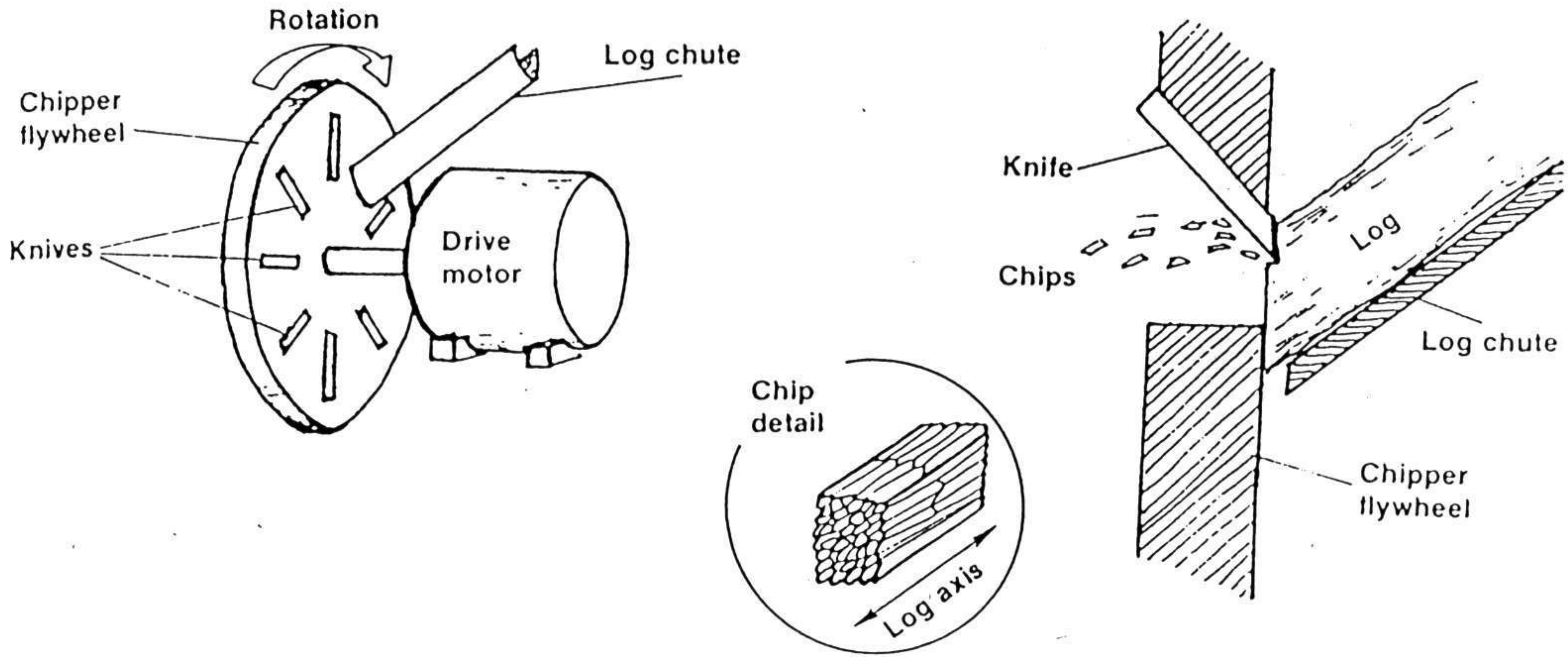


Figure 4.2. Drum barker

Figure 4.4. Chipper and chipper detail



BASICS OF NEWSPRINT MANUFACTURE

DIFFERENT TYPES OF PULP

- Mechanical pulps (1):

- Stone Ground Wood pulp (SGW)

- Rotary stone to grind the wood.

Addition of water (cooling effect)

Advantages: yield (≈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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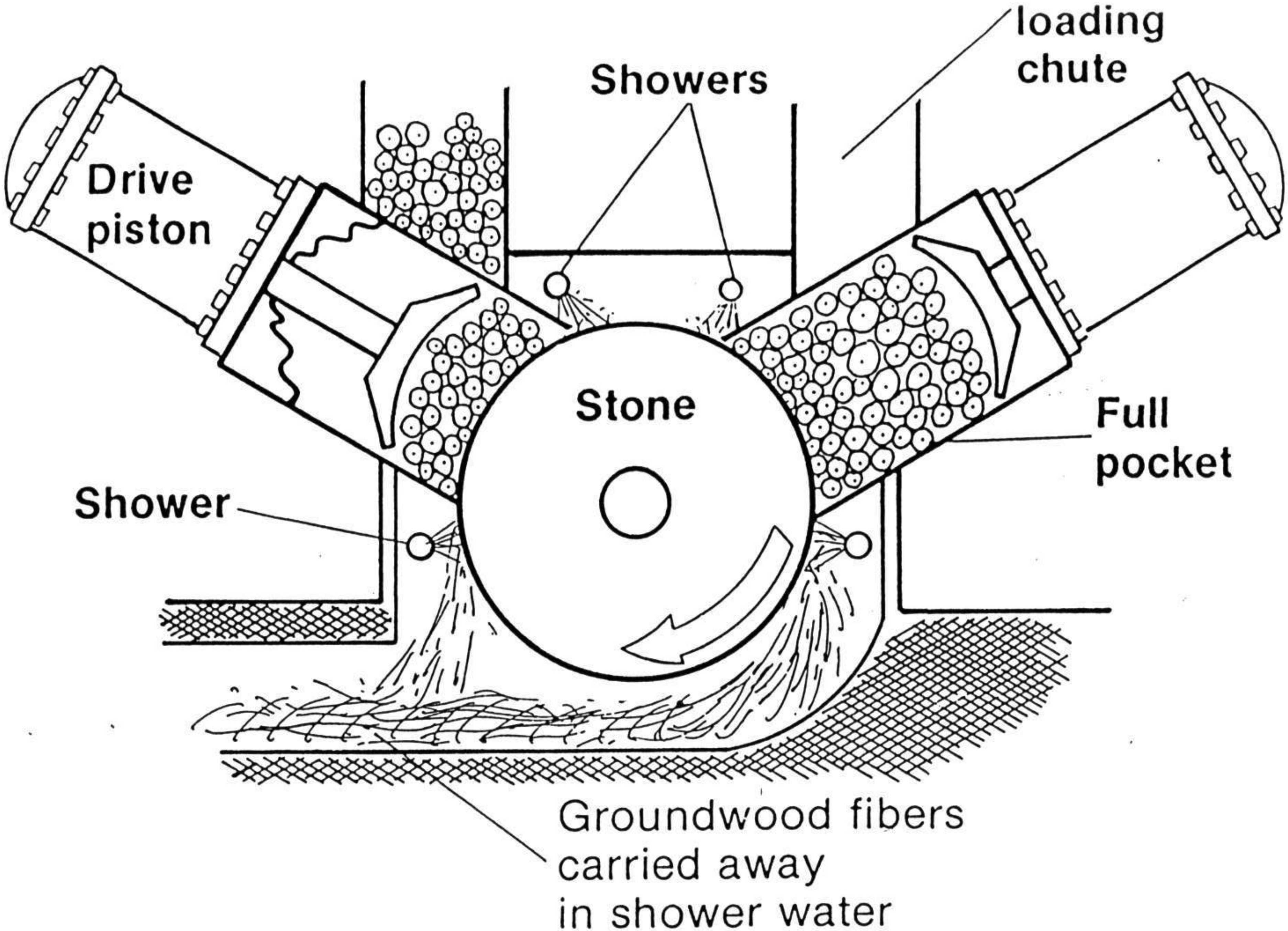

Figure 4.6. Two-pocket grinder

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)

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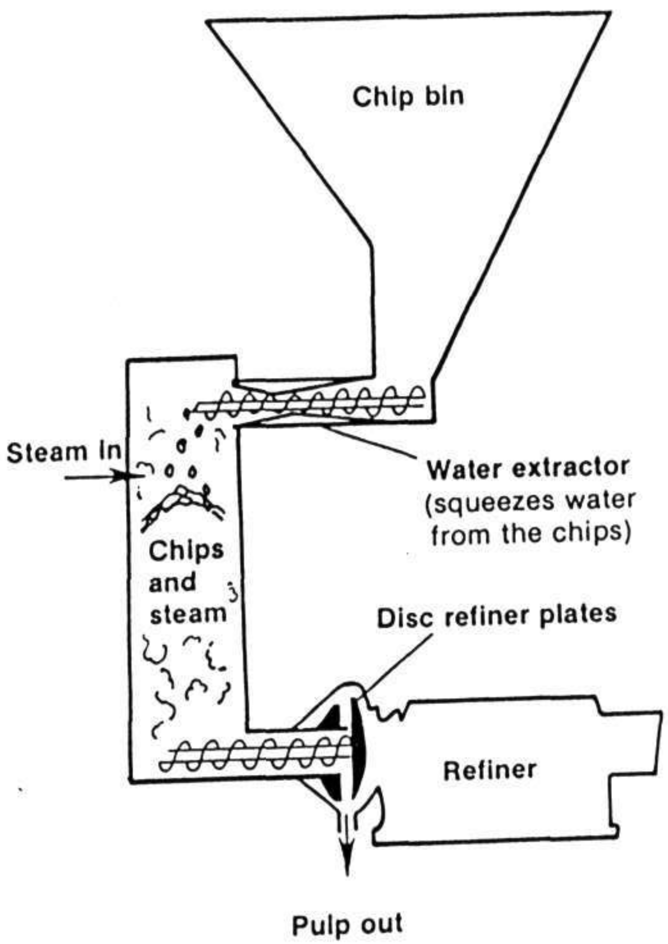


Figure 4.11. High-yield mechanical pulp process

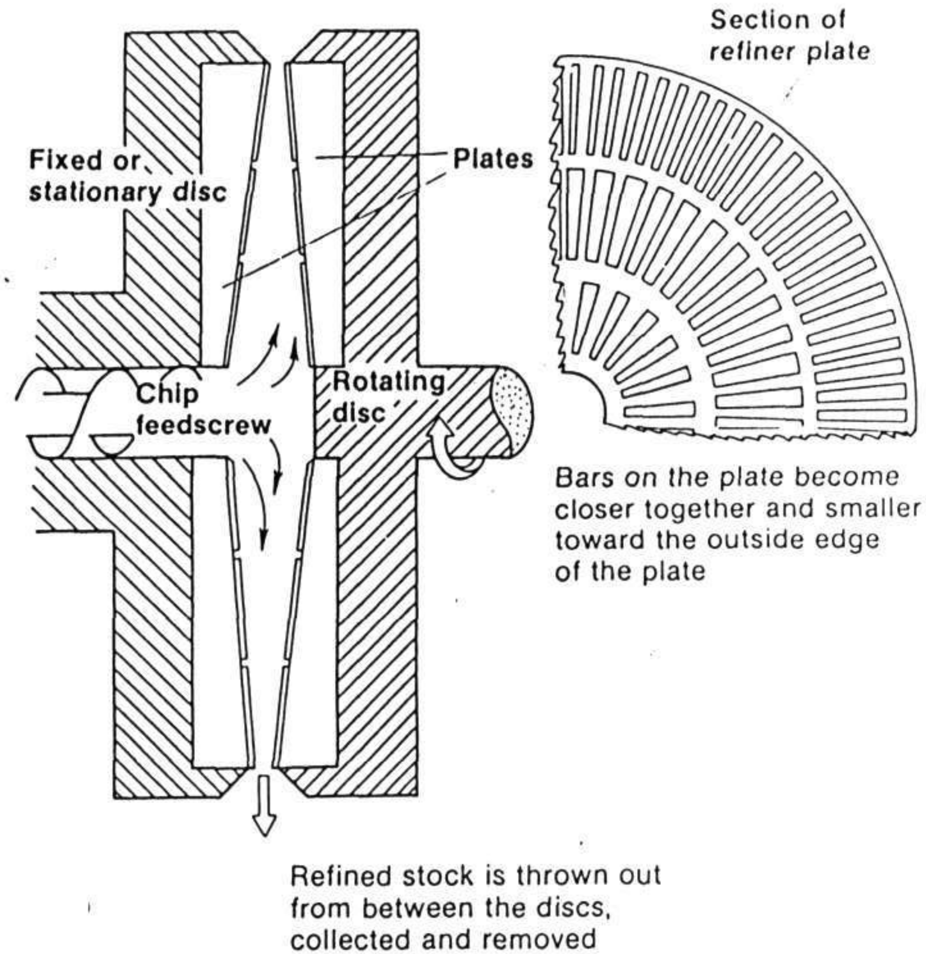
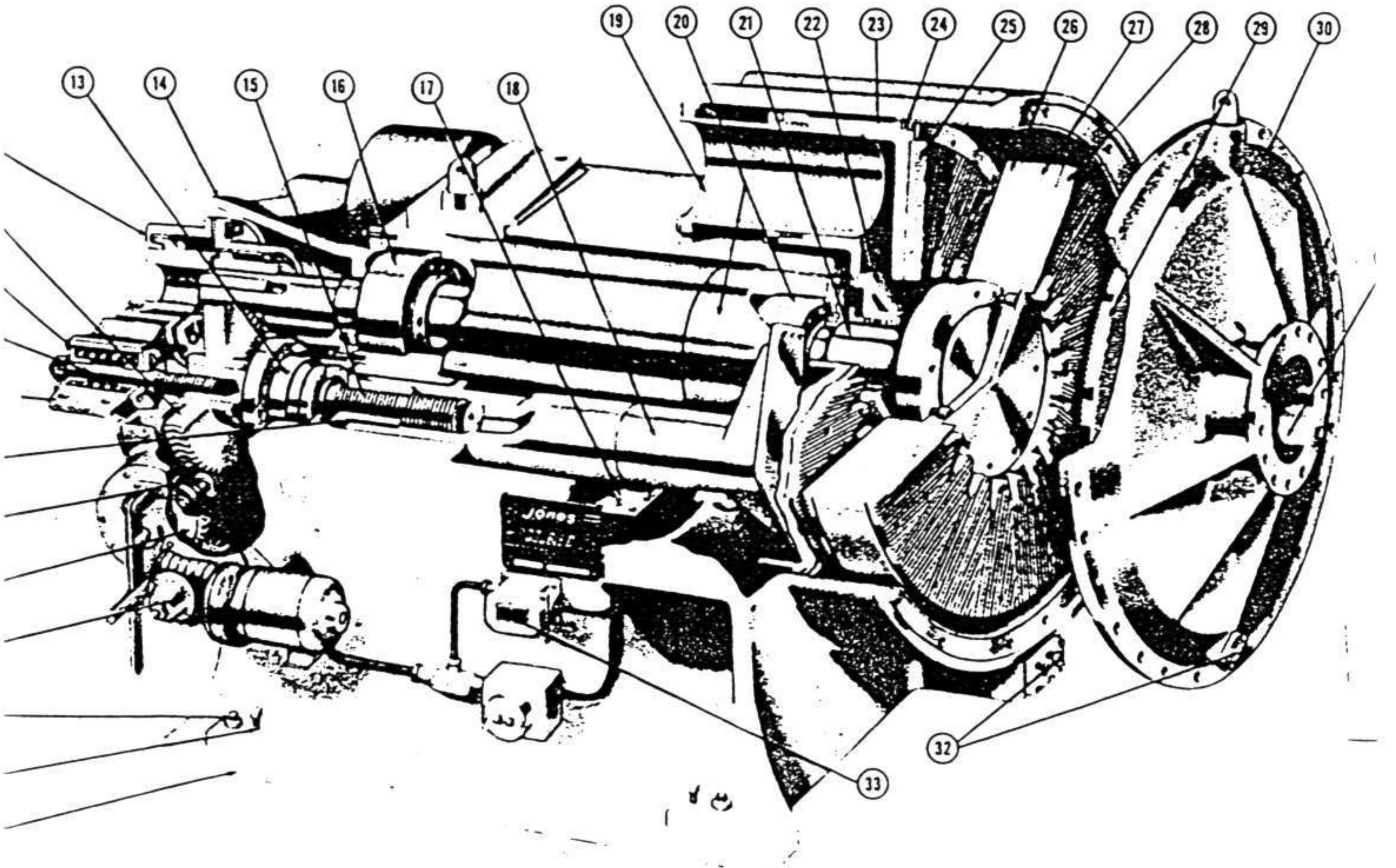


Figure 4.12. Disc refiner detail

Refiner used for Thermo-Mechanical Pulp (TMP) Production



BASICS OF NEWSPRINT MANUFACTURE

DIFFERENT TYPES OF PULP

- 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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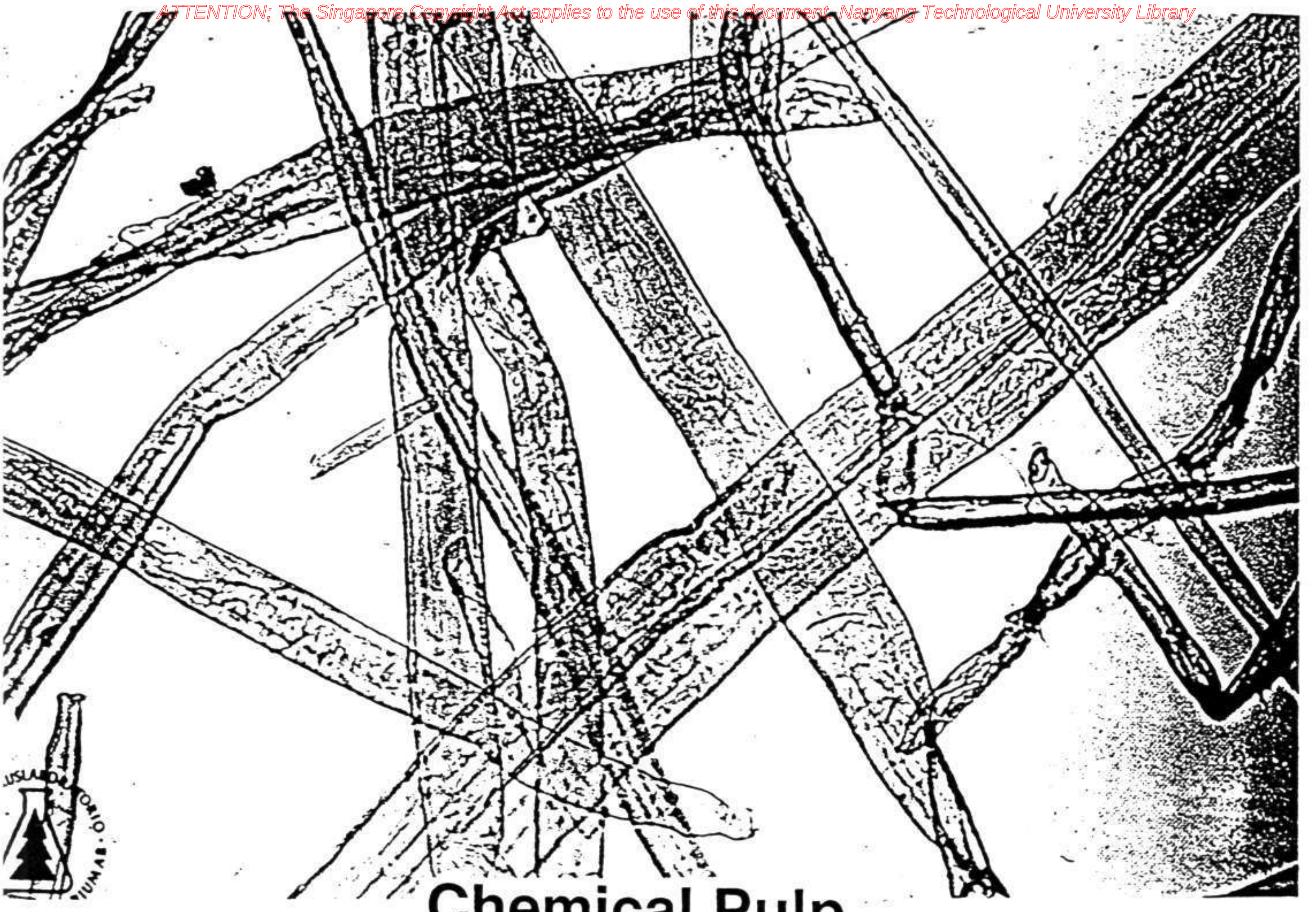

Chemical Pulp

Groundwood Mechanical Pulp

BASICS OF NEWSPRINT MANUFACTURE

DIFFERENT TYPES OF PULP

- 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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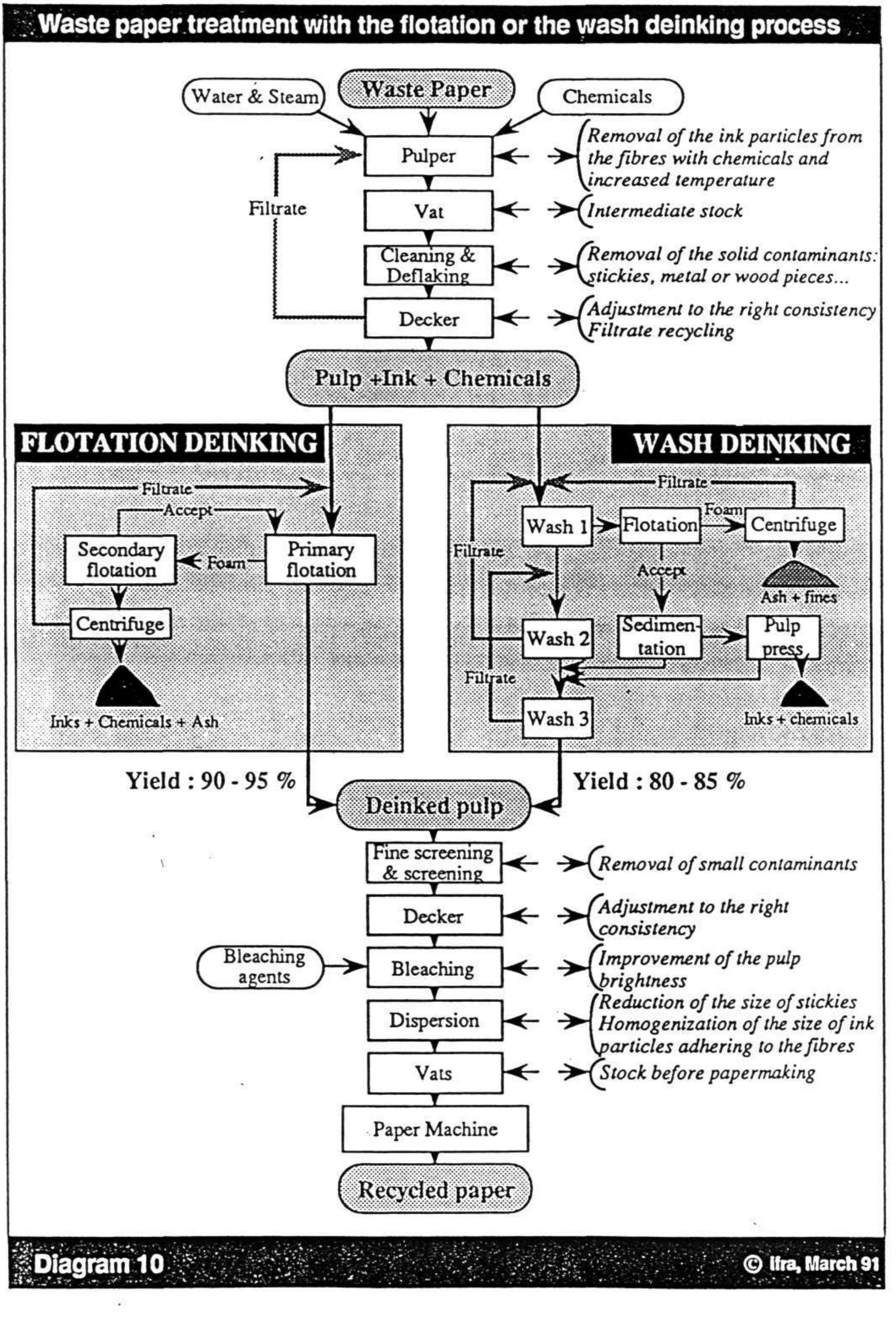

Waste paper treatment with the flotation or the wash deinking process
Water & Steam
Waste Paper
Chemicals
Pulper
Removal of the ink particles from the fibres with chemicals and increased temperature
Filtrate
Vat
Intermediate stock
Cleaning & Deflaking
Removal of the solid contaminants: stickies, metal or wood pieces...
Decker
Adjustment to the right consistency
Filtrate recycling
Pulp +Ink + Chemicals
FLOTATION DEINKING
Filtrate
Accept
Secondary flotation
Foam
Primary flotation
Centrifuge
Inks + Chemicals + Ash
WASH DEINKING
Filtrate
Foam
Wash 1
Flotation
Centrifuge
Filtrate
Accept
Ash + fines
Wash 2
Sedimentation
Pulp press
Filtrate
Wash 3
Inks + chemicals
Yield : 90 - 95 %
Yield : 80 - 85 %
Deinked pulp
Fine screening & screening
Removal of small contaminants
Decker
Adjustment to the right consistency
Bleaching agents
Bleaching
Improvement of the pulp brightness
Dispersion
Reduction of the size of stickies
Homogenization of the size of ink particles adhering to the fibres
Vats
Stock before papermaking
Paper Machine
Recycled paper
Diagram 10
© Ifra, March 91

Simplified mechanism of the flotation process

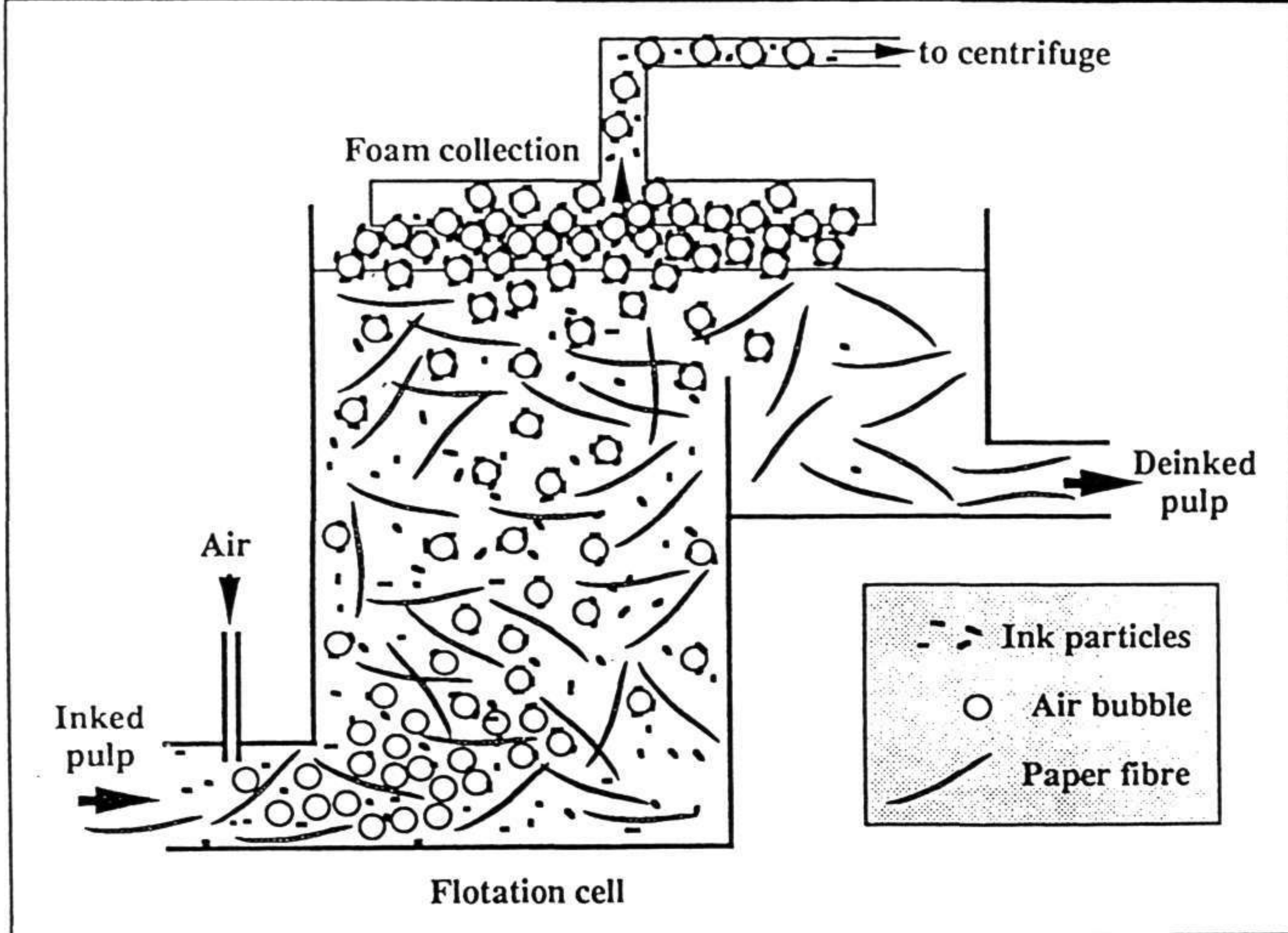


Diagram 11

Simplified mechanism of the wash deinking process

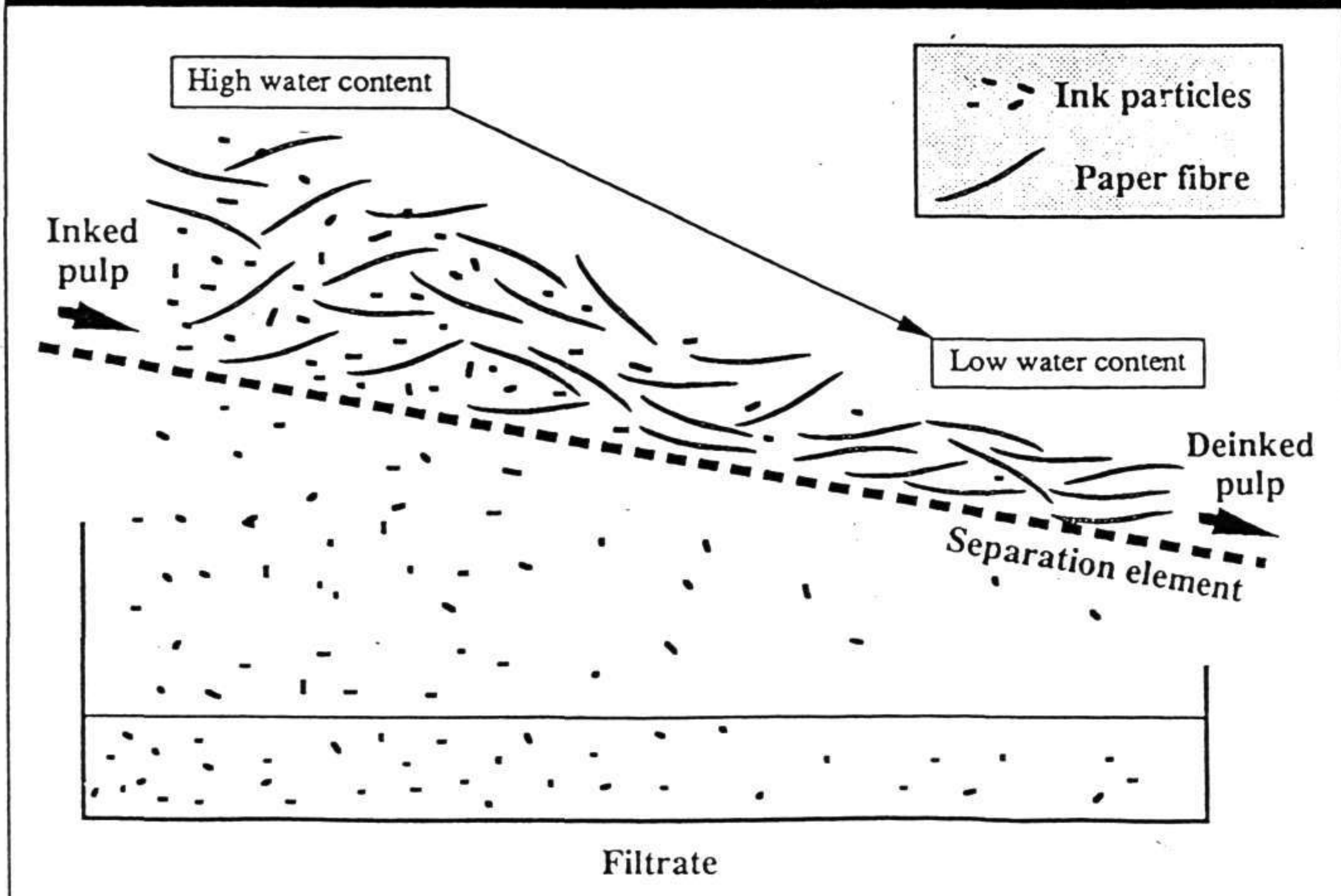
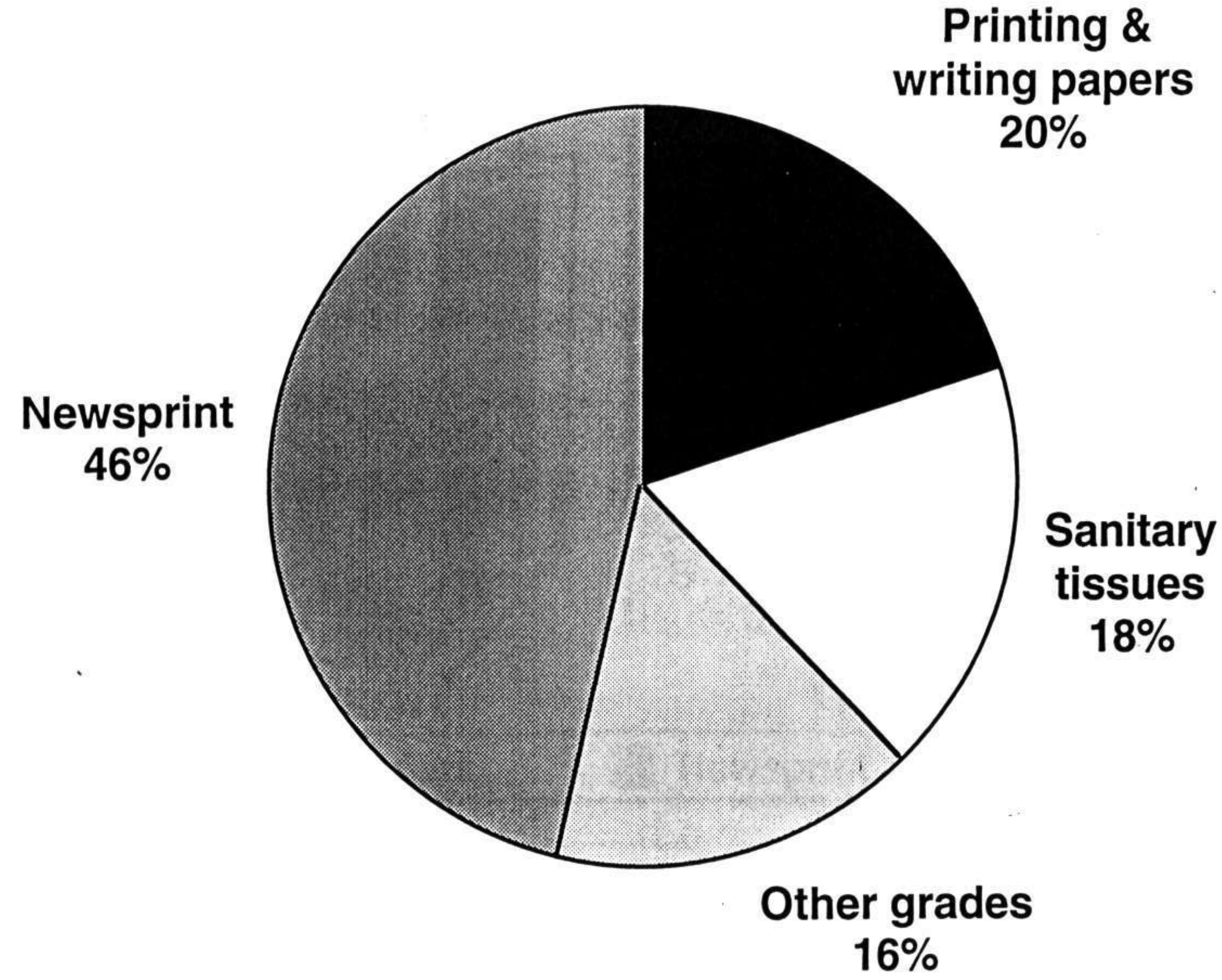
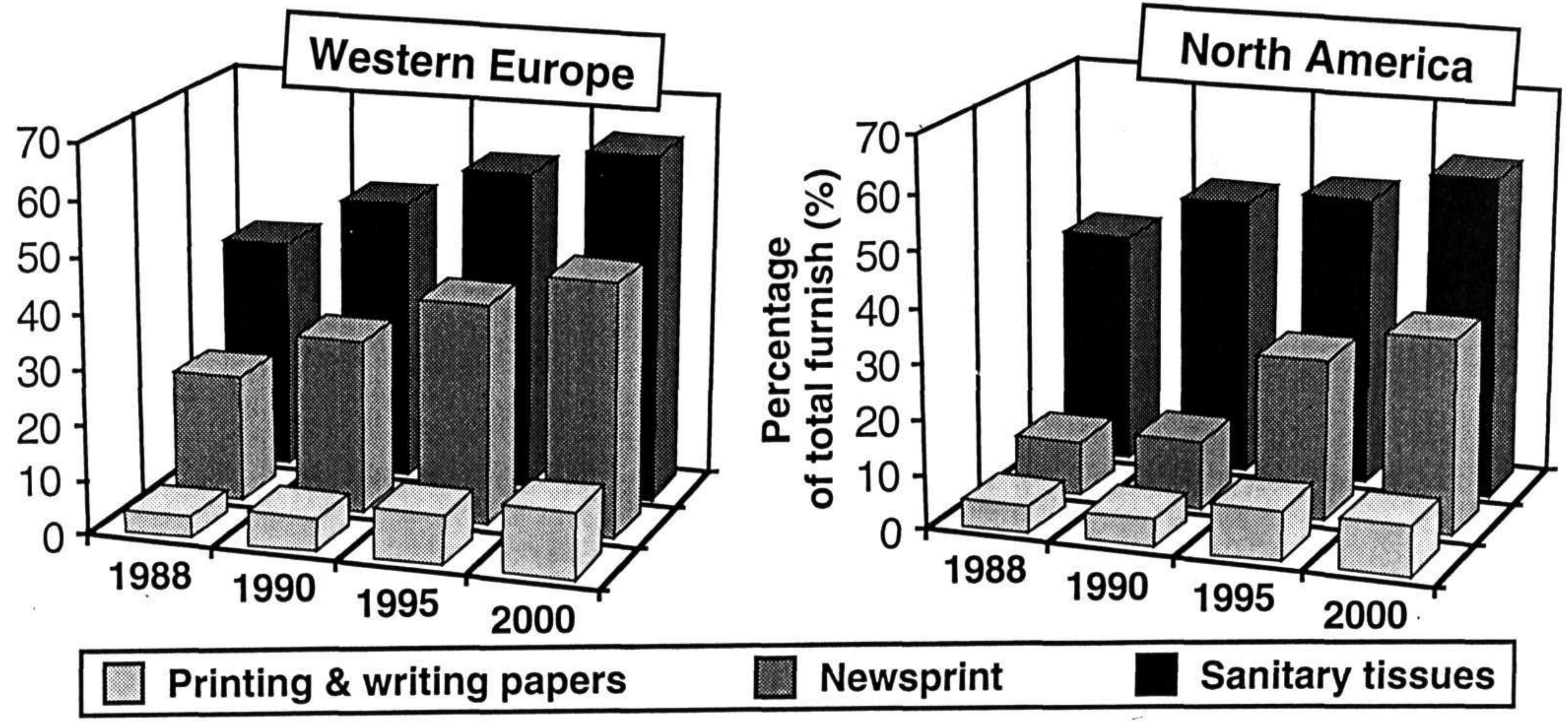


Diagram 12

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

Special Report

The runnability and the printability of recycled newsprint

The production and use of recycled fibre-containing newsprint became an absolute necessity because of economical (energy savings) and ecological (lack of landfill space) reasons. After some hesitant starts with 30% recycled content, the good results encouraged papermakers to go up to 70-80%. The newest mills built in Central Europe will even use 100% recycled fibres as raw material to make newsprint. The waste paper used for deinking and making newsprint is a mixture of old newspapers and magazines and, when correctly collected and sorted, enables the manufacture of a good quality product.

However, the use of this new raw material may change some paper properties and will require other adjustments when this paper is used on the rotary press. Some critical voices have been raised among the newspaper printers. On the initiation of Erwin Krauthauf of Haindl Papier and with the support of Clemens Mühl from Druck- und Verlagshaus Frankfurt/Main, IFRA organised a Forum (in the German language) on March 3, 1994 in Darmstadt to discuss these problems in an open way. This report gives a summary of the discussions of this group of experts. Under paragraph 8, some advice is given from all parties involved in producing and using newsprint containing a high percentage of deinked pulp.

We do hope that this Special Report will enable our members to gain a clearer view on the problems related to the use of recycled newsprint, which often suffers from a negative image.

Boris Fuchs
Research Director
Deputy Managing Director

Mai 1994
Bruno Thoyer
Research Engineer

8. Question: "What can be done to improve the situation?"

By the newspaper printers:

- Different newsprints (different types from different manufacturers) should not be mixed during the same production run.
- Different blanket types should not be mixed on the same press.
- The newspaper printer has to be willing to modify the web tension on the press according to the needs of recycled newsprint.

By the newsprint manufacturers:

- Inform the newspaper printer about the modification of the web tension on the rotary press.
- The bulk and the surface properties of recycled newsprint should be optimised to ensure a good penetration of the ink into the paper.
- The tension/elongation characteristics of the paper should be as constant as possible.
- The fibre orientation in the width of the paper machine should be as constant as possible.

By the rotary press manufacturers:

- Build different metering units when different papers have to be run in the press.
- The number of guide rollers should be limited. Rollers with lower inertia moments should be developed.
- The web leads should be as short as possible. The remaining drawbacks linked with the use of four-high towers should be eliminated.
- The splice preparation should be further automated to eliminate mistakes due to manual operation.

By all the involved parties:

- Show more co-operation, with at least two meetings per year to discuss open questions. IFRA could act as a moderator.
- Try to learn the language of the others to overcome the problems due to different technical terminology.

Figure 5.5. Centrifugal cleaner

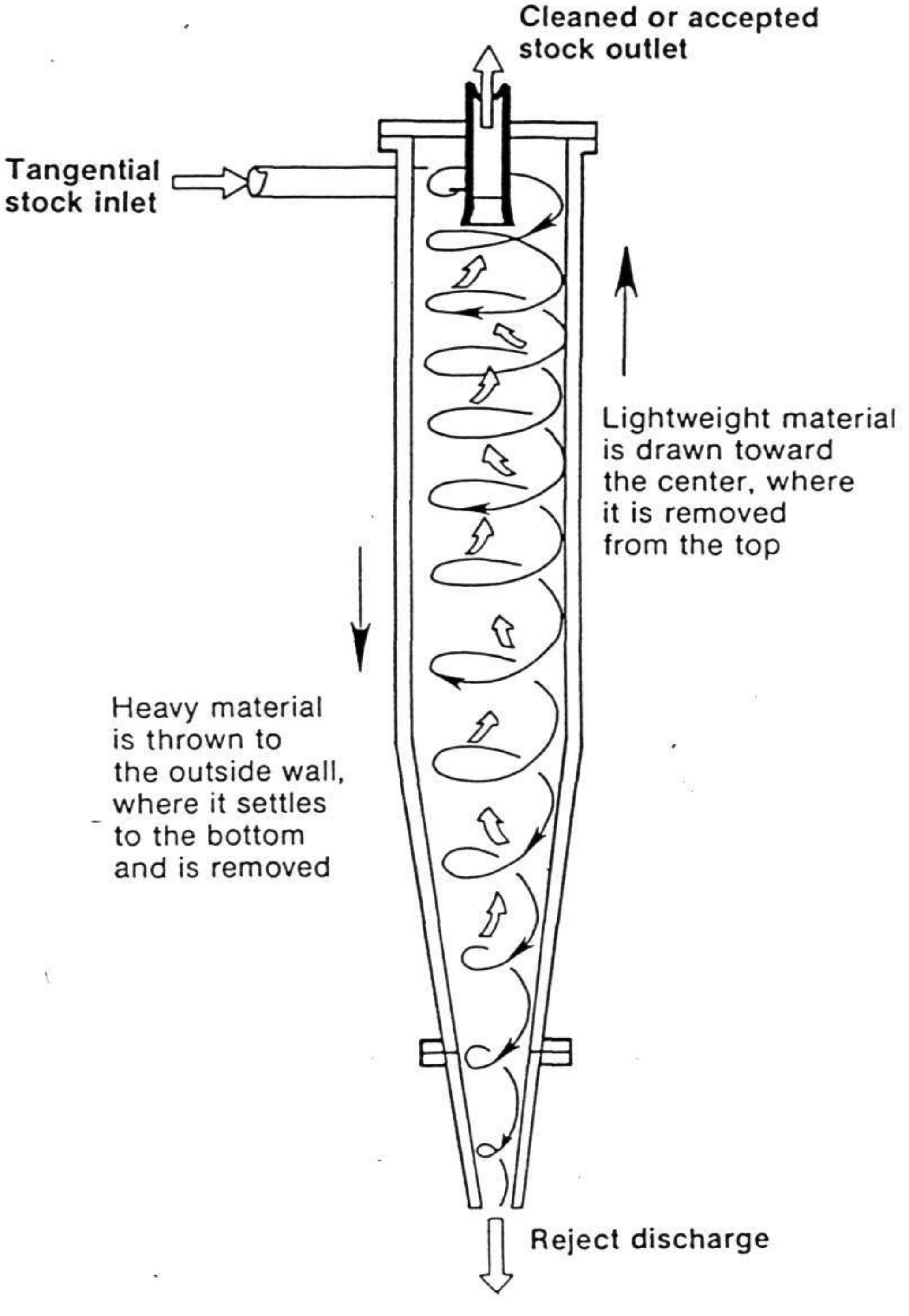
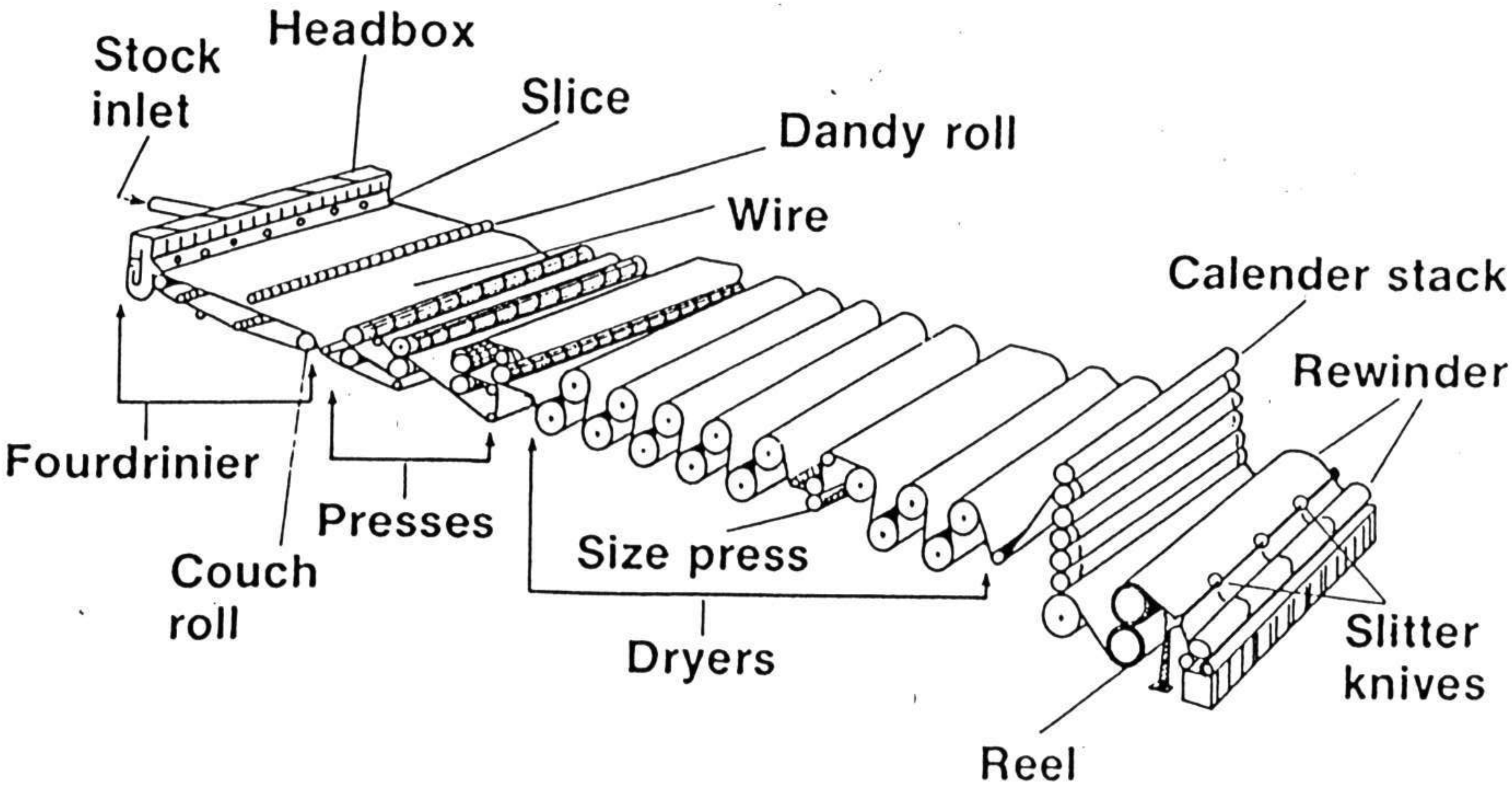


Figure 6.1. Fourdrinier paper machine



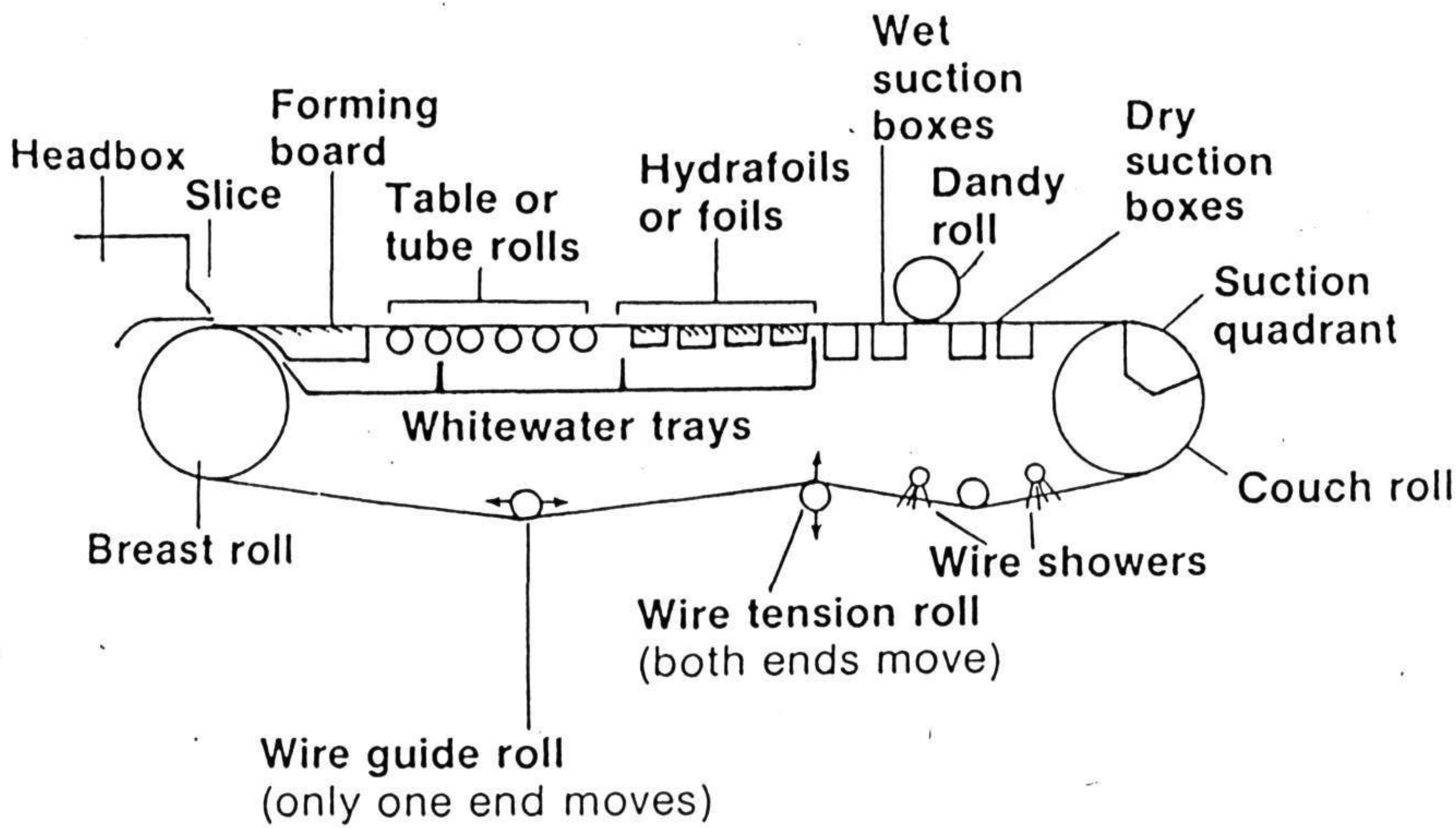


Figure 6.11. Fourdrinier wet-end parts

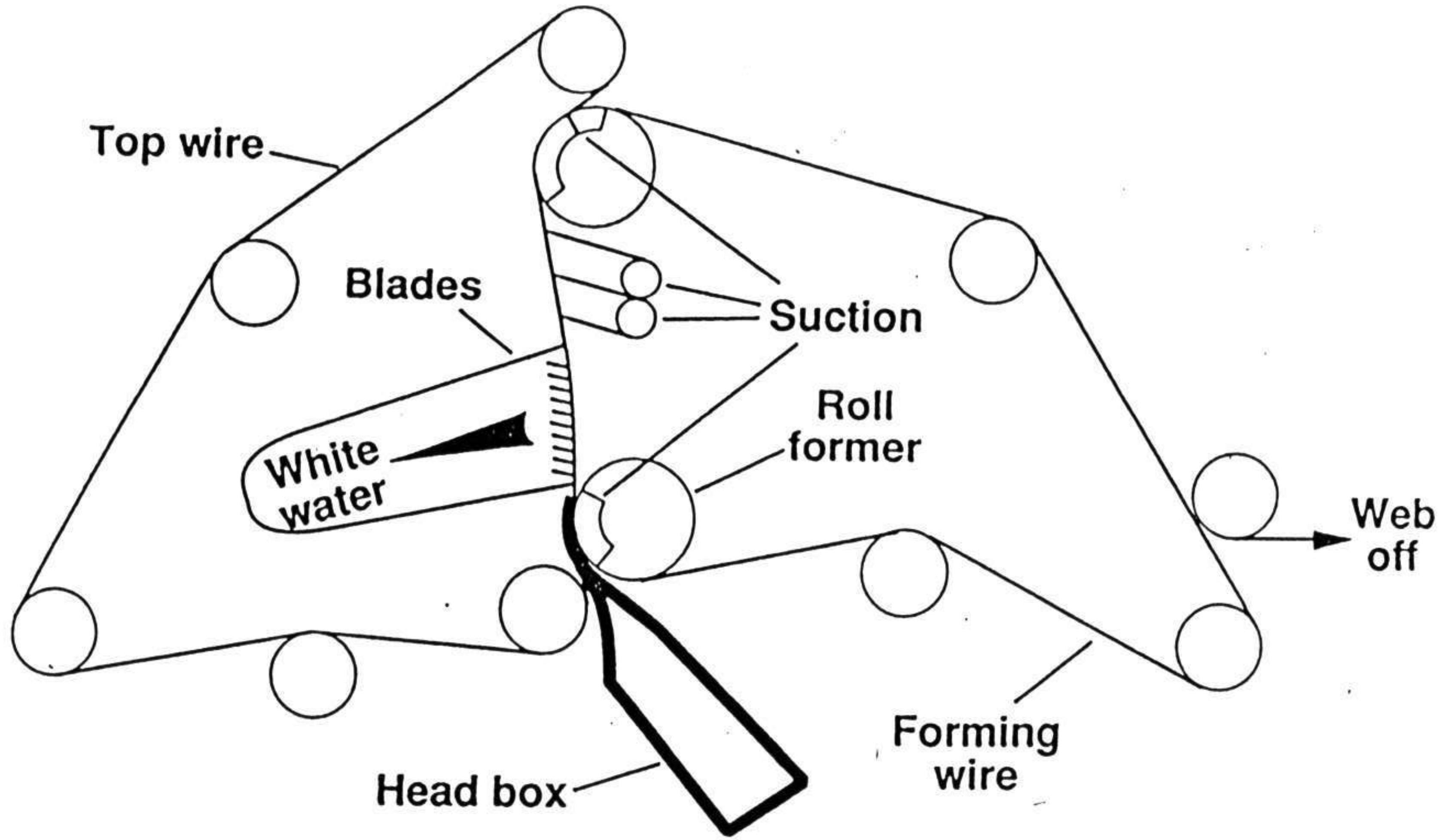


Figure 6.21. Roll and blade-type twin-wire former

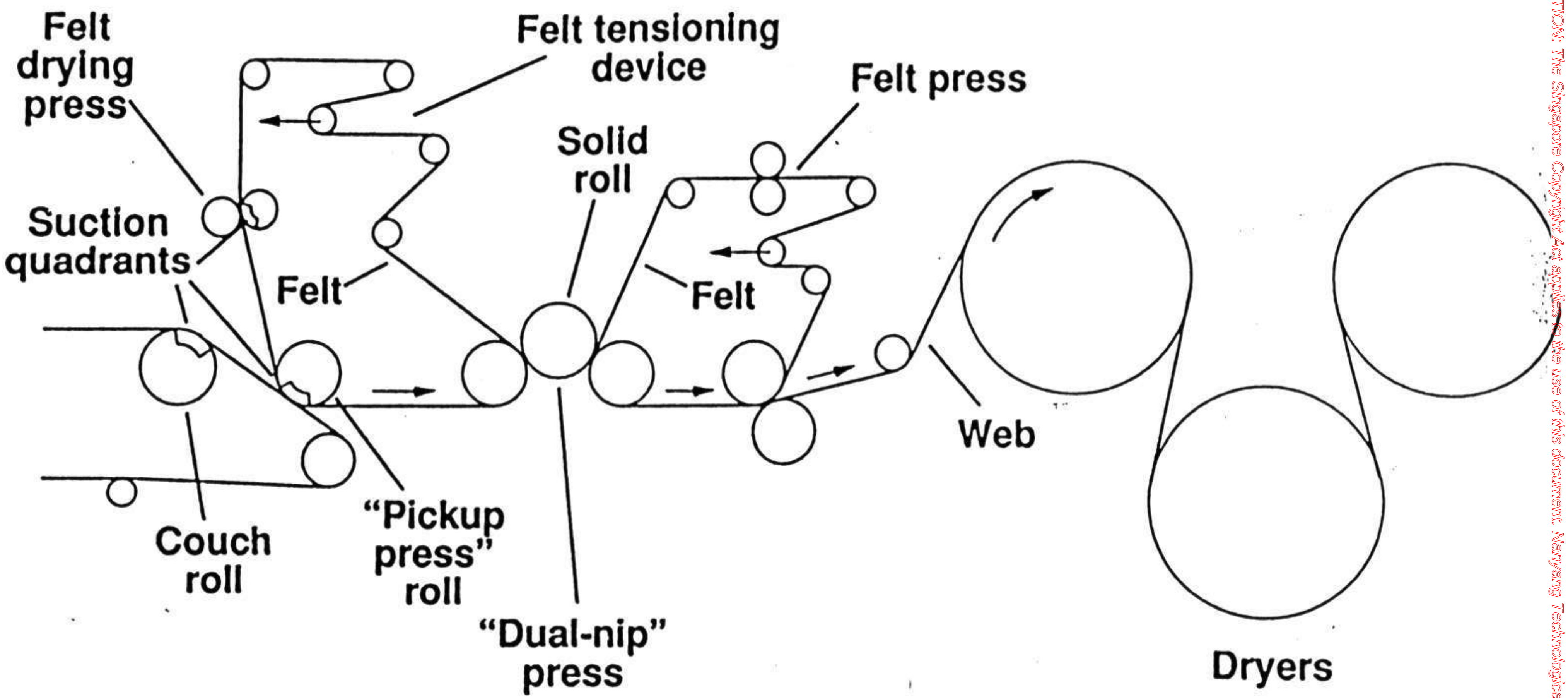
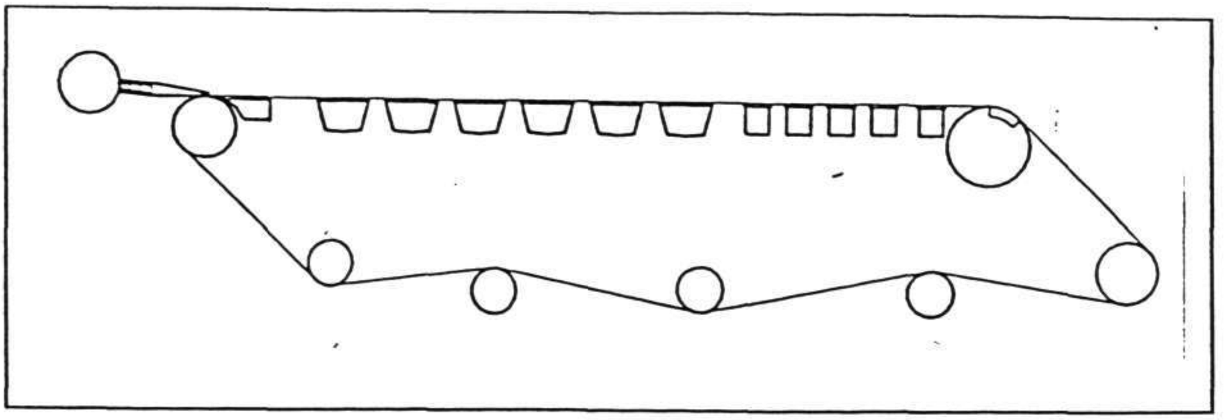
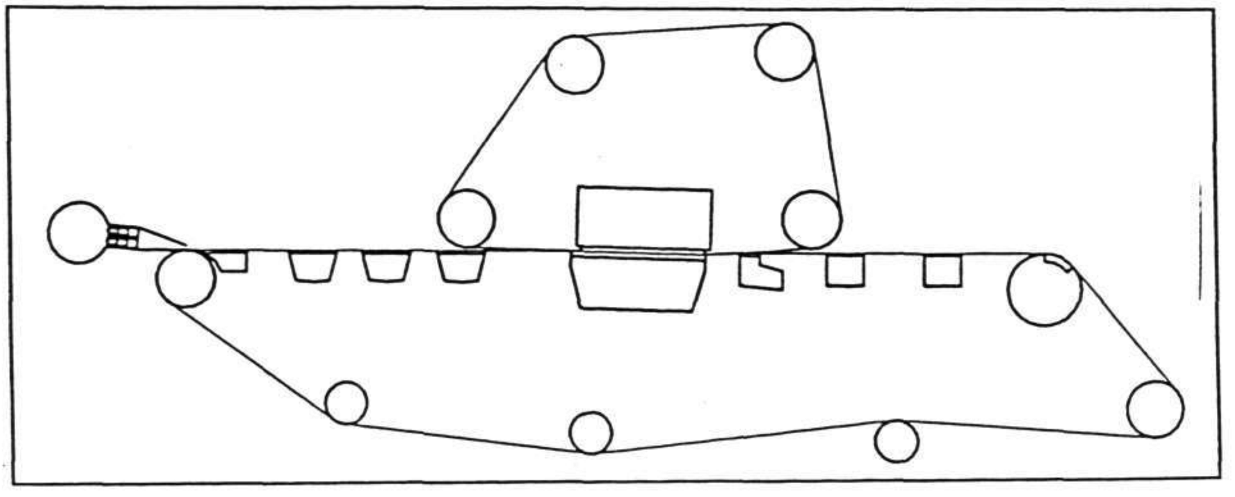


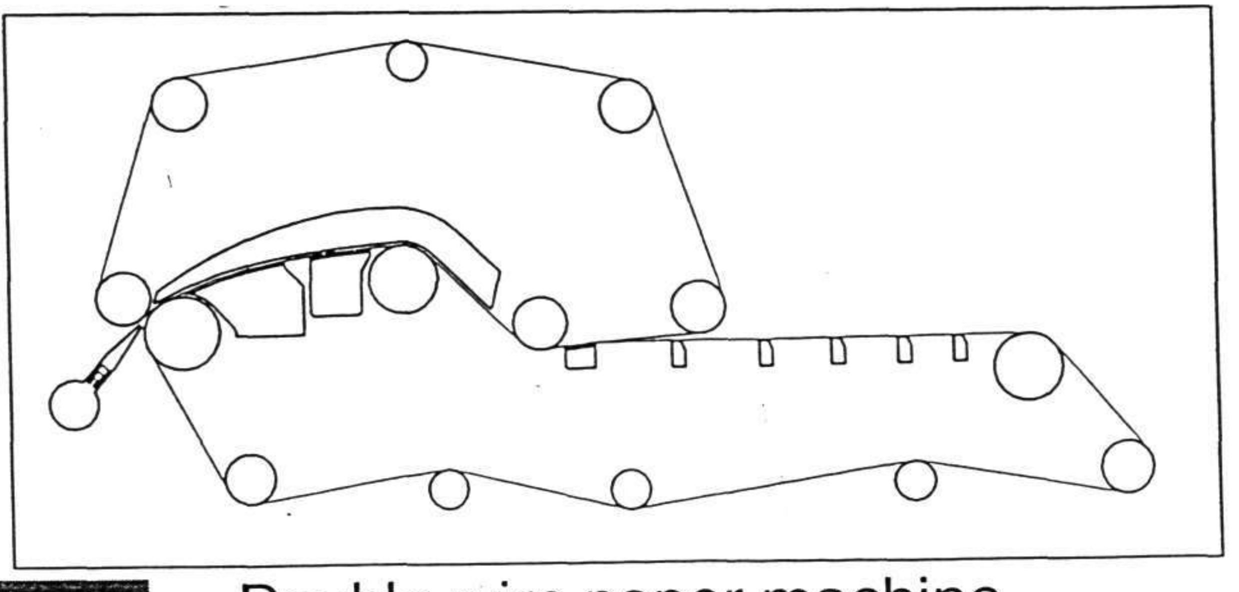
Figure 6.25. Press section design



Fourdrinier (single-wire) paper machine



Hybride former



Double-wire paper machine
(Gap former)

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Basics of papermaking

SHEET FORMATION

- 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

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

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)

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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

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Fig. 1: Comparison of calendering effects.

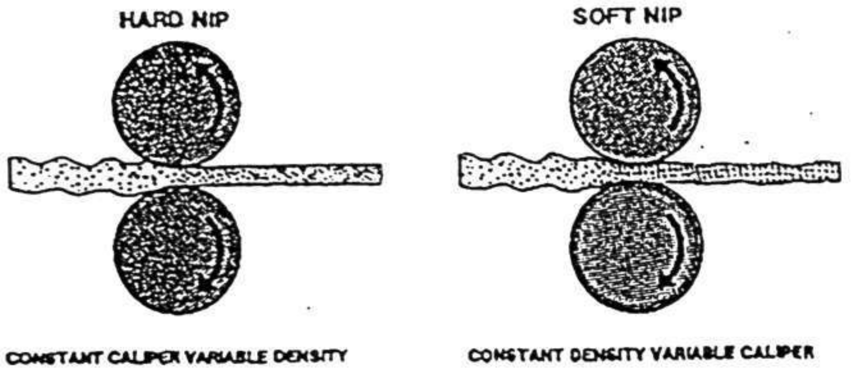
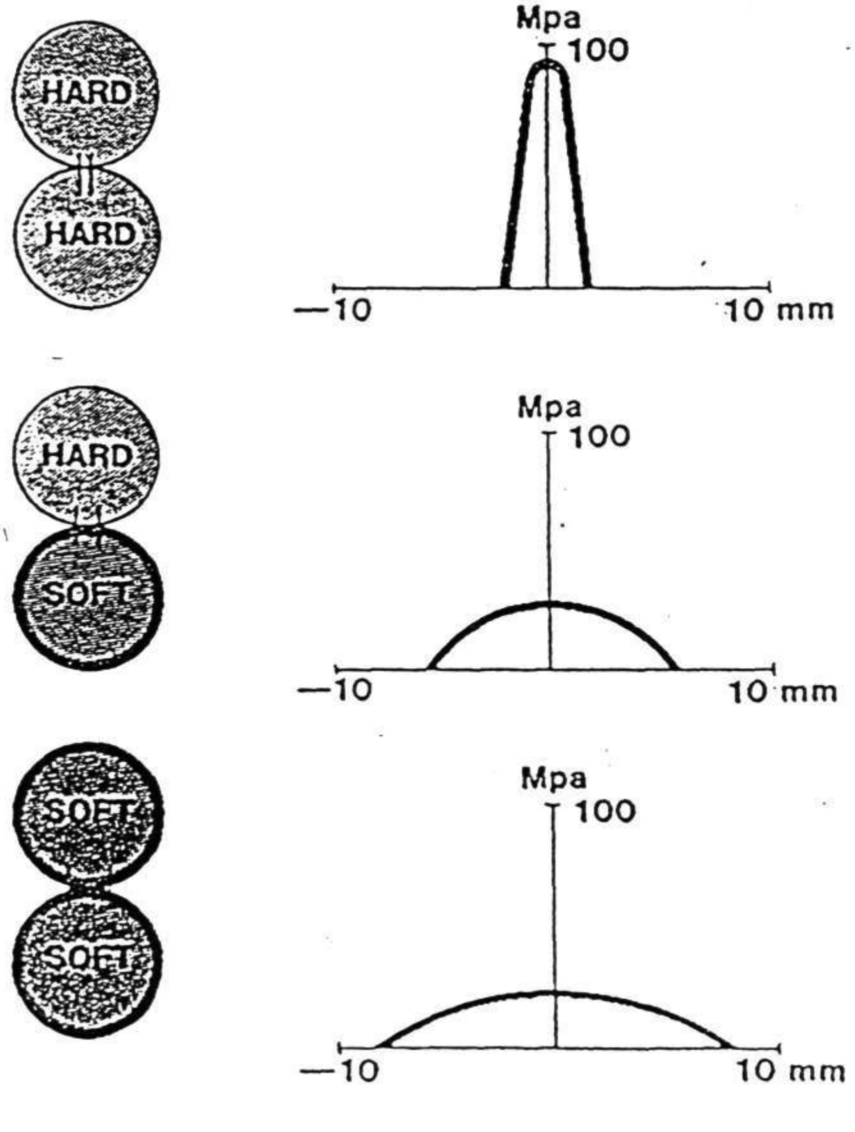
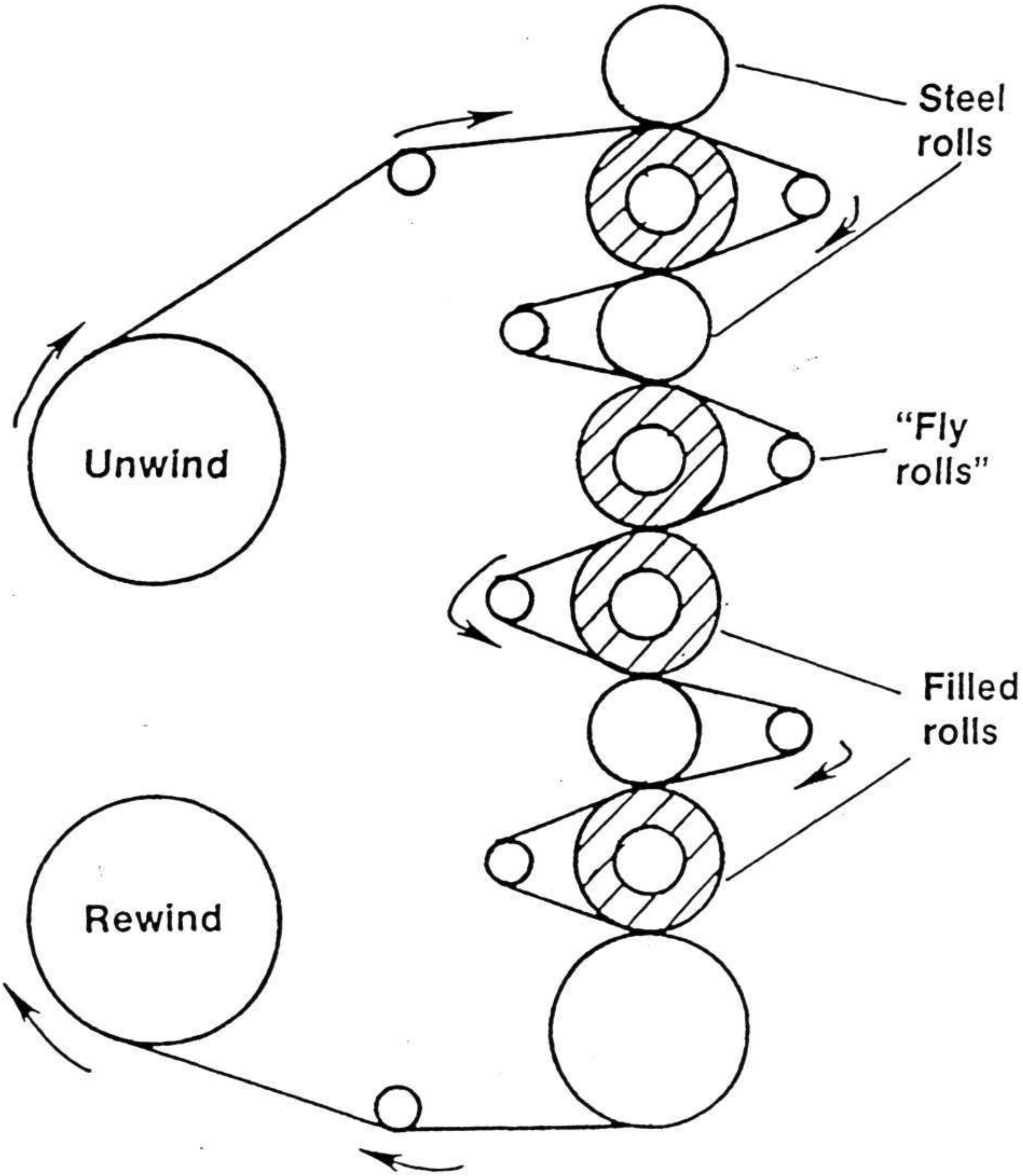


Fig. 2: Nip pressure at 1000 kN/m, Ø 1000 mm.



re 7.14. Supercalender design



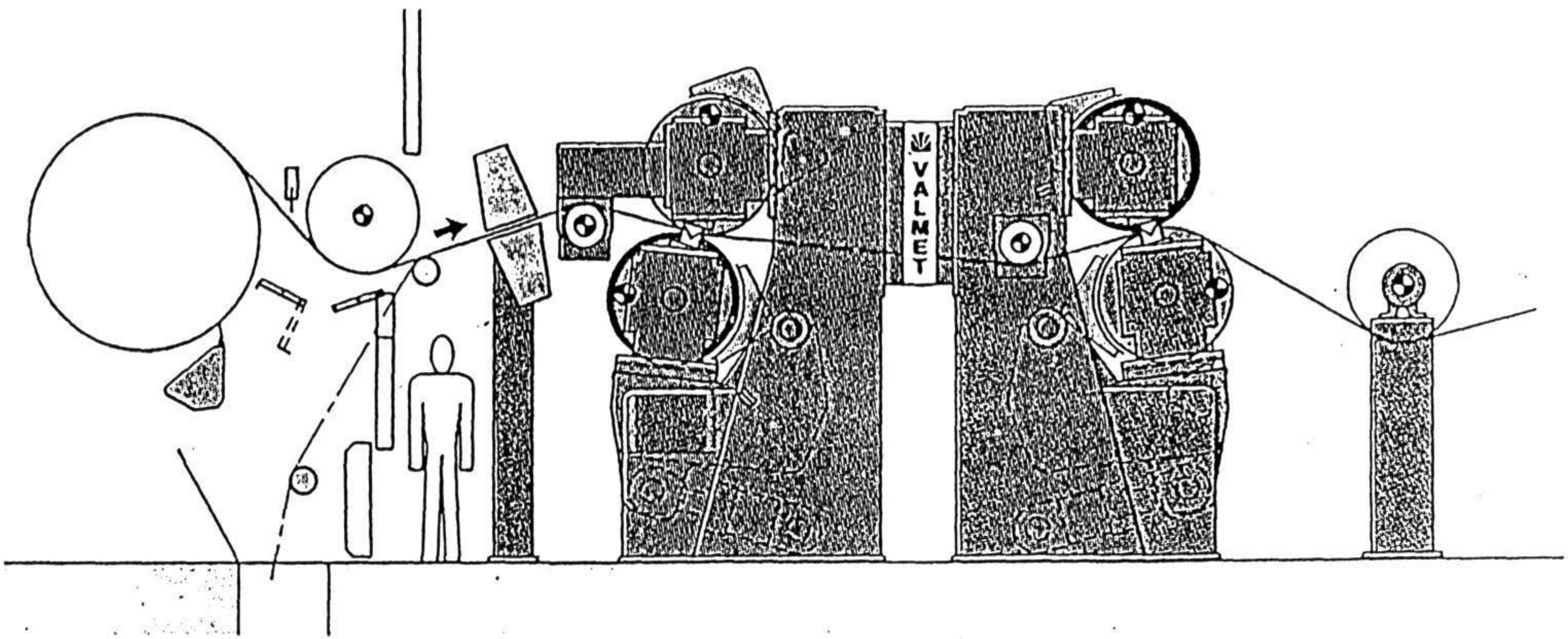
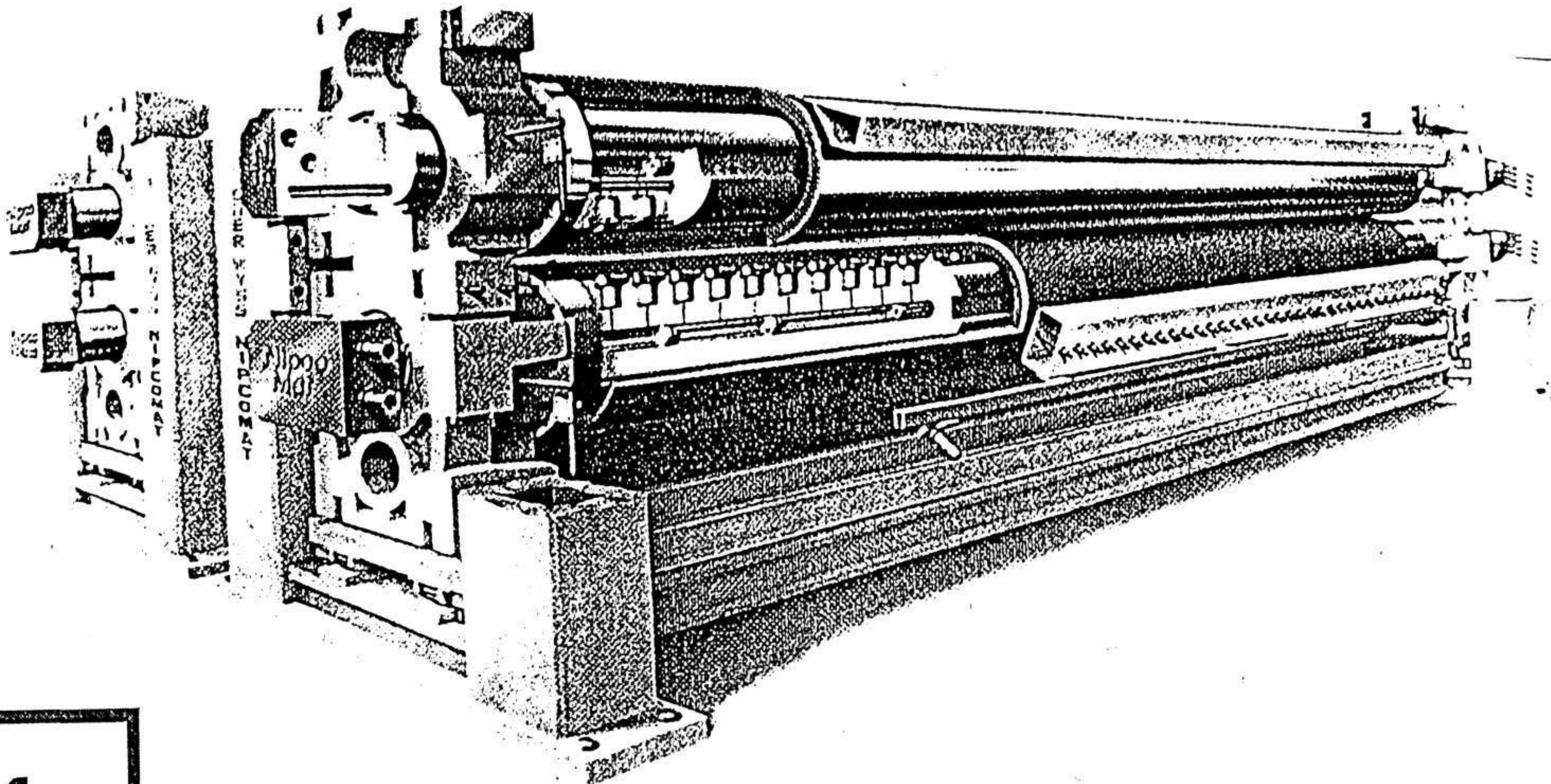


Fig. 3: Soft calender, newsprint.

NipCoMat Soft Calender



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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^2	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		

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STORA FELDMÜHLE KVARNSVEDEN
PM 11
STORA NEWS 49g/m²

Grammage, g/m²	48,4		
Apparent Density, kg/m³	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. m²/kg	52,8		
Lightabs.coeff. m²/kg	5,1		
Excitation purity, %	7,6		
Dom. wave-length, nm	576,2		
Oil absorbtion, Cobb Unger g/m², 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/m² 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/m²

Kvarnsveden 1994-04-11

 Paper I

ske Skog

PAPER ANALYSIS

denfjelske Treforedling
ER LABORATORY

Date : 15/03/94
Sign : M.LEINSVANG.

ill : NSI
uality : AVIS STANDARD
rammage : 48.8 g/m²

omment: PRODUSERT FOR GUARDIAN, TILSATT FYLLSTOFF.

M : 1
ambour No : 2269
eel No : 11131618

rammage			g/m²	48.9
eet thickness			µm	77.9
heet density			kg/kbm	628
oughness Bendtsen	0,1 MPa	Ts/Ws	ml/min	91 / 89
oughness Bendtsen	0,5 MPa	Ts/Ws	ml/min	29 / 29
ardness		Ts/Ws		32 / 32
oughness P.P.S		Ts/Ws	µm	3.2 / 3.3
orosity Bendtsen			ml/min	175
riction		Ts/Ws		0.35 / 0.36
ensile Strength		MD/CD	kN/m	2.47 / 0.81
ensile index		MD	Nm/g	50.5
ensile ratio	CD/MD			0.33
longation		MD/CD		0.94 / 3.12
earing resistance		MD/CD	mN	180 / 273
ear index		CD	mNm²/g	5.58
ear ratio	CD/MD			1.52
sh content			%	1.10
ightness ISO			%	60.2
- value			%	64.5
xcitation purity			%	5.40
ominant wavelength			nm	576.7
pacity			%	94.7
pesific light scattering coeff.			m²/kg	54.9
ormation				5.86
urnish	TMP		%	100
	Chem.pulp		%	
	Broke		%	9

Dip: Yes/No Starch: Yes/No

Different types of newsprint

Directory paper:

- Main use: telephone books and various catalogues
- High pagination: lower grammage

--> 40 g/m2 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/m2)

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^2	45	48.8		52		55		60
Brightness, % ISO	66	66	71	66	71	66	71	71
Luminance, % (Y-value)	69.5	69.5	73.5	69.5	73.5	69.5	73.5	73.5
Dominant wavelength, nm	573	573	568	573	568	573	568	568
Excitation purity, %	4.5	4.5	3.0	4.5	3.0	4.5	3.0	3.0
Opacity, %	89	90.5	89	91.5	90	92.5	91	92,5
Roughness Bendtsen 0.1 MPa, ml/min	95	95		105		105		105
Moisture content, %	8-9							

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Reel diameters

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: ≤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/mm². Not critical at normal web widths (1.6 m), but becomes critical at web widths of 2.5 m.
7. Linearity (warpage): ≤2 mm/m.
8. Out-of-roundness: maximum 0.5 mm.
9. Deformation on core: Acceptable on inner diameter to a certain extent without mayor 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 mm², central drive; 2000 mm², belt drive.

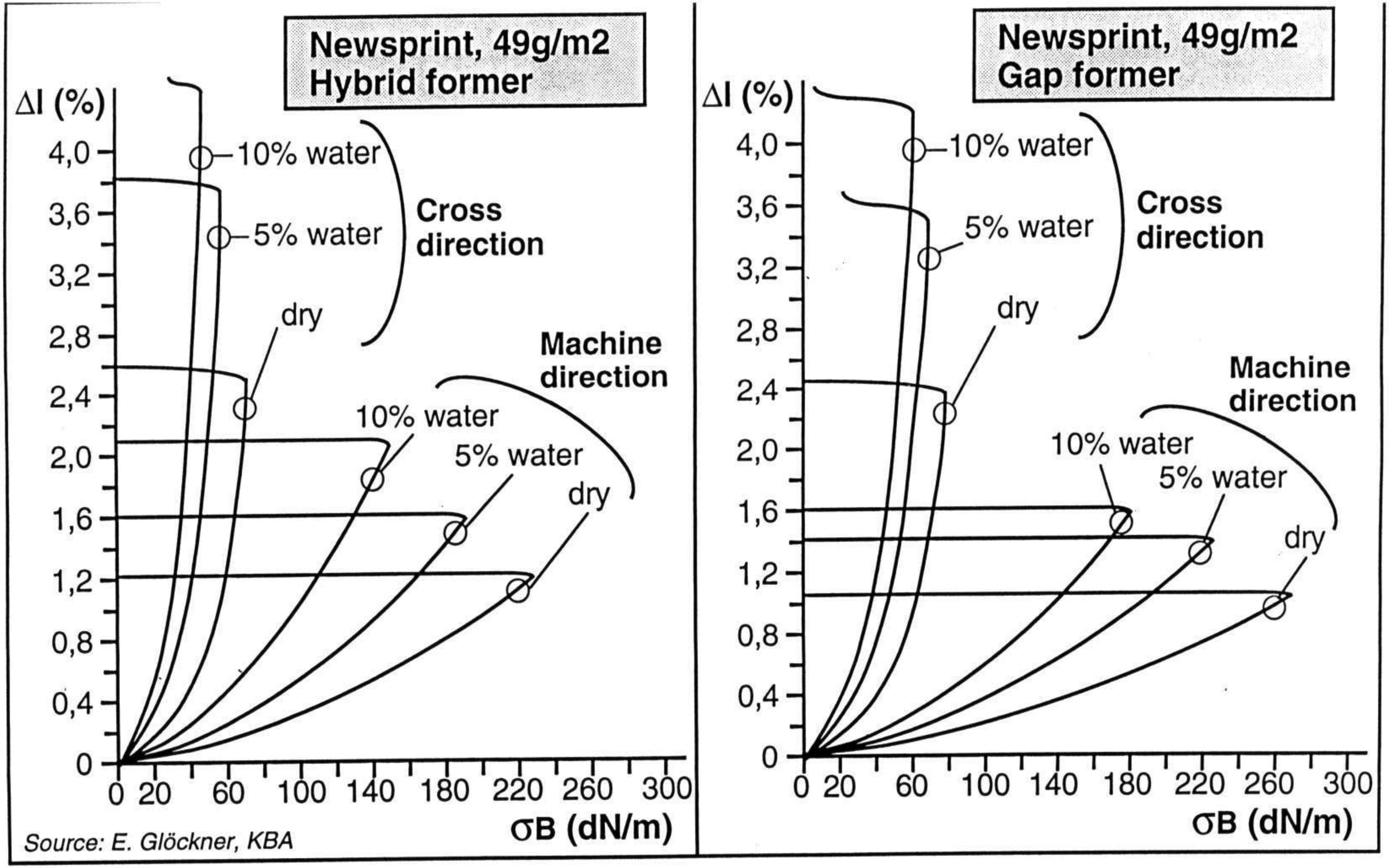
Conical chucks

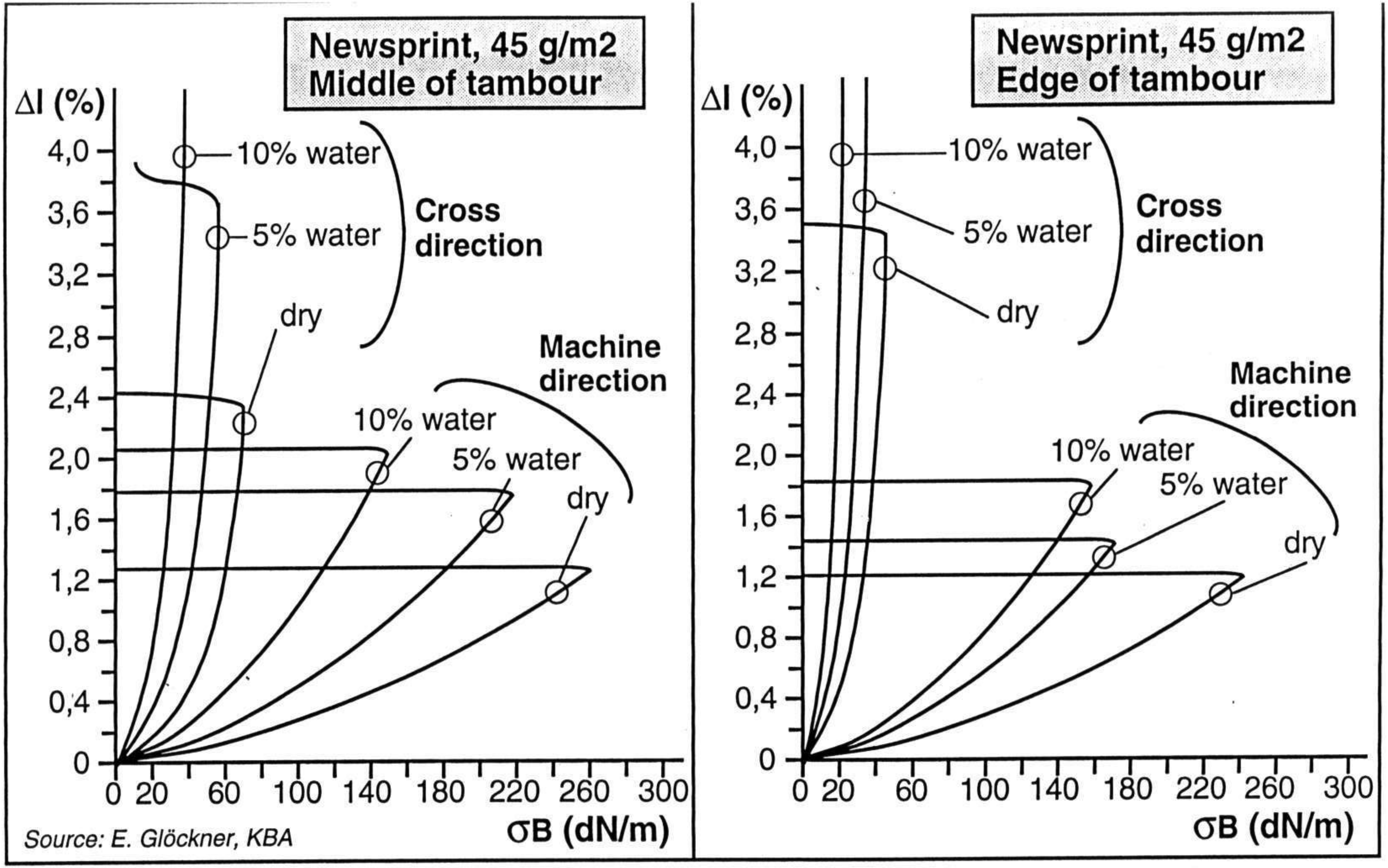
1. Contact surface: Long type of chucks recommended.

4.3. Information needed for core selection

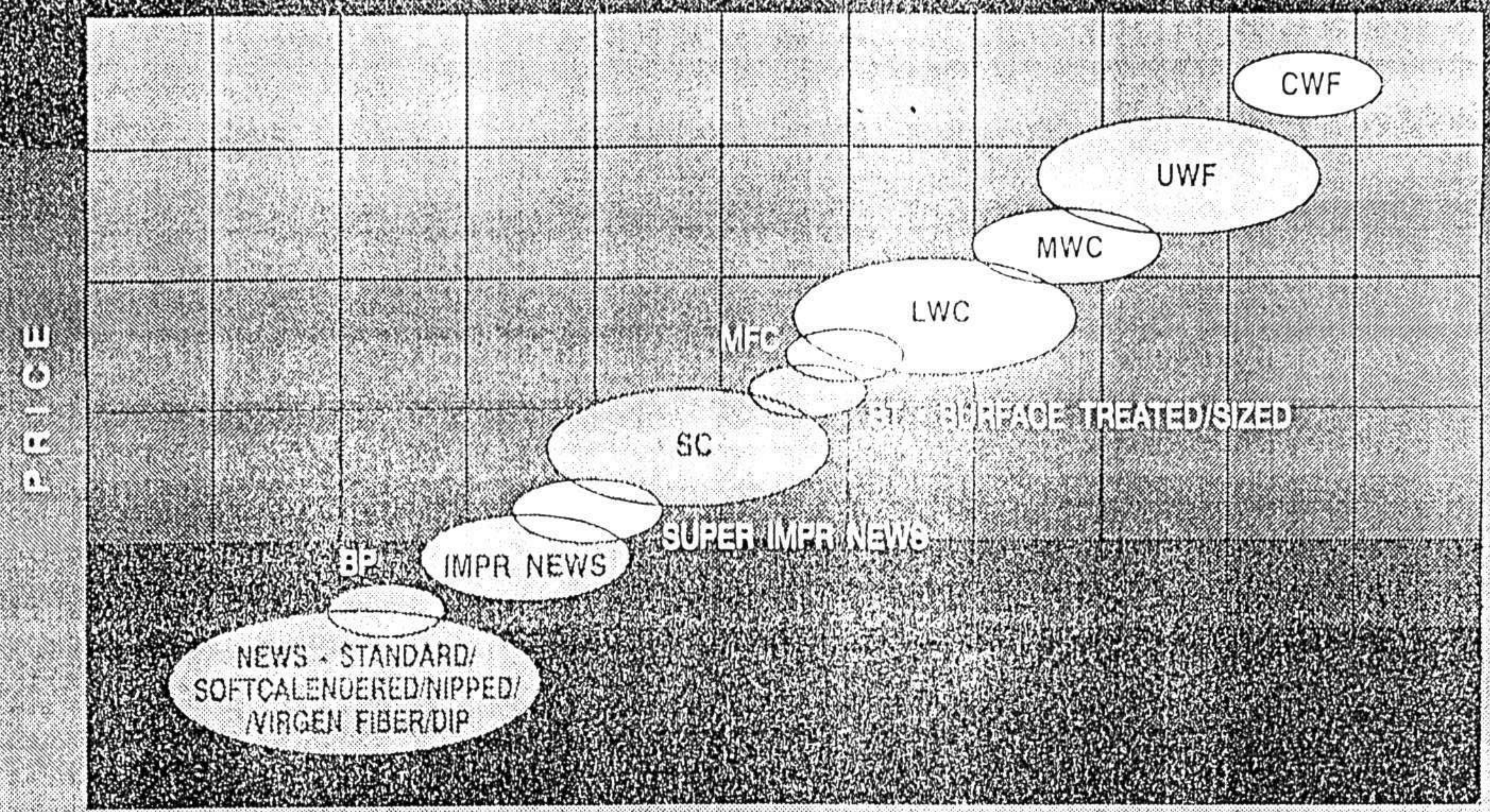
In order to enable an optimum choice of core the following data concerning the reel and the reelstand should be given to the core manufacturer. This is of utmost importance in more problematic cases, such as extremely short conical chucks, big reel diameters or widths.

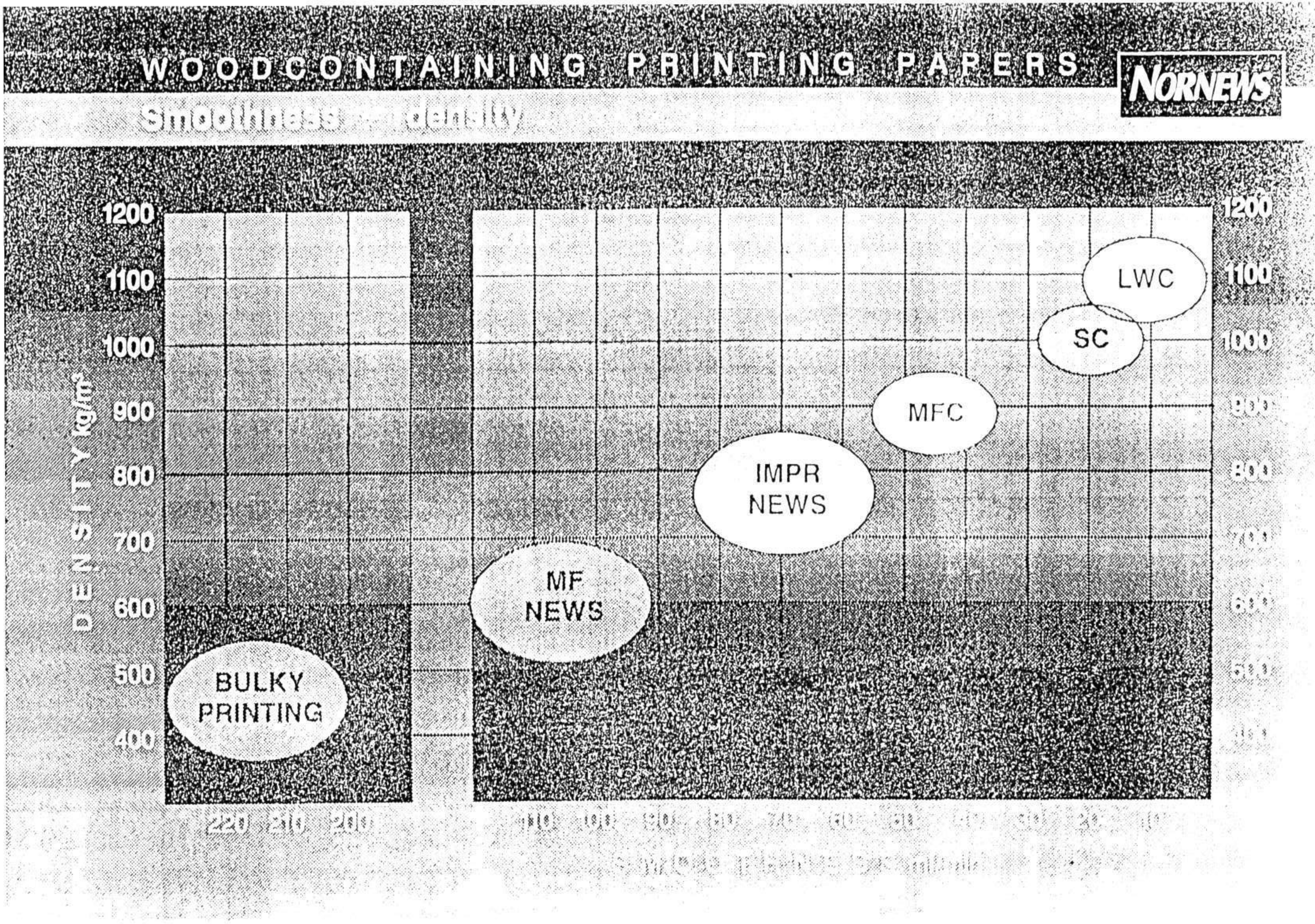
1. Maximum web width (cm)
2. Maximum reel diameter (cm)
3. Maximum reel weight (kg)
4. Paper caliper (μm)
5. Chucking thrust force (kp/cm² or kPa)
6. Maximum press speed (m/s)
7. Maximum deceleration rate (m/s²)


Newsprint, 49g/m2
Hybrid former
ΔI (%)
4,0
3,6
3,2
2,8
2,4
2,0
1,6
1,2
0,8
0,4
0
10% water
5% water
dry
Cross direction
Machine direction
10% water
5% water
dry
0 20 60 100 140 180 220 260 300
σB (dN/m)
Source: E. Glöckner, KBA
Newsprint, 49g/m2
Gap former
ΔI (%)
4,0
3,6
3,2
2,8
2,4
2,0
1,6
1,2
0,8
0,4
0
10% water
5% water
dry
Cross direction
Machine direction
10% water
5% water
dry
0 20 60 100 140 180 220 260 300
σB (dN/m)


Newsprint, 45 g/m2
Middle of tambour
ΔI (%)
4,0
3,6
3,2
2,8
2,4
2,0
1,6
1,2
0,8
0,4
0
10% water
5% water
dry
Cross direction
Machine direction
10% water
5% water
dry
0 20 60 100 140 180 220 260 300
σB (dN/m)
Source: E. Glöckner, KBA
Newsprint, 45 g/m2
Edge of tambour
ΔI (%)
4,0
3,6
3,2
2,8
2,4
2,0
1,6
1,2
0,8
0,4
0
10% water
5% water
dry
Cross direction
Machine direction
10% water
5% water
dry
0 20 60 100 140 180 220 260 300
σB (dN/m)

WOODCONTAINING PRINTING PAPERS




WOODCONTAINING PRINTING PAPERS
NORNEWS
DENSITY kg/m³
1200
1100
1000
900
800
700
600
500
400
BULKY PRINTING
MF NEWS
IMPR NEWS
MFC
SC
LWC
220
210
200
110
100
90
80
70
60
50
40
30
20
10

Newsprint properties

- Basic characteristics
  - Grammage
  - Moisture content
  - Ash content
- Structural characteristics
  - Sheet thickness
  - Sheet density
  - Surface roughness
  - Compressibility
  - Porosity
  - Oil & water absorption
- Optical characteristics
  - ISO brightness
  - Shade
  - Opacity
- Mechanical characteristics
  - Tensile strength and elongation
  - Tearing resistance
- Newsprint quality control
  - Why quality control?
  - ISO 9000
  - Establishing purchasing specifications
  - How to establish a quality control programme?
  - Which properties to test?

PHYSICAL PROPERTIES OF NEWSPRINT

Basic characteristics

- Grammage
- Moisture content
- Ash content

Structural characteristics

- Sheet thickness
- Sheet density
- Surface roughness, smoothness
- Compressibility
- Hardness
- Porosity, air permeability
- Oil absorption
- Water absorption

Optical characteristics

- ISO brightness
- Shade
- Opacity
- Light scattering coefficient

Mechanical characteristics

- Tearing resistance
- Tensile strength and elongation
- Tensile strain energy absorption

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NEWSPRINT GRAMMAGE

- Also called "basis weight" or "substance"

- **Definition:** mass of the paper per unit surface area of the sheet in the "as-taken" condition, i.e. with the moisture content with which the paper left the final stage of the papermaking process

- **Units:** SI Units: kg/m2
Preferred units: g/m2
American: Pounds/ream (lbs/ream)
--> The weight in pounds of a ream (500 sheets) of newsprint 24 by 36 inches (3000 square feet)

- **Recommendations:** The standard newsprint grammages are
48.8 g/m2 *(american equivalent: 30 lbs/ream)*
45 g/m2
40 g/m2

If a printer wants to use a higher grammage than 48.8 g/m2, he should use **52 g/m2**.
If a printer wants to use a grammage between 40 and 45 g/m2, he should use **42.5 g/m2**.

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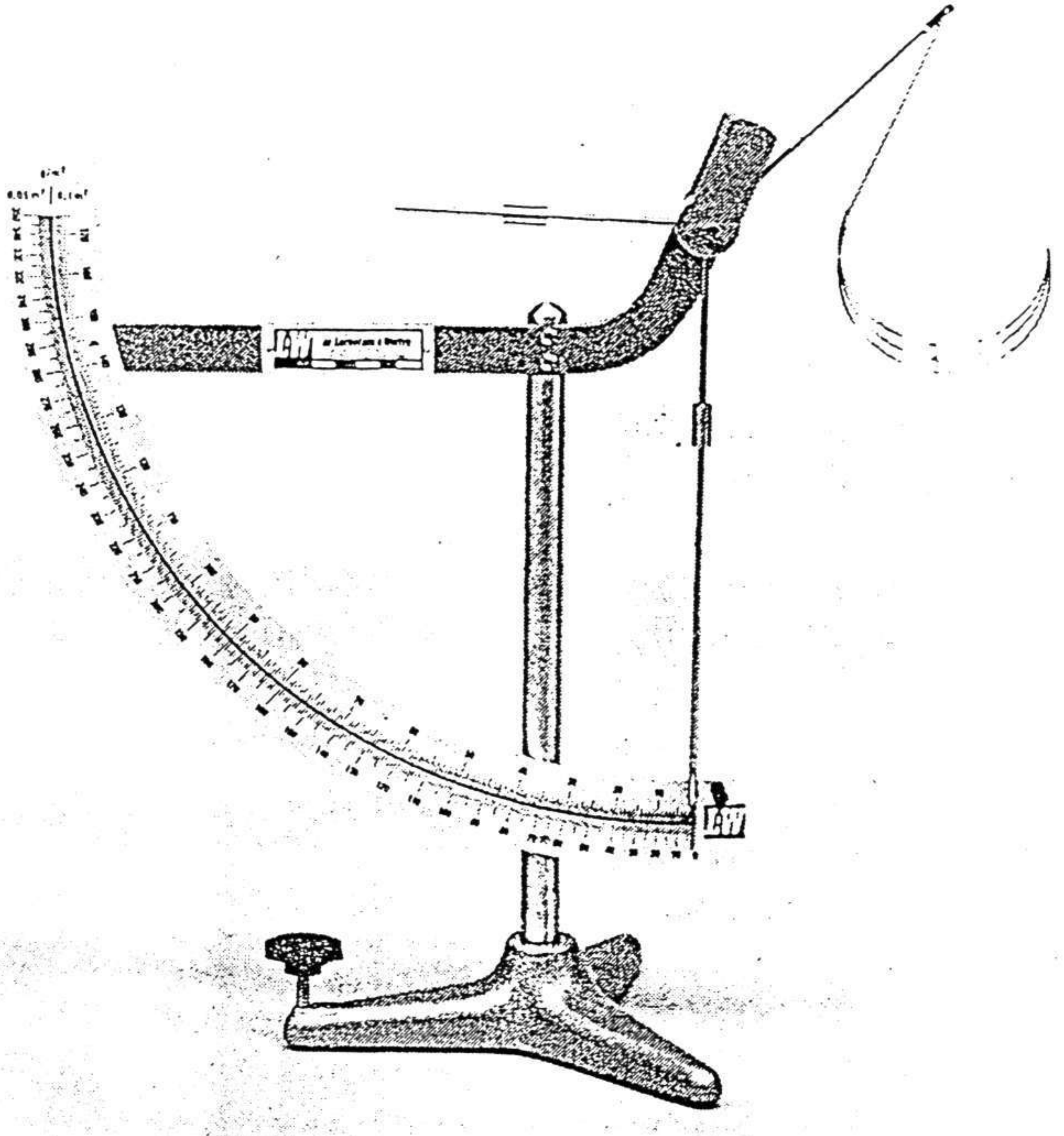

Grammage variations

It is a concern:

- for the runnability of the paper in the press
- because it is cost factor (influences the number of copies printed for a given tonnage.

Possible variations:

- between reels
- in the length of the same reel
- across the width of a reel

- If the actual grammage of a consignment is greater than the specified value, the printer is paying more than he would otherwise expect.
- If the real grammage is below the specified value, there is a cost advantage for the printer but some problems can appear during printing (drop in production performance)

What should be done?

It is not sufficient to specify the nominal grammage. A **tolerance** should also be agreed between the printer and the paper manufacturer.

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General trend: grammage reduction

- In the 70s and before: global standard 52 g/m2
  Since that time, trend to decrease
- In 1974, sudden change from 52 to 48.8 g/m2
  because of energy costs

Advantage of lower grammage:

- more web length per reel for a given diameter
- fewer reels for a given tonnage (less reel stub waste and strippings)
- reduced weight per copy: reduction of postal and freight costs
- thinner paper: higher pagination possible

Parameters for a decision in grammage reduction:

- type of product (esp. use of colour)
- Print quality (press characteristics)
- distribution characteristics (postal prices for ex.)

--> An estimation has to be made individually for each newspaper

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QUESTIONNAIRE

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NEWSPRINT REEL CHARACTERISTICS

List of the paper mills which answered to the questionnaire:

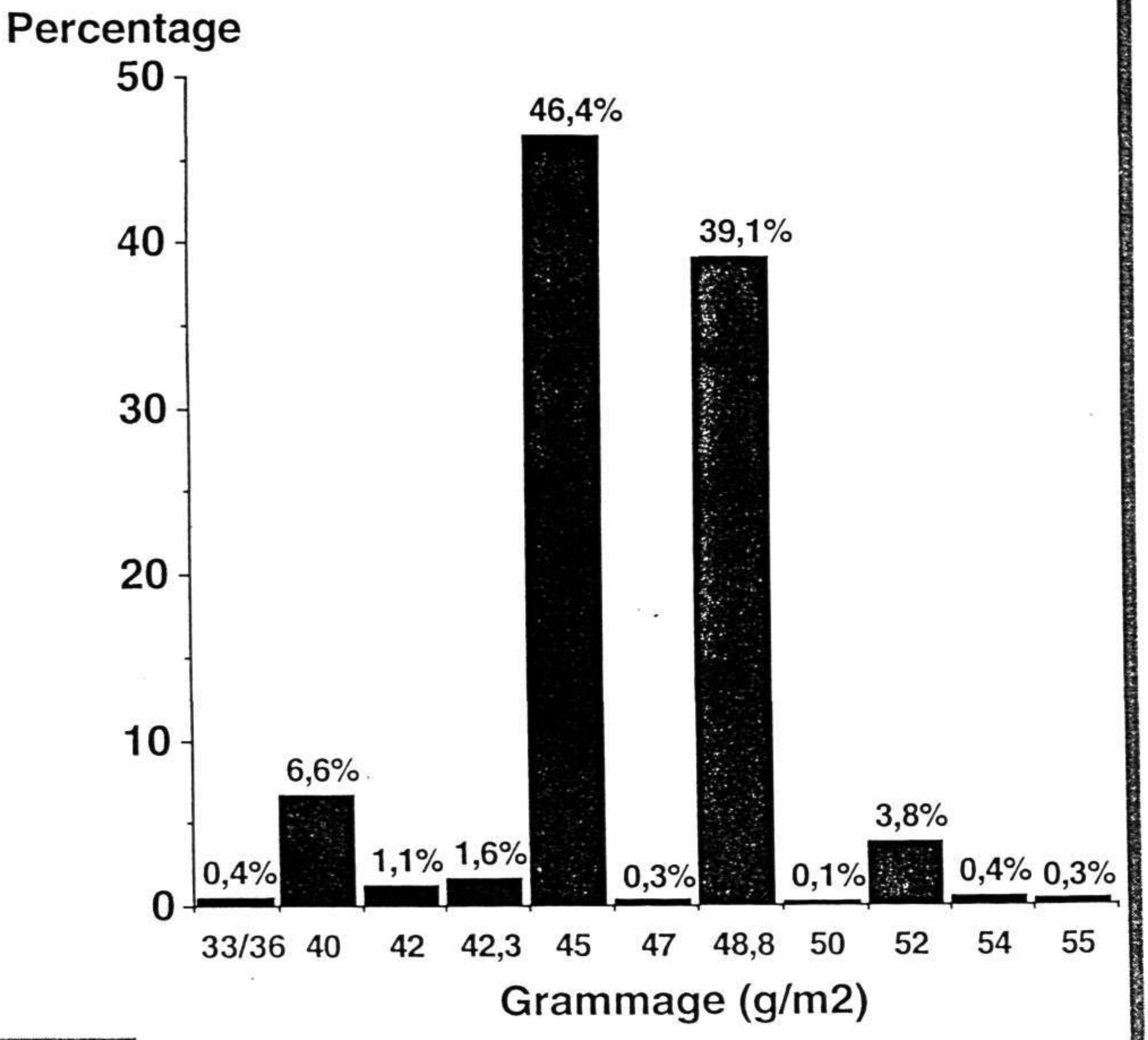
Name of the paper mill	Location	Annual production of newsprint
Stora Kvarnsveden AB	Borlänge (Sweden)	410 000 tonnes
Hylte Bruks AB	Hyltebruk (Sweden)	750 000 tonnes
Feldmuehle Langerbrugge N.V.	Ghent (Belgium)	110 000 tonnes
Shotton Paper	Shotton (United Kingdom)	430 000 tonnes
UPM Kajaani	Kajaani (Finland)	300 000 tonnes
UPM Kaipola	Kaipola (Finland)	320 000 tonnes
Follum Fabrikker	Hønefoss (Norway)	330 000 tonnes
Union Bruk	Skien (Norway)	180 000 tonnes
Nordenfjelske Treforedling	Skogn (Norway)	500 000 tonnes
Holmen Braviken	Norrköping (Sweden)	350 000 tonnes
Holmen Hallstavik	Hallstavik (Sweden)	250 000 tonnes
Bridgewater Newsprint	Cheshire (United Kingdom)	280 000 tonnes
Haindl Schongau	Schongau (Germany)	550 000 tonnes
Lang Papierfabrik	Ettringen (Germany)	255 000 tonnes
Leykam Mürztaler	Bruck/Mur (Austria)	100 000 tonnes
SCA Ortviken AB	Sundsvall (Sweden)	425 000 tonnes
Utzenstorf Papierfabrik	Utzenstorf (Switzerland)	150 000 tonnes
Palm Papierfabrik	Aalen (Germany)	60 000 tonnes
Perlen Papierfabrik	Perlen (Switzerland)	95 000 tonnes

TOTAL: 5 845 000 tonnes

If we estimate that the world production of newsprint is approximately 32 million tonnes, our study represents about **18% of the world production.**

Questionnaire
Newsprint Reel Characteristics

Tonnage produced from the different grammages



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Moisture content

- **Definition:** Reduction in mass of a paper sample when dried expressed as a percentage of the mass of the moist sample.

- **Units:** Dimensionless - Expressed in %

- **Recommendations:**

  Should not be less than 8%.

  For newsprint grades with high filler content, can go down to 7%.

  Should not exceed too high values.

- **Determination:** Samples in the "as taken" condition (with no preconditioning). Determination with ISO 287.

-----

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Moisture content

- Moisture affects the mechanical and printing properties of the paper

- After the paper machine, moisture between 5 and 10%

- On the press rapid and variable stresses:
  - Low moisture content:
    --> the paper loses elasticity
    --> more web breaks
    --> more static electricity
    --> web control more difficult
    --> build-up of fibres on blankets.

Good moisture control: better paper compressibility, better print result

- The paper should be in equilibrium with the ambiant air.

- Moisture problems are more important in offset than in letterpress

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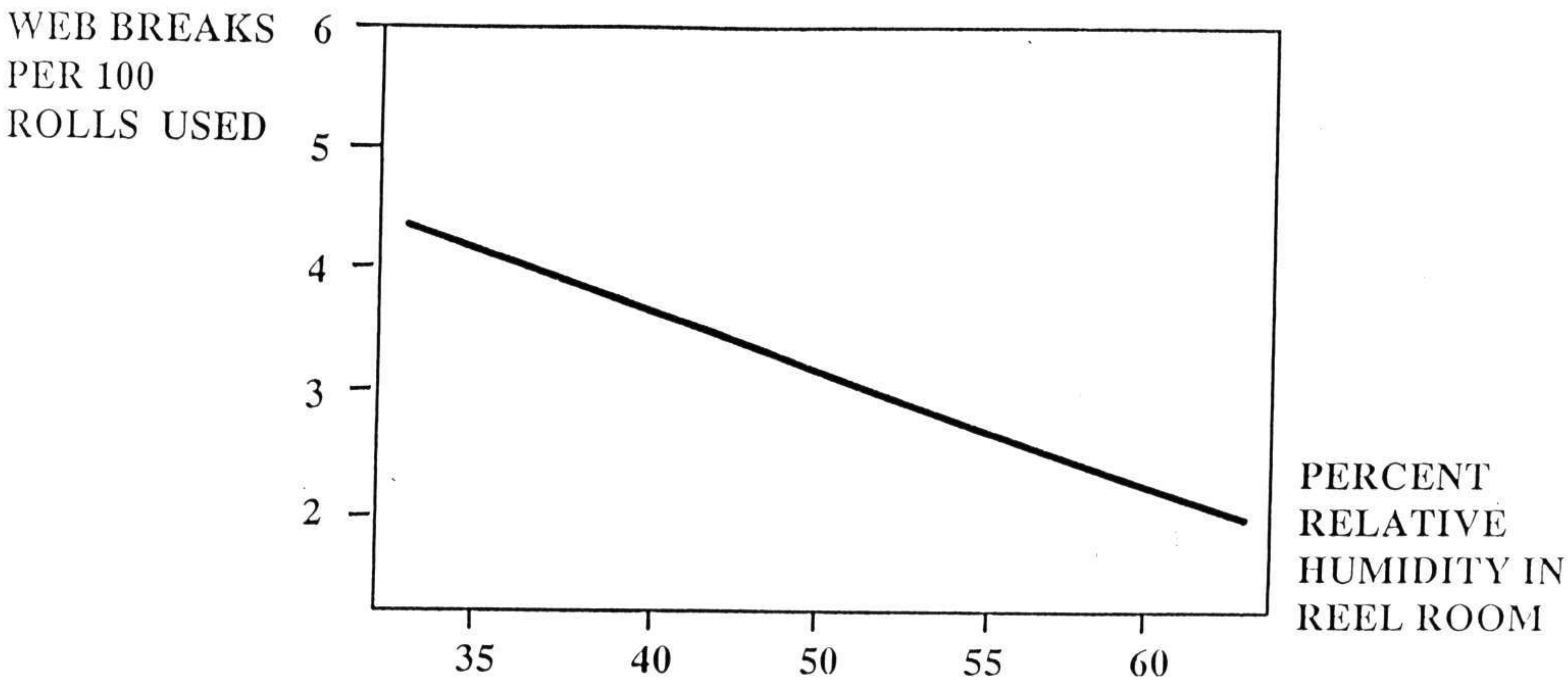
As Humidity Increases Web Breaks Drop



Moisture content increases due to damping application on the press

- Blanket-to-blanket configuration (1 colour): +1% of water on each side of the paper.

- Four-colour printing: +4%

- 4-over-4 colour printing: up to +8%

--> This has an influence on press performance (particularly in the folder)

--> Register problems

IFRA Research Project: Register stability of newsprint under damping application in collaboration with TFL (Swedish Newsprint Research Centre) in Stockholm.
Aim of the project: study the expansion of newsprint under damping application and propose solutions to counteract.

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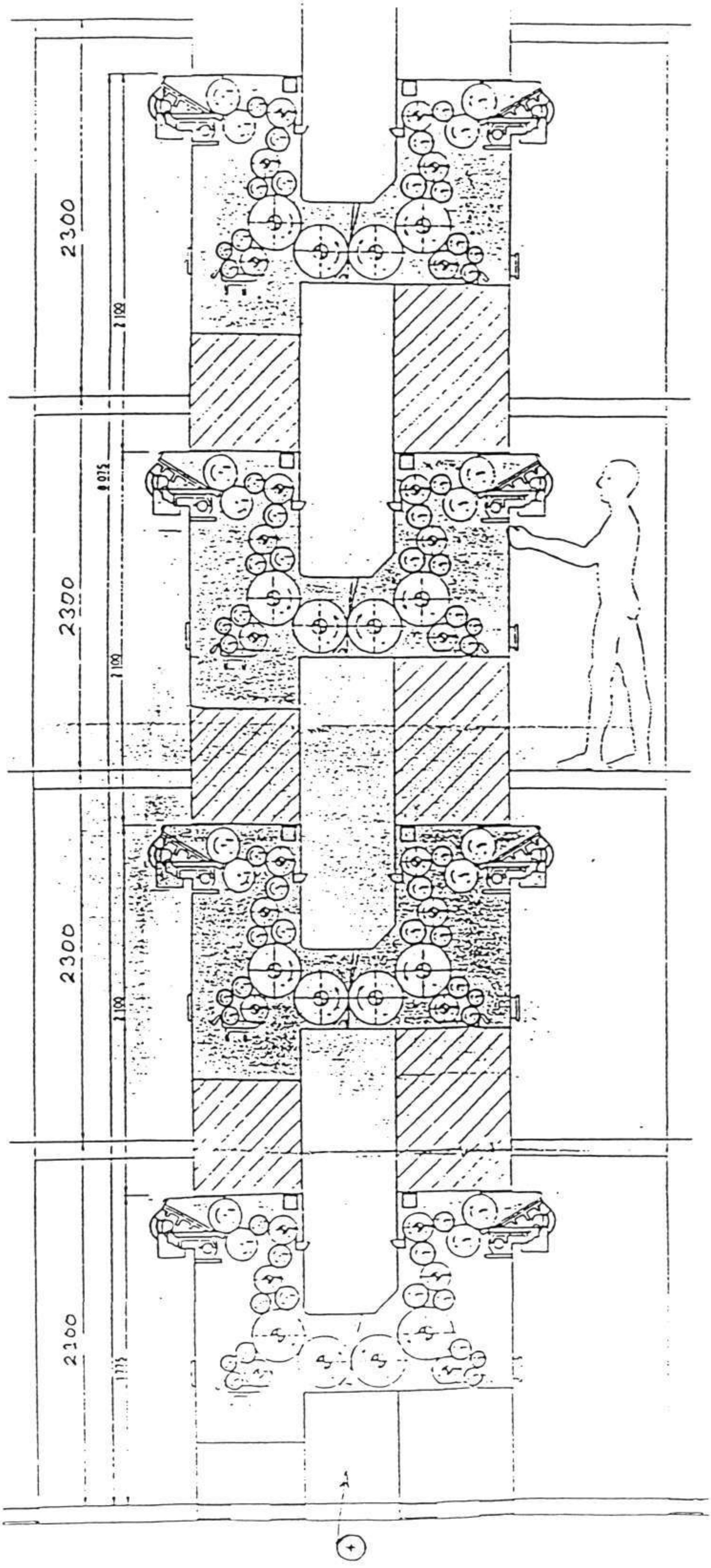
APPENDIX 1

Press H



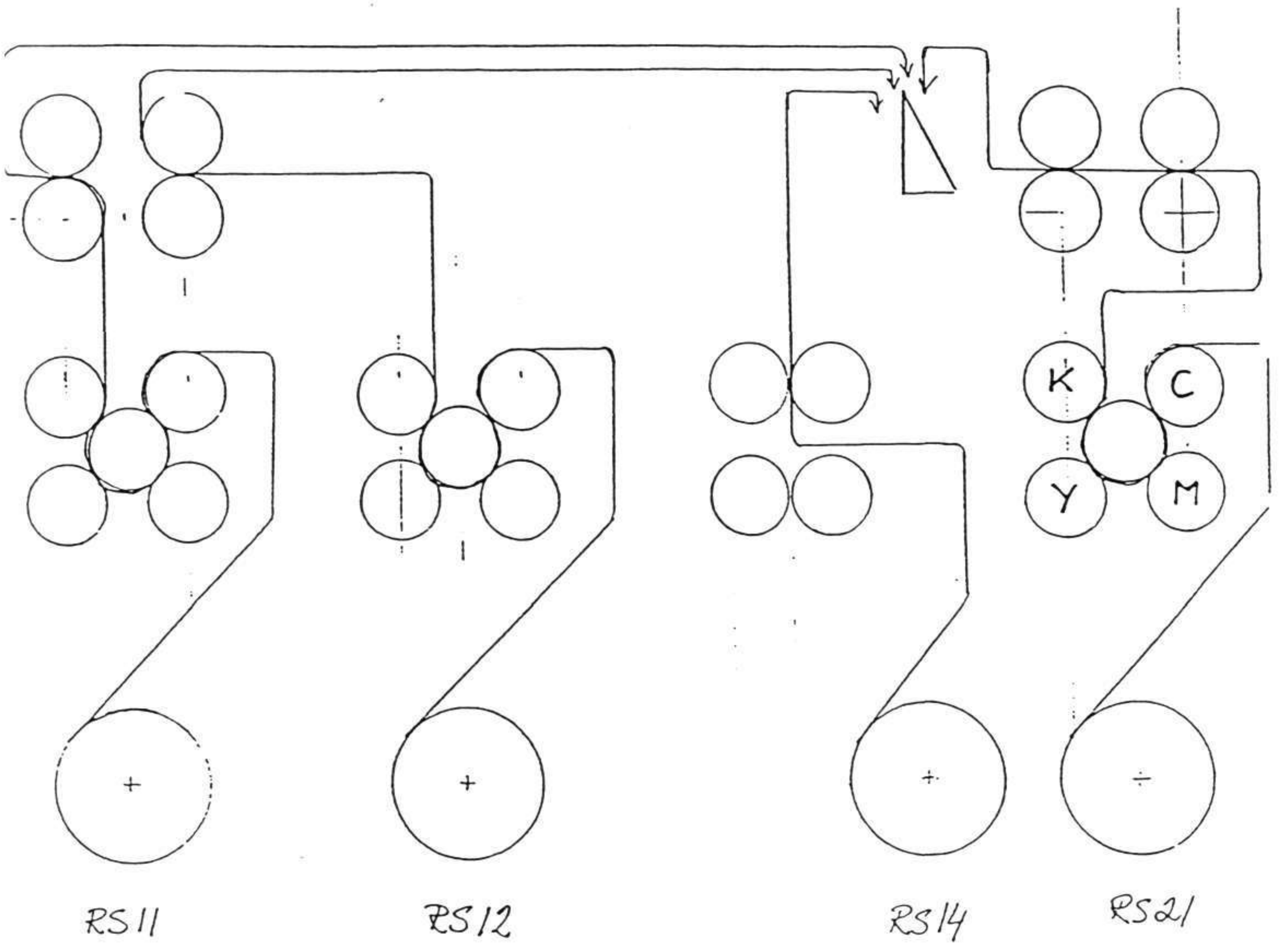
Black

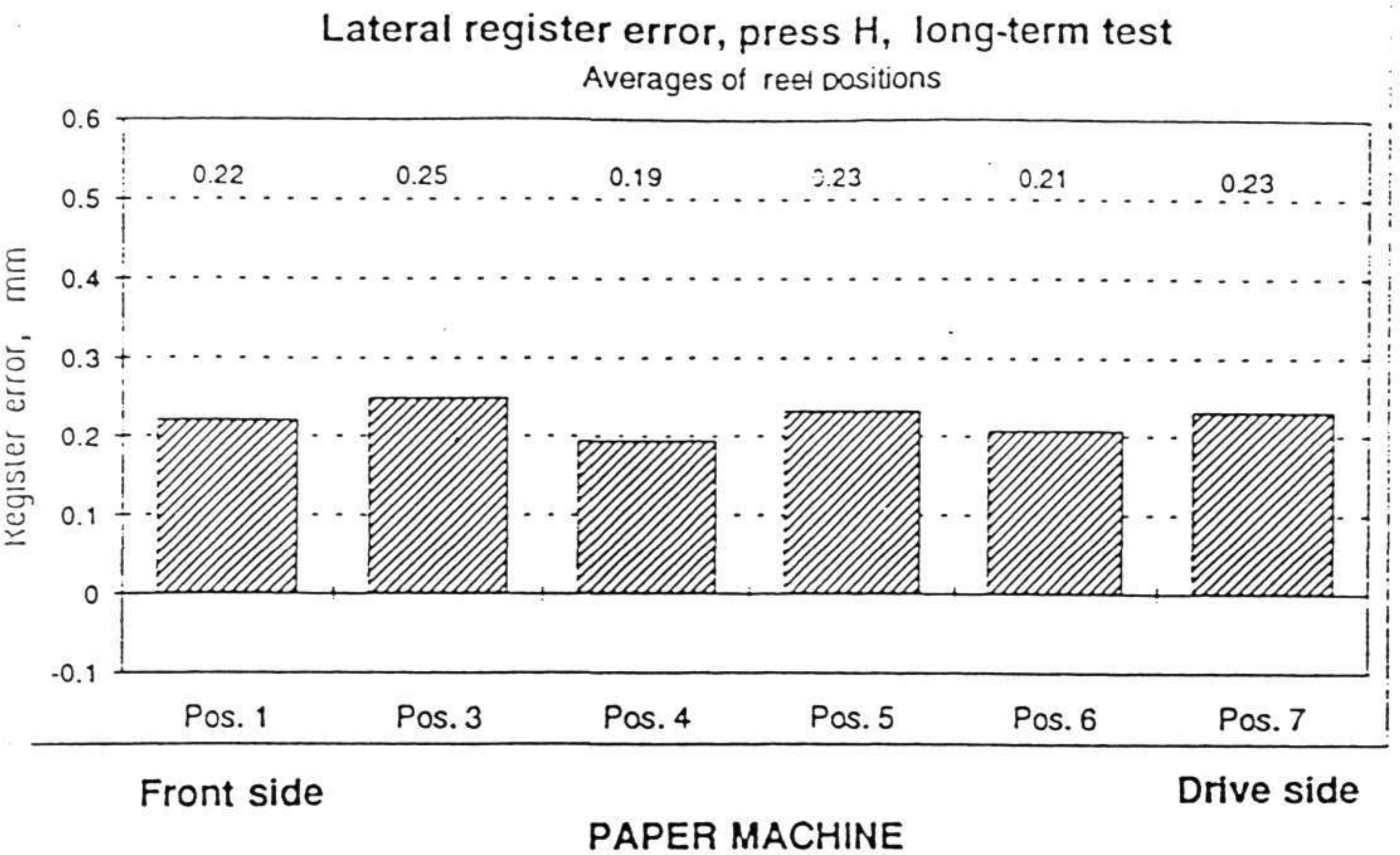
Yellow

Magenta

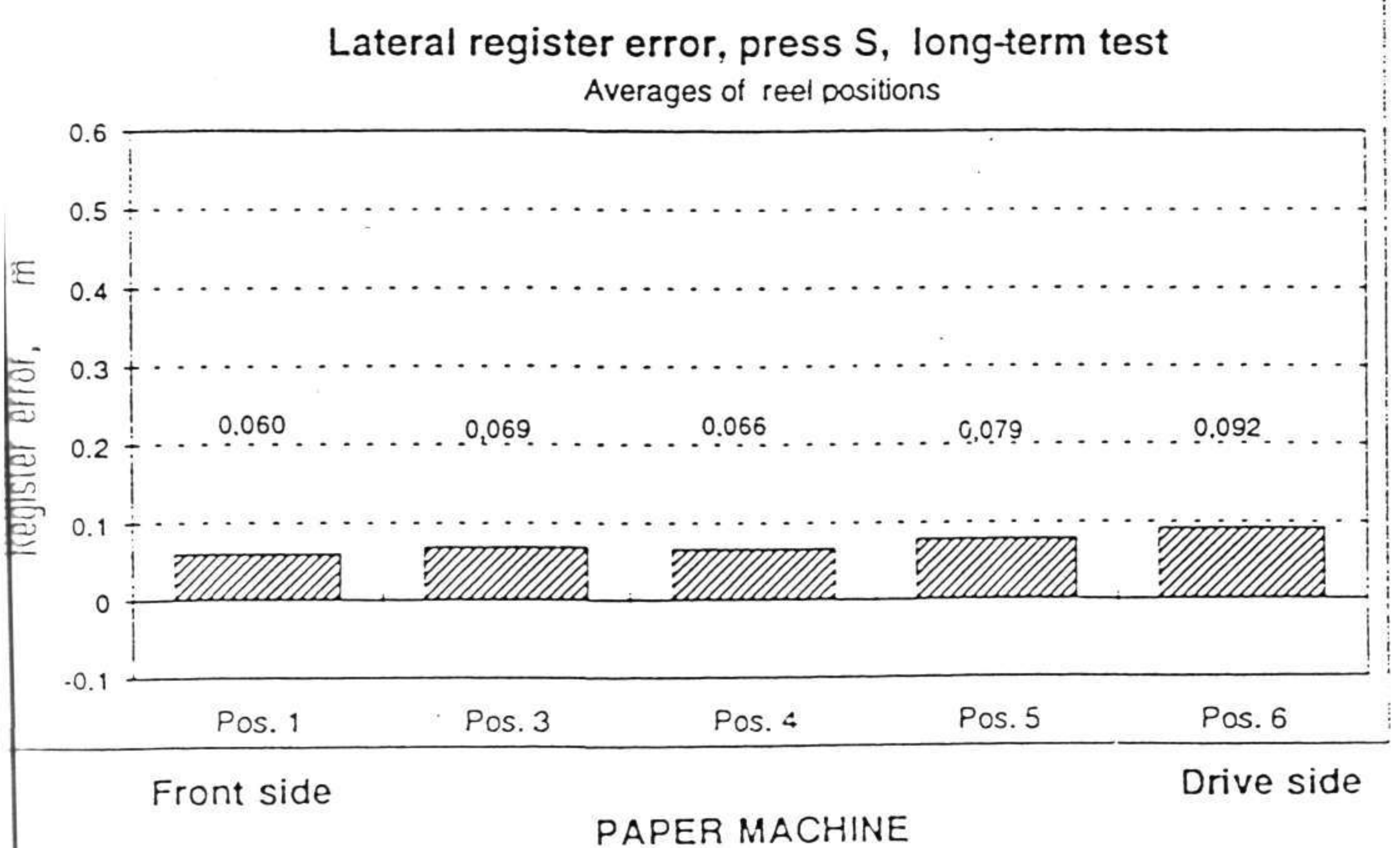
Cyan

Press S





igure 3. *The average lateral register error in press H was 0.224 mn*



igure 4. *The average lateral register error in press S was 0.072 mi*

Ash content

- **Definition:** Content of mineral (inorganic) matter in the finished sheet.

- **Determination:**
  Determined by incineration of the paper.
  Expressed as a fraction of the original (moisture-free) mass of the paper

- **Units:** Dimensionless quantity
  Expressed in %

- **Recommendation:**
  - Generally: 0-12%
  - Some users specify an upper limit (especially when long plate runs are necessary because of abrasion)

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Different types of fillers

Filler type	Chemical nature	Density (g/cm^3)	Brightness	Ignition loss (% at 900°C)
Kaolin	Aluminium silicate	2.4—2.7	70—90	12—14
Talc	Magnesium silicate	2.6—2.9	70—88	4—6
Calcium Carbonate	$CaCO^3$	2.7—3.0	93—98	38—42

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Ash content

- The **ash** can come from:
  - residue of additives (chemicals) added during papermaking
  - mineral matter in the pulp (comes from the wood)
  - filler material added by the papermaker
  - filler or coating pigments from waste paper (recycled newsprint)

--> **Advantage** of loading the paper with fillers: improves brightness, opacity and smoothness.
For newsprint, mostly kaolin (china clay)

--> **Disadvantage**: reduction of the mechanical properties.

If ash content < 2%: no loading, virgin-fibre newsprint
If ash content > 8-10%: recycled newsprint

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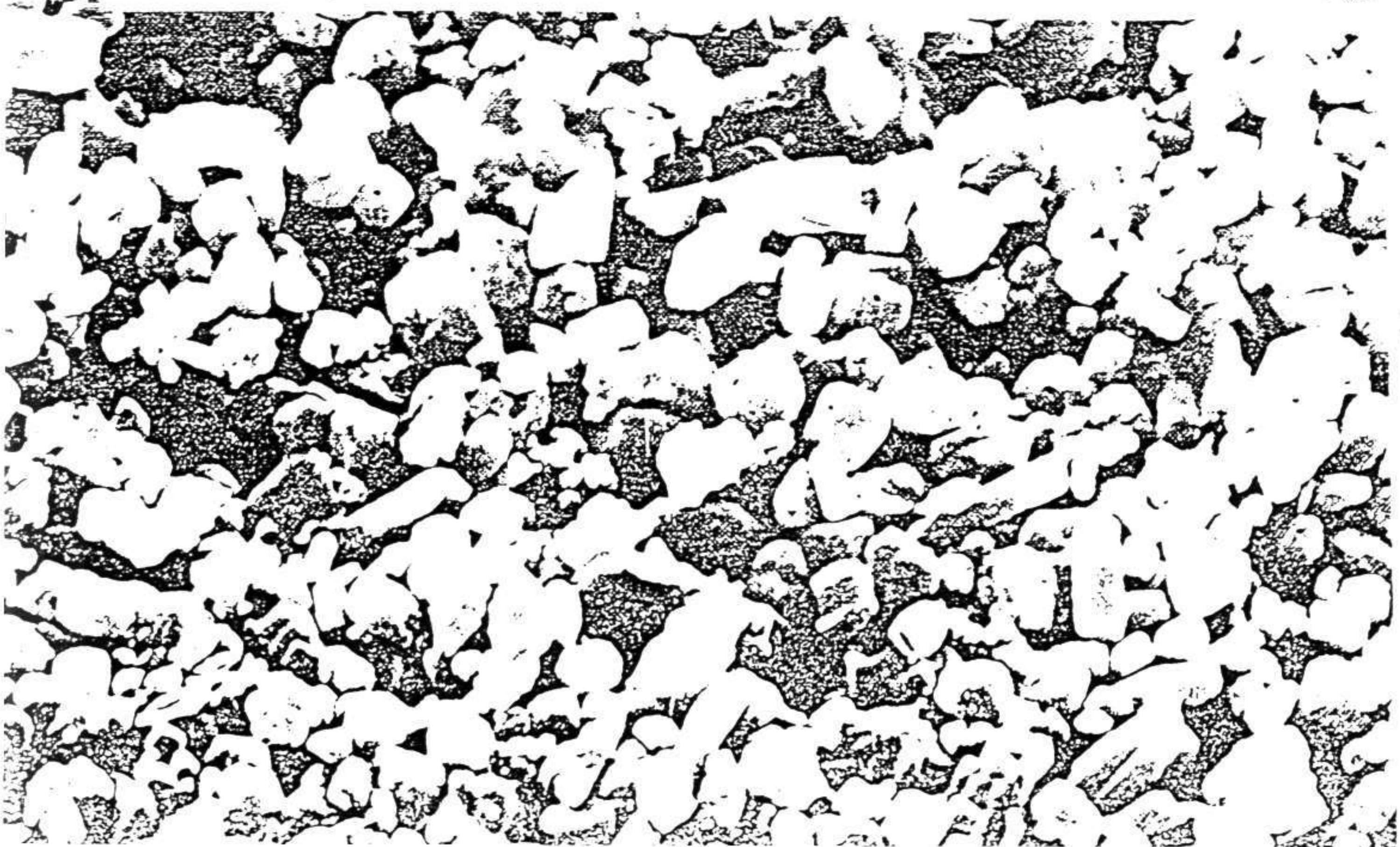
Kaolin (aluminium silicate)

Microscope views of fillers

Calcium Carbonate

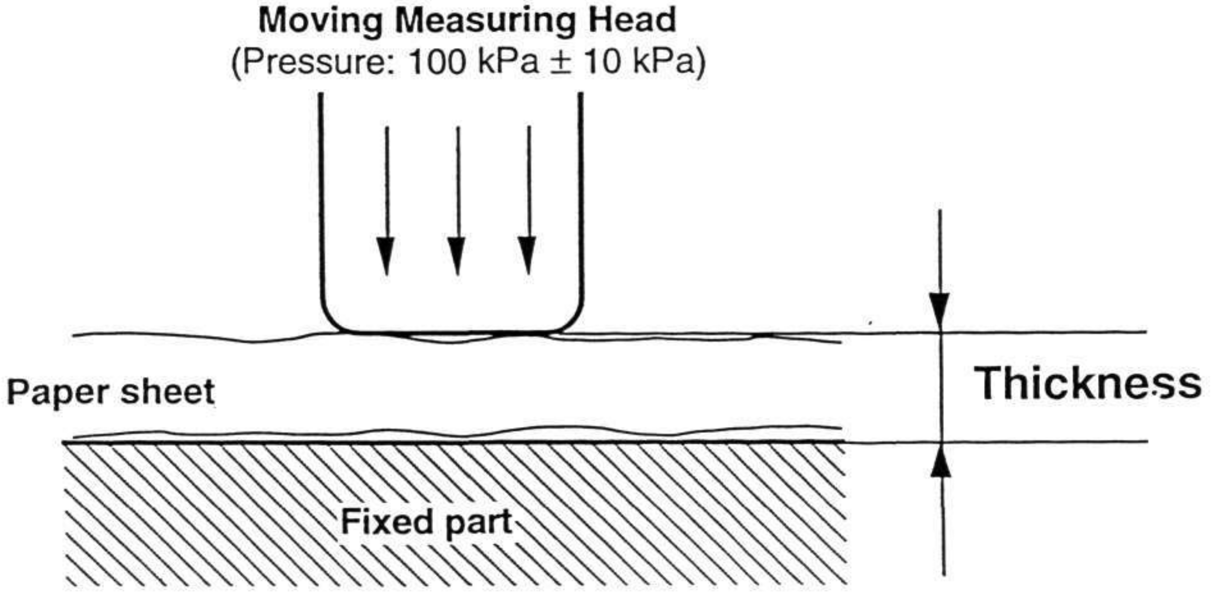


SHEET THICKNESS

- **Definition:** Thickness of a single sheet
The term "caliper" is also used.

- **Units:** Micrometer (µm)
1 µm = 0.000001 m = 1/1000 mm

- **Determination:** According to ISO 438



- **Recommendation:** No special recommendation (depends on manufacturing conditions and furnish). The variations should be kept to a minimum.

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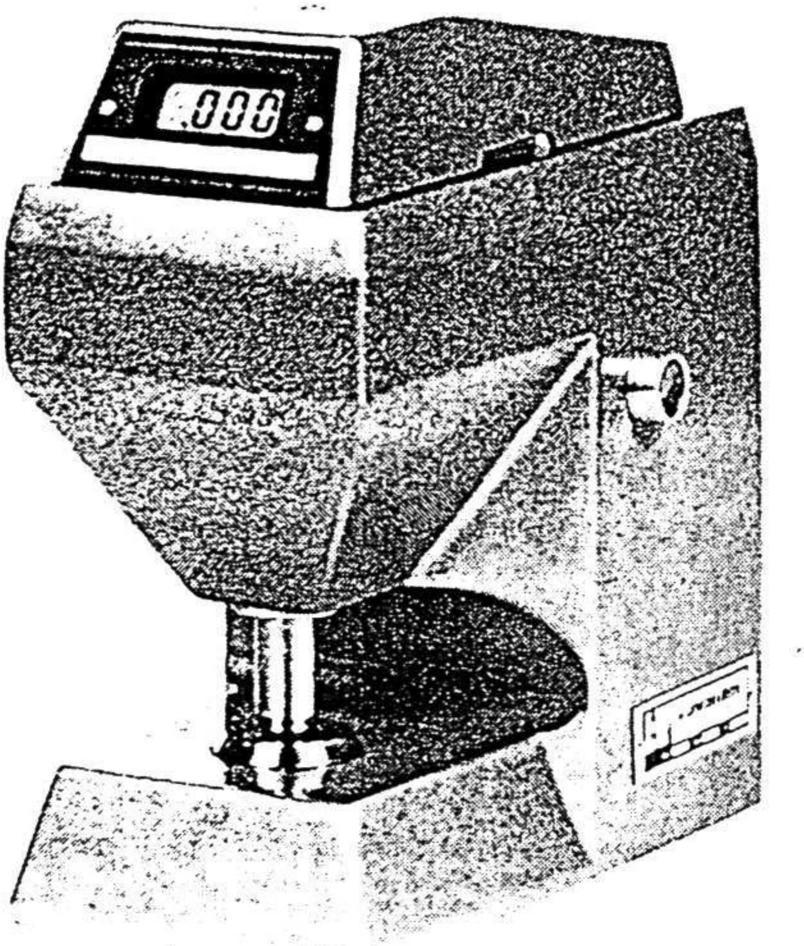
For rapid and accurate measurement of the thickness of paper, board and plastic.



Type D2 with digital display.
Easy-to-read digits, 12.7 mm (1/2") high.

SHEET DENSITY

- **Definition:** Specific mass of the paper sheet, i.e. the ratio between the mass of a sheet and its volume.
As it includes voids (open and closed), it is an "apparent" density
The **"bulk"** is the reciprocal of the density.

- **Units:** SI units: kg/m3
Preferred units: g/cm3

- **Determination:**
Density (g/cm3) = G/T
where: G: Grammage (g/m2)
T: Thickness (µm)

- **Recommendation:**
No general recommendation

- **Remark:** Average density of a consignment = average of the densities of the samples (and not average grammage divided by average thickness)

-----

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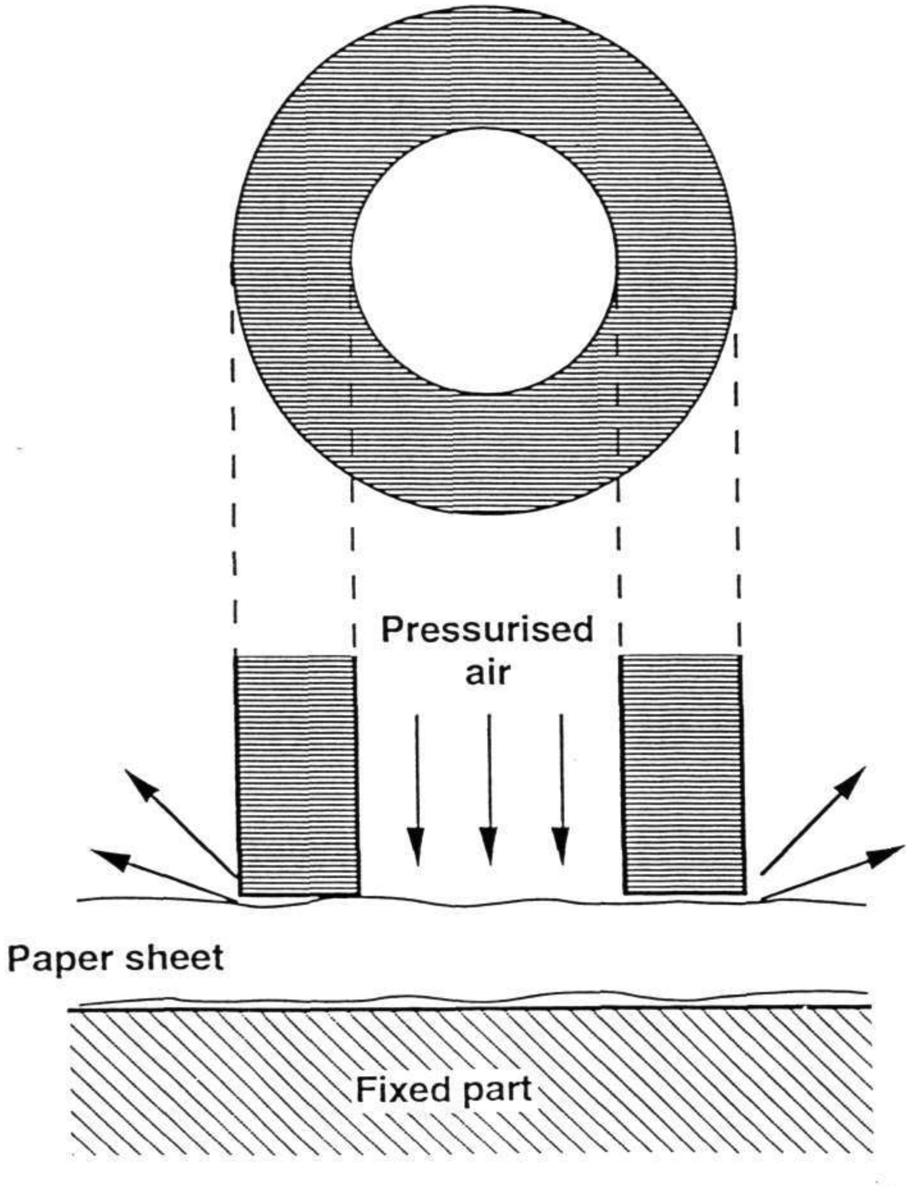
SURFACE ROUGHNESS - SMOOTHNESS

- **Definition:** Physical irregularity of the surface of the paper sheet
Measured as the volume of air which, at a specified pressure, passes per time unit between the surface of the paper and a flat ring



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SURFACE ROUGHNESS - SMOOTHNESS

Depends on humidity.
For the measurement, samples should be taken from reel stubs immediately after they are removed from the press.

Smoothness is one of the most important properties affecting printability.

Better smoothness:
- better printability
- but ink penetration into the paper decreases (set-off & rub-off)

Rougher paper:
- more ink consumption
- more print-through

--> There is a compromise to be found

On single-wire paper machines, more "two-sidedness" of the paper --> differences in smoothness between the two sides of the paper.

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SURFACE ROUGHNESS - SMOOTHNESS

- Units:

- Bendtsen: Bendtsen roughness number (ml of air escaping per minute)
- Bekk: seconds.
- Parker Print Surf (PPS): µm

- Recommendation: For newsprint:

Bendsten 98 kPa: Between 75 and 175 ml/min

Bekk: between 45 and 75 s

(75s corresponds to high-filler content grades or super-calendered grades)

PPS (10Mpa): between 3.0 and 4.6 µm

- Determination:

ISO 2494 (Bendtsen)

PPS widely used

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COMPRESSIBILITY

- **Definition:** Extent to which the sheet thickness is compressed when a pressure is applied to the surface of the sheet.

- **Units:** Dimensionless quantity
  Expressed in %

- **Recommendation:** No

- **Determination:** No standard

In general:
- A sheet with high smoothness will have low compressibility
- Mechanical pulp is more compressible than chemical pulp (for a given smoothness).

-----

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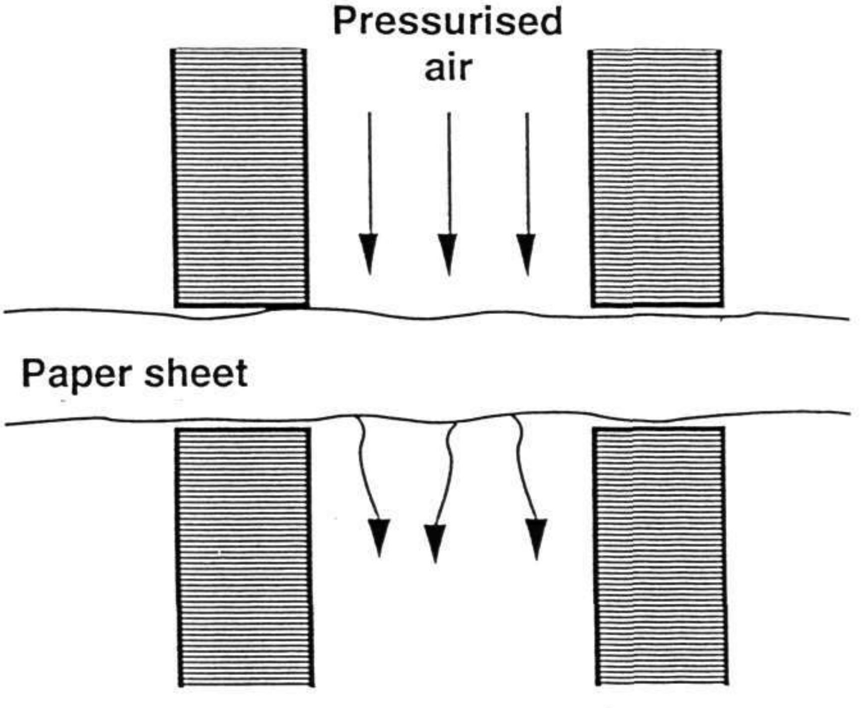
POROSITY - AIR PERMEABILITY

- **Definition:** Combined volume of pores, capillaries and other voids between the fibres

Not directly measurable. Air permeability: flow rate of air through a specified surface area of the paper with a constant and specified pressure difference between the two sides of the sheet.



- **Units:** m/Pa.s. Preferred: µm/Pa.s

$$S(m/Pa.s) = \frac{u(m3/s)}{A(m2)\ .\ \Delta P(Pa)}$$

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POROSITY - AIR PERMEABILITY

- **Recommendation:** No

- **Determination:** Bendtsen, Bekk or PPS devices fitted with special accessories.

In general:

- Poor correlation with print result
- However, variations should be kept to a minimum during manufacture.

-----

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OIL ABSORPTION / WATER ABSORPTION

- **Definition:** Amount of liquid absorbed by a piece of paper of a given surface within a given time.

- **Units:** SI units: kg/m2
  Preferred units: g/m3

- **Determination:**
  Cobb-Unger testing instrument

- **Recommendation:**
  No general recommendation

- **Remark:**
  Oil absorption simulates the paper behaviour with **ink**
  Water absorption simulates **damping solution**
  But:
  - measurement not easy
  - correlation with printing difficult

-----

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ISO-BRIGHTNESS

- **Definition:** Diffuse blue reflectance factor. Ability of the newsprint to reflect diffuse light in the blue region of the visible light spectrum.

Ratio of light reflected by a pad of newsprint (thick enough to be totally opaque) to the light reflected by a perfect reflecting diffuser, under the same conditions, both reflected lights being measured at an effective wavelength of 457nm.

- **Units:** Dimensionless. Expressed in %

- **Recommendation:**

ISO-brightness gives a good indication on the brightness of the furnish from which the newsprint was manufactured. But, it is not a good description of the shade of the paper. No general recommendation can be given.

- **Determination:**

ISO 2470

ISO 2469 (for the calibration of the reference instrument)

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How to improve brightness?

- **Purification:** physical or chemical removal of non-cellulosic materials which can cause light absorption.

- **Bleaching:** decolouration by oxidation.

- **Fillers:** high-brightness fillers can be used. The role of filler is to improve opacity.

- **Fluorescent dyes:** counteract the yellowing of lignin by boosting blue reflectance.

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NEWSPRINT SHADE *(Y-value / Dominant wavelength / Excitation purity)*

- **Definition:** Shade is an attribute of the visual perception of colour

It is characterised by three parameters:

- Y-value: lightness of the sheet. Ratio of C-light reflected by a pad of newsprint to the light reflected by a perfect diffuser (2° observation angle).
- Dominant wavelength: wavelength of the monochromatic component of the colour mixture which matches the evaluated shade of newsprint.
- Excitation purity: Proportion of the monochromatic component which matches the evaluated shade of newsprint.

- Units:

- Both Y-value and excitation purity are dimensionless and expressed in %
- Dominant wavelength is expressed in nanometers (nm)

1 nm = 10^{-9} m = 0.000000001 m

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NEWSPRINT SHADE

- Recommendation:

IFRA recommends **NewsShade 88**:

Y-value = 64.5 %
Dominant wavelength = 576.5 nm
Excitation purity = 7.5%

Or

L* = 84.2
a* = -0.4
b* = 6.9

(Measured with the Elrepho 2000 instrument, Light source C, Observation 2°)

- Determination: ISO 2469

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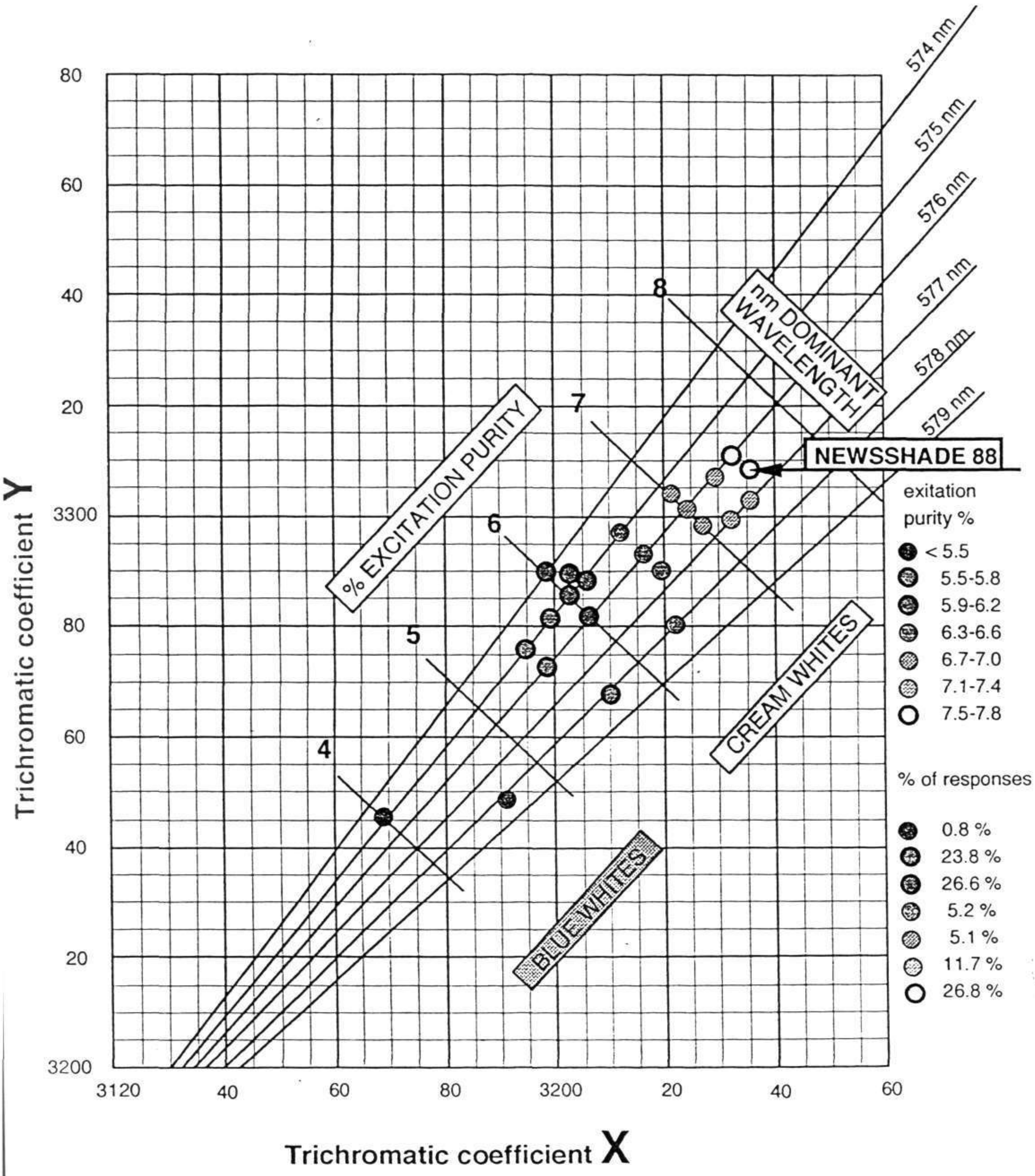
SHADE CHART


574 nm
575 nm
576 nm
577 nm
578 nm
579 nm
nm DOMINANT WAVELENGTH
% EXCITATION PURITY
NEWSSHADE 88
CREAM WHITES
BLUE WHITES
4
5
6
7
8
exitation purity %
< 5.5
5.5-5.8
5.9-6.2
6.3-6.6
6.7-7.0
7.1-7.4
7.5-7.8
% of responses
0.8 %
23.8 %
26.6 %
5.2 %
5.1 %
11.7 %
26.8 %
Trichromatic coefficient Y
80
60
40
20
3300
80
60
40
20
3200
3120
40
60
80
3200
20
40
60
Trichromatic coefficient X

OPACITY

- Definition: Ability of the sheet not to transmit light. Ratio between the luminous reflectance factor of a single sheet with a black background and the Y-value, both measured through a green filter with an effective wavelength of 557 nm.

- Units: Dimensionless. Expressed in %

- Recommendation:

For the printer, opacity should be at its highest possible level (no show-through)
With normal conditions (Y-value=64.5%):

Grammage (g/m2)	Opacity (%)
48.8	93.5
45	92
40	90

- Determination:

ISO 2471
ISO 2469 (for the calibration of the reference instrument)

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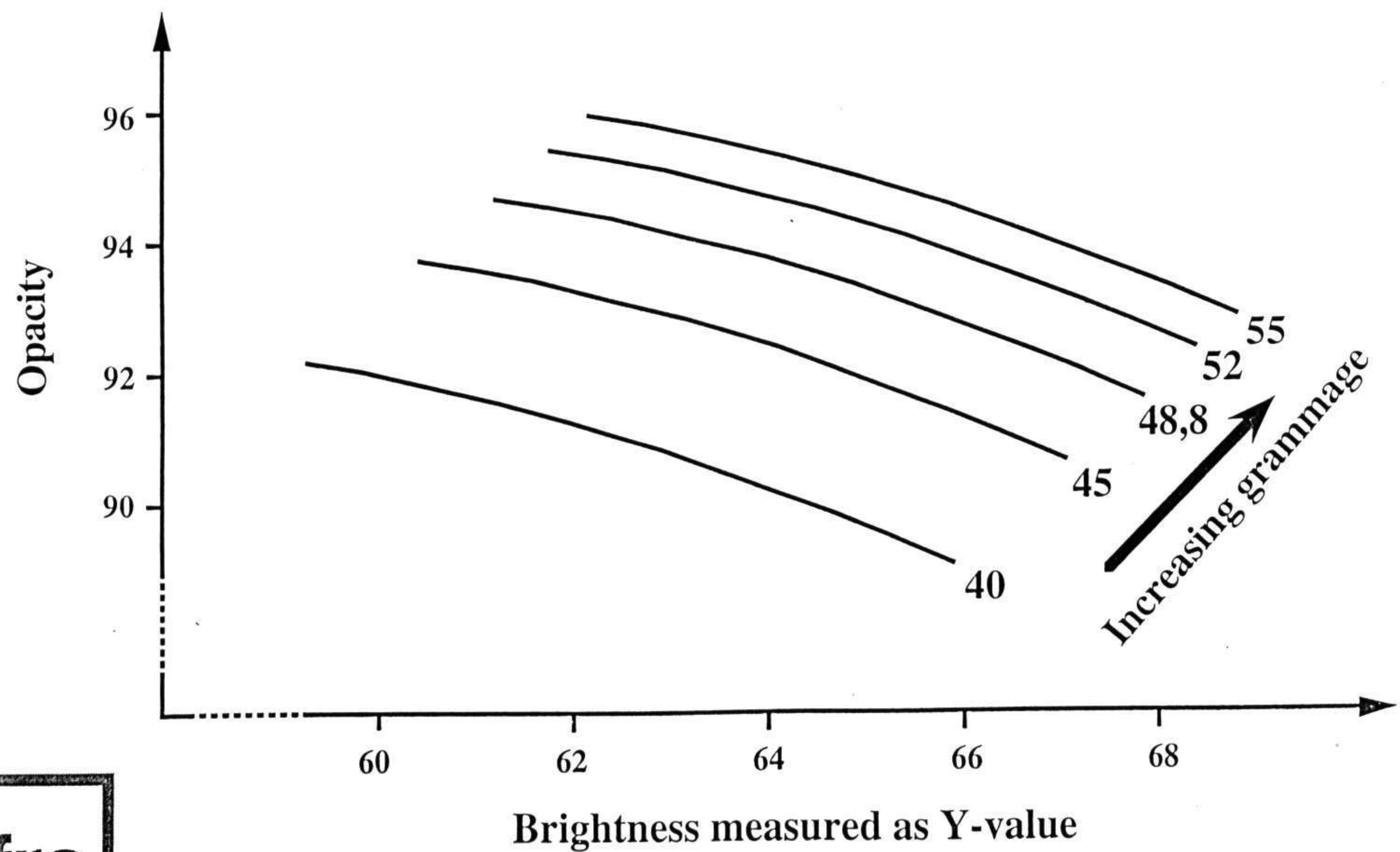
Opacity
96
94
92
90
60
62
64
66
68
Brightness measured as Y-value
40
45
48,8
52
55
Increasing grammage

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MECHANICAL CHARACTERISTICS

- Important for the **runnability** at the press. But: does not correlate perfectly.

- Mechanical strength of a sheet:
  depends on:
    - strength and orientation of the individual fibres
    - strength of the bonds between fibres

  which depends on:
    - furnish of the newsprint
    - processing conditions of the pulp
    - manufacturing conditions at the paper machine

There is a **compromise**: a better paper needs a better furnish and better manufacturing conditions

--> That costs money !!

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TENSILE STRENGTH & ELONGATION

- Definition:

Tensile strength: maximum tensile force per unit width that a test piece of paper can stand before breaking

Elongation: ratio of the increase in length of a test piece submitted to the max. tensile force to its length before the test.

- Units: Tensile strength: kN/m
Elongation: %

- Recommendation: No

- Determination: ISO 1924

-----

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M
ne

ubber fabrics, composites, or 0KM. It's a compact, rugged,

oice of SI, metric or Imperial bers and recorders available

Recirculating Ball Screws

drive system uses two recirculating screws for smooth crosshead ion and optimum testing accuracy. y're protected by expandable ws-type screw covers.

C shead Limit Switches

easily positioned collars can be set re needed to prevent over-travel in er direction.

Fully Guided Crosshead

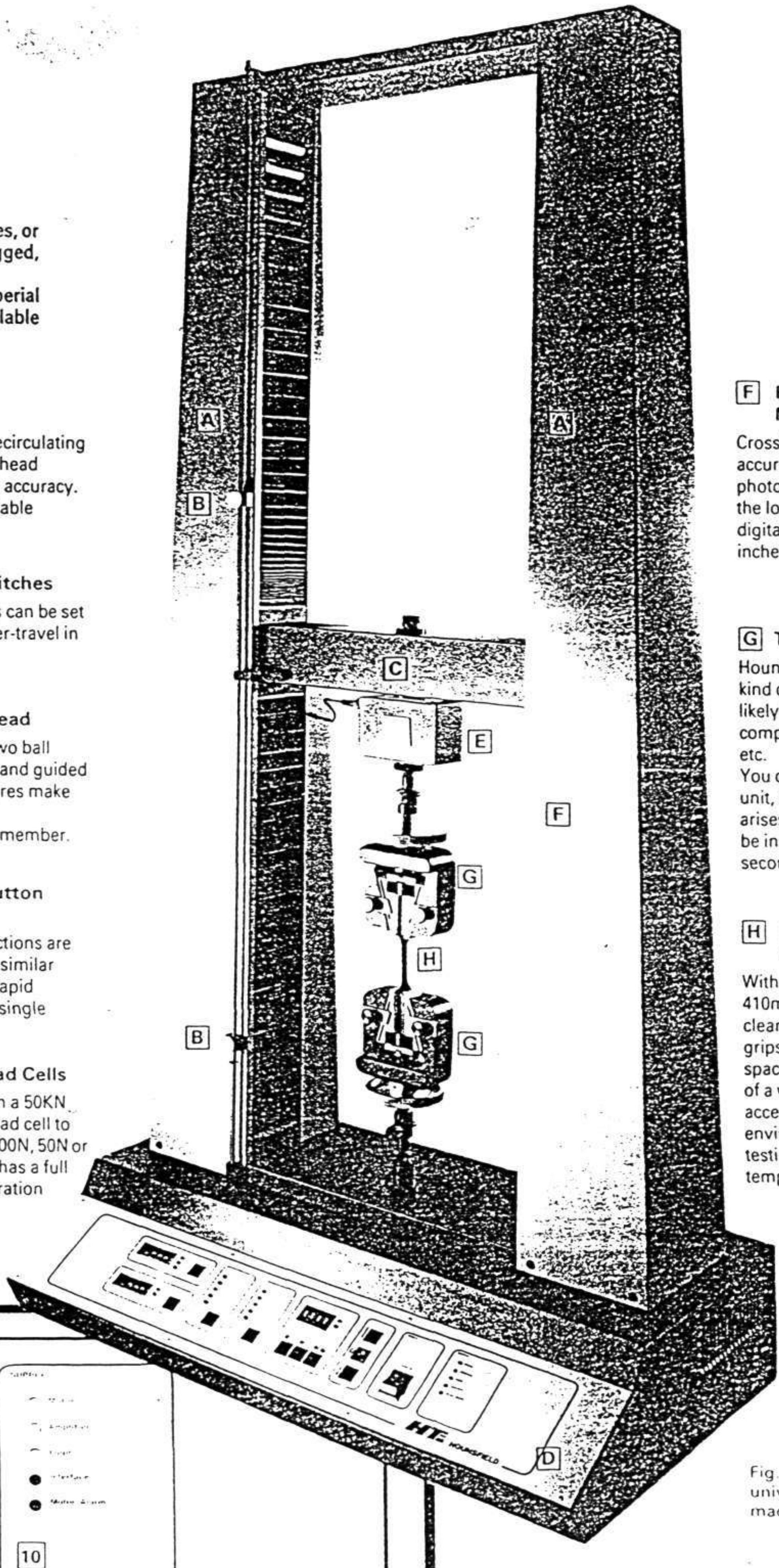
crosshead is driven by two ball ws and is also stabilized and guided wo columns. These features make moveable crosshead an eptionally stable loading member.

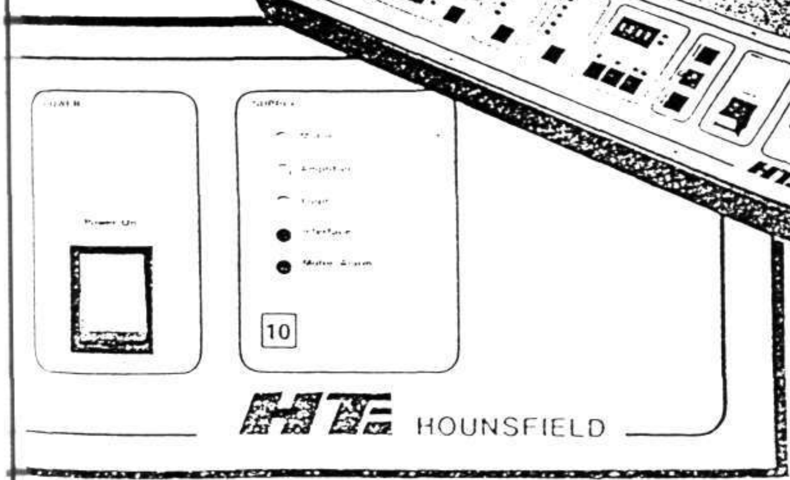
Easy-to-Use Pushbutton Controls

trols for all machine functions are in easy reach. Once set, similar cimens can be tested in rapid uence just by pressing a single n.

erchangeable Load Cells

can change quickly from a 50KN 0kg,10000lb) capacity load cell to with a capacity of 5KN, 500N, 50N or Each pre-calibrated cell has a full ge strain gauge configuration is temperature pensated.





F Precise Extension Measurement

Crosshead motion is accurately measured by a photo-optical encoder within the load frame and shown digitally in millimetres or inches.

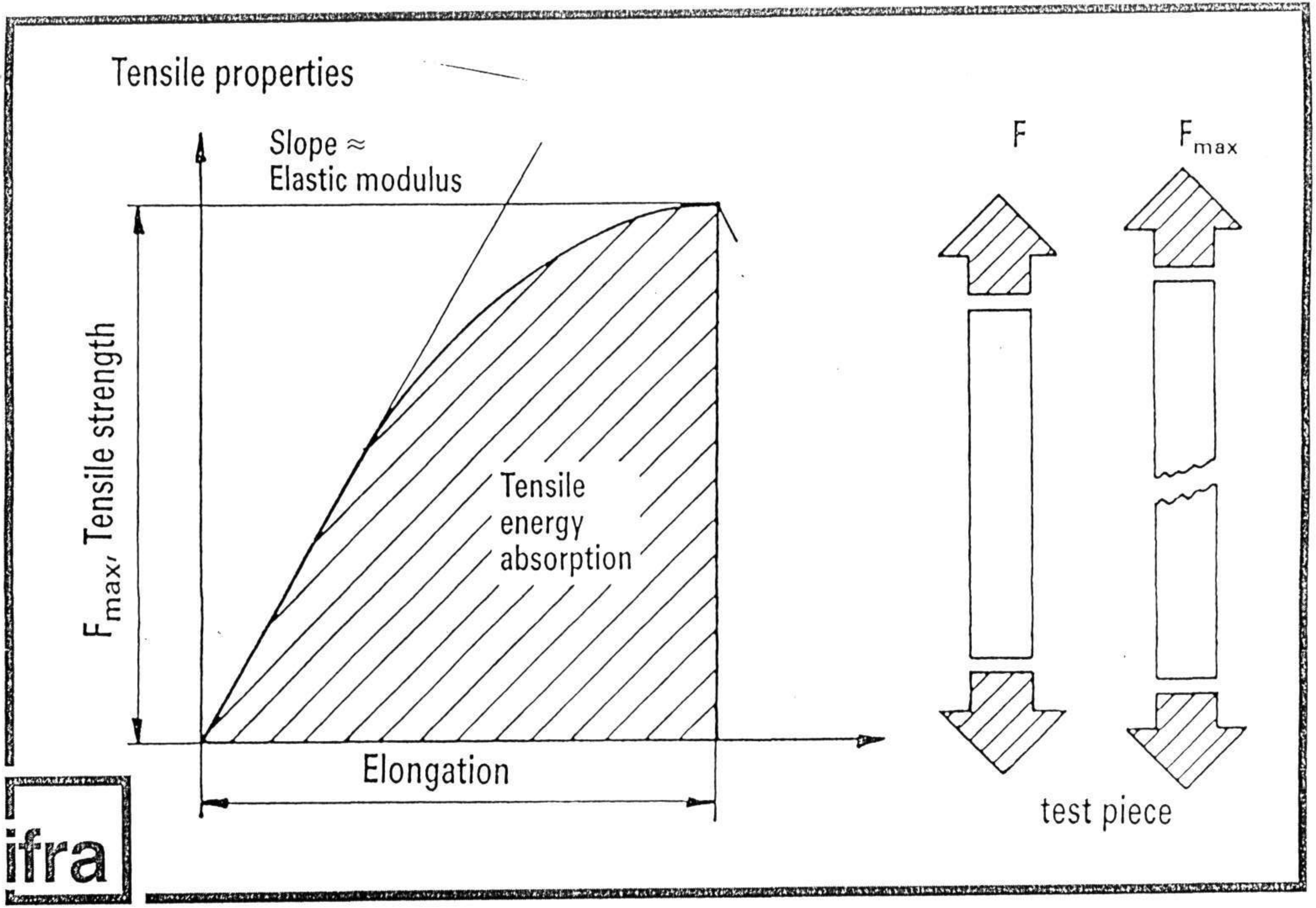
G Testing Tools

Hounsfield offers almost any kind of testing tool you're likely to need for tension, compression flexure, shear, etc.
You can order them with the unit, or add them as the need arises. Most grips or tools can be installed in a matter of seconds.

H Large Testing Clearance

With a horizontal clearance of 410mm and a vertical clearance of 1100mm less grips the H50KM has ample space for accommodating any of a wide range of tools or accessories, including environmental chambers for testing at non-ambient temperatures.

Fig. 3 Rugged bench-top universal testing machine


Tensile properties
Slope ≈
Elastic modulus
F_{max}, Tensile strength
Tensile
energy
absorption
Elongation
F
F_{max}
test piece
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TEARING RESISTANCE

- **Definition:** Mean force required to continue the tearing on an initial cut in a single sheet of paper.
Two different values:
    - machine direction (MD)
    - cross direction (CD)

- **Units:** SI: mN
Tear index in Nm2/kg

- **Recommendation:** No

- **Determination:**
ISO 1974 (Elmendorf device)
Other possibilities (Ex: Brecht-Imset)

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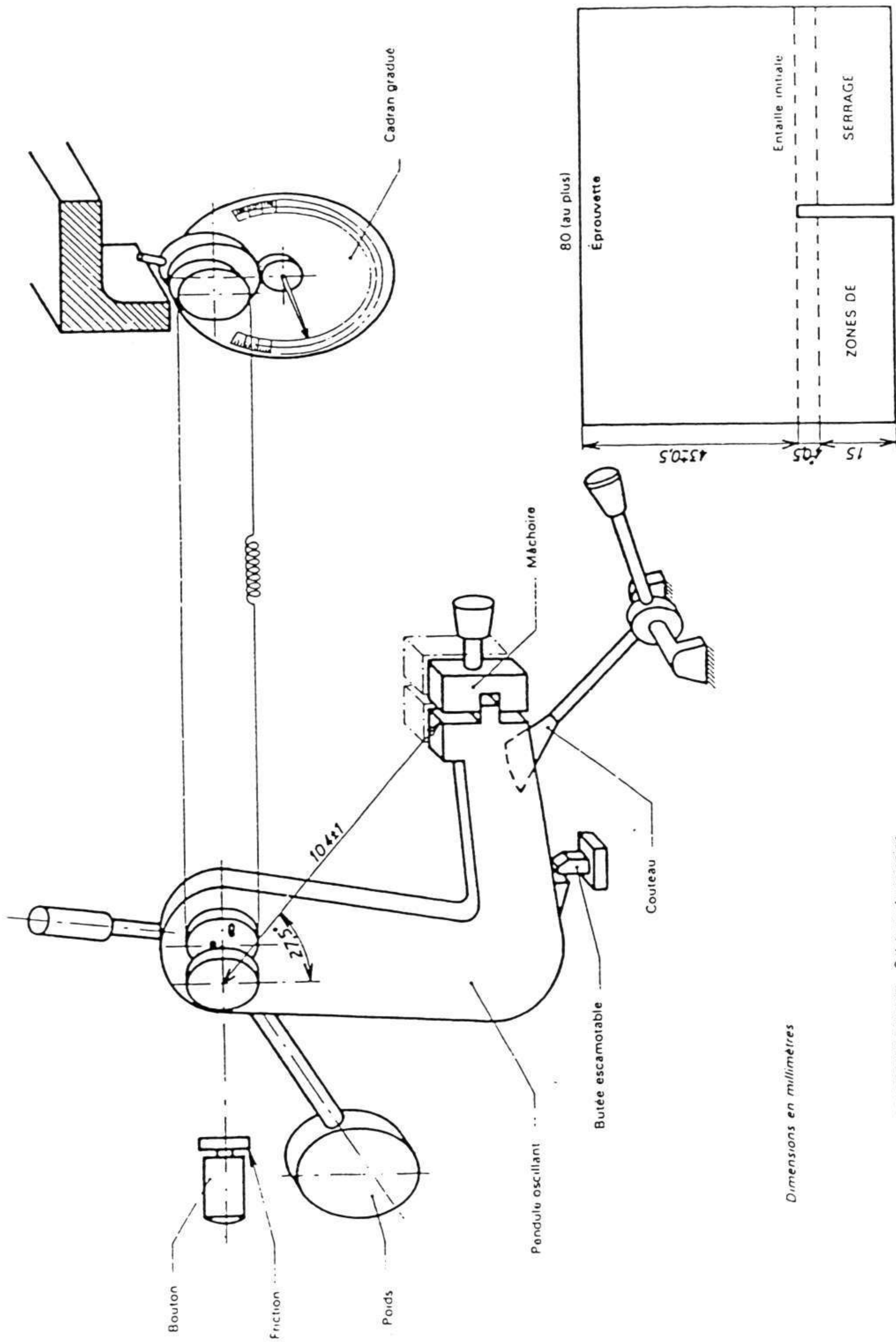

Dimensions en millimètres

APPAREIL DE DECHIREMENT : Schéma de principe

Newsprint Properties and their Correlation to Print Quality

Print Uniformity (evenness, sharpness, etc.)

Basic characteristics	
Moisture content	○
Ash content	○
Structural properties	
Sheet formation (incl. pin holes)	●●
Sheet defects (holes, shives, etc.)	○
Sheet density/Sheet thickness	○
Roughness/Smoothness	●
Hardness	●
Oil absorption (permeability)	○
Mechanical characteristics	
Surface strength	●

○ Low influence

● Medium influence

●● High influence

Ink setting (smearing, set-off)

Basic characteristics	
Moisture content	○
Ash content	●
Structural properties	
Sheet formation (incl. pin holes)	○
Sheet defects (holes, shives, etc.)	○
Sheet density/Sheet thickness	●
Roughness/Smoothness	●●
Oil absorption (permeability)	●●

○ Low influence

● Medium influence

●● High influence

Relative print density / ink requirement

Property	Influence
Basic characteristics	
Ash content	○
Structural properties	
Sheet density/Sheet thickness	○
Roughness/Smoothness	●●
Hardness	○
Oil absorption (permeability)	●
Optical characteristics	
Shade	○
Y-Value (brightness)	●●
Opacity	○
Light scattering coefficient	○

○ Low influence

● Medium influence

●● High influence

Print-through

Strike through and Show-through

Print-through	Strike-through	Show-through
Basic characteristics		
Grammage	●	●
Ash content	●	●
Structural properties		
Sheet formation (incl. pin holes)	○	○
Sheet density/Sheet thickness		○
Oil absorption (permeability)	●	
Optical characteristics		
Shade		○
Y-value ("brightness")		●●
Opacity		●●
Light scattering coefficient		●●

○ Low influence

● Medium influence

●● High influence

Linting/Plugging
(fibre and filler deposit)

Basic characteristics	
Moisture content	●
Ash content	○
Mechanical characteristics	
Surface strength	●●
Web and reel characterictics	
Slitter defects	●

○ Low influence

● Medium influence

●● High influence

Web breaks

Basic characteristics	
Moisture content	●●
Structural properties	
Sheet defects (holes, shives, etc.)	●●
Water absorption	○
Mechanical characteristics	
Tearing resistance	○
Tensile strength	○
Elongation	●
Web and reel characteristics	
Winding defects	●●
Slitter defects	●
Splicing defects	●●
Cross direction profile (non-uniformity)	●
Core defects	○
Wrapping defects (glue on end)	●●
Transport and storage defects	●

○ Low influence

● Medium influence

●● High influence

NEWSPRINT QUALITY CONTROL

WHY QUALITY CONTROL?

1. Heterogeneous nature of paper
2. Methods used to measure properties
3. Variations in quality requirements from user to user

Four major areas:

- Establishing **purchasing specifications** to be met by newsprint suppliers
- Realistic **control** of consignments
- As **day-to-day service support**:
  - use certain consignments for certain jobs
  - reject some consignments
- **Troubleshooting and complaints** are only possible with a well-established quality control programme.

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NEWSPRINT QUALITY CONTROL

ISO 9000

- Series of standards developed by the "International Organisation for standardisation"

- Define the requirements for an in-plant quality assurance.

- With ISO 9000, it is not the product quality that is defined but the capacity of a business to produce quality.

- Five part standards: ISO 9000-9001-9002-9003-9004

- See IFRA Special Report 6.11: The ISO 9000 certificate, encouragement and guarantee for a continually effective quality control system

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NEWSPRINT QUALITY CONTROL

HOW TO ESTABLISH A QUALITY CONTROL PROGRAMME?

Each printing plant is an individual case: different printed products, different printing processes, different paper consumptions and different quality levels

Each printer must start from scratch and search for relations between newsprint properties and press performance / print quality.

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NEWSPRINT QUALITY CONTROL

ESTABLISHING PURCHASING SPECIFICATIONS

3 following stages:

- an educational period:

- best tools for the printers: his senses (**eyes** to check the shade of paper, colour matches, print densities / **fingers** to test the smoothness of the paper, bulk of the sheet, hardness of a reel, rub-off tendency of a print).
- From that, correlate to measuring methods

- qualitative calibration period:

- influence of paper quality on print quality and press performance
- have to be taken into account: effect of inks, plates, blankets, press and print conditions
- Start systematic evaluation of newsprint deliveries by a representative sampling procedure

- quantitative evaluation of quality requirements:

For each property: min., max. and optimum values

- variations between deliveries and within a delivery
- the tolerances can be used as purchasing specifications

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NEWSPRINT SPECIFICATION
(Newcastle Chronicle & Journal)

Test	Value
Grammage: (BS 3432 : 1985)	Nominal ± 0.5%
Thickness: (BS3983 : 1989)	75 microns ±5
Moisture content (BS 3433 1986)	8.0 ± 0.5%
Machine direction Tensile strength (BS 4415 : 1985)	30N/15mm minimum
Machine direction Stretch %	1.1± 0.1
Stretch ratio	
Cross direction/machine direction	2.5 maximum
Set-off index (Pira method: instantaneous)*	35 maximum
Print Penetration (IGT method)* W24	17-20
Tear strength (BS 4468 : 1990)	
Cross direction	250 min
Brightness % (BS 4432 Pt 2 : 1980)	59 minimum
Opacity % (BS 4432 Pt 3 : 1980)	
for 48.8 gsm :	94
for 45 gsm :	93
Colour measurements	
Y value %	63.5 minimum
Dominant Wavelength	576 ± 2
Excitation purity %	5.5 ± 0.5
Bendsten Porosity ml/min (BS 4420: 1990)	250 ±100
Printsurf roughness (μm) (BS 6563: 1985)	
at 1000 kPa	3-4
at 2000 kPa	2.5-3.5
Reel hardness profile (Schmidt Hammer Test	40 ± 5 Less than 10

Note : Set-off index: see test method appended

CONTROL OF DELIVERIES

Purchasing specifications have been established.

It is better to have:

- low quality but consistent

than

- high quality with a lot of variations

Important: variations in cross direction should be checked.

First step: check the usable amount of paper. If damages during transport: contact suppliers, transporters or insurance companies.

Second step: check average grammage of each consignment. The tolerances should be agreed with the supplier.

DAY-TO-DAY SERVICE SUPPORT

When receiving a new consignment: some reels should be chosen **randomly** and run on the press. Afterwards, paper samples could be taken on the reel stubs for evaluation.

Three possible options:

1. good delivery, uniform in quality and consistent with previous ones
   --> should be no problem on the press

2. delivery within the specified tolerances but with variations with previous deliveries
   --> pressroom should be notified

3. delivery outside specifications
   --> potential cause of quality or production troubles. (see troubleshooting and complaints)

DAY-TO-DAY SERVICE SUPPORT

However, if a delivery is considered as good, some problems can still arise:
- local sheet defects possible
- a laboratory evaluation does not simulate completely press performance.

If there are defective reels (out-of-roundness, uneven hardness)

--> use them for a "quiet" working day (lower pagination or black&white works)

TROUBLESHOOTING & COMPLAINTS

Newsprint properties are relative:
--> you need a reference point.

A printer who does not check his deliveries is helpless when problems arise

To be efficient a quality control programme should involve a **continuous measurement of the properties** of newsprint deliveries with a **well-thought statistical procedure**.

Then, productivity and quality problems can be related to paper properties.

When a problem arises, there can be a dialogue between the printer and the papermaker.

WHICH PROPERTIES TO TEST?

Different printers have different points of view. They may want to:

- reach a certain print quality level.
- reach a certain runnability level in the press.
- reach a certain runnability level for the copies in the mailroom
- only check the delivered newsprint quantities.

The following properties are evaluated according to their influence on:

- printability
- linting
- runnability
- economic aspects --> **most important: all described problems will have an influence.**

Different rates can be given at the end: no influence, low, medium and high influence. (see table).

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WHICH PROPERTIES TO TEST?

PRINTABILITY ASPECTS

Print uniformity: (solid & halftone areas)
- uneven distribution of fibres
- low compressibility
- linting (too low surface strength)

Relative print density:
- depends on the Y-value. The more luminous, the smaller the ink requirement to achieve a certain print density.
- paper too rough

Ink setting:
- paper too smooth: less ink absorption, set-off.

Print-through= Show-thr. + Strike-thr.
Show-through: opacity
Strike through: penetration (pigments particles normally stay at the surface)

Colour rendering: influenced by shade variations.

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WHICH PROPERTIES TO TEST?

LINTING

Definition: loosening of fibre particles in the printing nip during ink splitting

blankets --> plates --> ink rollers --> ink fountains

When build-up on blankets affect print quality: press has to be stopped for wash-up.

Some methods to test surface strength.

Plugging: term used in letterpress - mix of fibres and ink in the voids between the dots in highlight areas.

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WHICH PROPERTIES TO TEST?

RUNNABILITY ASPECTS

Web breaks: paper-related causes:

- too low moisture content
- sheet defects
- winding or splicing defects at the mill
- wrapping defects (Ex: glue on reel ends)

Web stability:

(MD and CD register accuracy)

- variations in elasticity modulus: different reactions to web tension
- variations due to damping application
- variations in winding tension
- core defects

Web tension control:

- cross direction non-uniformity.

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DIRECT RELATIONSHIP BETWEEN NEWSPRINT CHARACTERISTICS AND END-USE REQUIREMENTS (TABLE 1)

no mark — no influence
○ low influence
● medium influence
●● high influence

	Printability aspects							Runnability aspects				Economic aspects			
	Print uniformity (evenness, sharpness etc.)	Relative print density/ink requirement	Ink setting (smearing, set-off)	Print-through: Strike through	Print-through: Show-through	Colour rendering	Linting/Plugging (fibre & filler deposit)	Web breaks	Web stability (register), wandering web	Web tension control (creasing)	Production efficiency	Extra newsprint costs regarding waste and overgrammage	Other material costs (ink, damp solution, plate)	Processing in mailroom	Distribution costs
Basic characteristics (*see also Section 1.1*)															
Grammage				●	●										●●
Deviation from specified grammage												○			○
Moisture content	○		○				●	●●	●	●	●	○			
Ash content	○	○	●	●	●		○						○		
Structural characteristics (see also Section 1.2)															
Sheet formation (incl. pin holes)	●●		○	○	○								○		
Sheet defects (holes, shives, etc)	○		○					●●			●●	○			
Sheet density/sheet thickness	○	○	●		○									○	
Roughness/smoothness	●	●●	●●			○			●				○	●	
Hardness	●	○													
Oil absorption (permeability)	○	●	●●	●		○							○	○	
Water absorption						○		○	○	●	○		○		
Optical characteristics (see also Section 1.3)															
Shade		○			○	●									
Y-value ("brightness")		●●			●●	●									
Opacity		○			●●										
Light scattering coefficient		○			●●	○									
Mechanical characteristics (see also Section 1.4)															
Tearing resistance								○			○	○			
Tensile strength								○			○	○			
Elongation								●			○	○			
Elasticity modulus (extensional stiffness)									●●	●	○	○			
Dimensional hygro-instability									●●	○	○	○		○	
Surface strength	●						●●				●	○	○		
Sheet stiffness									●		○	○		●	
Web and reel characteristics (see also Chapter 3 and Section 7.1)															
Winding defects								●●	●●	○	●●	●			
Slitter defects							●	●			●	○			
Splicing defects								●●		○	●●	○			
Cross direction profile (non-uniformity)								●	●●	●●	●●	●			
Core defects								○	●●	●	●	●			
Wrapping defects (glue on end)								●●			●●	○			
Transport and storage defects								●	●	●	●	●			
Length per reel											●	○			
Reel dimension tolerances [1]											○	○			

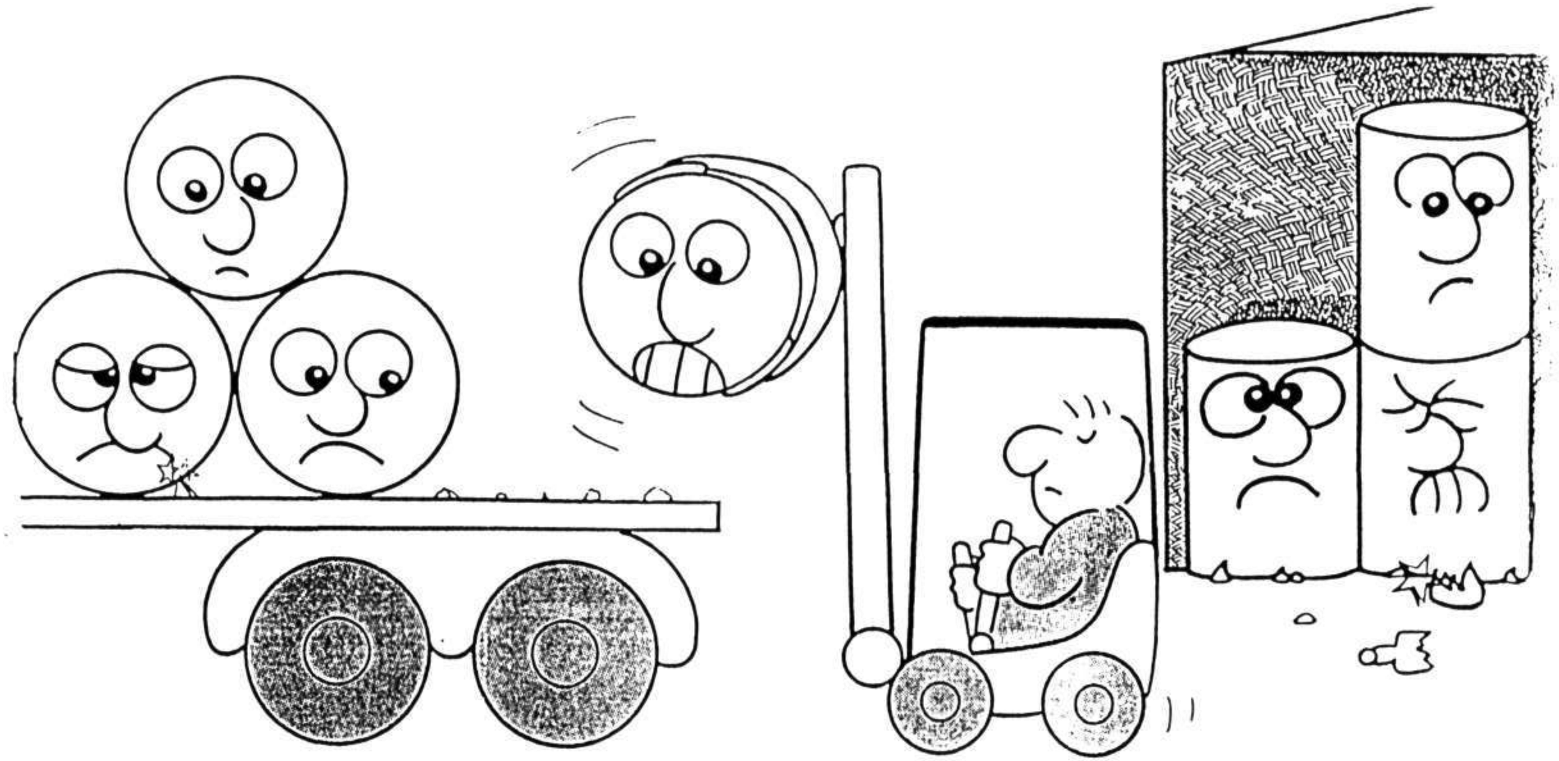
1) web length, reel width and diameter

Efficient use of newsprint

- Newsprint reel transport
- Reel handling in the printing plant
- Storage: different types of warehouses
- Classification of newsprint and reel defects
- Newsprint waste control
    - Waste definitions
    - How and where to measure waste?
    - Setting waste targets
    - Useful equipment and tools
    - How to reduce waste?
- Web break control
    - Web break as a cost factor
    - Web break recording
- Case studies on efficient waste management

Efficient Use of Newsprint

Reel Transport, Handling and Storage



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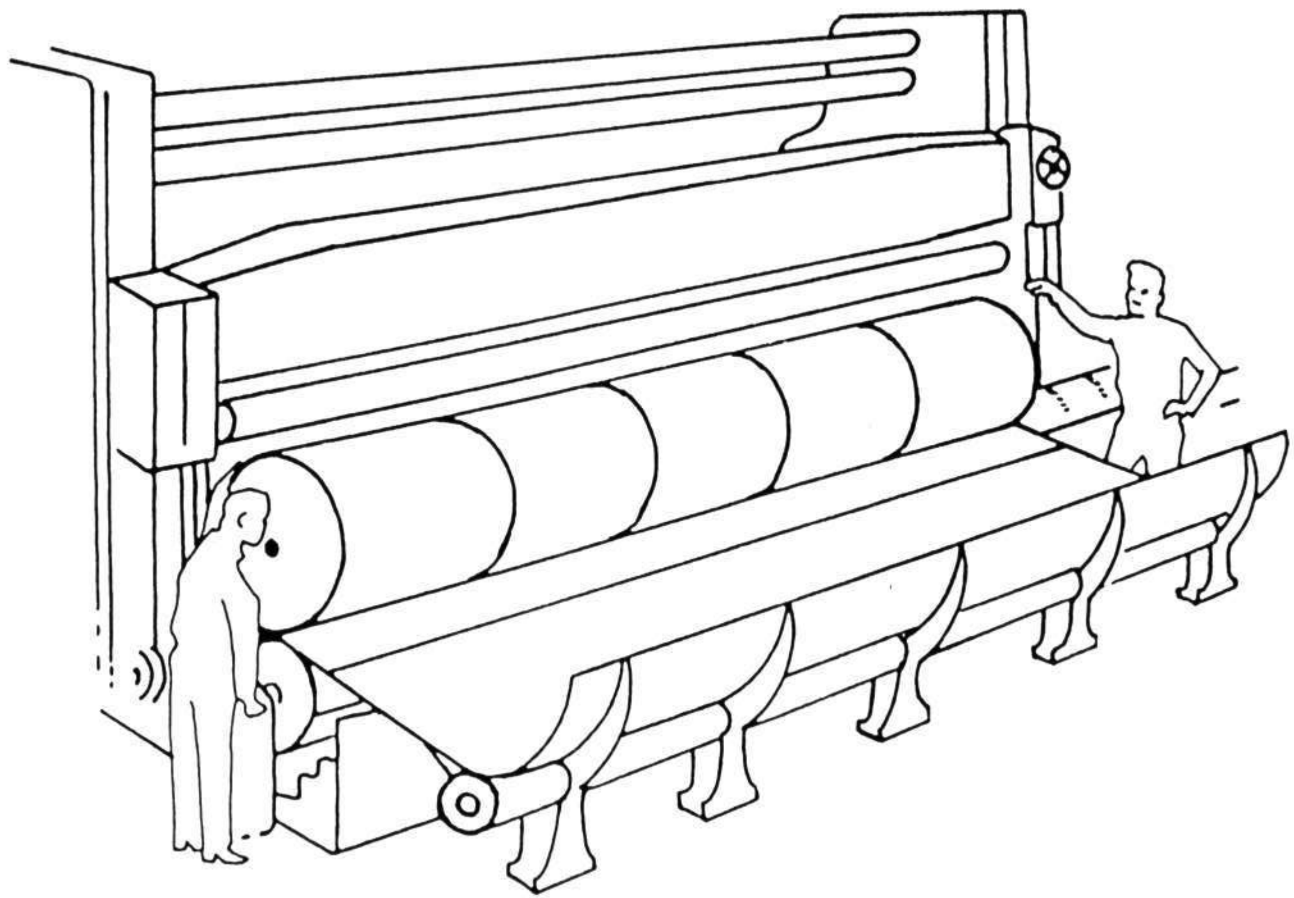
The mill roll and winder

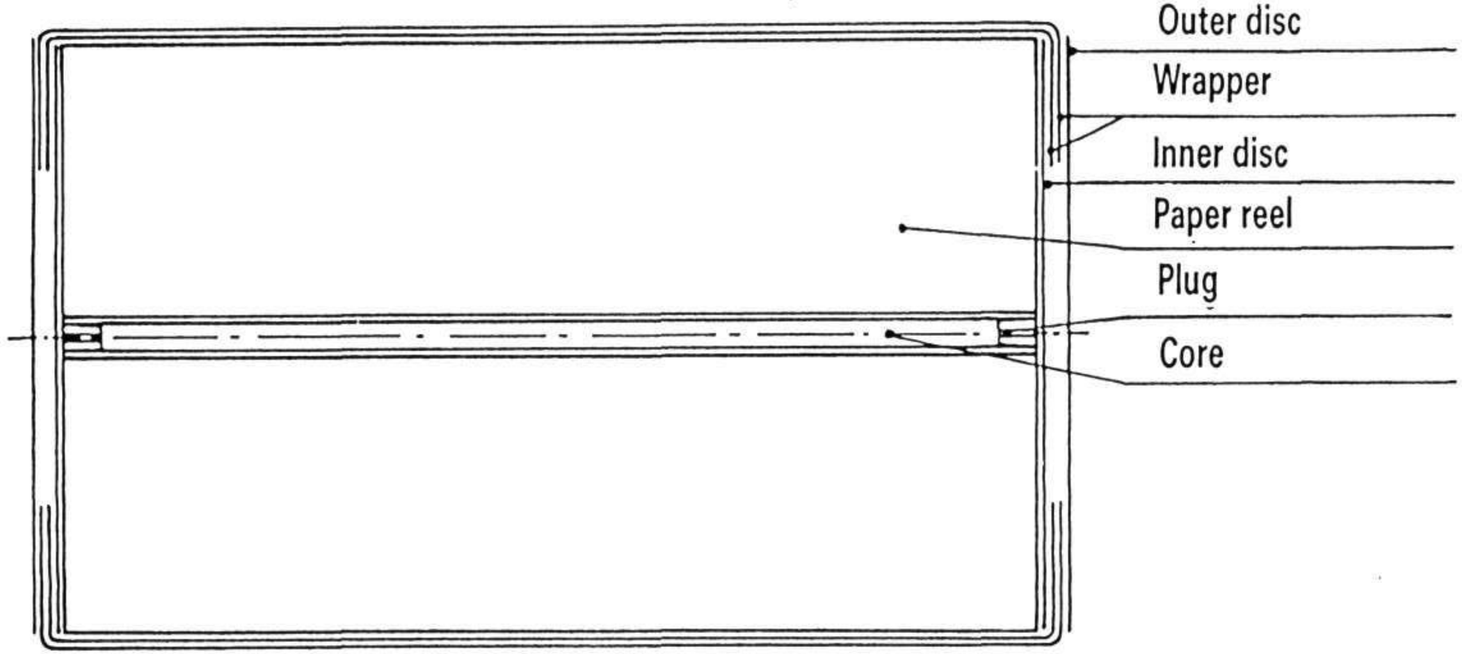
The web from the paper machine is wound onto a steel cylinder to form a **mill roll or tambour** with a width corresponding to the width of the paper machine. Once the mill roll has been fully wound, it is transferred to the **winder** where:

- the web is slit by rotating knives to produce reels to the ordered widths, and
- the web is wound onto a reel core to the diameter or, when such is the case, to the web length ordered by the printer.



Wrapping

To protect the body of the reel against damage, several layers of wrapper are wound around the outside of the reel. The ends of the reel are protected by paper discs. Once the inner discs have been set in place, the body wrapper is folded over the end discs and an additional disc is glued over each end.



The reel wrapping serves mainly:

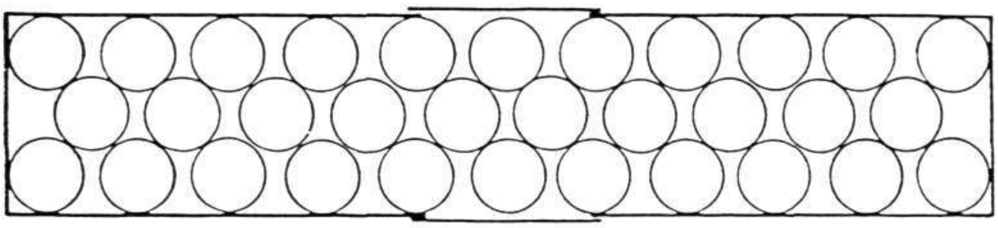
- to protect the paper against *light* mechanical pressure, impacts and friction, and
- to provide temporary protection against dirt and moisture, but *not* water.

Reel Transport, Handling and Storage

Transport to the printer

Transport by road: capacity about 20-25 tonnes. Important: water protection and cleanliness.

Rail transport: make best use of the space. Example:



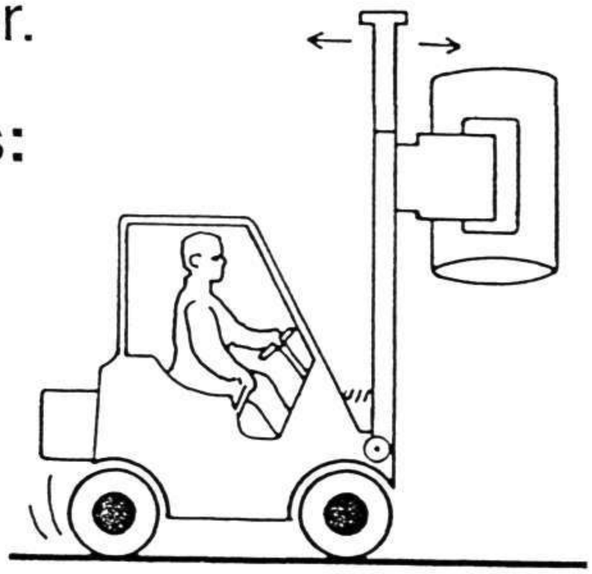
Sea transport: Different kind of loading possible. Important: water damage should be prevented and sufficient ventilation ensured.

Containers: Special containers can be used to transport newsprint reels. They can be transported by road, rail or sea.

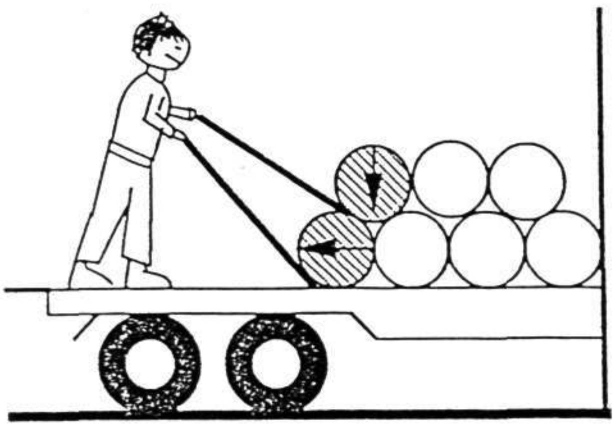
Reel Transport, Handling and Storage

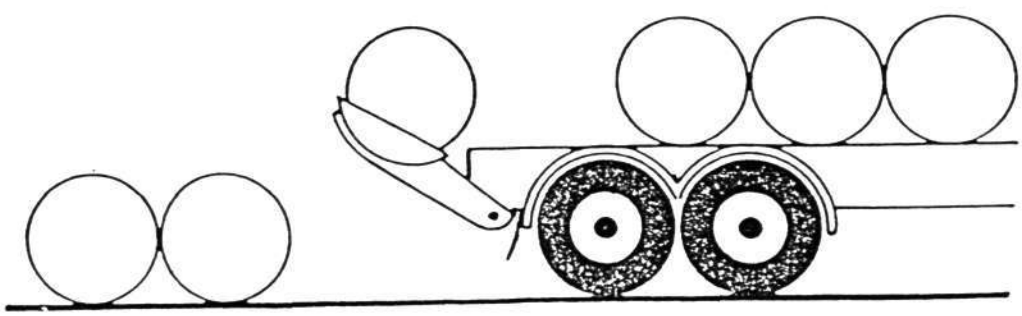
Reel Handling in the Printing Plant

Reel receiving: careful visual inspection should be carried out to detect damage (physical damage of the body, damage to the heads or edges, water damage or out-of roundness).
All damages should be recorded and reported to the supplier.



Off-loading of reels:





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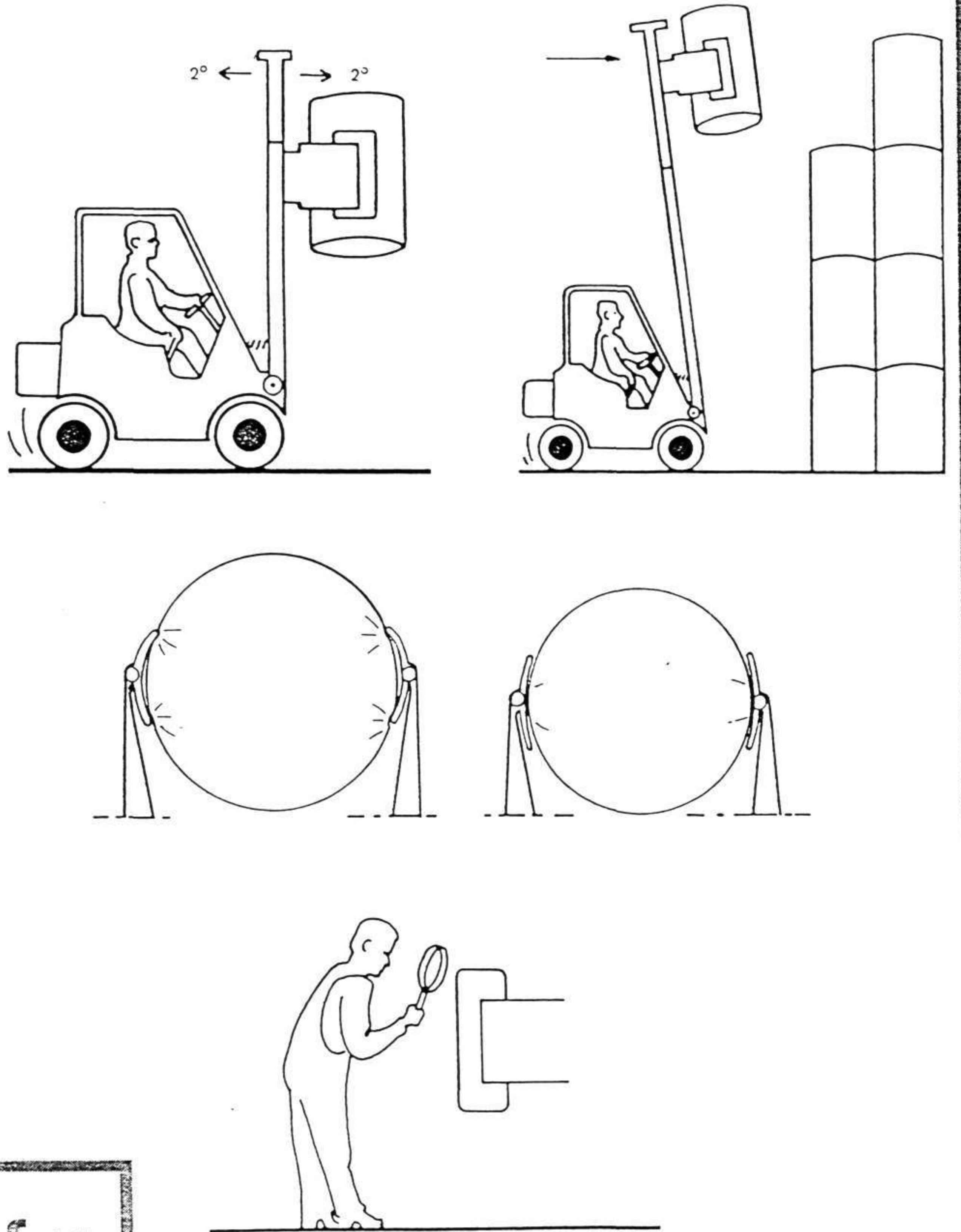
Reel Transport, Handling and Storage

Clamp trucks and truck handling



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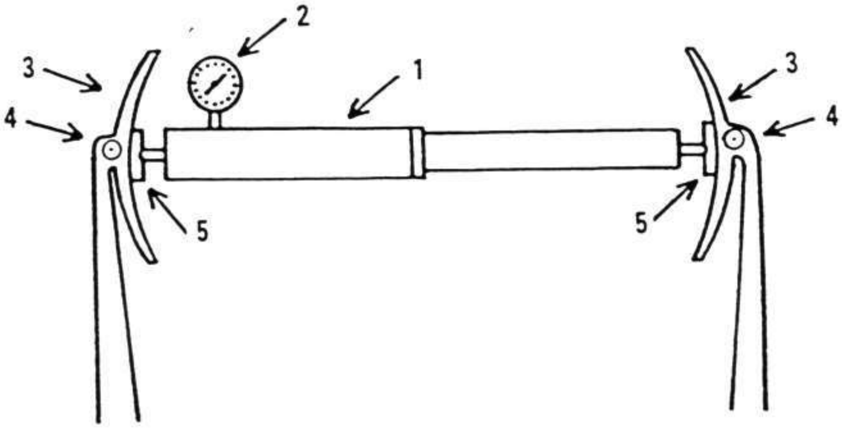
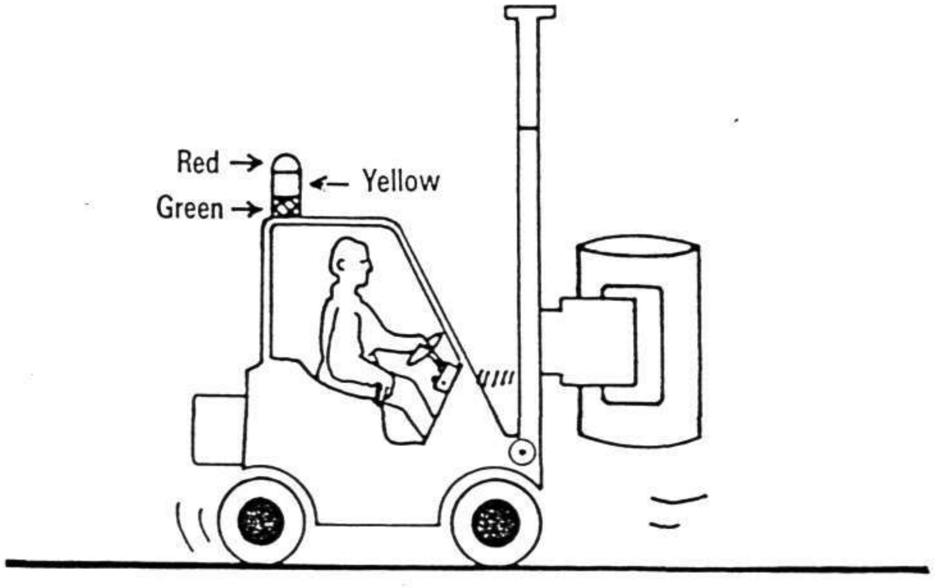
Reel Transport, Handling and Storage

Clamp trucks and truck handling



1 = Test cylinder
2 = Pressure gauge
3 = Clamp plate
4 = Gripping arm
5 = Pivot-mounted friction plate



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Reel Transport, Handling and Storage

The Newsprint Warehouse

- Large enough for several days' use
- Good location (near the presses)

Temperature and humidity:

- Moisture content of newsprint very important for runnability properties.
- Should be controlled as much as possible (esp. when extreme temp. and hum. are reached outside)
- If possible, climatization system to control temperature and humidity. If not, humidifiers are recommended.
- Water condensation should be avoided (formation of water droplets).

The Golden Rule of Storage:

-->The reels should be arranged in a proper manner: each grade and size should be accessible and the "first in-first out" (FIFO) principle should be used.

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Reel Transport, Handling and Storage

The Newsprint Warehouse

- To estimate the floor area:
    - take about 1 tonne/m2 for the calculation in the case of several grades and reel sizes.
    - take 2 tonnes/m2 in the case of few grades and sizes.

- Main reels should not be stacked more than 4 high. Max. height: 6.5 m. The stacks should be straight and stable.

The reel storage building:

- think water and fire damage
- should be as clean as possible

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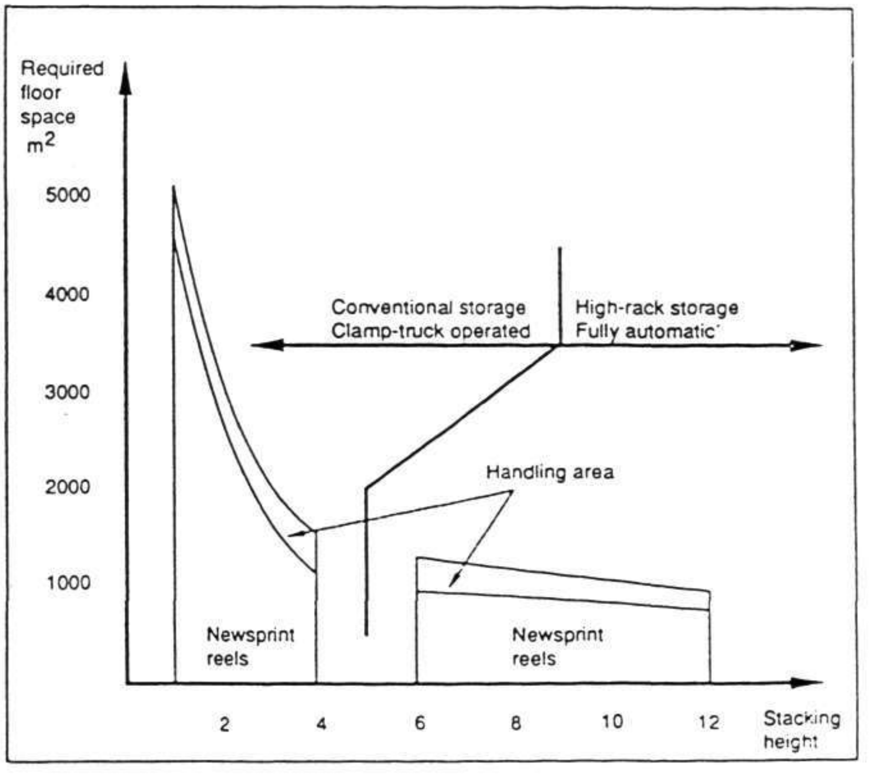
Reel Transport, Handling and Storage

New Developments in Newsprint Warehouses

IFRA Special Report 1.4 (Oct. 90):

- High-rack storage: reels handled automatically with carriages and lifts, commanded by a central data management system.



- Alternative to clamp trucks: vacuum lifts or overhead cranes

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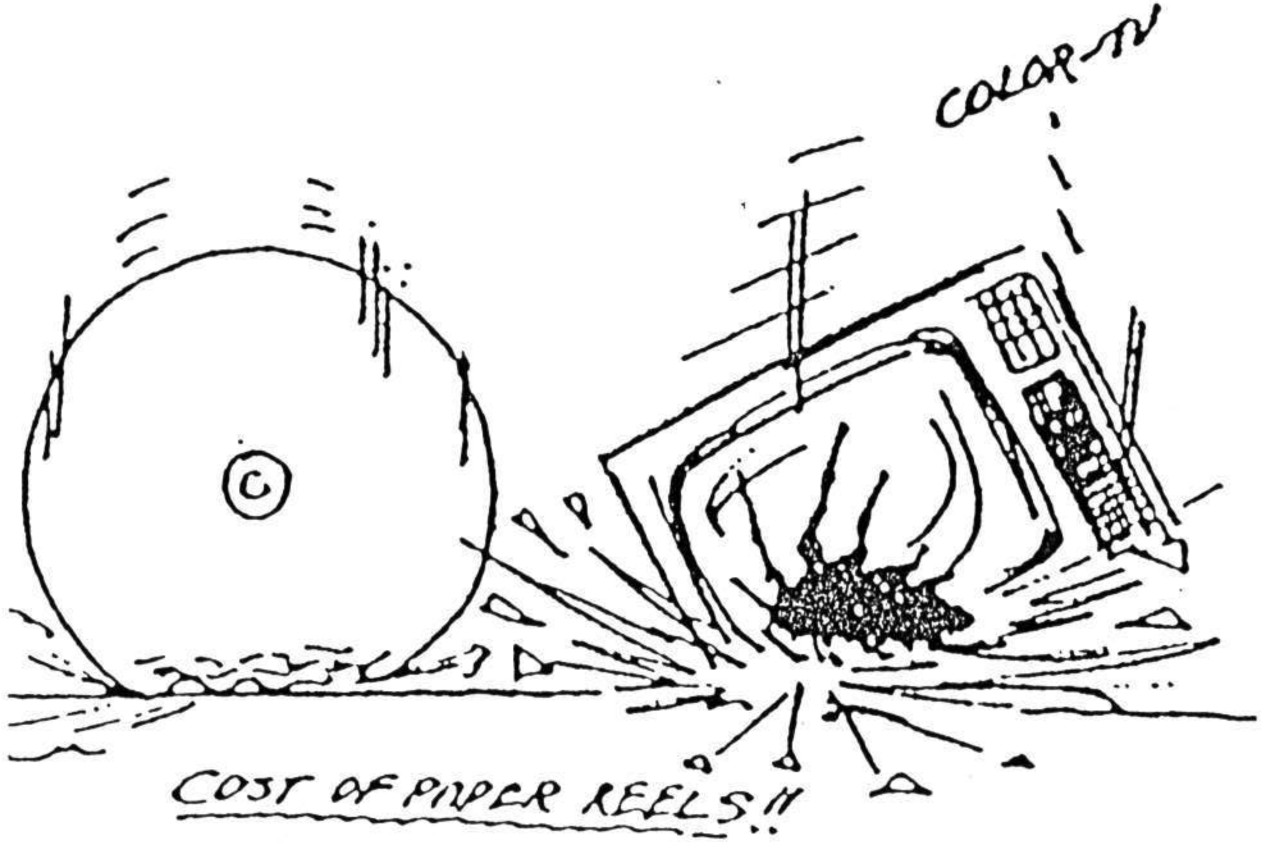
Efficient use of newsprint

Newsprint waste



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Efficient use of newsprint

Different waste reasons

- Transport damage of paper reels
- Damages during storage
- Wrong preparation of paper reels
- Incorrect start-up of presses
- Change of print speed of the press
- Incorrect ink/water balance
- Web breaks
- Miscount of copies
- Damages in mailroom handling
- Badly controlled distribution
- Bad maintenance of equipment

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WASTE DEFINITIONS

According to IFRA specification

1. Wrapper waste
The actual weight of all wrapper protection stripped from the reels, including the heads and body wrapper but not including the core or any white paper which may be removed when the wrapper is stripped off.

2. White make-ready waste
The total wight of all white paper stripped from the reel prior to the actual running of the reel through the press. White make-ready waste may be subdivided into:
a) Claimable make-ready waste: damage to the reels during transport and handling for which the newspaper is not responsible.
b) Non claimable make-ready waste due to normal make-ready procedure.

3. White core waste
The total weight of white paper remaining on the reel core when the reel stub has been removed from the press. Shall not include the weight of white paper remaining on partially run reels which are set aside for re-use in later production.

4. Core tare waste
The weight of the reel core, but not including the weight of any white paper remaining on the core when the reel stub is removed from the reel-stand.

5. Reel stub waste
Total weight of the reel stub, i.e. the sum according to the definition with 3 and 4 above.

6. Total tare waste
The total weight of the reel core and wrapping material, i.e. sum of wrapper waste and core tare waste.

7. White press waste
The total weight of all white, i.e. unprinted, paper taken from the reel from the time the reel is started through the press to the time the reel stub is removed from the reel-stand.

8. Start-up waste
The total weight of all printed paper which does not leave the pressroom between press start-up and the start of delivery to the mailroom.

9. Production printed waste
The total weight of all printed paper which does not leave the pressroom, e.g. spliced copies, waste following web breaks, waste from the time copy delivery to the mailroom commences to the time at which the mailroom order has been completed.

10. Production waste
The sum of start-up waste and production printed waste. The difference can usually be obtained by subtracting the net copy count from the gross copy count at the rotary press.

11. Mailroom waste
The total quantity of saleable copies, sent from the pressroom until the end of the run, is compared with the total quantity of copies dispatched from the mailroom for that run including the in-house copies.

The corresponding number of copies can usually be determined by subtracting the copies dispatched from the mailroom from the net copy count at the rotary press.

12. Over-production
The difference between the net copy count at the rotary press and the ordered circulation. This figure is included in the mailroom waste.

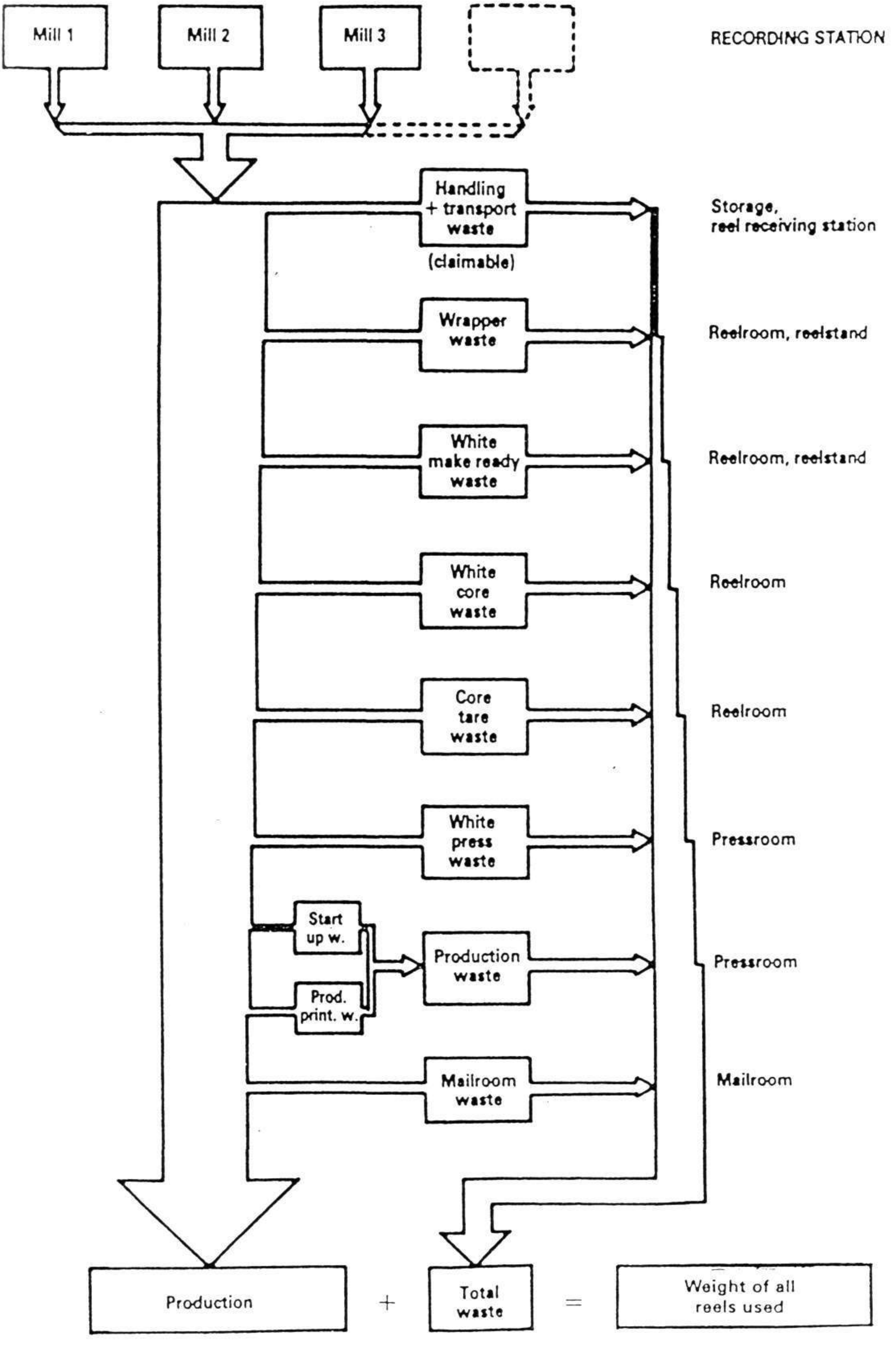
13. Total waste
The sum of waste according to the definitions with 2,3,6,7,10 and 11 above.

14. Apparent weight difference
The gross weight of all reels used in the printing of a given product, minus (a) the total waste; and minus (b) the theoretical weight of the circulation dispatched from the mailroom.

This can be expressed as follows:

apparent weight difference	=	gross weight of all reels used	—	total waste	—	theoretical weight of circulation

by which definition the apparent weight difference serves as a correction factor.


Mill 1
Mill 2
Mill 3
RECORDING STATION
Handling + transport waste
(claimable)
Storage, reel receiving station
Wrapper waste
Reelroom, reelstand
White make ready waste
Reelroom, reelstand
White core waste
Reelroom
Core tare waste
Reelroom
White press waste
Pressroom
Start up w.
Prod. print. w.
Production waste
Pressroom
Mailroom waste
Mailroom
Production
+
Total waste
=
Weight of all reels used

Waste statistics NAA

Newsprint consumption between 1000 and 5000 tons/y:
(averaged from 70 newspapers)
Damaged waste: 0.29 %
Printed waste: 3.11 %
Total waste: 4.82 %

Newsprint consumption between 5000 and 20000 tons/y:
(averaged from 70 newspapers)
Damaged waste: 0.26 %
Printed waste: 2.47 %
Total waste: 3.91 %

Newsprint consumption over 20000 tons/y:
(averaged from 60 newspapers)
Damaged waste: 0.26%
Printed waste: 2.91%
Total waste: 4.33 %

--> In average, damaged waste represents about 6% of total waste

Waste Control

How and where to measure waste?

Number of waste categories: up to you
Aim: produce statistics (and see the evolution between productions, days, months, deliveries...) and give ideas on how to reduce waste.

How to measure waste?

- as actual weight
- in number of copies
- in terms of length
- or by combination of these factors.

Ex: wrapper waste can be weighed but mailroom waste is often counted in number of copies.

Weight determination of the printed products: Not easy!!

- Newsprint grammage varies
- Moisture content
- Damping
- Possible dryers
- Inks

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Waste Control

How and where to measure waste?

Total calculation of consumed paper and produced waste:

- Record in kilograms and/or copies
- Whatever suits you the best

Where should waste control be exercised?

- Reel receiving station
- Reelroom
- Pressroom
- Mailroom

Let's look at these individual stations

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Waste Control

How and where to measure waste?

Reel receiving station:

Several checks should be made:

- reel condition must be recorded (types of damage, depth of damage...)
- reel weight, labelled versus actual
- check of reel number

Claimable make-ready waste: (for which the newspaper is not responsible) has to be recorded by weight or depth of damage.

Percentage of loss caused by newsprint reel damage

Depth of damage mm	Paper loss as % of gross weight Diameter 900	1070	1250
2	0.9	0.8	0.6
5	2.3	1.8	1.6
10	4.5	3.7	3.2
30	13.1	11.0	9.4

Check the total weight of a delivery. Any weigh bridge or scale has to be calibrated regularly

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Waste Control

How and where to measure waste?

Reelroom:

Wrapping inspection: last inspection before unwrapping

Several waste categories in the reelroom --> different practices:

- using one or more weighing scales to weigh reels individually --> costly and time-consuming
- collecting and weighing waste components individually
- taking some waste components as constant figures

Reel make-ready:

- important to avoid missplices
- reel control and repair of small damages
- stripping the reel: only one or two layers
- prepare the splice carefully.

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Waste Control

How and where to measure waste?

Pressroom:

White press and production waste:
White waste: webbing-up with the furthest unit first.
Start-up waste: preparation before the start and pre-settings, clean blankets

- Adjustments during the start-up
- Bad copies
- Copies produced during the paster cycle
- Deceleration phase
- Control copies

Mailroom:

Difference between the number of copies entering the mailroom and the number of copies leaving it

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Wrapper and reel stub waste in relation to reel weight (45g/m2, 160 cm width)

Reel diameter	100	115	125
Reel weight	800	1050	1250
Wrapper waste (kg)	6.8	8.0	8.8
Wrapper waste (%)	0.9	0.8	0.8
Reel stub waste (%)	1.5	1.1	0.9
Total (%)	**2.4**	**1.9**	**1.7**

(Reel stub: 10 mm, Core: 8kg)

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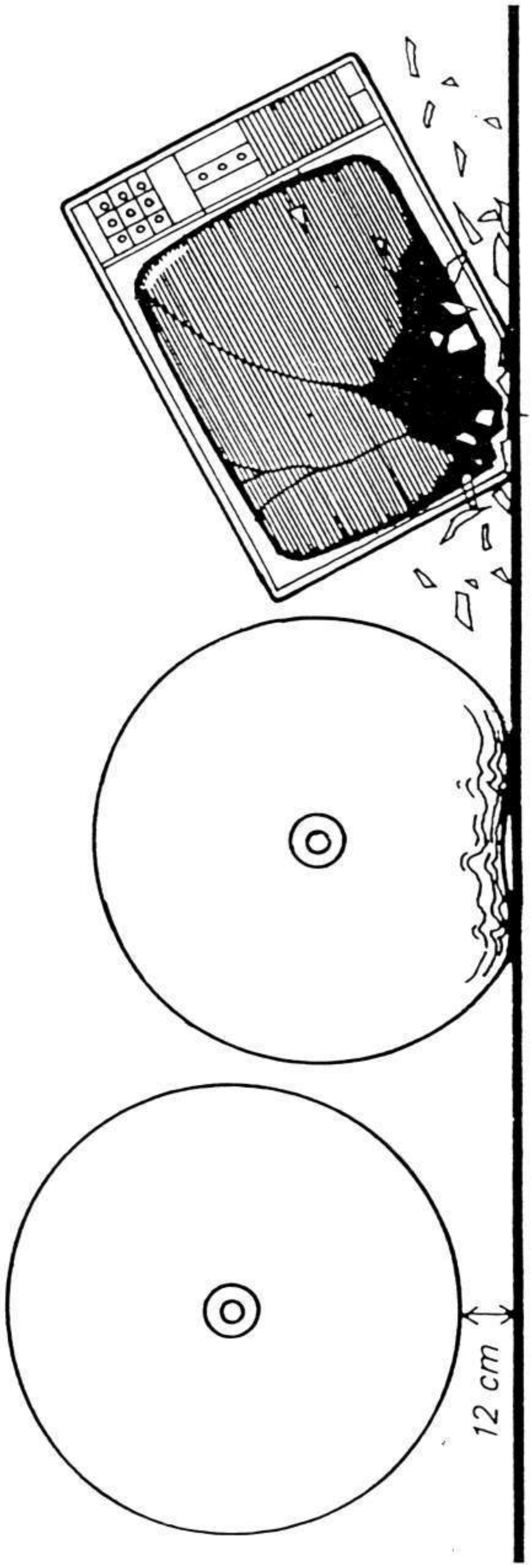
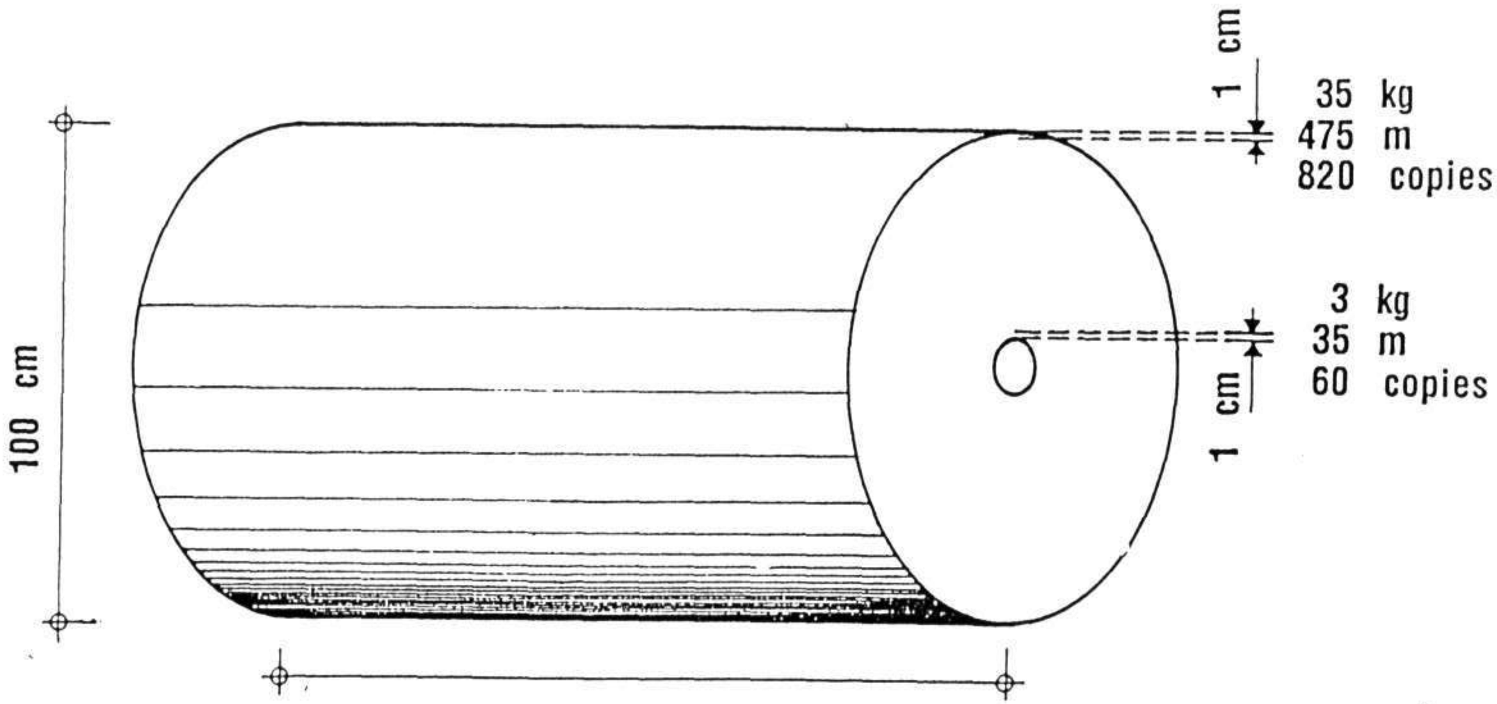

12 cm


1 cm
35 kg
475 m
820 copies
3 kg
35 m
60 copies
1 cm
100 cm

Waste - Expensive ?

Case:

- *45 g/m2, 550 $/ton*
- *350 edit./year*
- *32 pages broadsheet*
- *circ. 100.000 cps./day*

Costs, 12 % waste

Consumption 18,3 ton/day
Waste 2,2 ton/day = 1207 $/day
Annual losses 422.500 $

Reduce waste from 12 % to 8 %
Savings 141.000 $/year

Example of figures for damaged waste:

Average value for American newspapers concerning damaged waste: 0.26% of the total consumption

Extreme examples:

Daily News:

Damaged waste: 1.06% (1/4 of total waste)

Lancaster Newspapers:

Damaged waste1.9% (1/4 of total waste)

Other example: Het Laaste Nieuws (Belgium)

Claimable damaged waste: 0.30%
Non-claimable damaged waste: 0.09%
Damaged waste: 0.39%
Printed waste: 1.21%
Total waste: 3.13%

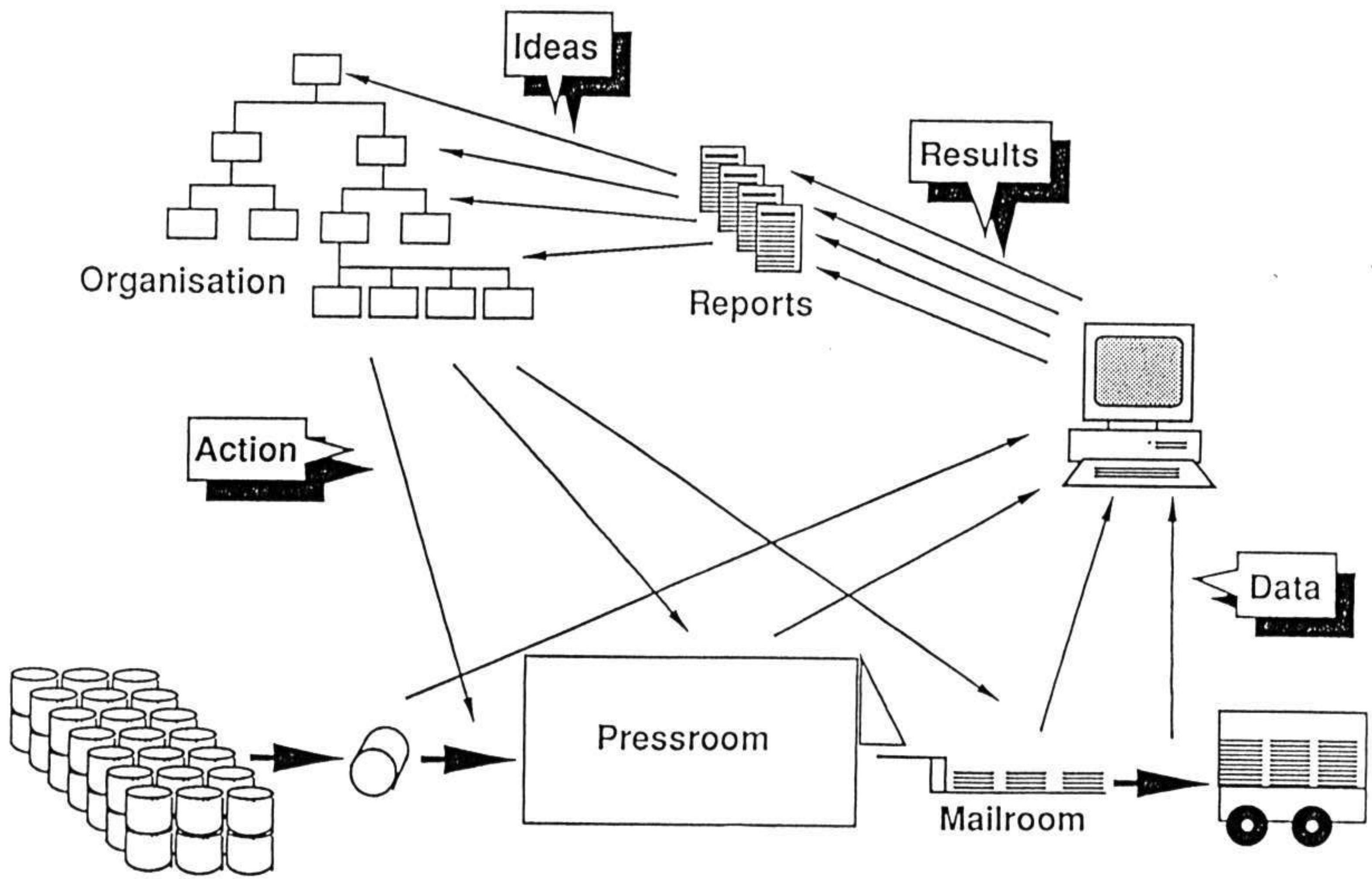
Copy counting

Case:

- *45 g/m2, 550 $/ton*
- *350 edit./year*
- *32 pages broadsheet*
- *circ. 100.000 cps./day*

Extra in bundles

Needed 2000 bundles x 50 cps
Manual stacking, 51 cps/bundle
Needed overproduction 2000 cps
Waste 2 %, losses 83.000 $/year


Ideas
Results
Organisation
Reports
Action
Data
Pressroom
Mailroom

200 : 32

Efficient use of newsprint

Web breaks

- General aspects
- Causes of web breaks
- Web break as a cost factor

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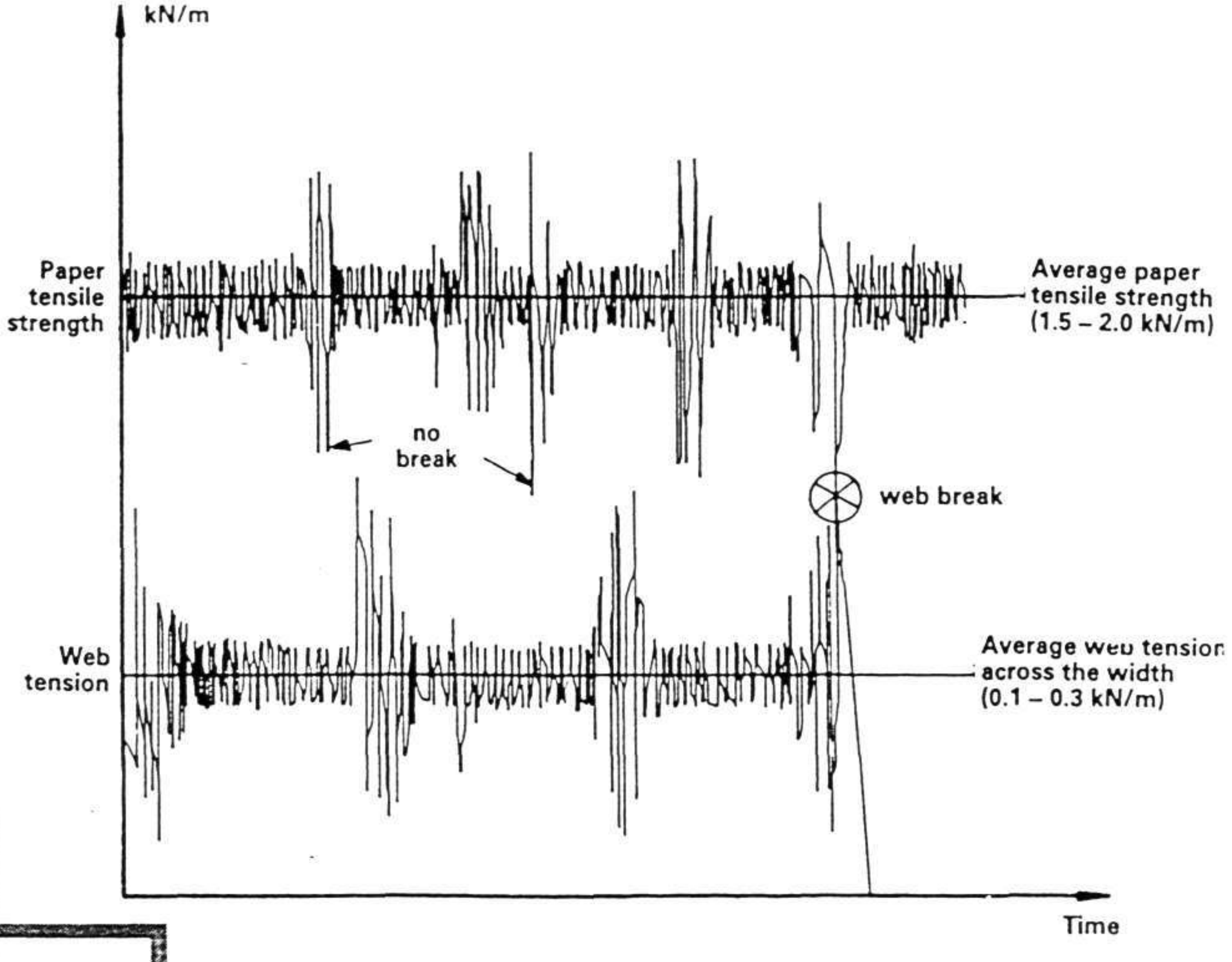
Efficient use of newsprint

Web breaks

General aspects:

- Big influence on plant efficiency
- Better paper but increased demand on it (faster presses, multi-colour printing...)
- When do web breaks occur?



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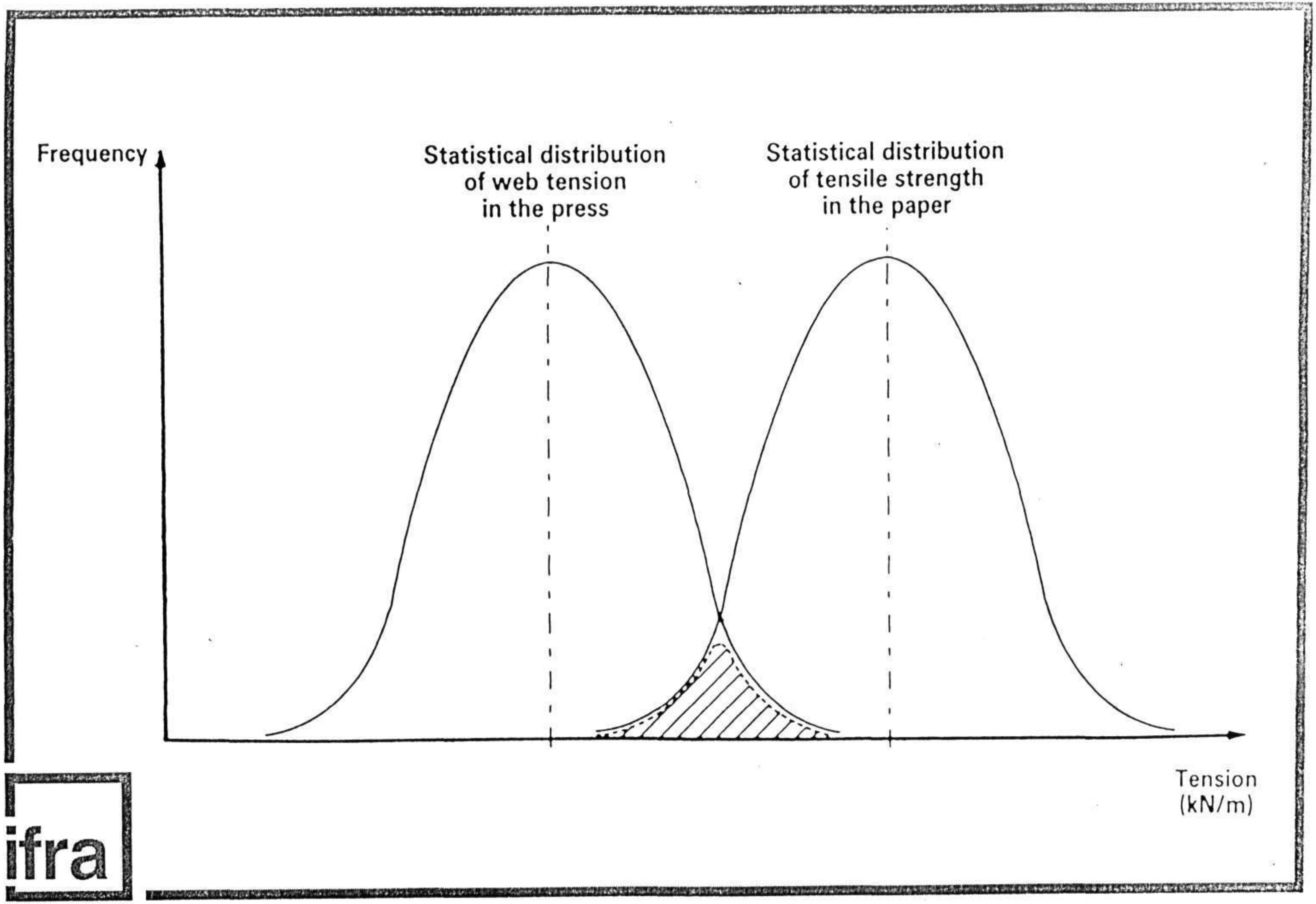
Frequency
Statistical distribution of web tension in the press
Statistical distribution of tensile strength in the paper
Tension (kN/m)
ifra

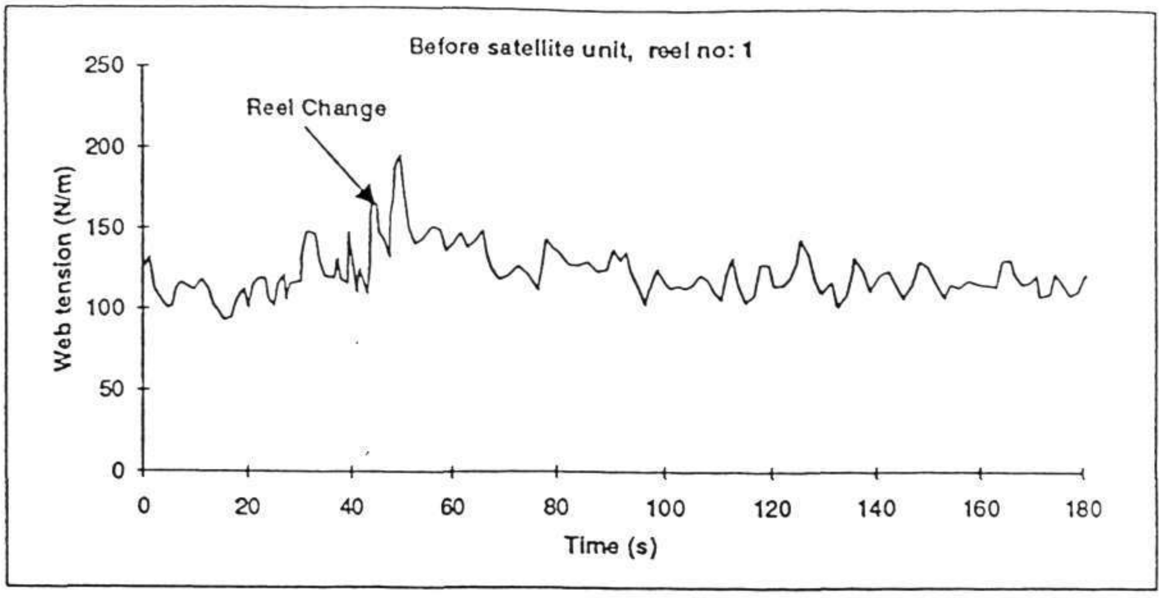

Figure 3-15. An example of web tension as a function of time during reel change at T2. Measurement after reel stand before the first printing unit.

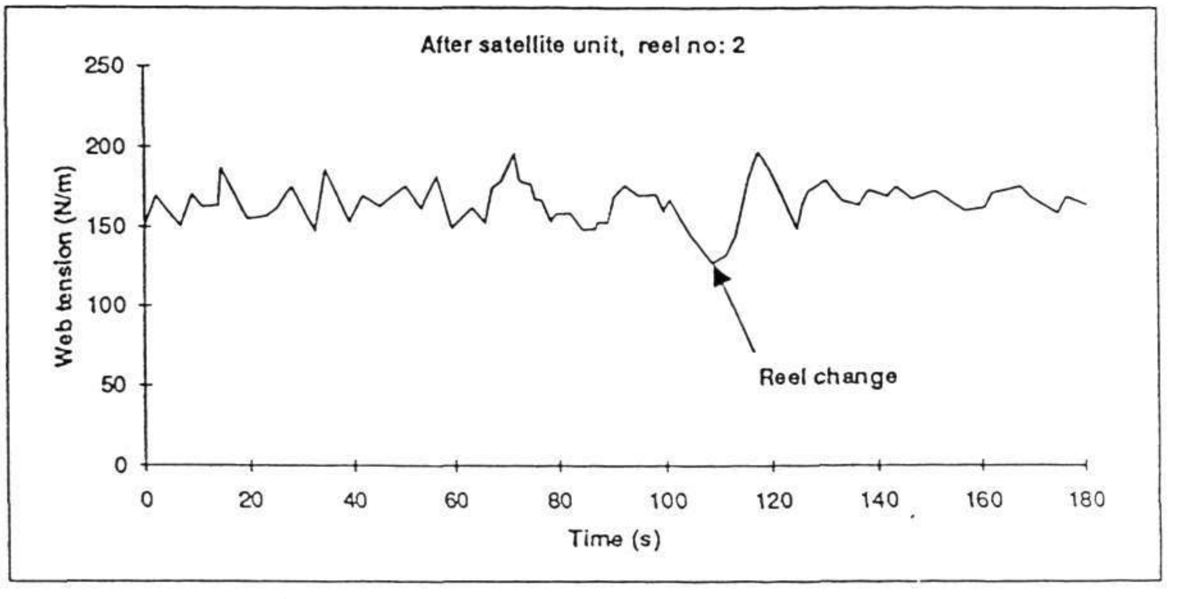

Figure 3-16. An example of web tension as a function of time during reel change at T2. Measurement performed after the first printing unit.

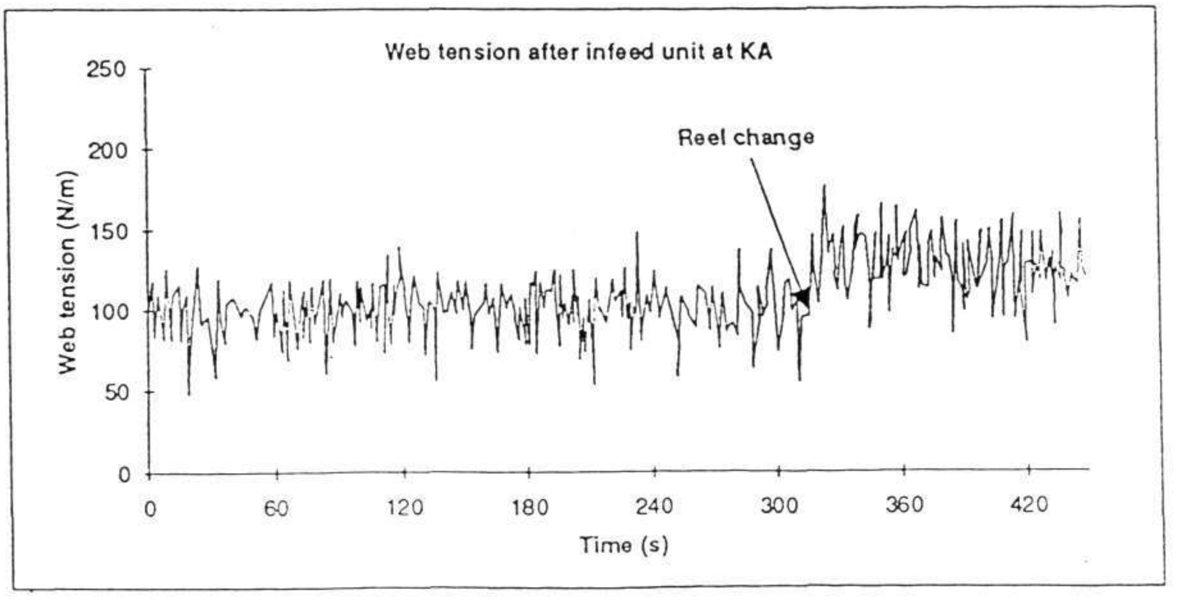

Figure 3-17. An example of a change in web tension level after reel changeover. (Measured at KA, after the infeed unit)

Efficient use of newsprint

Web breaks

Causes for web breaks:

- press-related breaks
- reelstand related breaks
- folder-related breaks
- material-related breaks
- operating errors
- unknown causes

--> See NNG!!

2.15 burrs on tension belts
2.16 loose tension belts
2.17 dirty or worn-out paster brushes or rollers
2.18 improper setting of tension on paster brushes or rollers
2.19 incorrect load on brake
2.20 improper adjustment or malfunction of paster carriage
2.21 other paster malfunction

3. FOLDER-RELATED BREAKS

3.1 draw rollers pulling insufficiently or excessively
3.2 slitter and/or slitter check dull or not set properly
3.3 former angle is wrong
3.4 turner bar angle is wrong
3.5 excessive air
3.6 foreign matter accumulating on former and/or turner bars
3.7 imperfect web tension
3.8 improper cutting or folding
3.9 fly damage or incorrect adjustment
3.10 incorrect setting of guiding elements
3.11 other folder malfunctions

4. MATERIAL-RELATED BREAKS

4.1 *Newsprint- and reel-related breaks*

4.1.1 *Sheet defects/holes*
– slime hole
– water drop hole
– plucking hole
– wire hole

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IDENTIFICATION AND PREVENTION OF WEB BREAKS – TROUBLE SHOOTING LIST

In the following a list of possible reasons for web breaks is given. This list should be regarded as a training aid for those who are working either in the pressroom or on the reelstand level. It clearly classifies the defect with regard to the time a break occured, to the location where it happened and gives some possible reasons for it. Finally the appropriate counter-measures are shortly described which you will also find in other sections of subchapter 7.2 and 7.3, especially in 7.3.1.

Defect	Location/ symptom	Reason	Counter-measure
Web break at press start	Before printing unit	Improper adjustment of tension control roller	Adjust tension control roller in the reelstand and/or in the infeed unit
		Knife is activated by the web break detector	Check setting of web break detector, the side-lay register and the web for "baggy" parts
	In or after the printing unit	Imperfect start-up sequence	Check start-up sequence
		Too tacky ink	Make sure that press and pressroom have a temperature of about 20°C
		Water in cylinder gap	Reduce water feed and clean gap with com-presed air
		Cleaning agent in the cylinder gap	Clean more thoroughly, use tape to cover the gap during cleaning
Web break during reel change	Start of the web fails to loosen from the new reel in the reelstand	No glue on the reel	Apply glue according to instructions
		Applied glue has dried out	Renew glue; check glue properties; don't apply glue too early and make sure that no dust sticks on the glued part

Breaks At Reel Changes

Represent 30% to 50% of all breaks

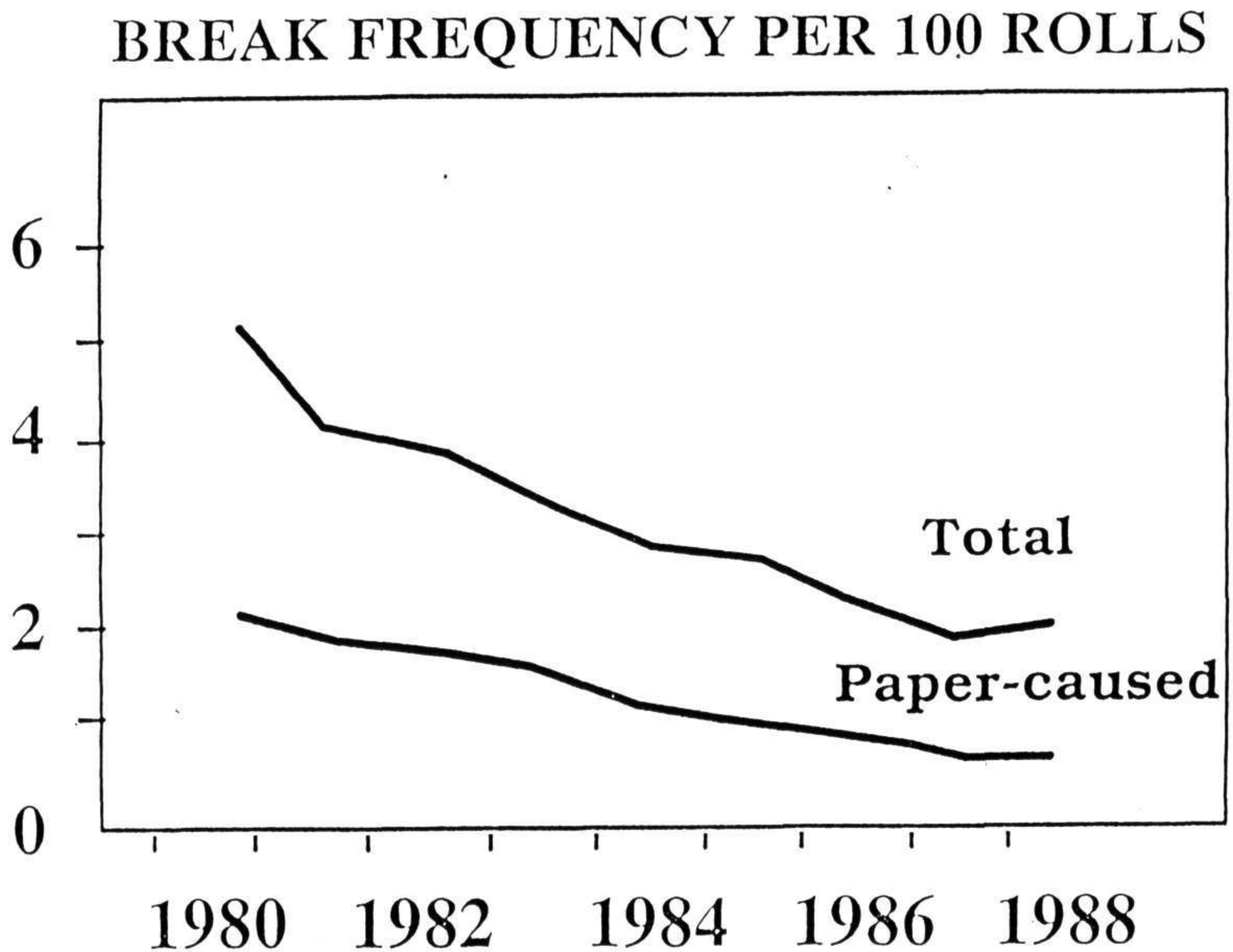
Causes Are:

- Tension variations
- Paster makeup and operation
- Faults near core of outgoing roll
- Structural faults in new roll
- Surface faults in new roll (roll damage)

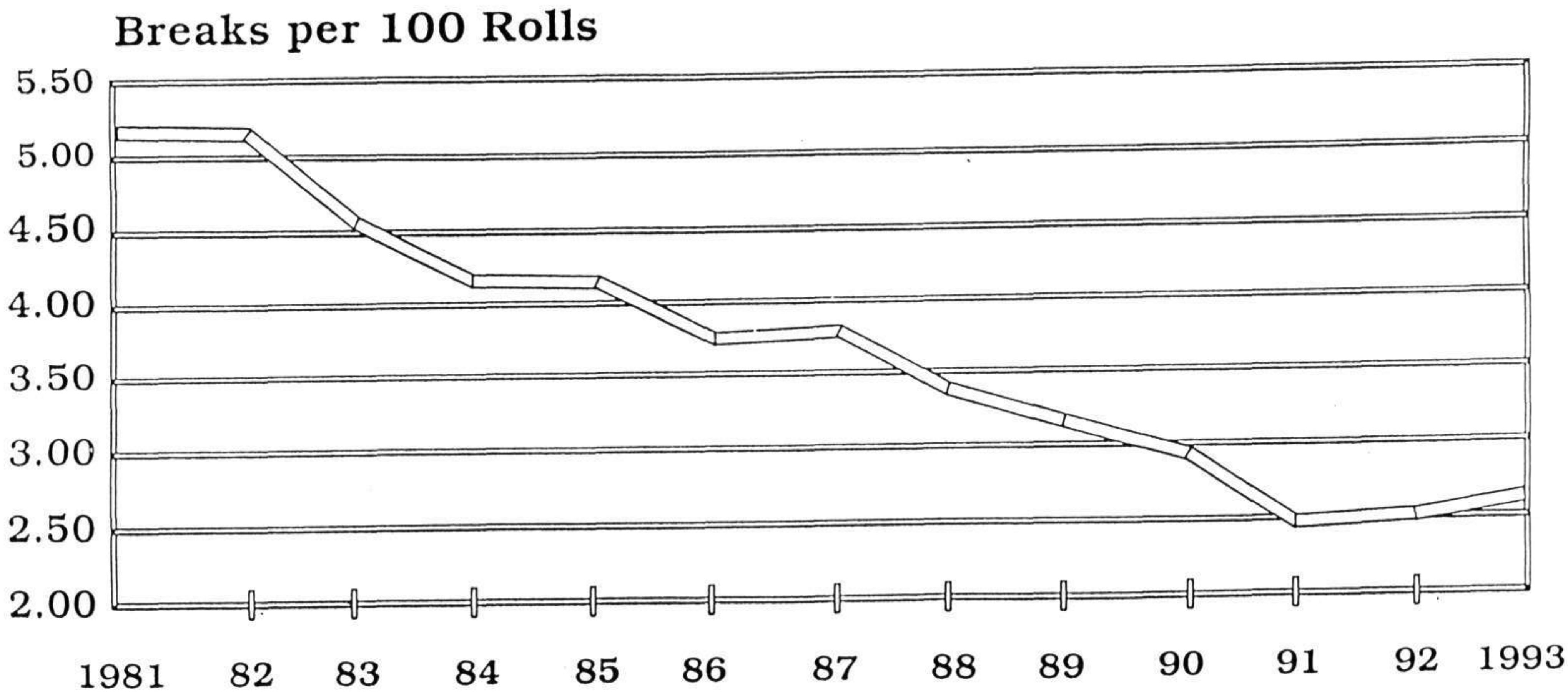
Suggestions

- Keep tension on the paper to an absolute minimum
- Use only newsprint from one supplier on any one reelstand
- Use damaged rolls on runs that have flexible deadlines
- Be aware of the stress from angle bar leads
- Offset press stops and sheet absorbency
- If edge damage has been corrected by making a cutout on the edge, do not use the roll on a split-sheet or angle bar lead

Break Frequency in Swedish Pressrooms



Pressroom Newsprint Runnability



10/11/93: Source: Abitibi-Price PDM data through August 1993..
Based on 3,000+ rolls/year. No correction for increasing average roll diameter

Efficient use of newsprint

Web breaks

Web breaks as a cost factor:

1. Newsprint costs:

Waste produced during A:	84 copies
Waste due to rewebbing:	50 copies
Re-start during D:	500 copies
Total	**634 copies**

Pagination: 24 --> 84 kg of paper at 1300 DM/t --> **110 DM for paper waste**

2. Ink costs: 4 DM for wasted inks

3. Energy costs: Difficult to estimate, **about 10 DM and 90 DM for a severe break**

4. Labour costs:

Hourly rates: 31 DM for press- and reel room personnel, 28 DM for mailroom and 30 DM for transport personnel

8 persons in the press- and reelroom, 2 in the mailroom and 3 responsible for transport

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Efficient use of newsprint

Web breaks

Web breaks as a cost factor:

10 minutes downtime (timeB)

Press and reelroom:	42 DM
Mailroom:	10 DM
Transport:	15 DM
	67 DM

90 minutes downtime (timeC)

Press and reelroom:	372 DM
Mailroom:	84DM
Transport:	135 DM
	591 DM

5. Costs for replacing plates and blankets: In case of severe breaks, plates and blankets might be changed. Estimated cost: 750 DM

6. Loss of sales

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Web breaks

Web breaks as a cost factor:

	Normal break (10 min)	Severe break (90 min)
1. paper	110	110
2. ink	4	4
3. energy	10	90
4. labour	67	591
5. plates	-	750
Total	**191 DM**	**1545 DM**

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Waste Control - Case Study
Helsingin Sanomat (FIN)
Forssa Plant

Presentation of the Sanoma Corporation:

- Helsingin Sanomat: biggest Scandinavian morning newspaper (circ. ~500.000)
- Ilta=Sanomat: afternoon newspaper, second in Finland (circ. ~200.000)

Three printing plants:

- Vaanta: 15 km of Helsinki - built 1977
- Varkaus: 300 km N of Helsinki - built 1988
- Forssa: 110 km NW of Helsinki - built 1992

--> With these three plants, 95% of the Finns can have Helsingin Sanomat delivered to their homes before 6.30 a.m.

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Waste Control - Case Study
Helsingin Sanomat (FIN)
Forssa Plant

Presentation of the Forssa Plant:

Built in 1992

Total surface: 25,000 m2

Production: ~80,000 Helsingin Sanomat
~130,000 Ilta=Sanomat

Newsprint usage: 15,000 tonnes/year

Number of employees: only 59

Machines and equipment:

- 2 WIFAG OF7 offset presses with 6 printing units, 28 printing couples and a folder
- Honeywell Printa Press Control System
- Reel unwrapping: two mechanical unwrapping stations from Von Roll
- 6 AGVs from BT
- Platemaking: 2 automatic line with Krause and Nela machines
- Ferag mailroom system

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1. Paper storage area
2. Pressroom
3. Mailroom
4. Bundle handling
5. Loading area

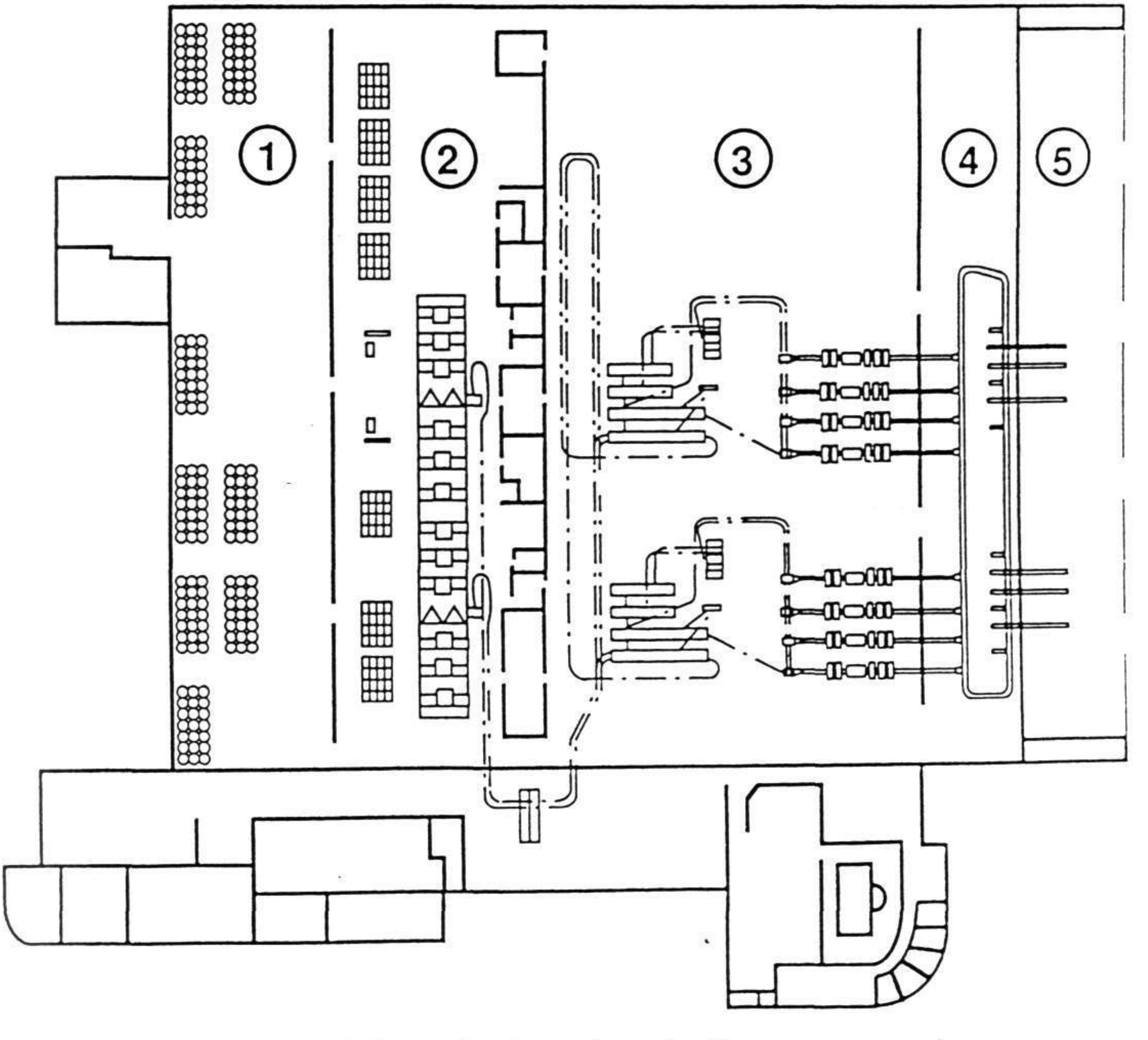
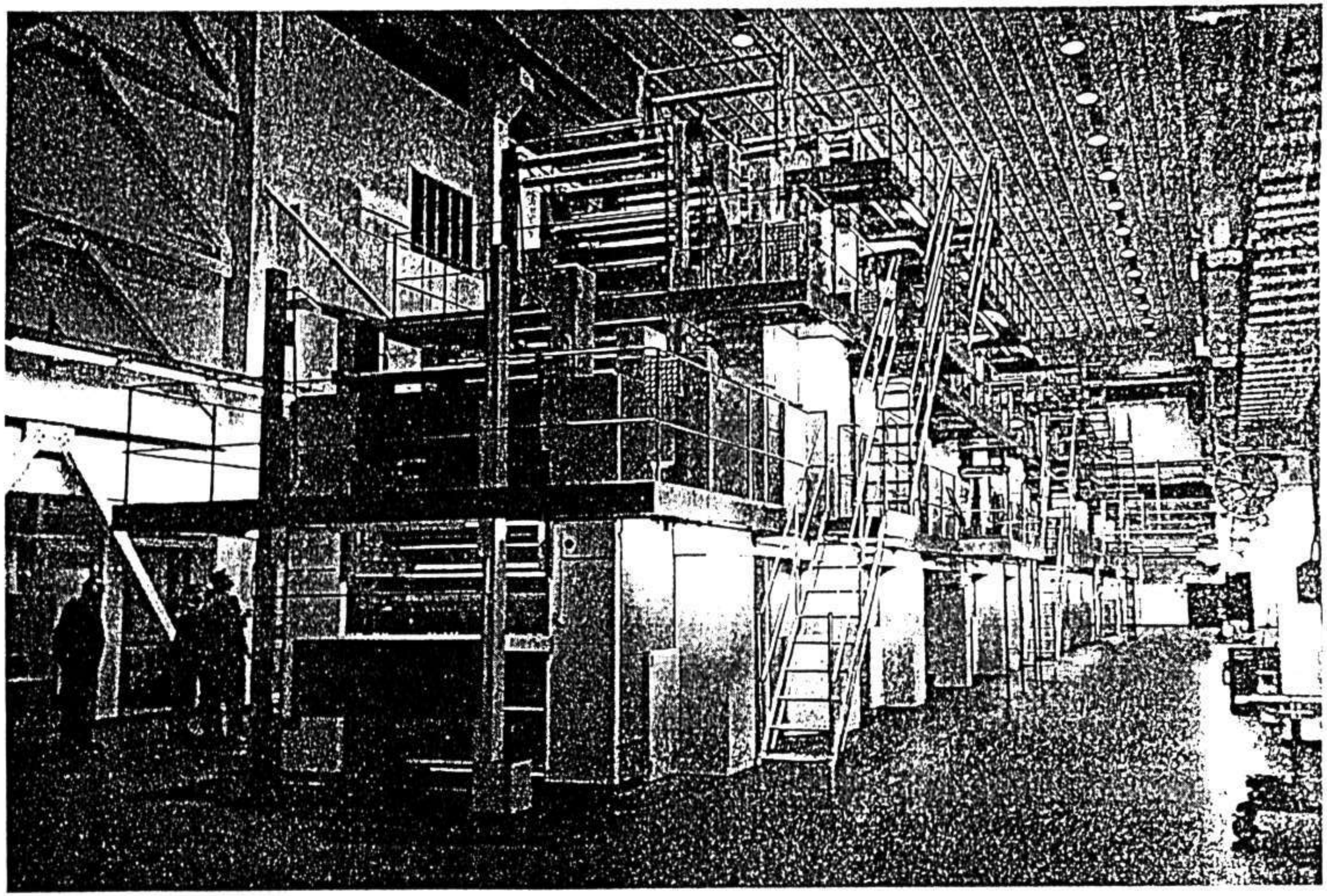
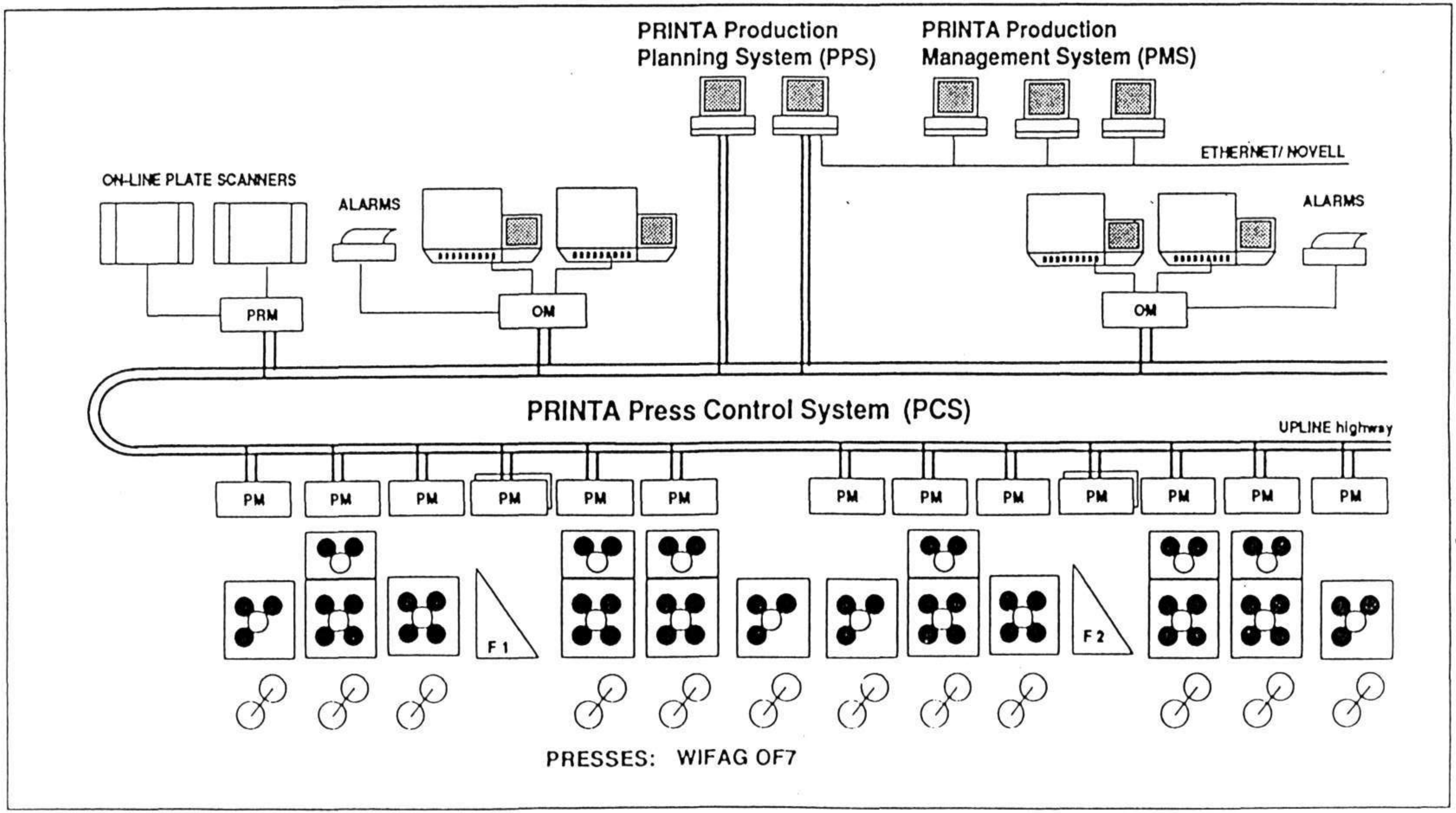
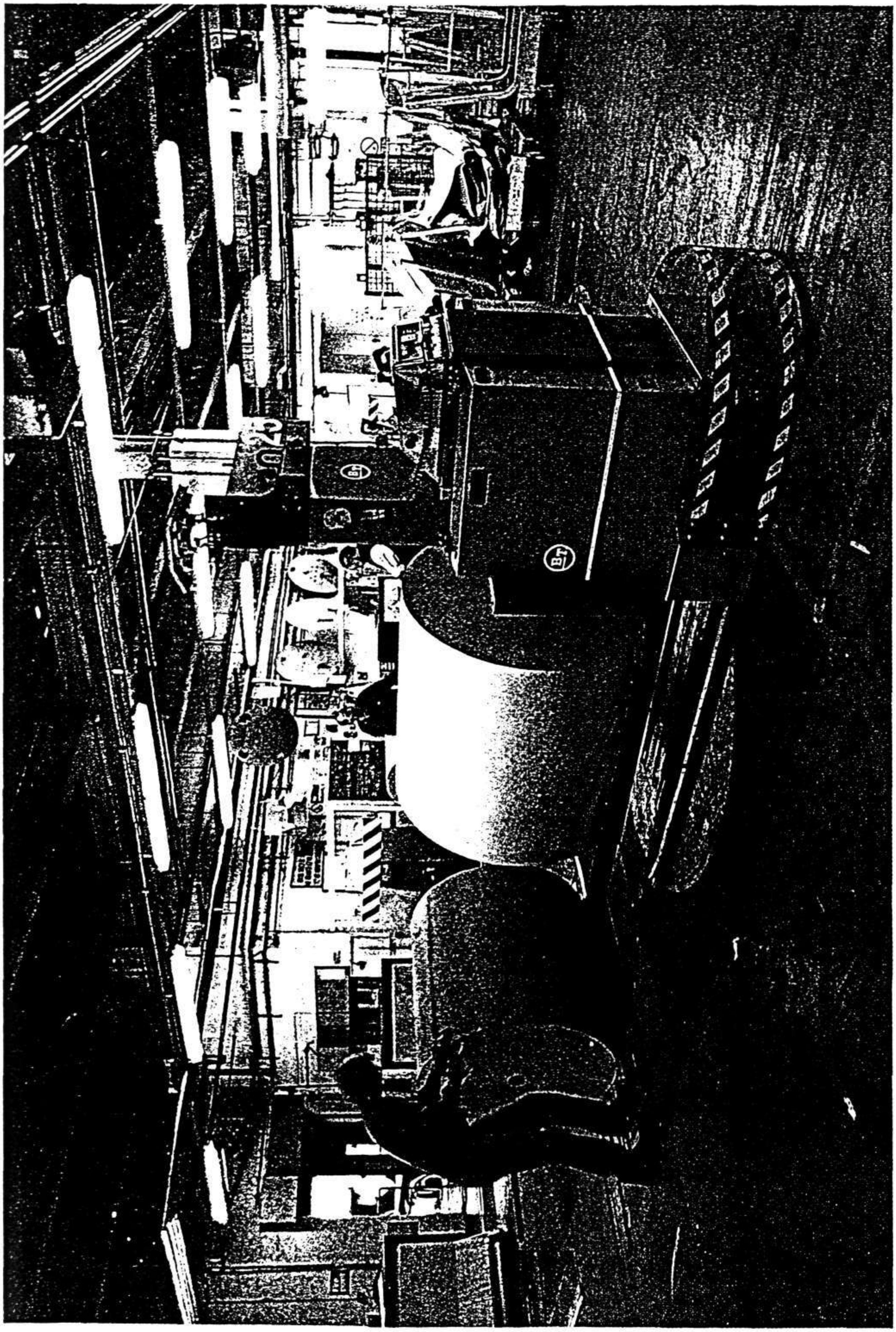


Fig. 3. The layout of the printing plant in Forssa



The Wifag OF 7 press, viewed from the drive side.

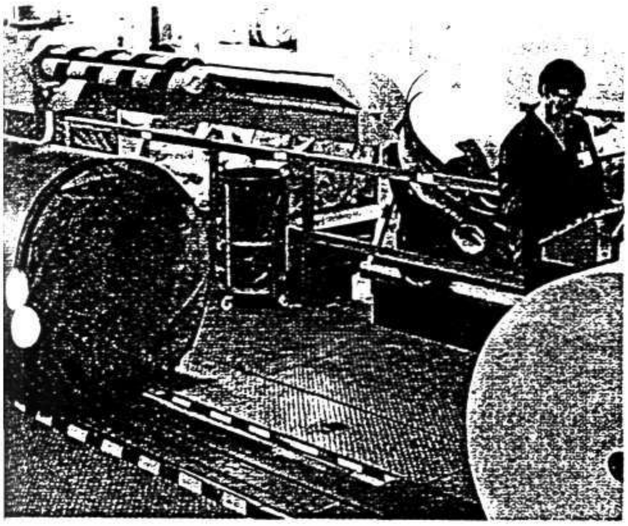

PRINTA Production
Planning System (PPS)
PRINTA Production
Management System (PMS)
ETHERNET/ NOVELL
ON-LINE PLATE SCANNERS
ALARMS
ALARMS
PRM
OM
OM
PRINTA Press Control System (PCS)
UPLINE highway
PM
F 1
F 2
PRESSES: WIFAG OF7

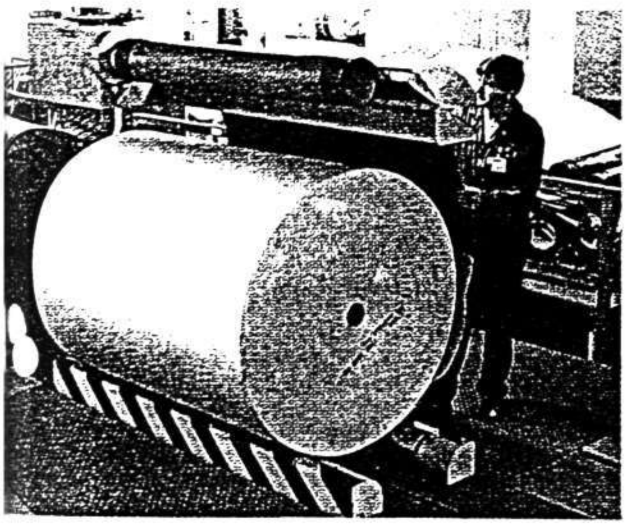


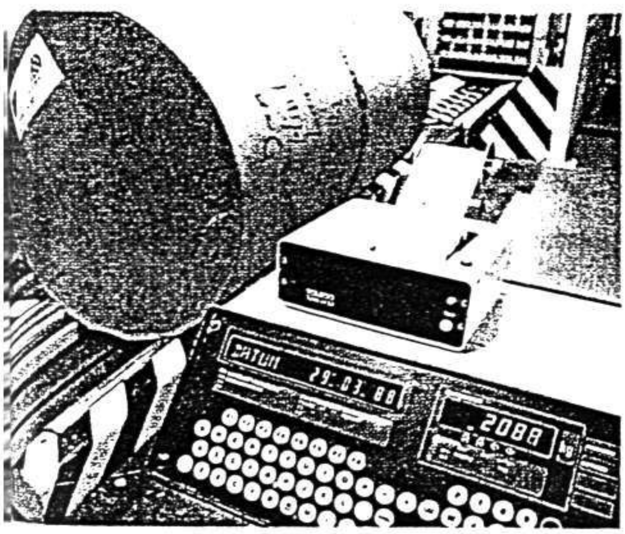
Delivery to the stripping station

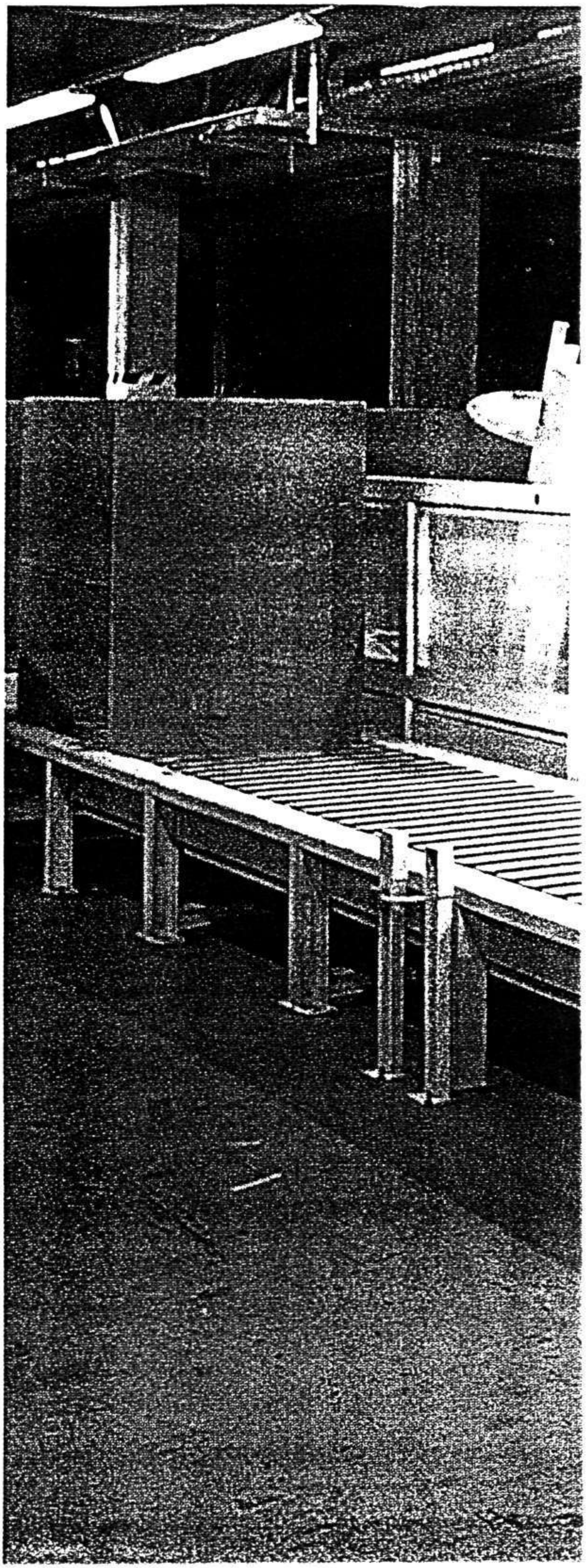
Stripping station with removal of wrapper

Weighing and data recording









Waste Control - Case Study
Helsingin Sanomat (FIN)
Forssa Plant

Reel handling and storage (1):

Paper storage capacity: 5,000 tonnes

Handling in the storage with fork-lifts

From storage to intermediate storage: mechanical conveyor which brings the reels to the unwrapping stations.

The mechanical unwrapping stations include also weighing scales

After unwrapping, the bar code is read by the BT AGV. From that time, the system knows the location and status of each reel. If the bar code cannot be read the data is input manually.

Depending on the number of copies needed, the AGVs bring the right number of reels to each reelstand.

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Waste Control - Case Study
Helsingin Sanomat (FIN)
Forssa Plant

Reel handling and storage (2):

The Wifag Autorob system moves the reel automatically to the reelstand arm.

When the old reel is changed to a new one, a container comes to take the core.

A button has to be pressed to unload these containers.

After production is over, all the reels still remaining near the reelstands are taken back by the AGVs to the intermediate storage. (This has to be made because the grammage of Ilta=Sanomat is 48.8 g/m2 and the grammage for Helsingin Sanomat is 40).

Waste Control - Case Study
Helsingin Sanomat (FIN)
Forssa Plant

Paper waste and its handling (1):

There are several types of waste.

In the reelstand and intermediate storage, there are 3 different types of containers:

- One for the wrapper waste from unwrapping station
- one the control samples from the control cabinets (belongs to production printed waste)
- one receives waste from the folder (white make-ready and white press waste) when the press speed is under 8000 ex/h.

The containers can be weighed by a scale form BT which lays on the route of the AGV. The AGV computer system stores the different weights coming from these different containers.

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Waste Control - Case Study
Helsingin Sanomat (FIN)
Forssa Plant

Paper waste and its handling (2):

When the newspaper is not ready but the speed is over 8.000 ex/h, the waste copies drop to the storage containers.

When the press is running, the Ferag net and Wifag gross counters are sending the real time figures to the Printa control system.

From these figures it is possible to get:

- the start-up waste
- the production printed waste
- the mailroom waste

In the mailroom, there are two waste containers which are emptied and weighed by AGVs.

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Waste Control - Case Study
Helsingin Sanomat (FIN)
Forssa Plant

Reel and waste handling systems - Automatic control (1):

Five different systems integrated together via interfaces:

1. BT Carrier system: gets the reel info from the IFRA bar code. When a reel is given to the Wifag autorob, the code is transmitted

2. The reelstand program of Printa (software Wifag and hardware Honeywell): transmits the IFRA code to Printa. Gives also the real-time diameter of the reels. When AGV comes to empty reels from the arm, it gives the remaining diameter and the IFRA-code.

3. Printa Control System: controls the number of net and gross copies for each production (gets the values from Ferag and Wifag counters). Receives the needed reel information from Wifag system. Gives the production information (time, copies, breaks, ...) to the production management system called FOHA

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Waste Control - Case Study
Helsingin Sanomat (FIN)
Forssa Plant

Reel and waste handling systems - Automatic control (2):

4. FOHA Production Management System: (developed by Honeywell and HS). Connects the three printing plants. For this system: 70 PCs. Handles all the production information and produce diagrams (press speed, facsimile transmission, printed copies...). Makes daily, weekly, monthly and yearly production reports. Counts the weight of the half-used reels from their diameters and grammages and send the information to the SOMA system. When a reel is used, the system sends its IFRA code to the SOMA system.

5. SOMA Material Management System: Real-time paper storage information. All the information concerning the reels come form the mill via an electronic mailbox.

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Waste Control - Case Study Helsingin Sanomat (FIN)
Forssa Plant

Waste statistics:

Most important figures: start-up waste, printed production waste and mailroom waste.

Results: Through 1993, the waste figures have decreased. The start-up waste has been many times under 500 copies

Total waste percentage:

8.5% for Helsingin Sanomat

8.1% with Ilta=Sanomat

Advantages: The targets for the different types of waste can be fixed and solutions can be discussed to reach these targets. The trends on the waste figures of the proposed solutions can be immediately followed

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Bar coding of the newsprint reels

The 16-digit bar code by IFRA

(Approved by the IFRA Newsprint Committee on October 1, 1991)

2355251207321272

2	3	5	5	2	5	1	2	0	7	3	2	1	2	7	2
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Digit nr.

Digits 1 to 8: Reel number

The reel number is in general as follows:

Scandinavian manufacturer:
Digit 1: Paper machine No.
Digits 2 and 3: Week of manufacture
Digits 4 to 8: 5-digit serial number
No. 00001-49999 even years
No. 50000-99999 uneven years

Central European manufacturer:
Digit 1: Paper machine No.
Digits 2 and 3: Week of manufacture
Digits 4 to 6: 3-digit tambour number
No. 001-499 even years
No. 500-999 uneven years
Digit 7: Set from tambour
Digit 8: Position in tambour

Digits 9 to 12: Reel weight

The digits 9 to 12 represent the gross reel weight.
For example, here, the gross weight of the reel is 732 kg.

Digit 13: Copacking + Manufacturer code

Copacking:
If digit 13 = odd number (1, 3, 5 or 7): 1 reel per wrapping.
If digit 13 = even number (2, 4, 6 or 8): 2 reels per wrapping.

Manufacturer code:
Digit 13 = 1 or 2: Previous classification
Digit 13 = 3 or 4, 5 or 6, 7 or 8: New classification

See enclosed list for the manufacturer codes

Digit 14: Grammage and quality

The ten possibilities for digit 14 are:

1 = 40 g/m2 standard newsprint
2 = 45 g/m2 standard newsprint
3 = 48.8 g/m2 standard newsprint
4 = 52 g/m2 standard newsprint
5 = other standard newsprint
6 = 45 g/m2 upgraded newsprint
7 = 48.8 g/m2 upgraded newsprint
8 = 52 g/m2 upgraded newsprint
9 = 55 g/m2 upgraded newsprint
0 = other

Digits 15 and 16: Manufacturer code

See enclosed list for the manufacturer codes.

Newsinks

- The role of ink
- Composition of inks: newsinks, heatset inks,...
- Drying mechanisms
- Properties of newsinks
- Testing methods: viscosity, ink length, ink tack, surface energy, water acceptance, print density, ink requirement, print-through, set-off, rub-off, monitoring of ink quality
- Handling of newsinks
- New developments:
    - Vegetable oil based inks
    - High-pigmented inks

The role of ink

- Form a coherent layer on the paper.
- Account to about 1 to 2% of the total newspaper weight
- Ink in non-image area --> bad quality
- Laboratory method can help but will never replace a trial on the press.
- Newsinks are often manufactured to suit the needs of a particular newspaper. Parameters used: location, needs of advertisers, press, general quality level. It will fix the price.

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The composition of a printing ink

Composed of three distinct parts:
- a pigment
- a vehicle
- additives.

Pigment

- Colouring agent. Dispersed in a very fined grained form.
- For black ink: carbon black (incomplete burning of hydrocarbons).
- In the production process, pigments go through a surface treatment.

Vehicle

- Transportation of the pigment and to give the ink its final aspect after drying.
- The vehicle is composed of a hard resin, a solvent and a diluent

Additives

- May be used to adjust flow, set-off characteristics, print-through, ink transfer...

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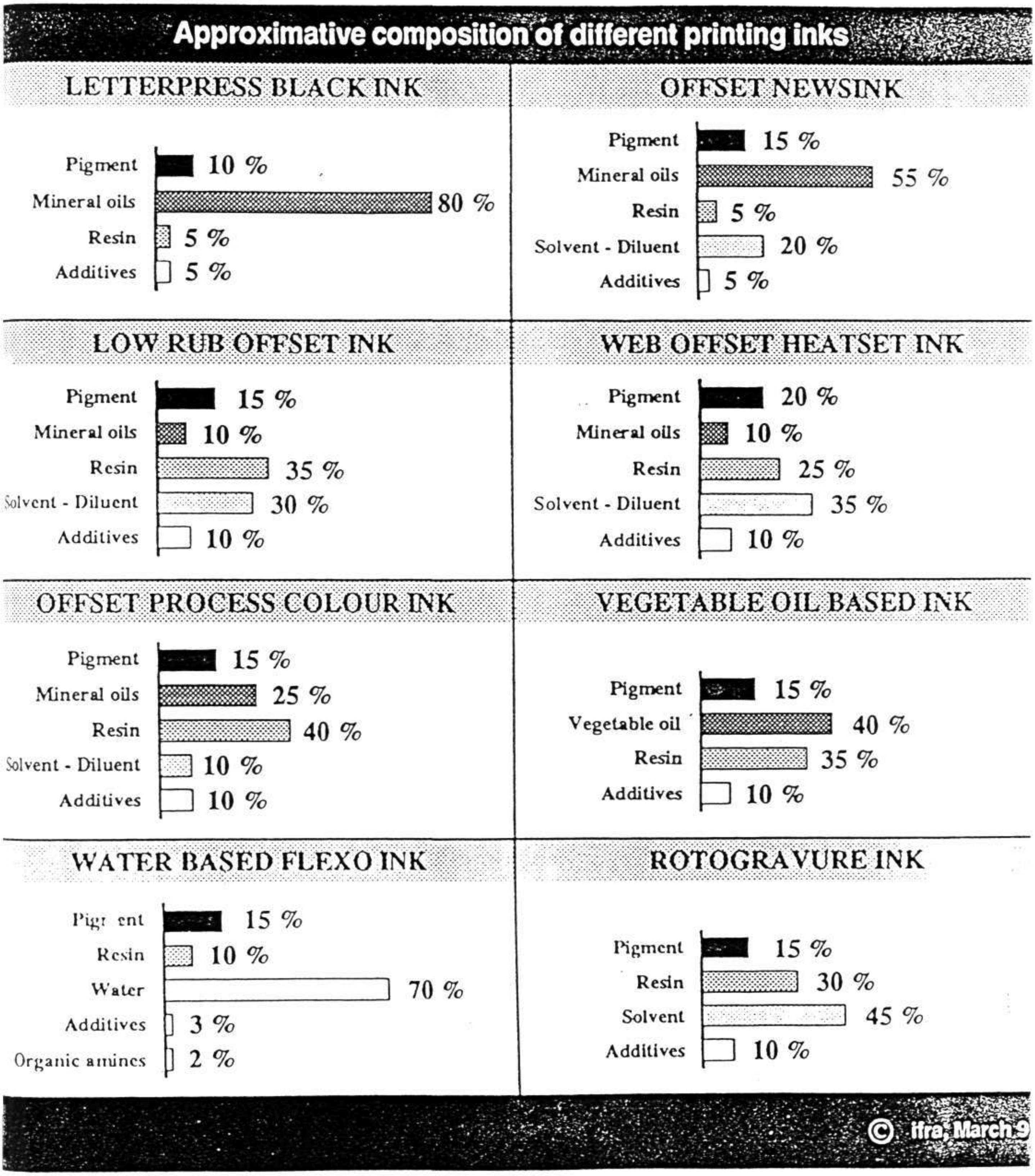
Approximative composition of different printing inks
LETTERPRESS BLACK INK
Pigment 10 %
Mineral oils 80 %
Resin 5 %
Additives 5 %
OFFSET NEWSINK
Pigment 15 %
Mineral oils 55 %
Resin 5 %
Solvent - Diluent 20 %
Additives 5 %
LOW RUB OFFSET INK
Pigment 15 %
Mineral oils 10 %
Resin 35 %
Solvent - Diluent 30 %
Additives 10 %
WEB OFFSET HEATSET INK
Pigment 20 %
Mineral oils 10 %
Resin 25 %
Solvent - Diluent 35 %
Additives 10 %
OFFSET PROCESS COLOUR INK
Pigment 15 %
Mineral oils 25 %
Resin 40 %
Solvent - Diluent 10 %
Additives 10 %
VEGETABLE OIL BASED INK
Pigment 15 %
Vegetable oil 40 %
Resin 35 %
Additives 10 %
WATER BASED FLEXO INK
Pigment 15 %
Resin 10 %
Water 70 %
Additives 3 %
Organic amines 2 %
ROTOGRAVURE INK
Pigment 15 %
Resin 30 %
Solvent 45 %
Additives 10 %
© ifra, March 9

The drying of the ink

Penetration and absorption drying

Oxidation drying

Precipitation and neutralisation

Evaporation

UV curing

Infra-red drying

Microwave or radio frequency drying

Electron beam curing

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TESTING METHODS

- Viscosity
- Length
- Tack
- Surface energy
- Water acceptance
- Print density
- Ink requirement
- Print-through
- Set-off
- Rub-off

properties.

VISCOSITY

Definition

The resistance of a fluid to flow is called **viscosity**. Because of this resistance, energy must be continuously added in order to maintain the flow of a liquid.

Viscosity gives expression to the drag which adjacent layers of a fluid exert on each other when subjected to a shear force. Figure 1 illustrates the situation in the basic geometry of fluid flow, namely flow between parallel plates. Ink flow as it occurs in the press is a modification of the flow described by this simple geometry.

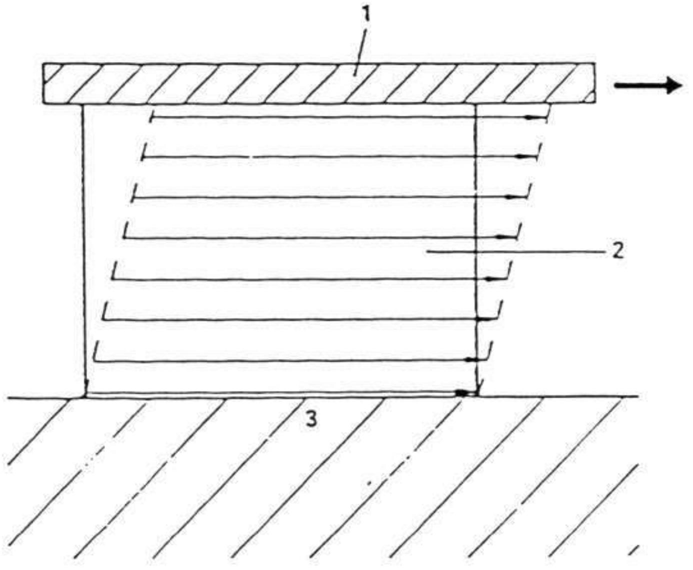


Figure 1. The flow of a liquid between two parallel plates.

The entire flow behaviour of an ink is depicted by the flow curve or rheogram which shows the relationship between a dimensionless speed, the shear rate D (s^{-1}) and the resulting force per unit area, the shear stress τ (Pa).

Shear rate gives expression to the drop of speed (in the direction of the applied force) over the thickness of the liquid layer. The force per unit in plain area needed to maintain a given shear rate is called the shear stress.

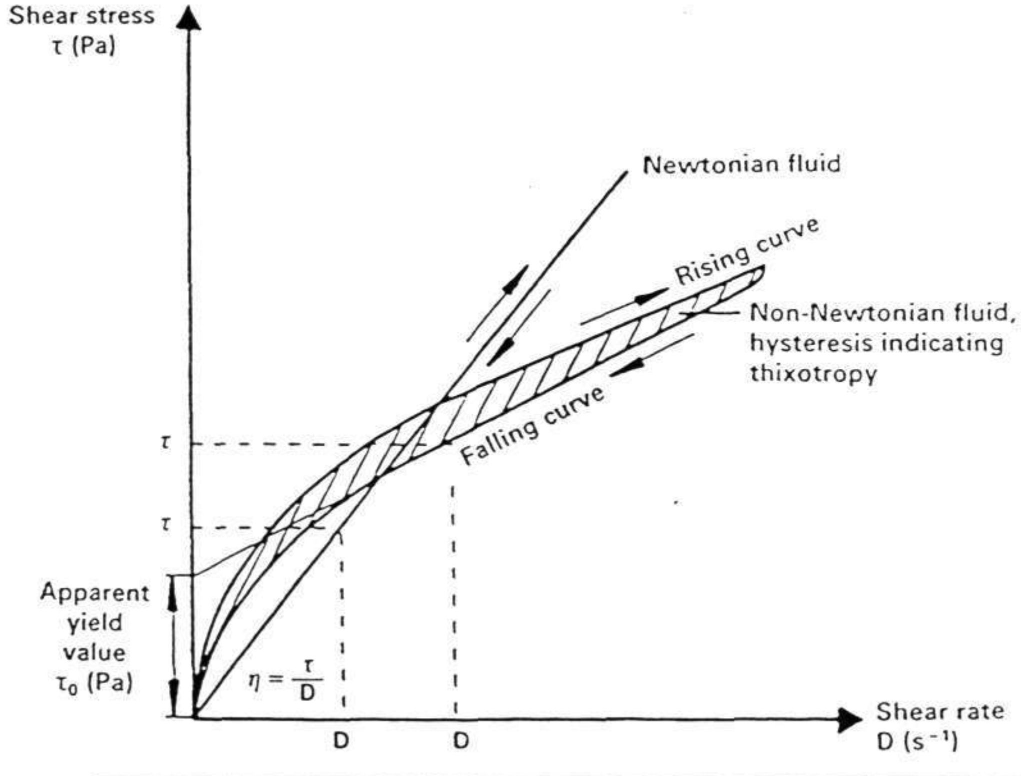
Two typical flow curves are shown in Figure 2. The basic parameter is viscosity which is defined as the ratio

$$\eta = \frac{\tau}{D}$$

where η is the viscosity (Pa s)
τ is the shear stress (Pa)
D is the shear rate (s^{-1})

When the relationship between shear stress and shear rate is linear, viscosity is independent of shear rate and then the fluid is called a Newtonian fluid. In other cases, more than one parameter is required to characterize the flow curve. When viscosity is dependent on the rate of shear the fluid is called a plastic fluid. For a plastic fluid, therefore, it is necessary to quote the corresponding rate of shear when quoting a viscosity value.

Viscosity also varies somewhat depending on the earlier history of shearing. The property which characterizes the magnitude of a decrease in viscosity is called **thixotropy**. In flow curve measurement, thixotropic behaviour becomes evident in that viscosity is different depending on whether the shear rate is increased or decreased. Increasing the shear rate from a state of rest breaks down structural forces in the liquid and thus lowers the viscosity. With decreasing shear rate, the fluid has no time to form a structure and this gives rise to a hysteresis loop in the flow curve.



Temp. °C	General behaviour of the ink	Relaxation period s	Viscosity: Stable viscosity level	Viscosity: Fixed shear rate, 250 s^{-1}	Yield value	Phase lag (elasticity)	Thixotropy	Rec. time s
23	Almost Newtonian	~0.8	15 Pas at 30 s^{-1}	15 Pas *	No	75°-80°	No	Immediate
40	Newtonian		2 Pas at 200 s^{-1}	2 Pas *	No	80°-83°		
23	Distinct Pseudoplastic	~0.5	4 Pas at 230 s^{-1}	3.5 Pas	~15 Pa	35°-65°	Strong	~200
40	Distinct Pseudoplastic		2 Pas at 220 s^{-1}	1.5 Pas	<10 Pa	25°-55°		
23	Weak pseudoplastic	~10	5 Pas at 370 s^{-1}	5.5 Pas	No	62°-66°	Weak ~3 s^{-1}	~60
40	Almost Newtonian		2.5 Pas at 370 s^{-1}	3 Pas	No	60°-66°		
23	Almost Newtonian	~0.5	10 Pas at 230 s^{-1}	10 Pas	No	62°-67°	No	~110
40	Weak pseudoplastic		2 Pas at 360 s^{-1}	2 Pas	No	65°-67°		
23	Distinct Pseudoplastic	~0.5	8 Pas at 150 s^{-1}	7 Pas	No	70°-74°	Weak ~5 s^{-1}	~30
40	Distinct Pseudoplastic		2.5 Pas at 230 s^{-1}	2 Pas	No	70°-74°		
23	Weak pseudoplastic	~0.3	5 Pas at 150 s^{-1}	4 Pas *	No	60°-66°	Strong ~2 s^{-1}	~45
40	Weak pseudoplastic		1.5 Pas at 240 s^{-1}	1.5 Pas	No	48°-62°		

Shear rate (s^{-1})	Viscosity (Pa s)	Change in viscosity (Pa s/s^{-1})
1	50 ± 10	2.8000
10	25 ± 5	0.1100
10^2	15 ± 5	0.0100
10^3	6 ± 2	0.0002
10^4	4 ± 1	≤ 0.0001

Shear rates ranging from 0 to 10^2 (s^{-1}) can occur in different regions of a roller nip, influencing ink transfer. This is one reason why the complete prediction of ink behaviour requires knowledge not only of the viscosity at a given shear rate but also the whole rheogram of the ink, i.e. the shear stress vs. shear rate relationship. For practical purposes, however, it suffices to cover a shear rate range of two powers of ten. Ink transfer mechanisms are dealt with in more detail in Chapter 6.

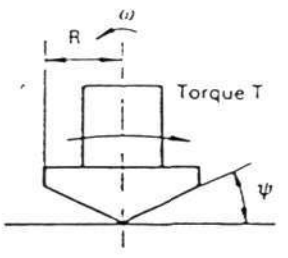
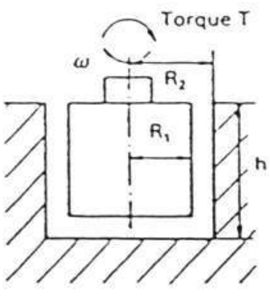
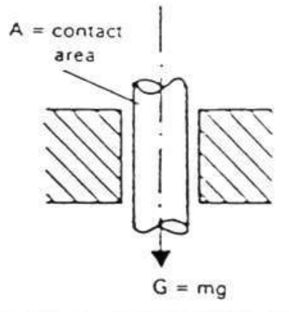
Temperature	(°C)	10	23	40
Viscosity	(Pa s)	13.1	7.8	2.9

Viscosity measurements should therefore be made at a standard temperature — most commonly at 23°C. In addition, the temperature dependence of the viscosity should be checked by determining the viscosity at different temperatures, preferably at 40°C, to take into account temperature increases in the press and, say at 10°C to represent low temperature storage conditions. High viscosity at low temperature may cause difficulties in ink pumping, whereas low viscosity at an increased temperature may contribute to excessive ink penetration into the paper in the printing nip.

Determination methods

Newsink viscosity is measured using a viscometer. Most viscometers in use operate according to one or other of the following principles:

Coaxial cylinder
Cone/plate
Falling rod

FIGURE			
TYPE	Cone-plate	Coaxial cylinder	Falling rod
CALCULATION OF NEWTONIAN VISCOSITY	$\eta = \frac{3\,T}{2\pi R^3} \cdot \frac{\psi}{\omega}$	$\eta = \frac{T}{4\pi h\omega}\left[\frac{1}{R_1^2} + \frac{1}{R_2^2}\right]$	$\eta = k \cdot Gt$
SHEAR RATE RANGE AVAILABLE (s^{-1})	$10^{-4} \ldots 10^3$ (10^4)	$10^{-4} \ldots 10^3$	$10 \ldots 10^4$
ADVANTAGES	Small sample Quick operation Easy to clean	Versatility	Simple construction
DIS-ADVANTAGES	Occasional edge effects (ink sample leaving the nip)	Difficult to clean	Lack of thermostating possibilities

G = m · g = weight
g = acceleration due to gravity
ψ = cone angle
ω = rotational frequency, revolutions per second
T = torque
t = time
k = proportional factor

Figure 3. Main types of viscometers for determining the viscosity of newsinks.

INK LENGTH

Definition

At higher shear rates, the relationship between shear rate and shear stress is almost linear (Newtonian). This can also be seen from Figure 2 in Section 5.4.1. The intercept of this linear part of the curve on the shear stress axis is defined as the apparent yield value. It expresses the amount of shear stress which is needed to break up the structure in the ink and to give rise to an almost Newtonian type of flow. However, for many newsinks a linear part cannot be found on the curve and hence no apparent yield value can be defined. Ink may also require a certain magnitude of applied stress to cause flow at all. This stress, which is usually very small, is called the true yield value.

The shape of the flow curve characterizes the consistency of an ink. A curved shape at low rates of shear implies that the ink has low cohesion: in other words it is short. The higher the apparent yield value in relation to ink viscosity, the shorter the ink. Conversely, if the flow curve resembles a straight line, the ink is long.

In a simple form **ink length** has been defined as the ratio of viscosity and apparent yield value (Zettlemoyer, 1955):

$$\text{Ink length} = \frac{\eta}{\tau_0} = \frac{\text{viscosity}}{\text{app. yield value}}$$

Determination method

According to Zettlemoyer, ink length is determined from a flow curve obtained as described in Section 5.4.1.

INK TACK

Definition

Tack is a measure of the split resistance of an ink. This is a complex property and can depend on a number of mechanisms appearing in a nip, e.g. type of flow, cohesion of the ink (i.e. inherent ink strength), cavitation (i.e. formation of micro-cavities and ink filaments), and surface energy phenomena (surface energy means the energy required to form new surfaces). See also Table 1 and Chapter 6.

Which mechanism becomes dominant in a given situation depends not only on the level of the rheological and physio-chemical properties of the ink, but also on the measuring conditions, such as speed, ink film thickness, roller characteristics, and nip pressure. Table 1 indicates the relative significance of the above-mentioned mechanisms in determining the tack reading under different testing conditions.

Change in the relative significance of	Increase of Speed	Film thickness	Roller hardness	Pressure
Ink flow behaviour	+	+	−	+
Surface energy phenomena	−	−	+	−
Cohesion and cavitation	+	−	+	−

+ = Increased significance of a mechanism due to an increase in level of the parameter in question.
− = Reduced significance of a mechanism due to an increase in level of the parameter in question.

Table 1. Changes in the relative significance of different mechanisms which determine tack under varying testing conditions.

Speed (m/s)	1	2	4
Tack	80 ± 30	95 ± 40	120 ± 30

nk code	Temperature °C Room	System	50 m/min. 0 min.	200 m/min. 0 min.	1 min.	5 min.	10 min.
G	23.6	24.7	3.5	7.7	7.7	7.5	7.7
R	23.7	24.8	1.7	3.6	3.7	3.9	4.1
S	23.5	24.8	2.1	4.1	4.2	4.3	4.5
H1	24.5	24.9	1.7	3.6	3.6	3.6	3.7
H2	24.6	25.0	1.9	4.2	4.2	4.2	4.2
Ref.	23.0	24.7	1.4	2.9	2.8	2.9	2.9

Tack measurements of the inks carried out on Prüfbau Inkomat 364.

SURFACE ENERGY

Definition

The forces that hold materials together are commonly divided into *adhesive forces*, acting in the interface between two different materials, and *cohesive forces*, acting between the molecules of a given material. Part of the adhesive forces acting at the surface are uncompensated and this gives rise to a **surface energy** which strives to reduce the surface area to a minimum. Increasing the surface area requires work to be done to overcome this surface energy.

In the case of a liquid, surface energy against air is most commonly called *surface tension*, while the surface energy in the interface between two liquids is called *interfacial tension*. Surface tension explains the tendency of a liquid to form droplets, and can easily be measured. The surface energy of a solid, on the other hand, cannot be measured directly. It can be estimated indirectly as the ability of a liquid with a given surface tension to wet the surface, i.e. *wettability*.

The ability of a liquid to spread or to form droplets on the surface of a solid (or another liquid) is governed by the surface tension γ_L of the liquid, the surface tension γ_S of the solid, and the interfacial tension γ_{SL} between the solid and the liquid. At equilibrium (Figure 1), Yong's equation must be satisfied. The lower the interfacial tension, the more apt the liquid is to spread.

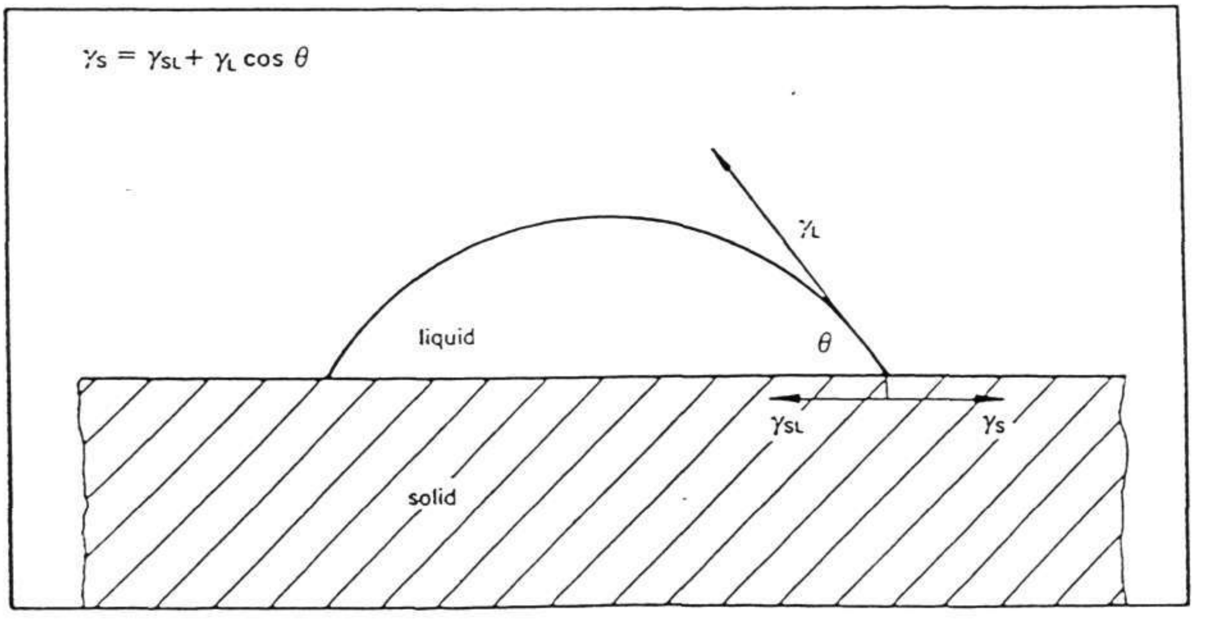
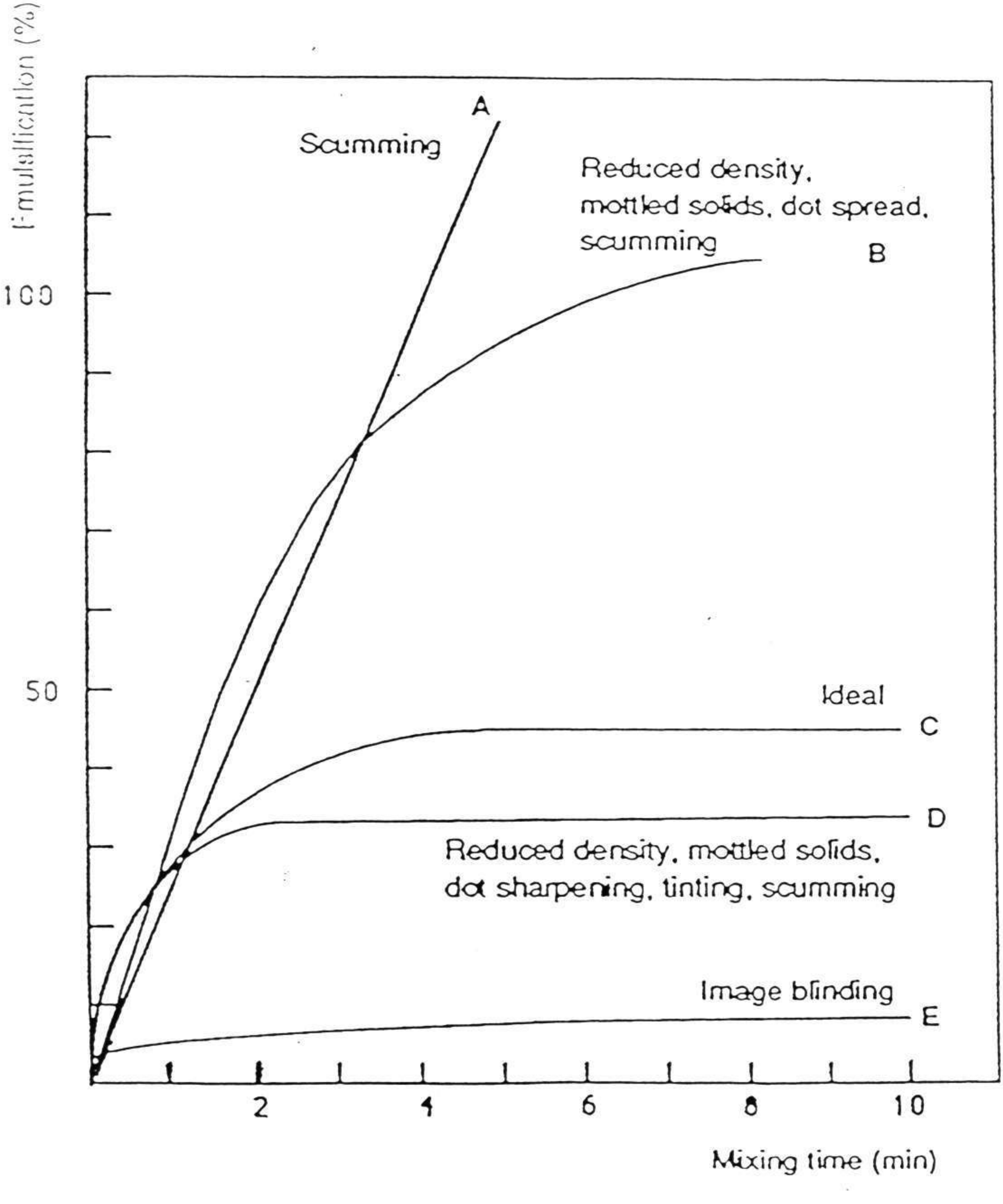


Figure 1. Yong's surface tension equilibrium.

The spreading and non-spreading of water and ink are of fundamental importance for the function of lithographic processes. The damping solution must only spread in the non-image

WATER ACCEPTANCE OF OFFSET NEWSINK



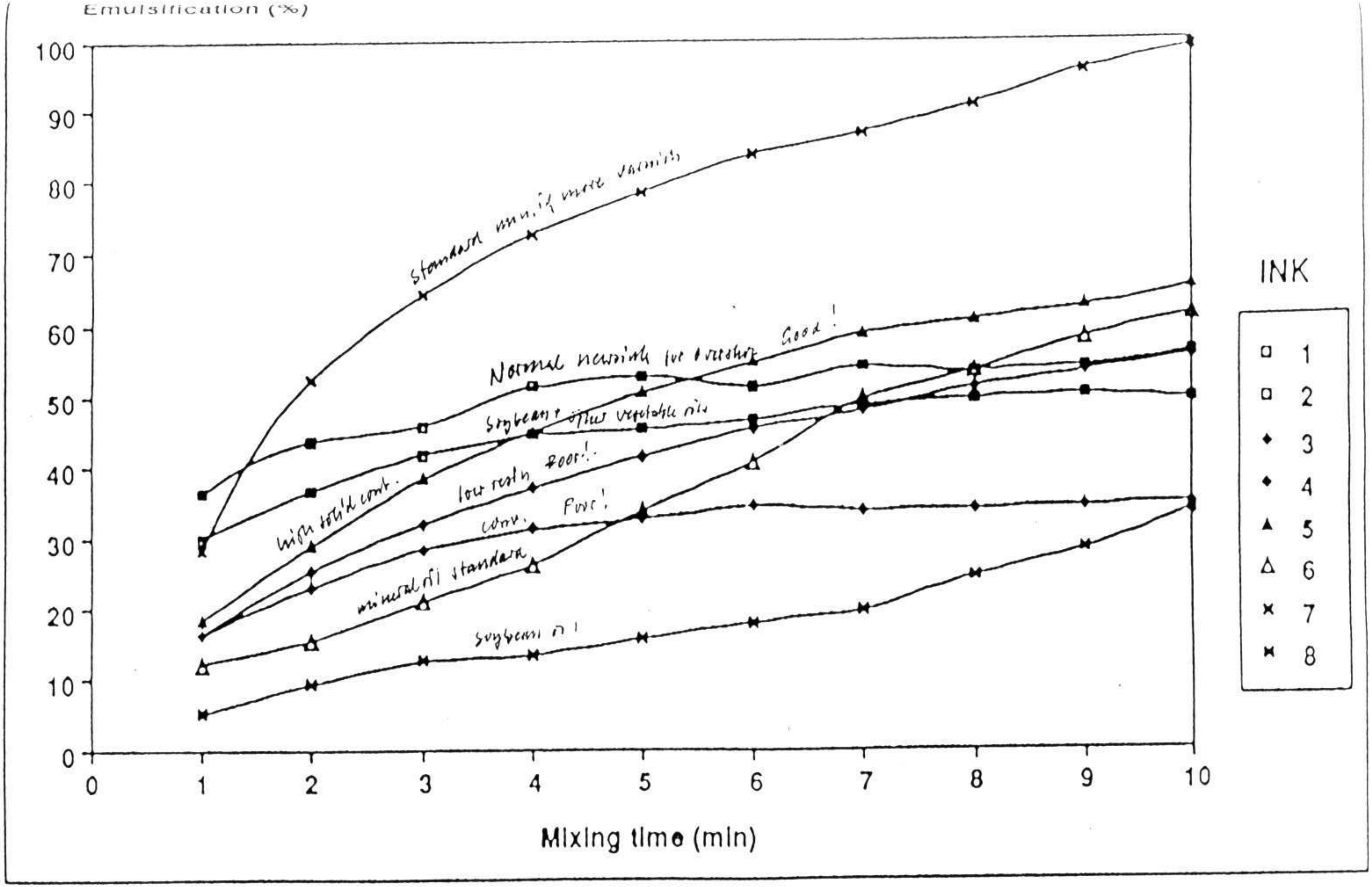
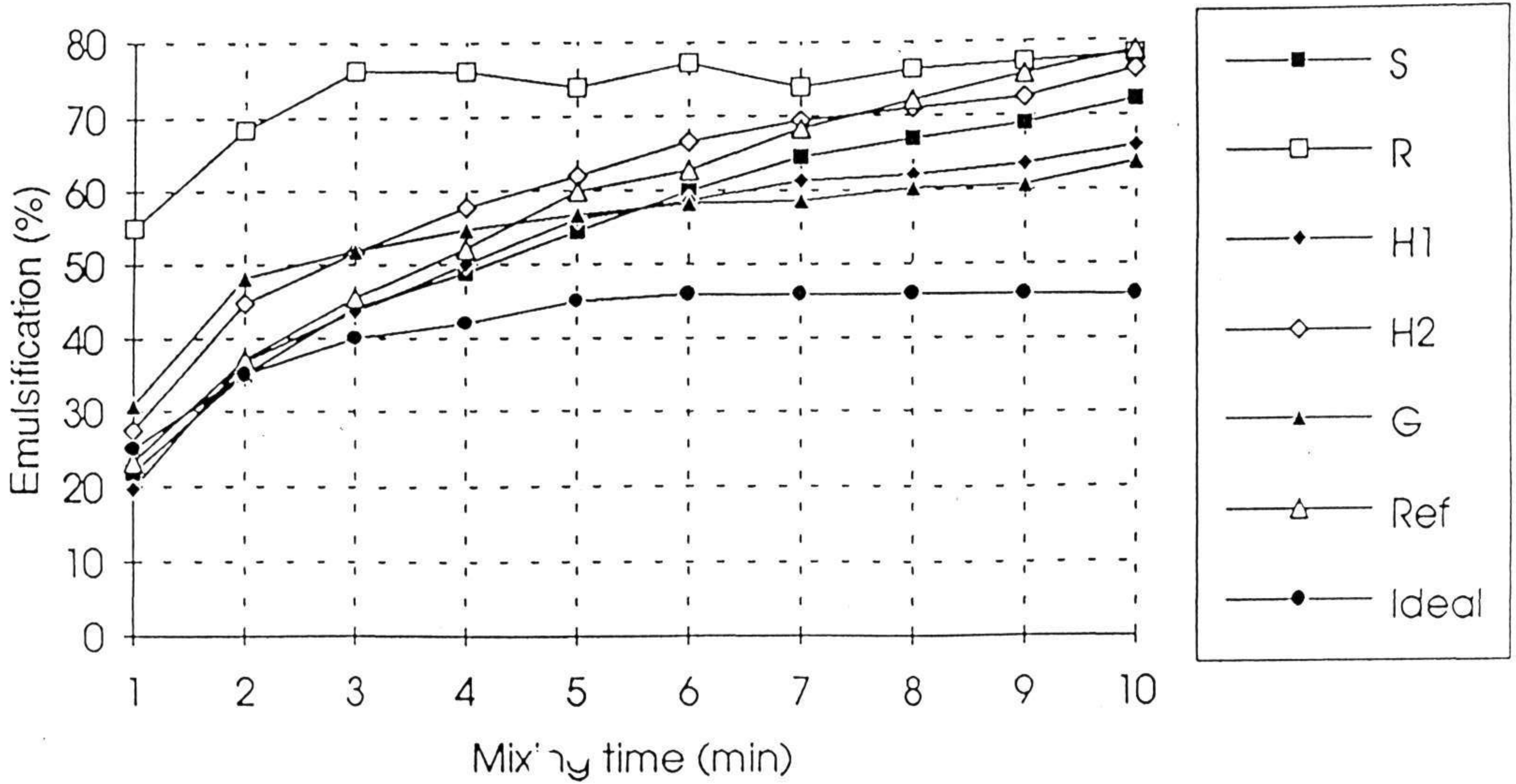


Figure 2.7. The dependence of er⁻ulsification on mixing time.

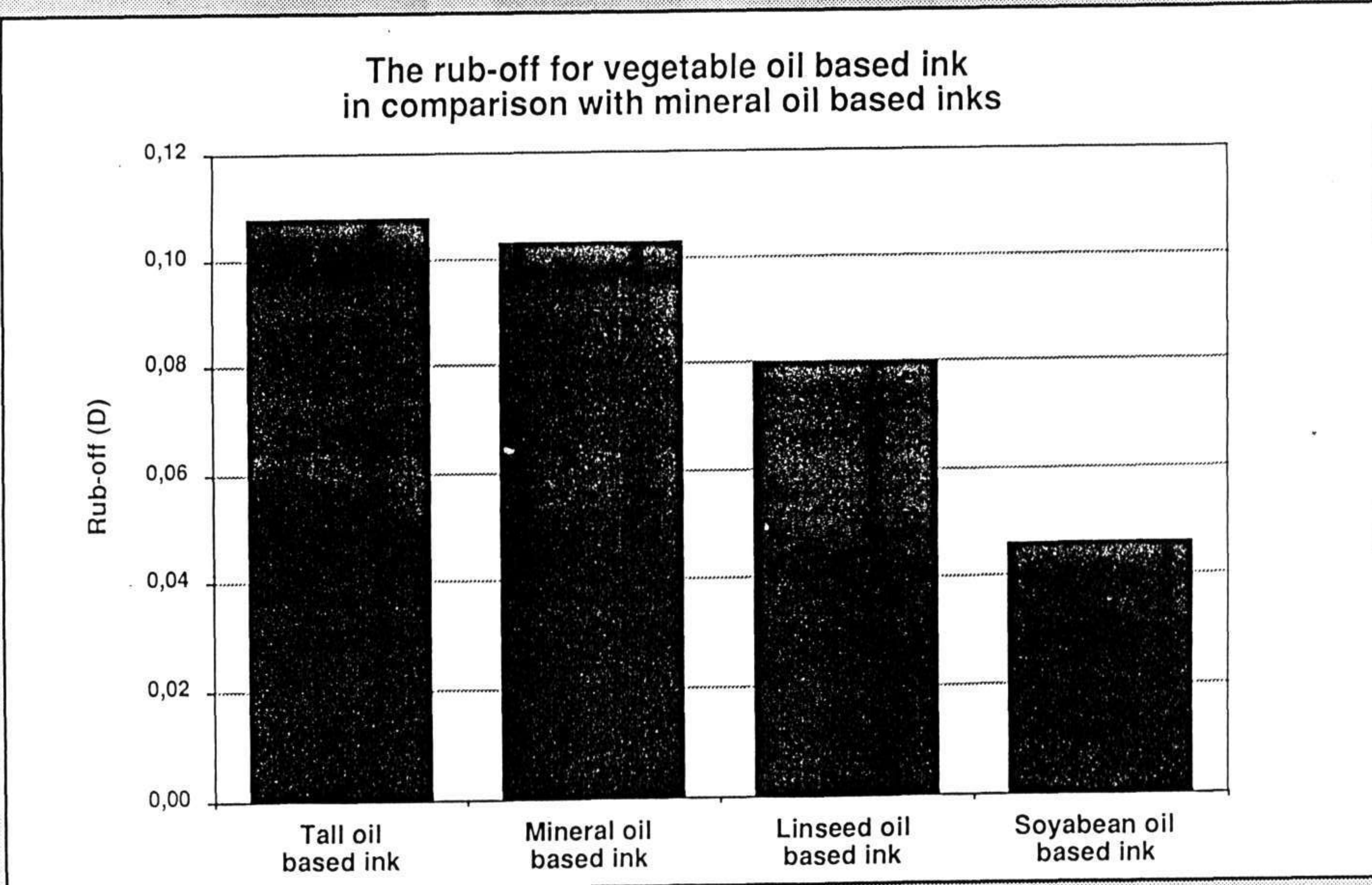
Sicpa-Winter Web	S	Hostmann-Steinberg Special	H2
Lorilleux Rotolit KBA	R	Gebr. Schmidt Ro-zet	G
Hostmann-Steinberg Standard	H1	Suomen Uusioväri (Reference)	Ref

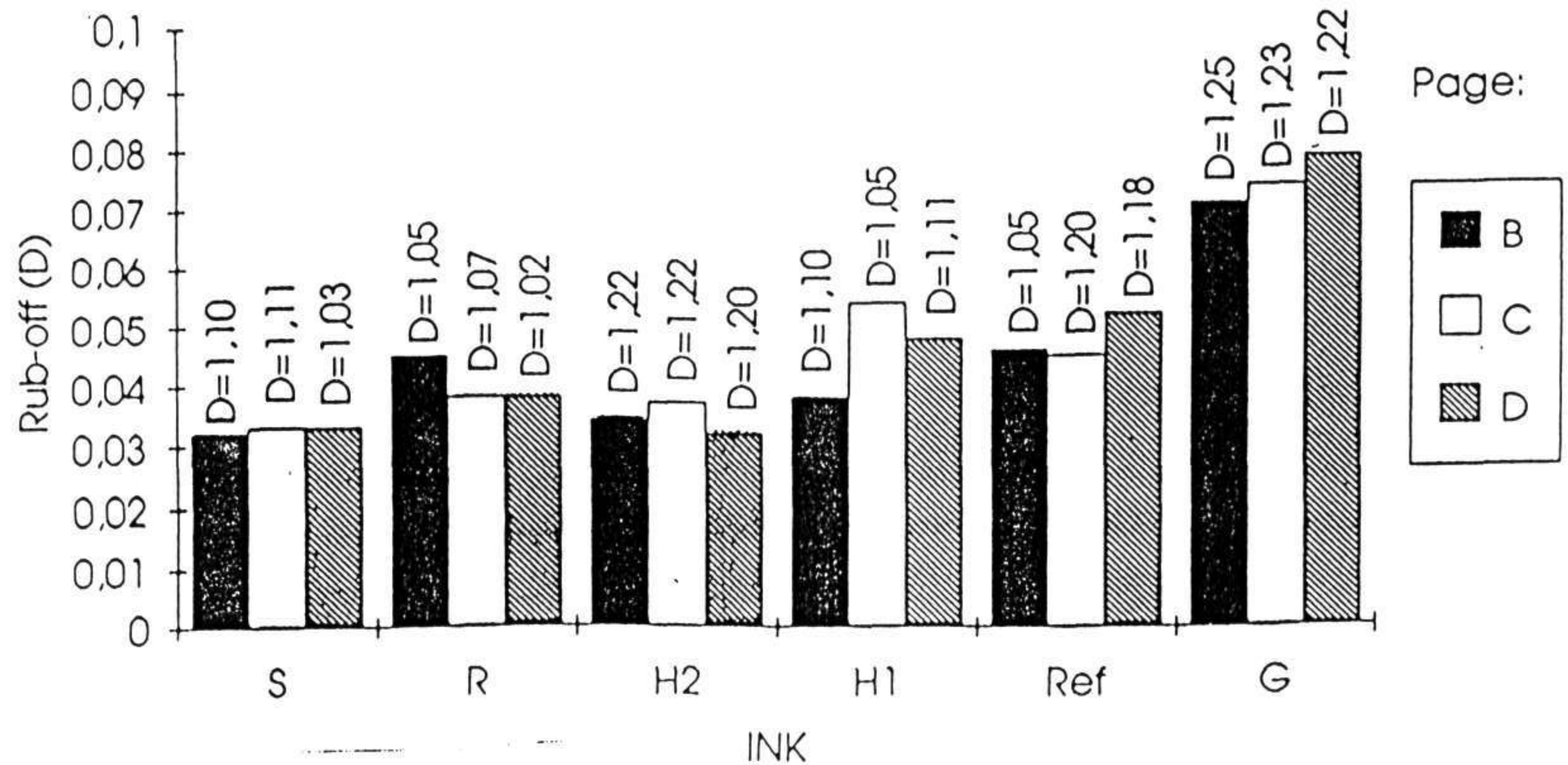


PRINTED WITH
SOY INK

Trademark of American Soybean Association

Results from the printing trials at Aamulehti





Rub-off (D)
0,1
0,09
0,08
0,07
0,06
0,05
0,04
0,03
0,02
0,01
0
D=1,10
D=1,11
D=1,03
D=1,05
D=1,07
D=1,02
D=1,22
D=1,22
D=1,20
D=1,10
D=1,05
D=1,11
D=1,05
D=1,20
D=1,18
D=1,25
D=1,23
D=1,22
S
R
H2
H1
Ref
G
INK
Page:
B
C
D

PRINT DENSITY

Definition

The **density of a print** can be expressed either as a relative or as an absolute density. The relative print density is most commonly used, and this is defined as Brigg's logarithm for the ratio between the reflectance of an opaque pad of the paper and the reflectance of the printed surface:

$$\text{Relative print density} = \log_{10} \frac{\text{(reflectance of paper)}}{\text{(reflectance of print)}}$$

Absolute print density is defined as:

$$\text{Absolute print density} = \log_{10} \frac{100}{\text{(reflectance of print)}}$$

where 100 stands for the reflectance of the white standard.

Units

Print density is a dimensionless quantity.

Normal values or recommendations

No international standardized procedure for measuring print density exists, mainly because of the range of different densitometer geometries and filter sets used.

However, when using a densitometer with narrow band and polarization filters, several industry standards in various countries, as well as IFRA's recommendation, specify the following for multicolour printing:

Printing density in colours (cyan, magenta and yellow): 0.90 ± 0.10.

Print density in black: 1.10 ± 0.10.

Determination methods

Print density can be determined using either a reflectometer (e.g. Elrepho) or a densitometer. Densitometers are more convenient to use, but the size of their measuring aperture is small in relation to the variations in print density of prints on the irregular surface of the newsprint sheet. This means that a greater number of single measurements have to be taken to obtain a reliable figure for the print density. Both reflectometers and densitometers can be used for black and colour print evaluation. All measurements have to be made with an opaque pad of the unprinted paper as background.

Special Report 1.7

In general, we recommend the printer to set in-house target values and tolerances for ink printability properties. General guidelines for these values are given in Chapter 4 of this report, but they should be agreed upon individually (including measuring methods) by the printer and the ink manufacturer.

Following measurements (described in the IFRA Newsprint and Newsink Guide Chapter 5.4) can be considered as suitable for newspapers:

- ink mileage
- print through
- set-off
- rub-off

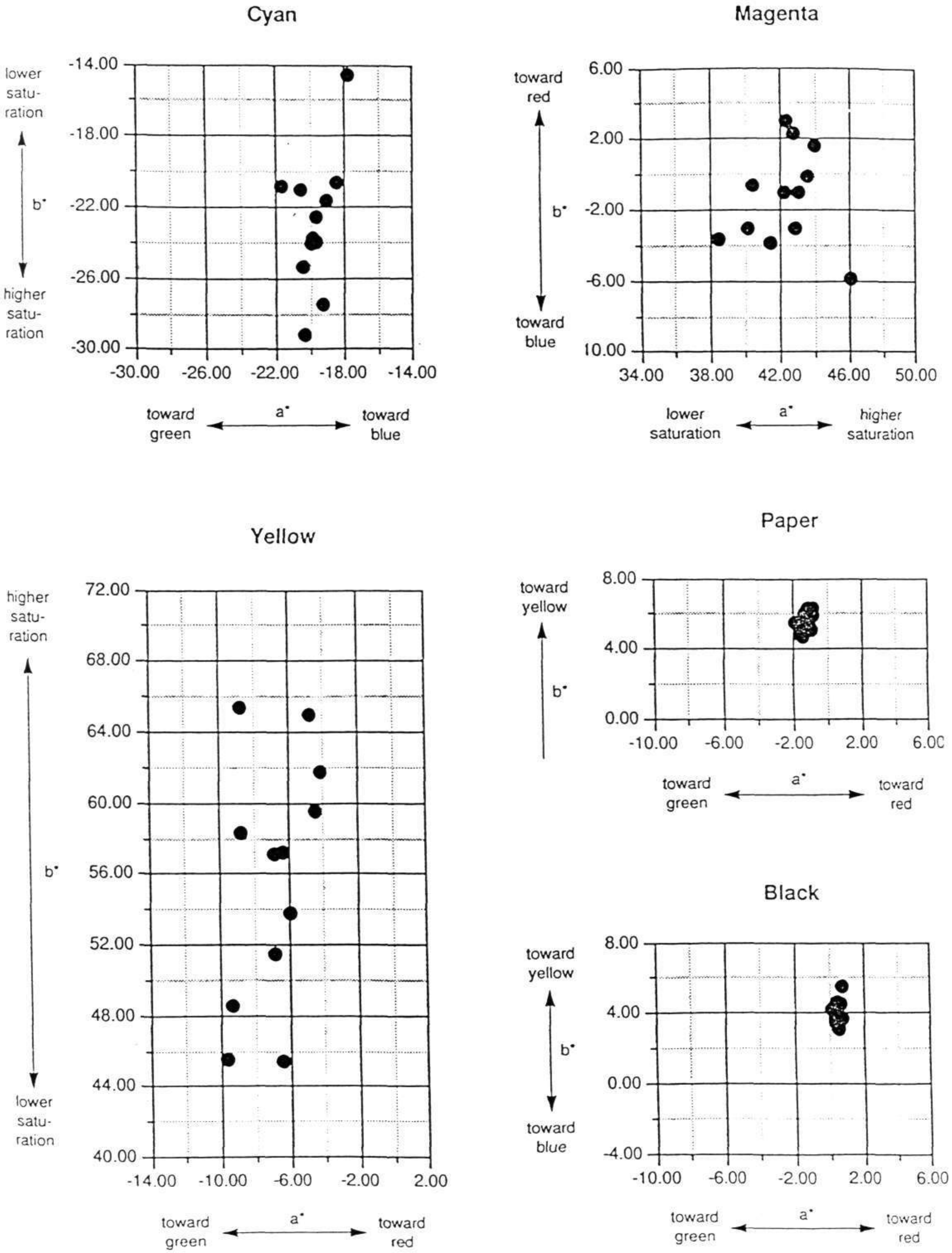
They can be used by specifying the testing conditions — such as test press (IGT or Prüfbau), paper grade (standard newsprint 40 or 45 g/m^2), and test performer (preferably the ink manufacturer). In principle, each delivery should be checked against these in-house target values.

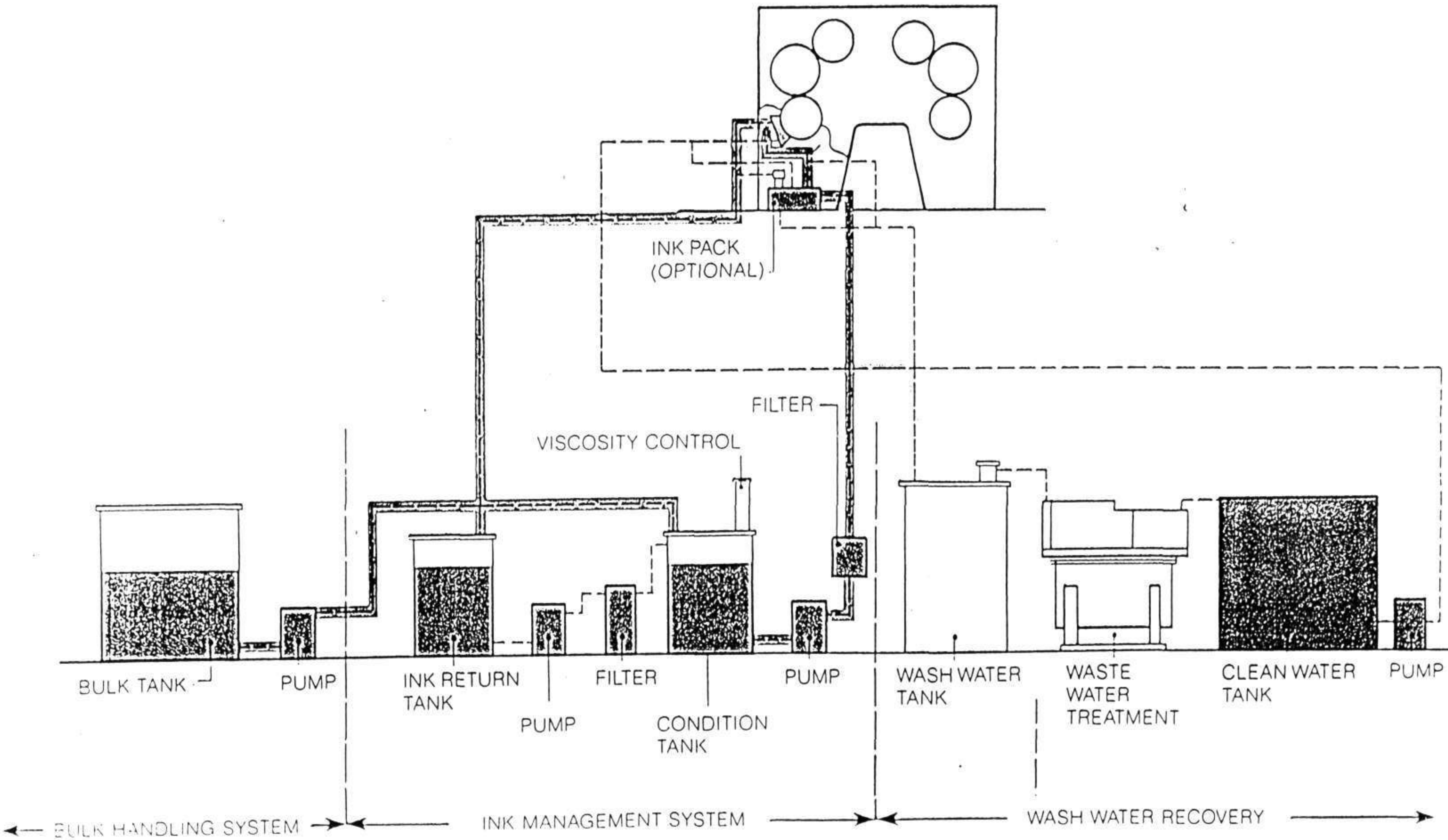
Regarding ink runnability, we recommend the rheological properties to be specified individually for each combination of press and ink type (ink manufacturer). This is done by determining the properties of inks with good on-press behaviour. Adequate measuring methods have again been given in the IFRA Newsprint and Newsink Guide Chapter 5.4 for ink viscosity, yield value (ink length) and tack. The testing conditions should always be specified.

Ink requirement	**$\leq$ 1.35 g/m^2**	(at density 1.10)
Set-off	**$\leq$ 0.4 D**	(measured after 0.017 s)
Rub-off	**$\leq$ 0.03 D**	(4 hours after printing)
Print-through	**$\leq$ 0.06 D**	(standard newsprint)

All the values refer to IGT test printings on newsprint (42.3 g/m^2) at a printing speed of 4 m/s and an impression setting of 20 kN/m. The target density was 1.10 measured with a Gretag D 186 densitometer with narrow band and polarising filters. Rub-off values were measured with PATRA, a rub tester as described in Chapters 3.1.3 and 3.2.

Colour values of the primary inks (as solid-tones) and of the paper white plotted in the CIELAB a*b*-diagram




INK PACK (OPTIONAL)
FILTER
VISCOSITY CONTROL
BULK TANK
PUMP
INK RETURN TANK
PUMP
FILTER
CONDITION TANK
PUMP
WASH WATER TANK
WASTE WATER TREATMENT
CLEAN WATER TANK
PUMP
BULK HANDLING SYSTEM
INK MANAGEMENT SYSTEM
WASH WATER RECOVERY

INK REQUIREMENT

Definition

Ink requirement is the amount of ink required per unit paper surface area to give a certain level of relative print density.*)

Units

In SI-units, the unit for ink requirement is kg/m². By convention, however, ink requirement is expressed in g/m².

Normal values or recommendations

Since there exists no standardized procedure for measuring ink requirement, no recommendations can be given.

By way of example, however, the ink requirement of 32 European black offset newsinks was found to vary from 1.05 to 1.65 g/m² at a print density level of 0.85 and from 1.65 to 2.30 g/m² at a density level of 0.95 when printed with an IGT test press on a normal 45 g/m² Scandinavian newsprint using rubber coated forms without water. (Lindqvist & Oittinen, 1980)

The ink requirement of 21 European black letterpress newsinks for photopolymer plates varied from 1.50 to 2.35 at a print density level of 0.85 when printed with a GFL test press on a normal 45 g/m² Scandinavian newsprint (Nyberg & Trollsas, 1984).

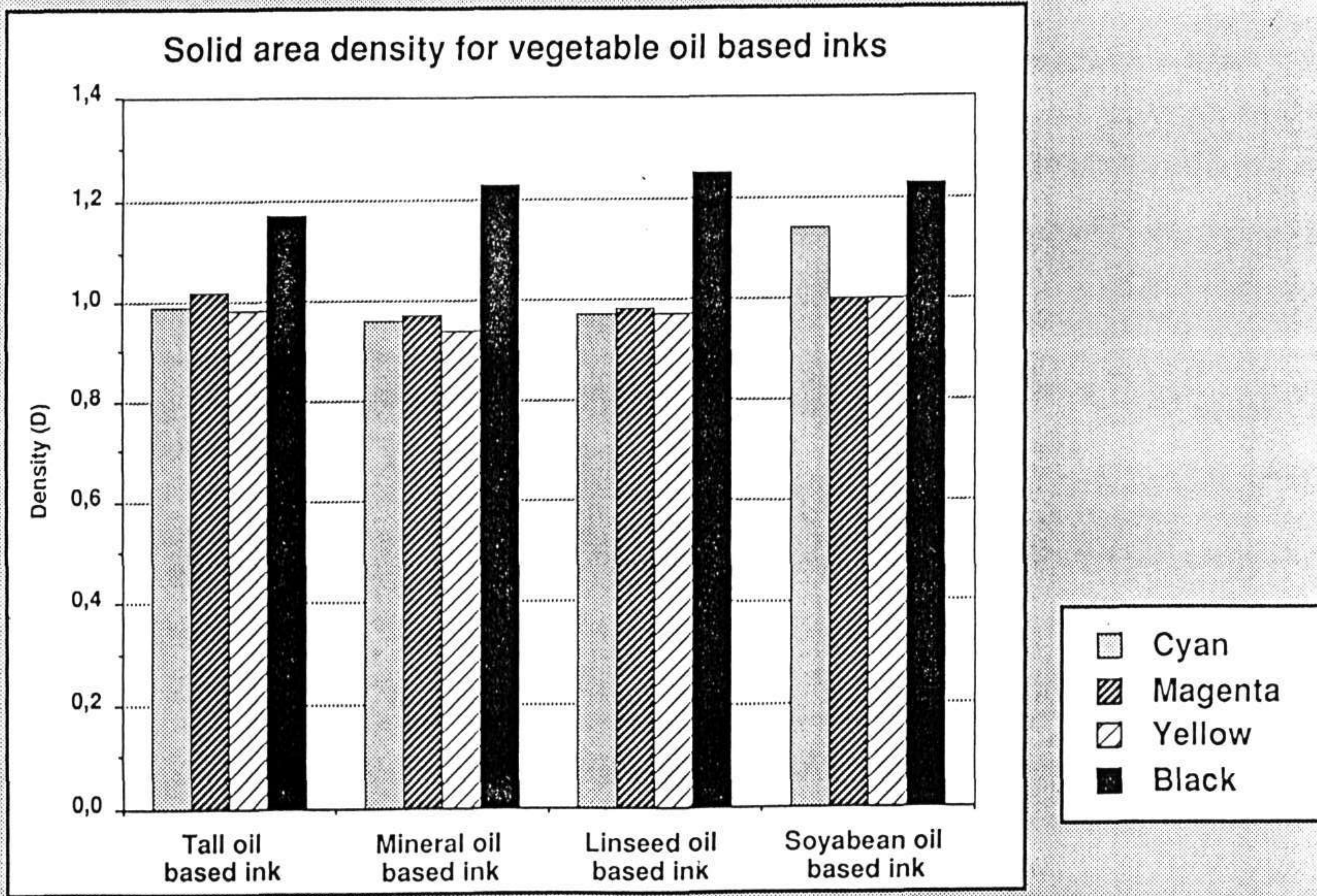
Determination method

The amount of ink transferred to the paper is determined by weighing and the corresponding print density is measured, preferably using a reflectometer.

Print density and the amount of ink on the paper are plotted against each other in a graph from which the ink requirement at any given point can be determined. Test prints are made with different amounts of ink on the paper, and ink requirement is evaluated at inking levels corresponding to given densities which are 0.85 for letterpress and 0.95 or 1.00 for offset.

*) Since ink requirement is commonly considered as a paper property, the conception **ink mileage** is often used in the sense of the corresponding ink property, and is then defined in exactly the same way as ink requirement.

Results from the printing trials at Aamulehti



PRINT-THROUGH

Definition

Print-through is most commonly defined as the relative print density of the reverse side of the printed paper.

$$\text{Print-through} = \log_{10} \frac{\text{(reflectance of reverse side of paper)}}{\text{(reflectance of reverse side of print)}}$$

Print-through results from the combined effects of ink penetration and the lack of opacity of the newsprint sheet.

Units

Print-through is a dimensionless quantity.

Normal values or recommendations

Print-through should be kept as low as possible, but since it is influenced by several parameters, no quantitive recommendations can be given.

In a test of 32 black European offset newsinks, print-through was found to vary from 0.044 to 0.061 at a relative print density level of 0.85 and from 0.049 to 0.070 at a level of 0.95, when tested on a normal 45 g/m² Scandinavian newsprint with an opacity of 93.0 (Lindqvist & Oittinen, 1980).

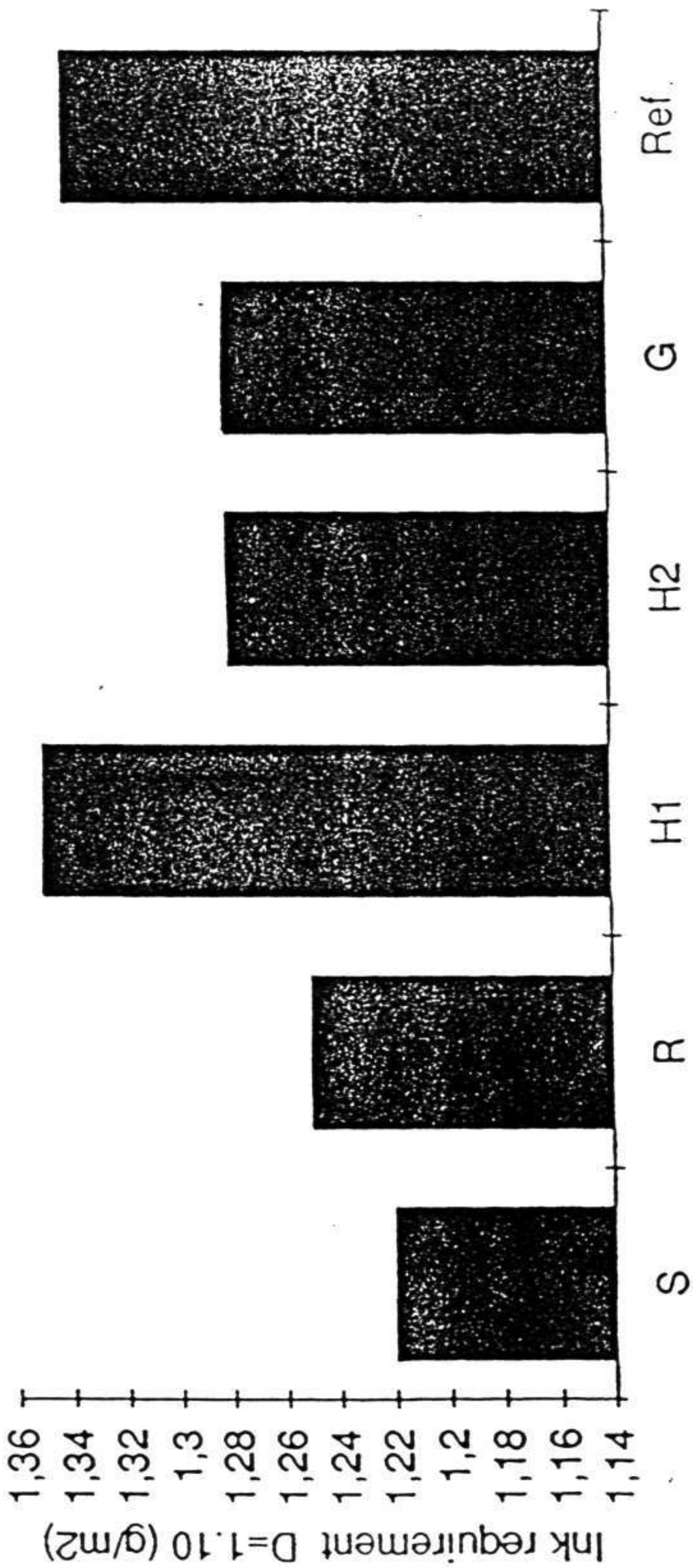
The print-through of 21 European black letterpress newsinks for photopolymer plates varied from 0.052 to 0.094 at a print density level of 0.85 when printed with a GFL test press on a normal 45 g/m² Scandinavian newsprint with an opacity of 92.2 (Nyberg & Trollsås, 1984).

Determination methods

Print-through can only be accurately determined with the aid of a reflectometer.

Test prints are made with different amounts of ink on the paper and print-through is evaluated at inking levels corresponding to given densities which are 0.85 for letterpress and 0.95 or 1.00 for offset.

Since print-through is time dependent, such measurements are carried out after a certain time, preferably 24 hours, after printing.


Ink requirement D=1.10 (g/m2)
1,14
1,16
1,18
1,2
1,22
1,24
1,26
1,28
1,3
1,32
1,34
1,36
S
R
H1
H2
G
Ref

SET-OFF

Definition

Set-off is a measure of the tendency of a freshly-printed ink layer to be partly transferred to a substrate coming into frictionless contact with the print. Set-off is defined as the relative print density of the transferred print.

$$\text{Set-off} = \log_{10} \frac{(\text{Reflectance of substrate})}{(\text{Reflectance of set-off print})}$$

Units

Set-off is a dimensionless quantity.

Normal values or recommendations

Since there exists no standardized procedure for measuring set-off, no recommendations can be given.

By way of example, however, in a test of 32 black European offset newsinks set-off was found to vary in the range of 0.12 to 0.18 at a print density level of 0.85 and in the range 0.19 to 0.28 at a print density level of 0.95. A normal Scandinavian newsprint of 45 g/m^2 was used for printing as well as a substrate. The time interval was 0.017 seconds (Lindqvist & Oittinen, 1980).

The set-off of 21 European black letterpress newsinks for photopolymer plates varied from 0.18 to 0.32 at a print density level of 0.85 when printed with a GFL test press (Nyberg & Trollsas, 1984). A normal Scandinavian newsprint of 45 g/m^2 was used for printing as well as a substrate. The time interval was 0.7 seconds.

Determination methods

Set-off is determined using a test printing device equipped with two separate printing nips or any similar construction, which enables printing from the freshly printed samples — also after short time intervals. A number of devices suitable for set-off tests are available.

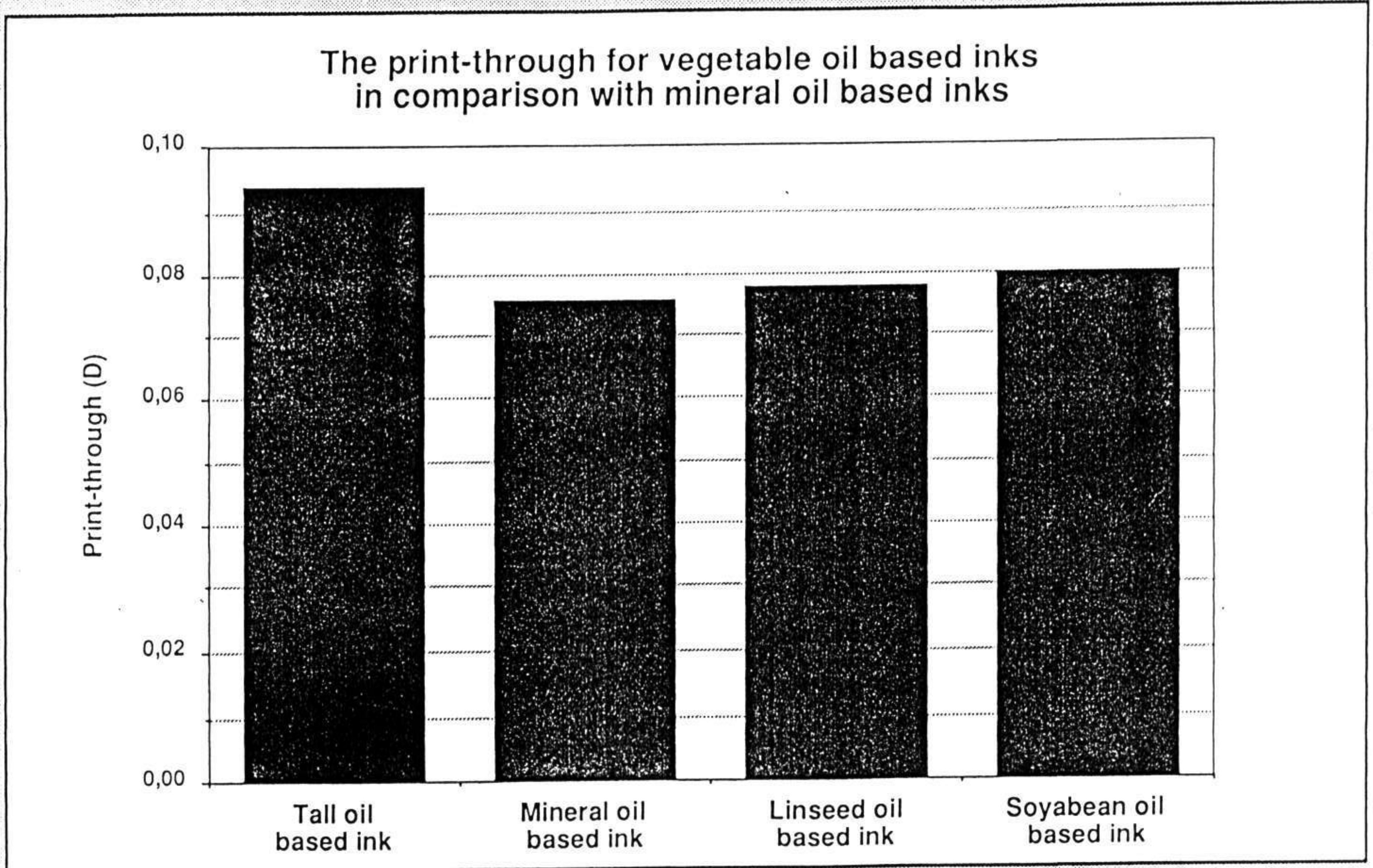
In the first nip, a quantity of ink is transferred to the paper. In the second nip, this printed strip is made to print onto a fresh paper strip of the same kind or onto some other substrate.

Set-off can only be accurately determined with the aid of a reflectometer.

Test prints are made with different amounts of ink on the paper and set-off is evaluated at inking levels corrresponding to given densities, which are 0.85 for letterpress and 0.95 or 1.00 for offset.

Since the results strongly depend on the time interval between the two printings, this must always be reported. Most commonly time intervals between 0.017 and 1 second are used. However, longer time intervals may be used in order to simulate set-off effects after the pressrun.

Results from the printing trials at Aamulehti



RUB-OFF

Definition

Rub-off is a measure of the tendency of a printed ink layer to be transferred to a substrate when mechanically rubbed against it. Rub-off can be defined as the relative print density of the transferred ink layer.

$$\text{Rub-off} = \log_{10} \frac{\text{(Reflectance of substrate)}}{\text{(Reflectance of substrate with transferred ink layer)}}$$

Units

Rub-off is a dimensionless quantity.

Normal values or recommendations

Since there exists no standardized procedure for measuring rub-off. no recommendations can be given.

By way of example, however, in a test of 32 black European offset newsinks, rub-off was found to vary in the range 0.02 to 0.10 at a print density level of 0.85 and in the range 0.02 to 0.12 at a print density level of 0.95. A normal Scandinavian newsprint of 45 g/m^2 was used for printing as well as the subtrate. The time interval was 24 hours. A PATRA Rub-off Tester was used.

The rub-off of 21 European black letterpress newsinks for photopolymer plates varied from 0.04 to 0.17 at a print density level of 0.85. A normal Scandinavian newsprint of 45 g/m^2 was used for printing and white linen was used as the substrate. The time interval was 24 hours. An Anderson & Sörensen Rub-off Tester was used (Nyberg & Trollsas, 1984).

Determination methods

Rub-off determination requires a laboratory test printing press and a special rub-testing device for rubbing the printed sample. A number of devices suitable for such rubbing tests are available.

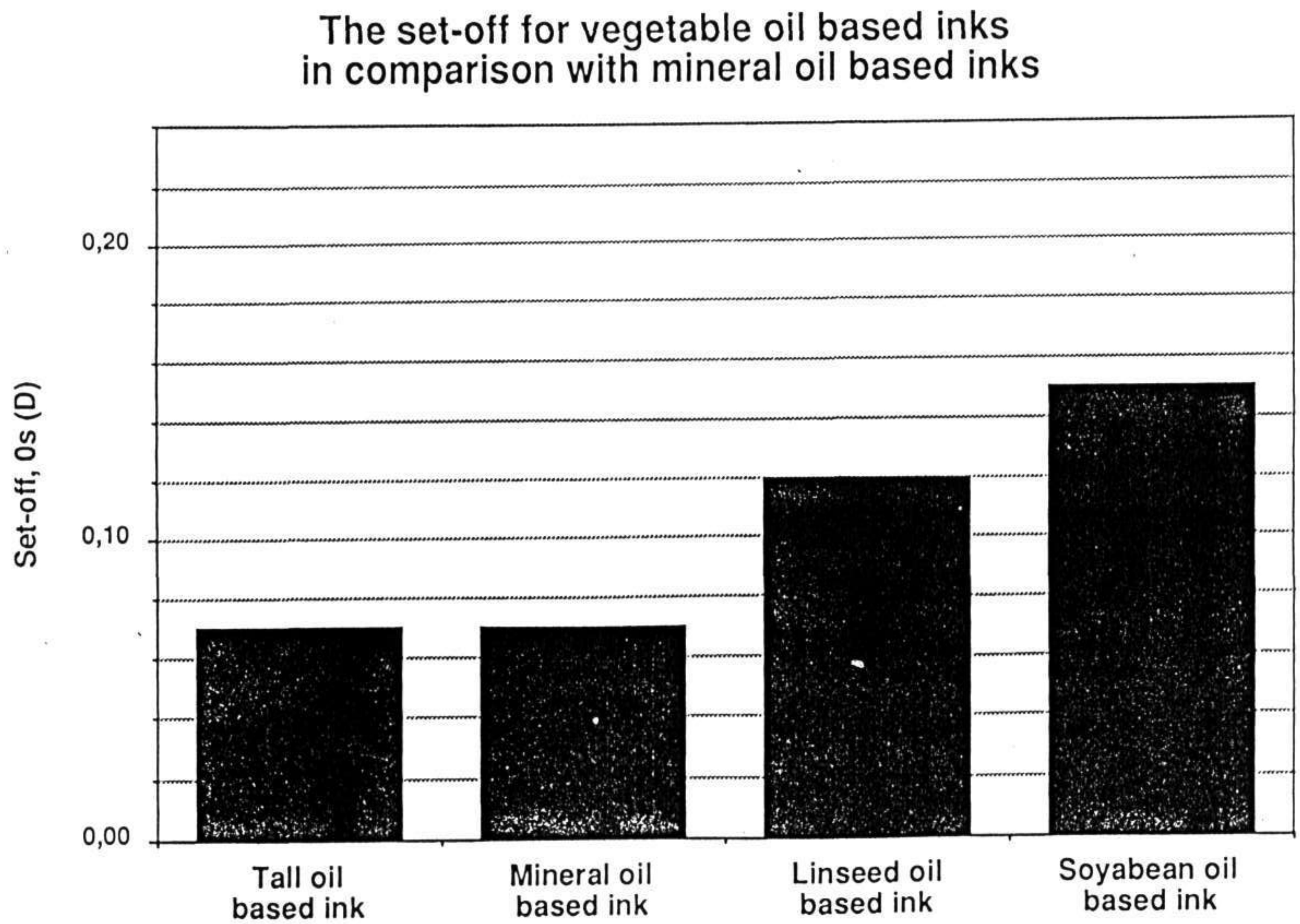
In the laboratory test printing press, a quantity of ink is transferred to the paper. The print is then rubbed against a fresh sheet of paper of the same kind or against some other substrate.

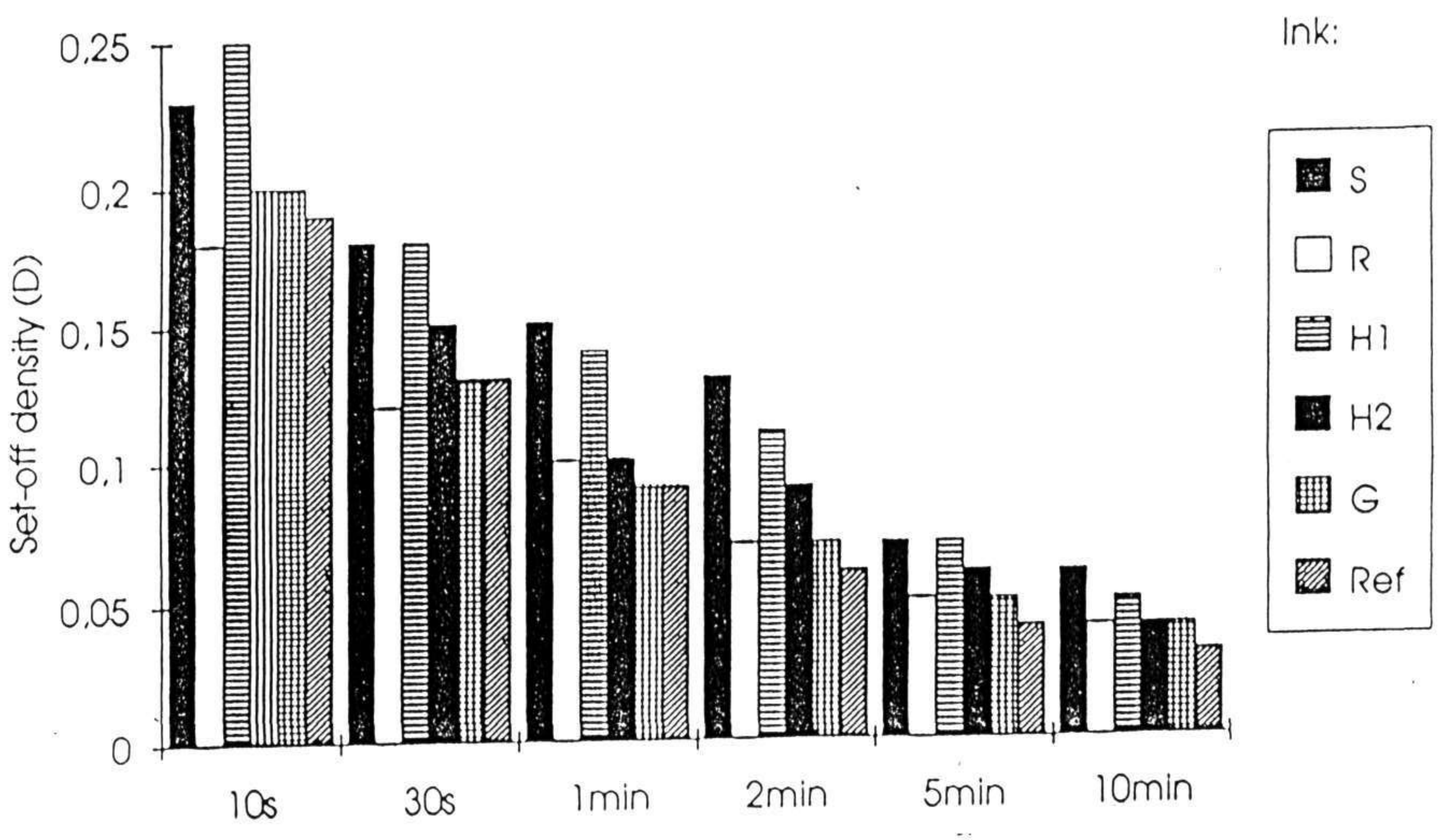
Test prints are made with different amounts of ink on the paper and rub-off is evaluated at inking levels corresponding to given densities which are 0.85 for letterpress and 0.95 or 1.00 for offset.

Since the results strongly depend on the time interval between the printing of the sample and the actual rub-test, this must always be reported. A time interval of 24 hours is most commonly used. The rubbing pressure, rubbing time, rubbing speed and the geometry of the rubbing device all influence the results and should be reported.

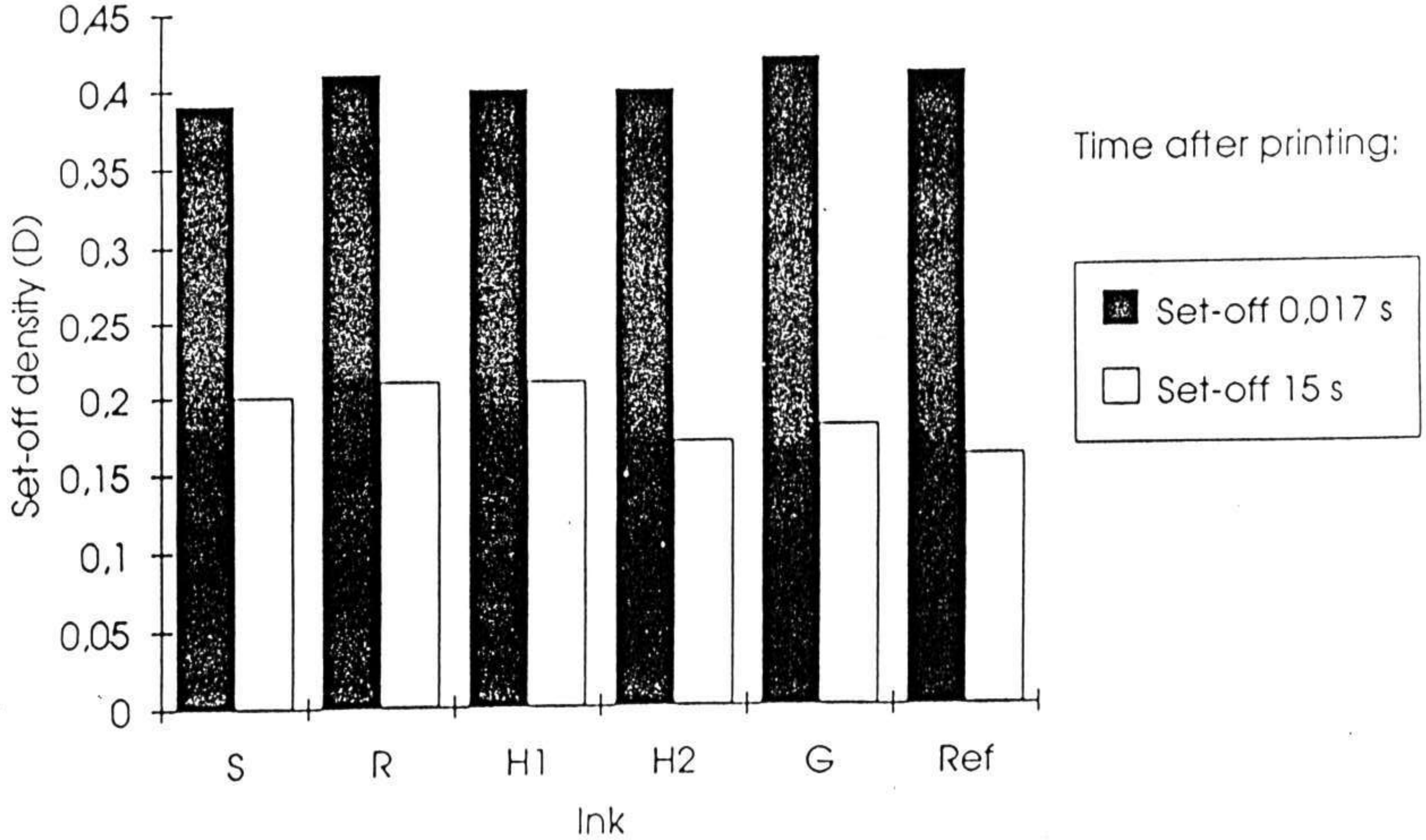
Rub-off can only be accurately determined with the aid of a reflectometer.

Results from the printing trials at Aamulehti





Ink:
S
R
H1
H2
G
Ref
Set-off density (D)
0,25
0,2
0,15
0,1
0,05
0
10s
30s
1min
2min
5min
10min


0,45
0,4
0,35
0,3
0,25
0,2
0,15
0,1
0,05
0
Set-off density (D)
S
R
H1
H2
G
Ref
Ink
Time after printing:
Set-off 0,017 s
Set-off 15 s

PRINTING PROCESSES IN NEWSPAPER PRODUCTION

OFFSET - CONVENTIONAL

FILM INKING

1. UNDERSHOT
2. OVERSHOT
3. PUMP INKING
   (INJECTION INKING)

DUCTOR INKING (Not used in newspaper printing)

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DEMANDS ON NEWSINK

UNDERSHOT	OVERSHOT	INKPUMPS
Viscous	Less viscous	Even less viscous
Short	Long	Long
High relative polarity for a high water take-up	Low relative polarity for a low water take-up	Even lower relative polarity to avoid excessive water take-up

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IN PRACTICE

- Viscous and short inks create greater tendency to linting and rub-off
- if undershot inking is used > use newsprint with low linting and rub-off propensity (rough newsprint)
- Long and low viscous inks have tendency to ink misting and strike-through
- if overshot or pump inking is used, special additives in ink and newsprint with good opacity properties are needed
- High water take-up requires fountain solution with good wetting properties

> Ink, fountain solution, paper, inking unit and blanket properties are interrelated and must be dealt with as an entity

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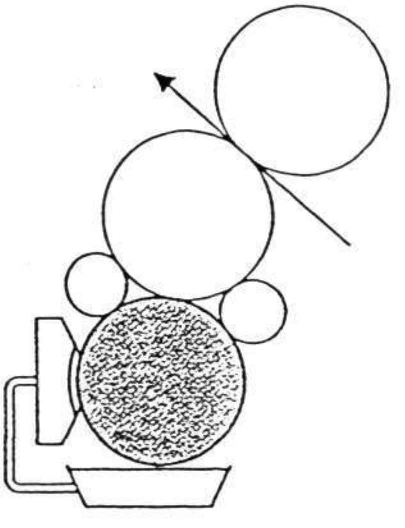
KEYLESS INKING

1. ANILOX LETTERPRESS

The hard letterpress plate has to be protected from the hard anilox-roller by means of soft ink forme rollers.
A short inking unit with no disturbances of emulsification giving a very constant ink feed.
Oil based inks.

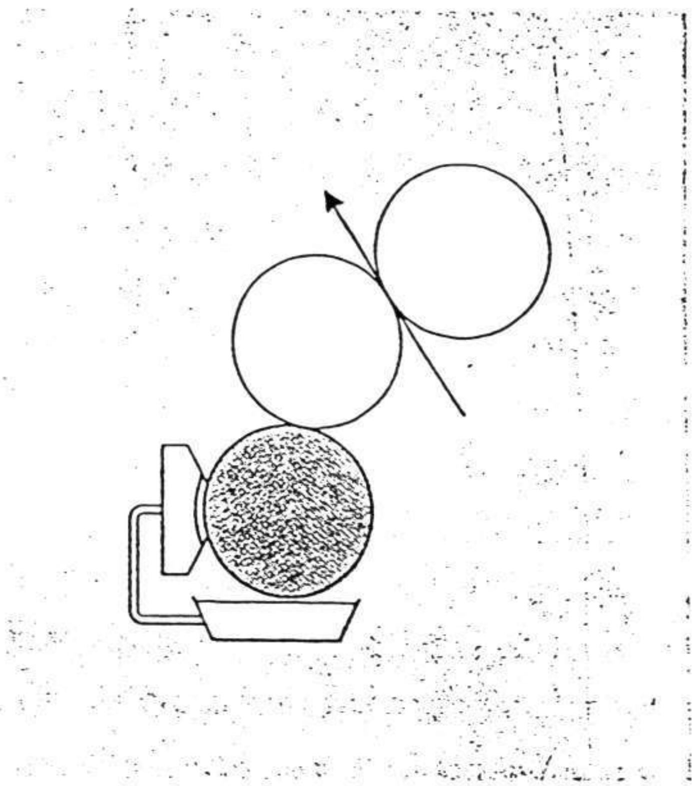


Anilox letterpress printing unit

ifra

2. ANILOX FLEXO

Because of the soft flexo plate, no ink forme rollers are needed > the shortest possible inking unit.
Water based inks.



Flexo printing unit

ifra

3. ANILOX OFFSET

Issues to consider:

-short inking causes tendency to excessive water in ink

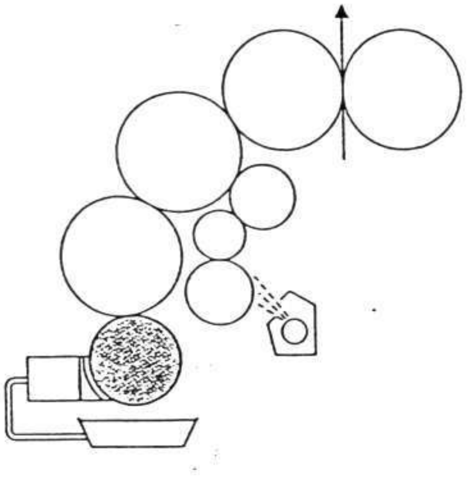
-ink water interactions are very essential

-temerature control to control viscosity

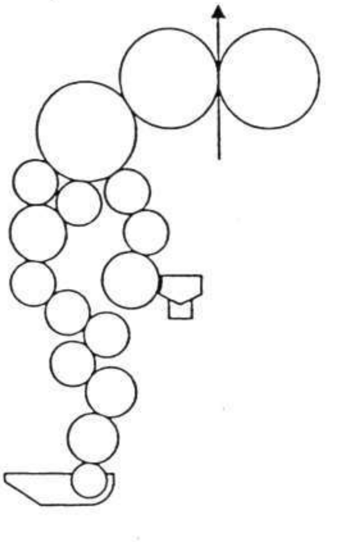
-wearing of anilox rollers

-wearing of ductor blades

To avoid **ghosting**, the forme roller is 1:1 in size to plate cylinder. Oil based

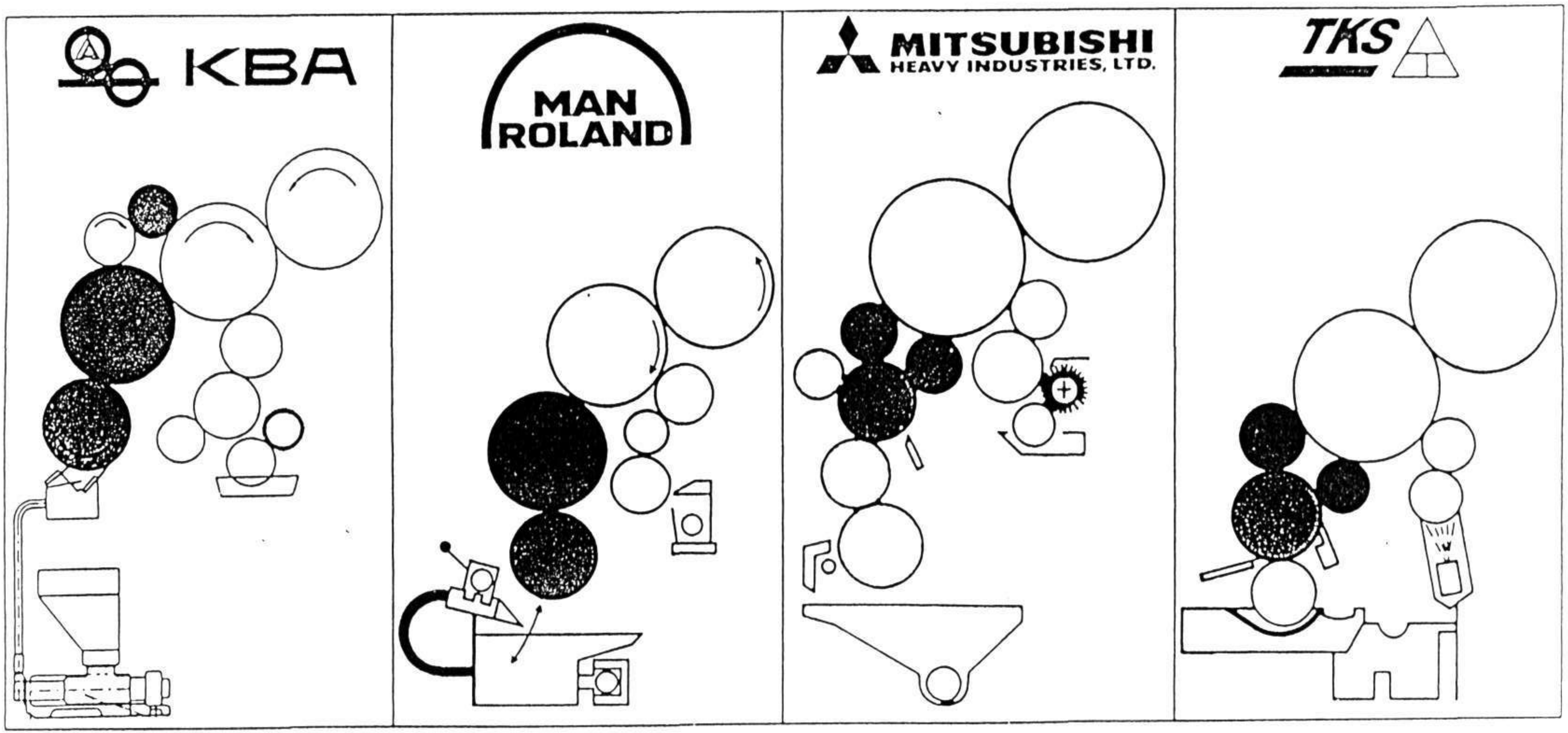


Anilox offset printing unit

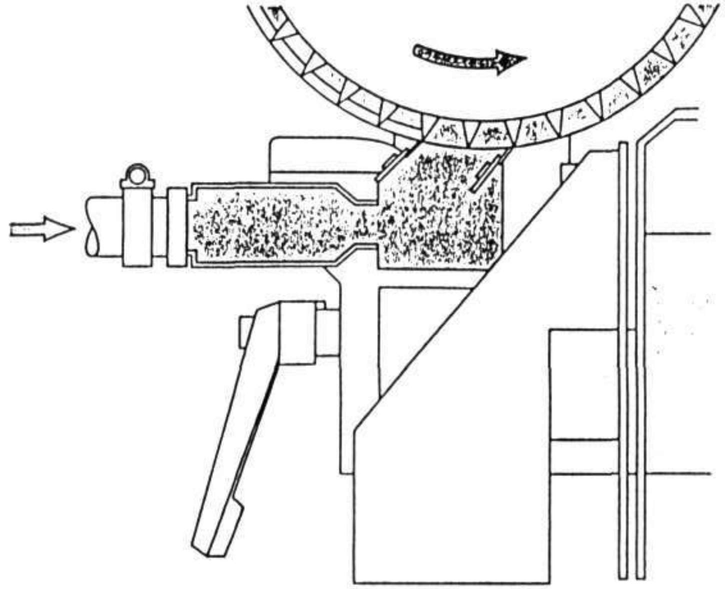


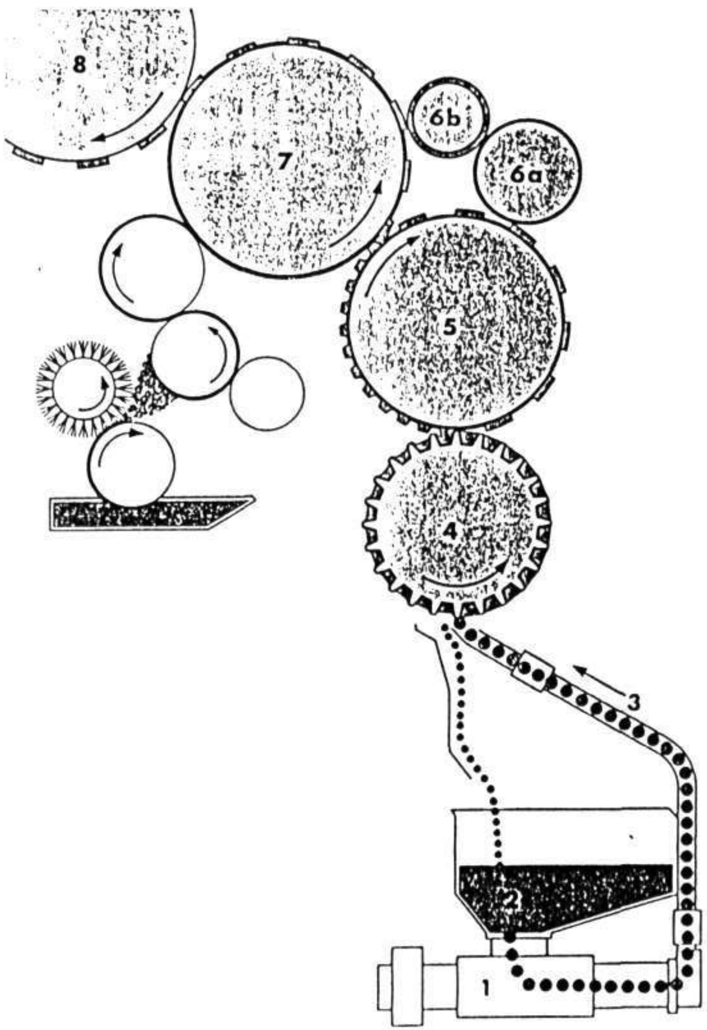
Offset printing unit

ifra


KBA
MAN
ROLAND
MITSUBISHI
HEAVY INDUSTRIES, LTD.
TKS

Cross-section through a chamber-doctor system with blade holder, clamp, doctor blades and ink feed





How ink transfer functions in anilox offset:
1. Ink pump
2. Ink trough
3. Ink feed
4. Anilox screen roller
5. Ink forme roller
6. Ink rollers
7. Plate cylinder
8. Blanket cylinder

FLEXO AND LETTER-PRESS PRINTING A FEW ASPECTS

The loss of small dots(especially in flexo) deteriorates highlight details significantly.

New screening trends - higher screen rulings and frequency modulated screening - cannot be easily fulfilled in flexo or letterpress.

Whether computer-to-plate will be available for these printing processes is questionable.

However, it must be noted that the best **consistency** in print densities can be achieved with anilox letterpress.

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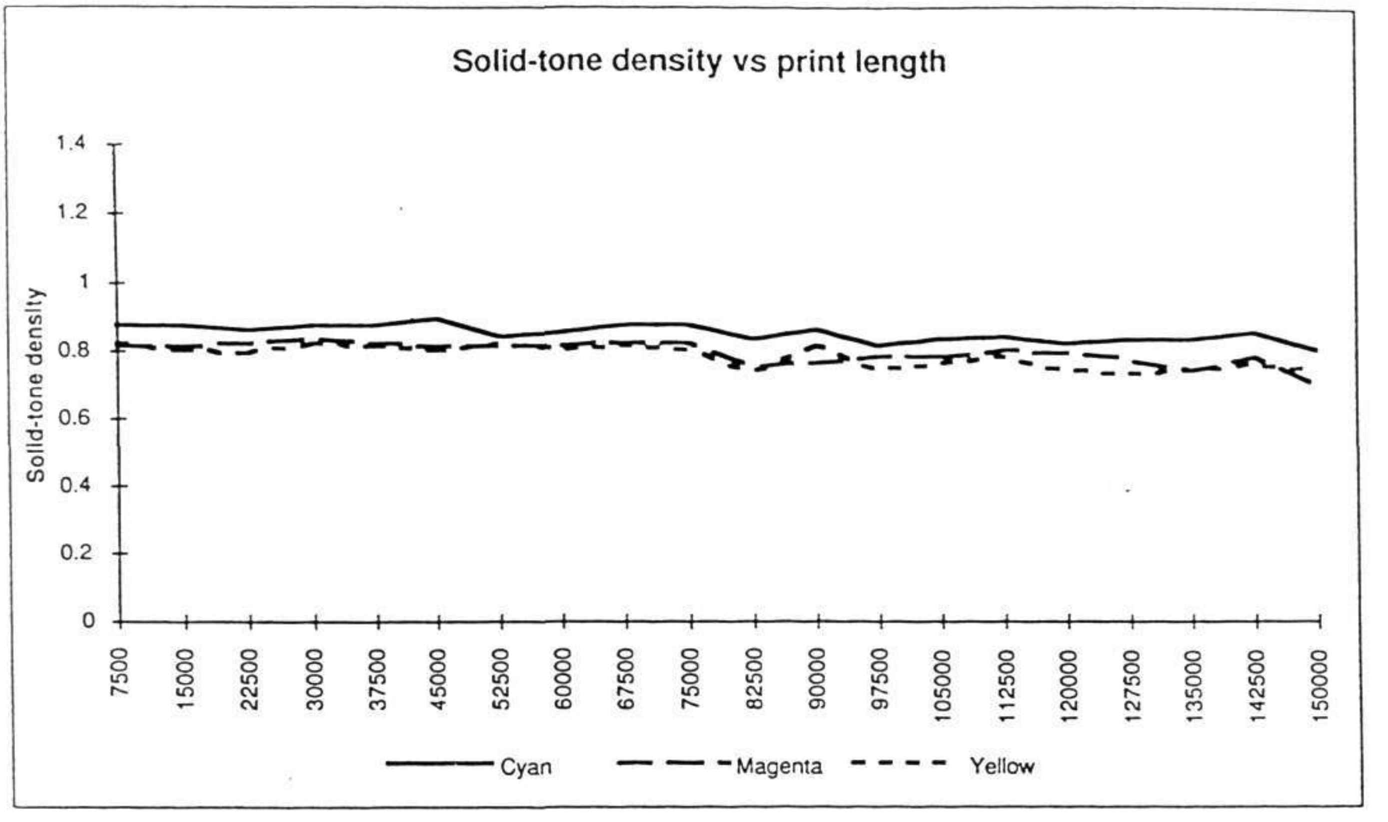
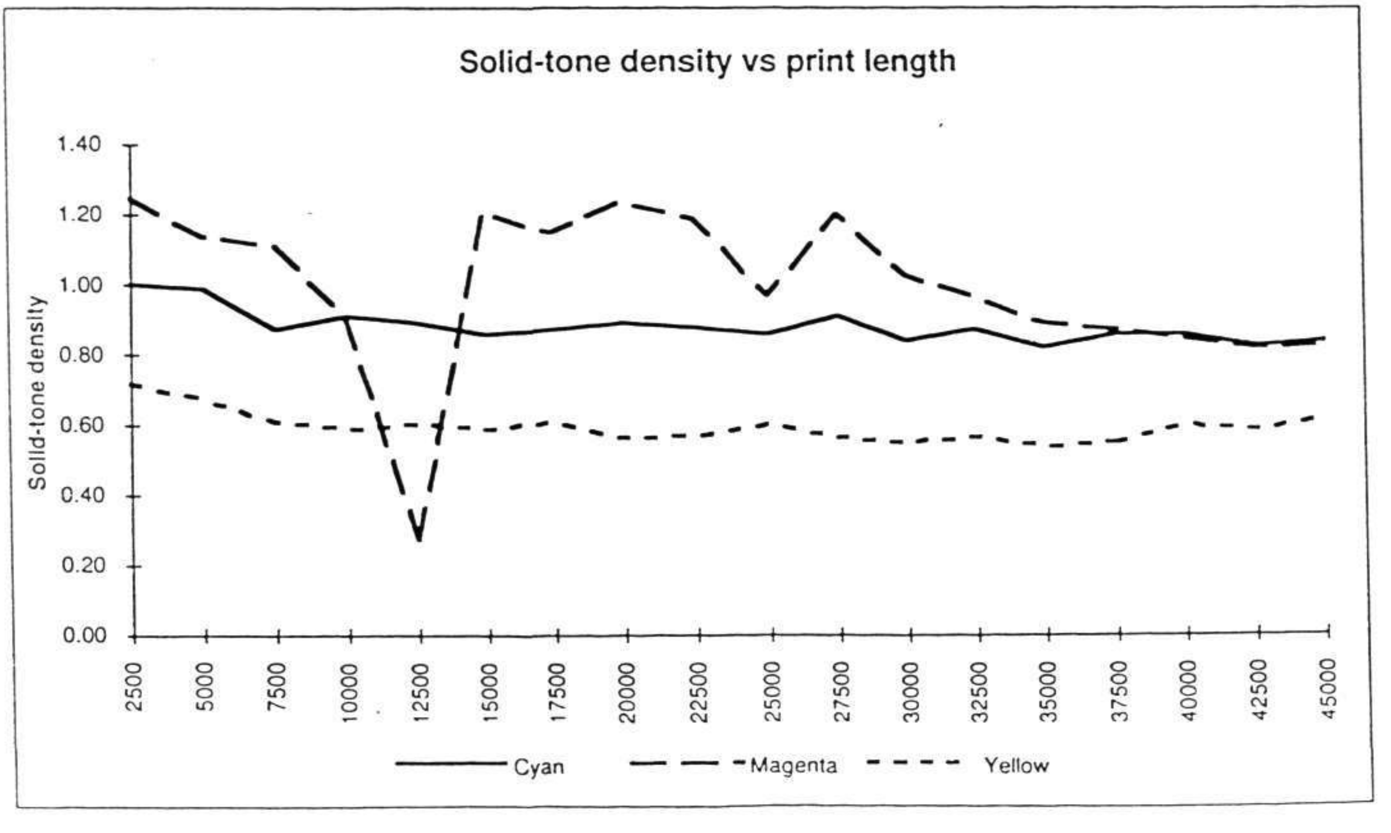
App. 1. Solid tone density vs print length



Example of a small variation



Example of a large variation

DAMPING SYSTEMS

PRINCIPLES:
contact - non-contact
direct - indirect
predamping - postdamping

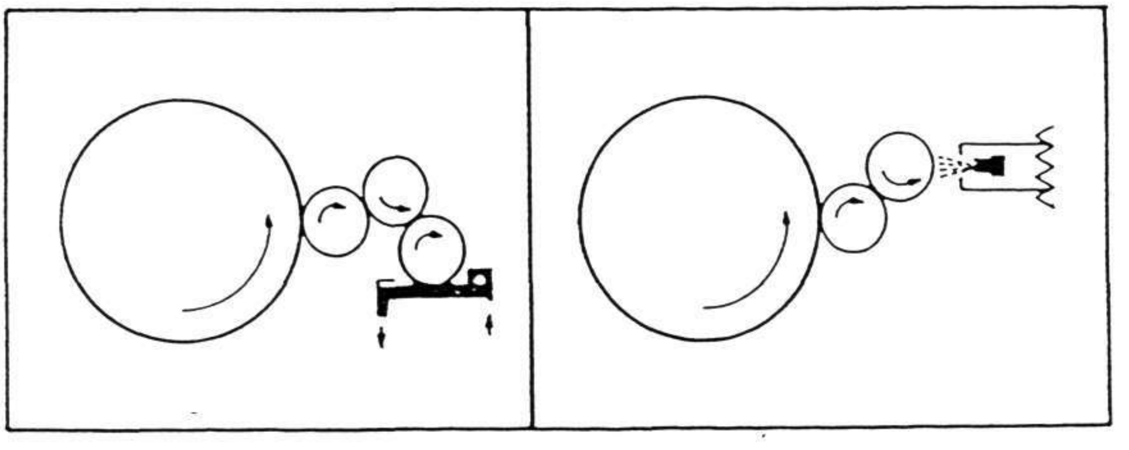


Figure 4. A conventional contact damping system (left) and a contactless system (right).

A preferable way is:
non-contact (to avoid ink feed back)
direct (to avoid over emuslification)
post damping (because of wider tolerances)

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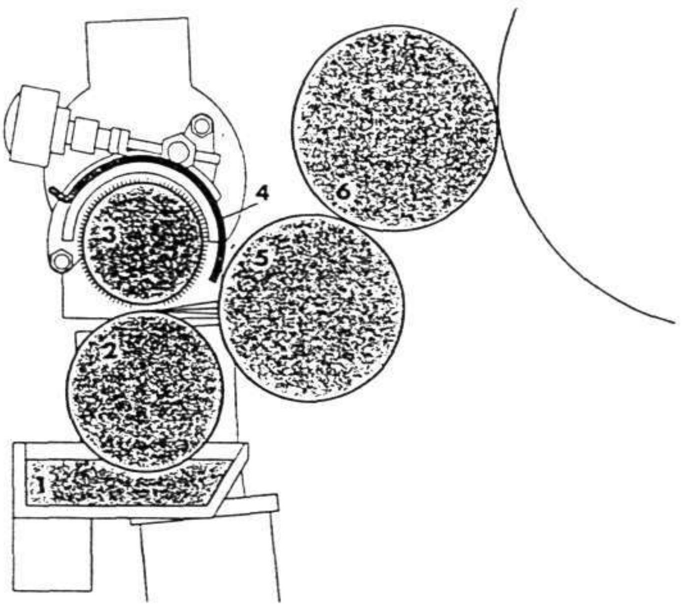
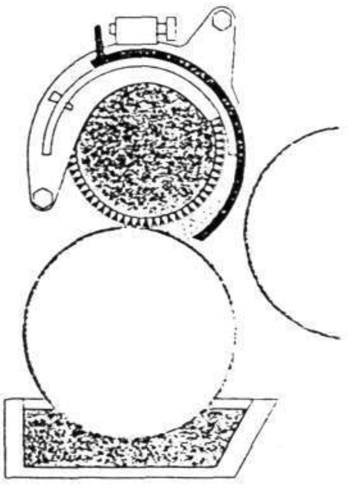


Page-wide, remote-controlled shutters for accurate water metering



1. Insulated water pan
2. Motorised, infinitely-variable water fountain rollers
3. Motorised brush roller
4. Page-wide brush shutters
5. Driven chrome roller
6. Plate dampener.

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SPRAY DAMPING

ADVANTAGES:

-No circulating water
-Lower temperature of the water
-Quicker start up
-Less water consumption
-Better adjustability (1/2 page)

PROBLEMS:

-Incoming water must be clean not to block the nozzles
-Nozzles must be maintained from time to time to avoid blockages

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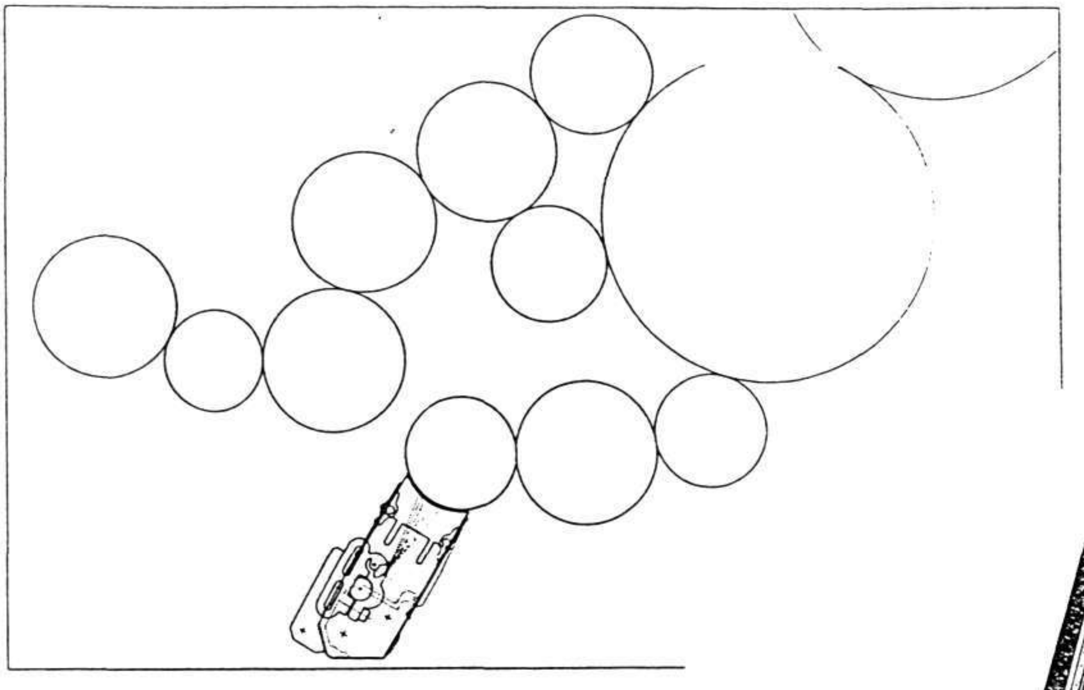

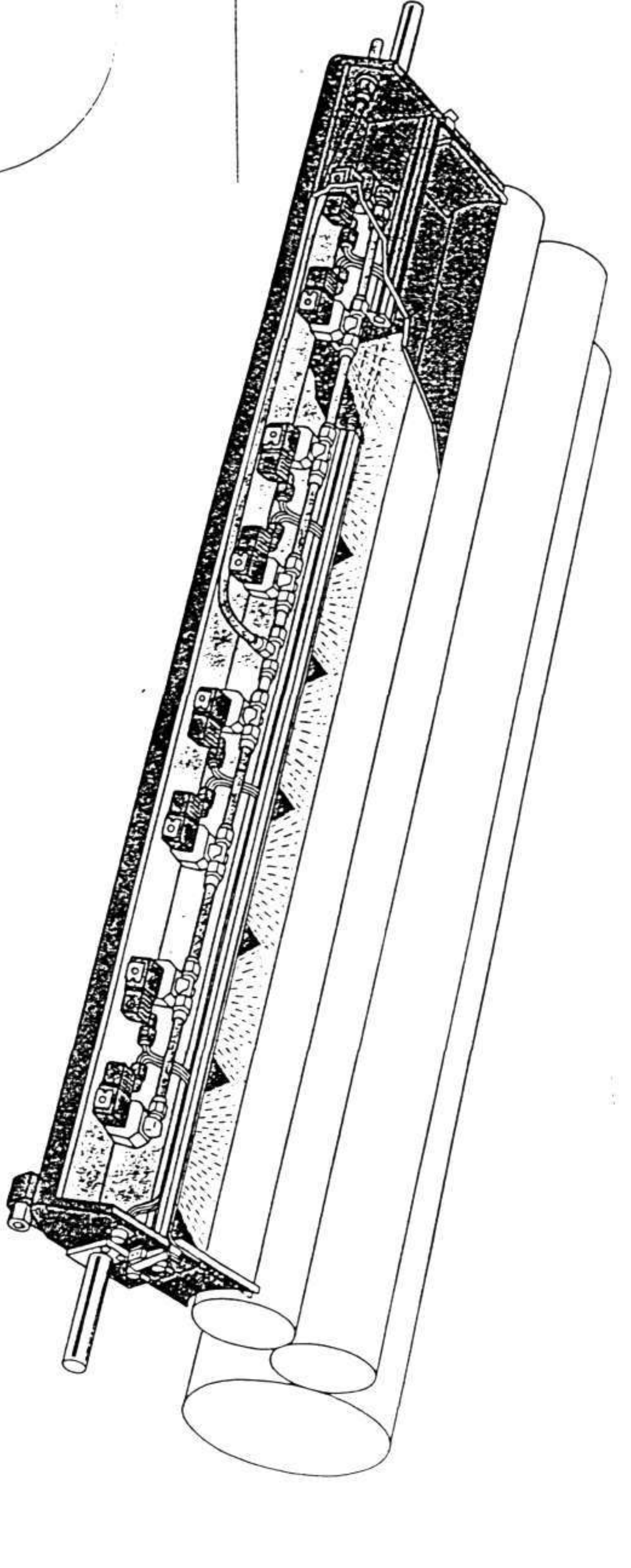

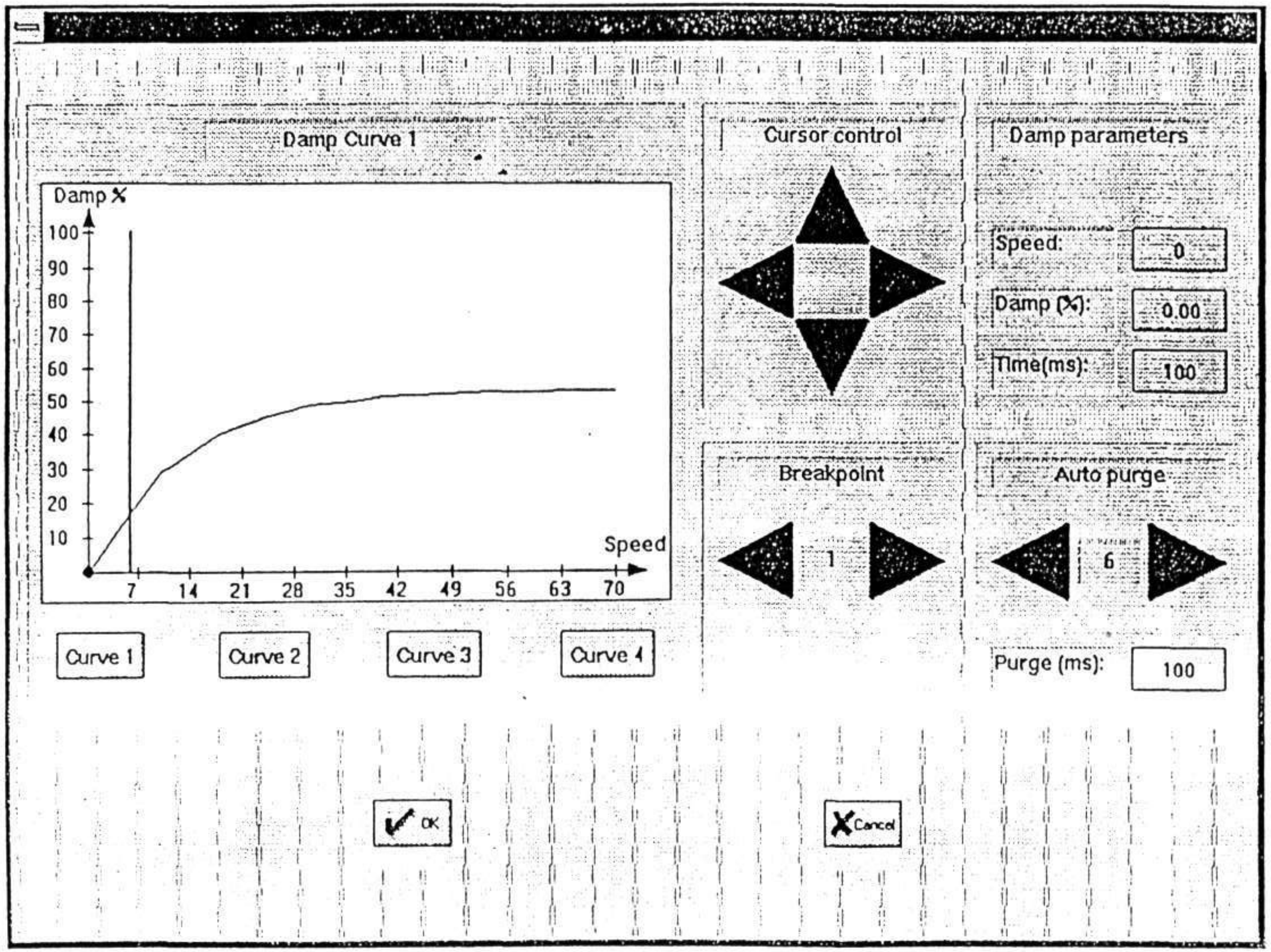
Damp Curve 1
Damp %
100
90
80
70
60
50
40
30
20
10
Speed
7
14
21
28
35
42
49
56
63
70
Curve 1
Curve 2
Curve 3
Curve 4
Cursor control
Damp parameters
Speed:
0
Damp (%):
0.00
Time(ms):
100
Breakpoint
1
Auto purge
6
Purge (ms):
100
OK
Cancel

PLATES

Basically the following four light sensitive coatings are suited for offset plates:

Silver halide	5%	
Electrophotographic	5%	
Diazo	85%	
Photopolymers	5%	of market share

These differ mostly in their **light sensitivity** and **spectral sensitivity.**

No matter which plate is used, the exposure must be correctly set to ensure:

-exact copying of microlines and halftones

-sufficient run length

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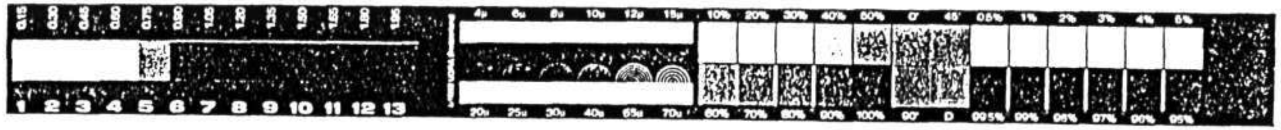


Fig. A2-2: UGRA Plate Control Wedge 1982 (original size)

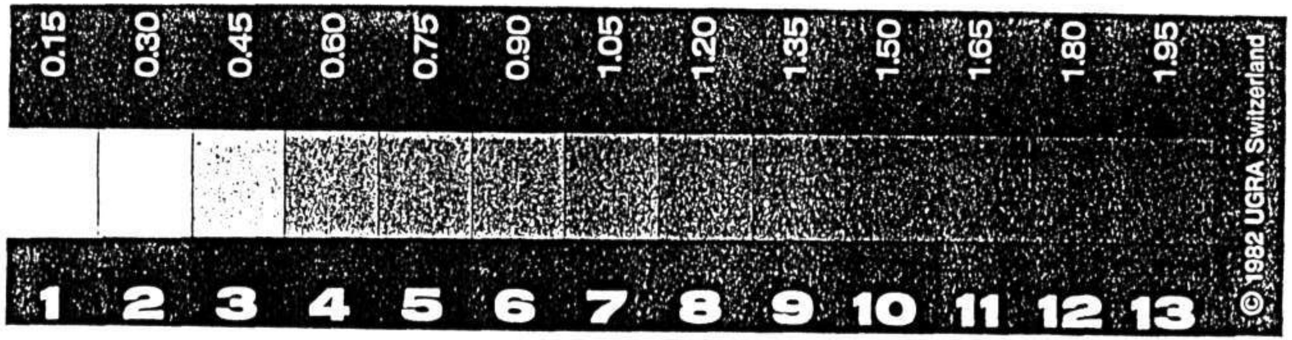
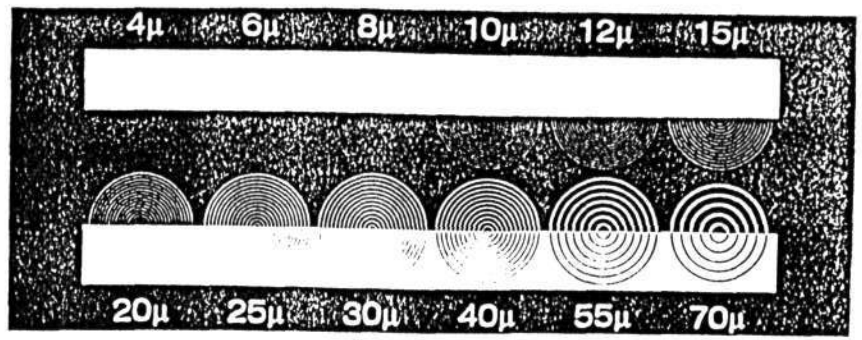


Fig. A2-2.1: Continuous tone wedge (magnified 3 times)

Fig. A2-2.2: Microlines, compatible with FOGRA-PMS (magnified 3 times)



Exposure setting by defining the resolution of the plate

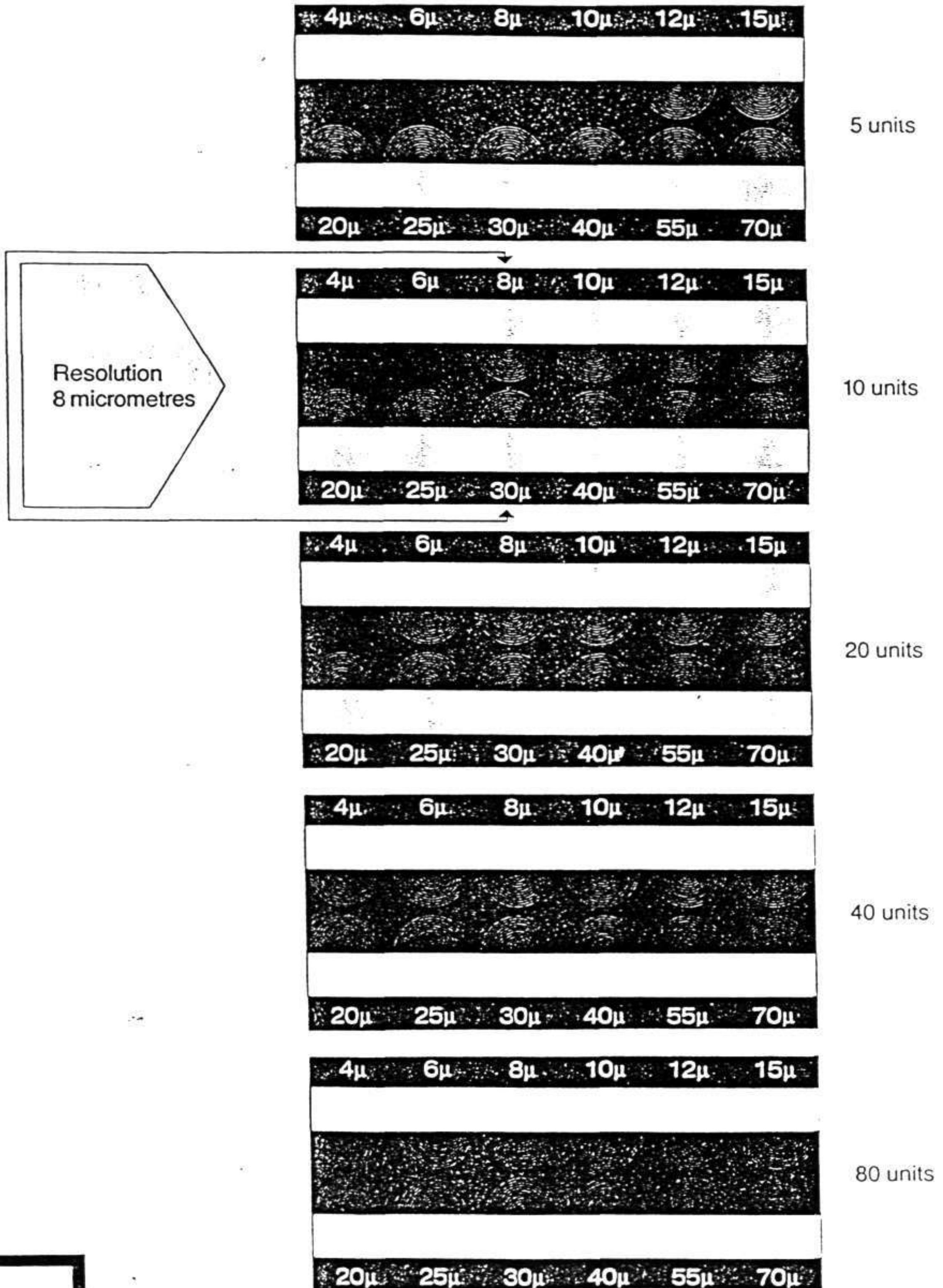


Fig. B1-1 Step test of a positive-working plate, produced using the UGRA Plate Control Wedge 1982

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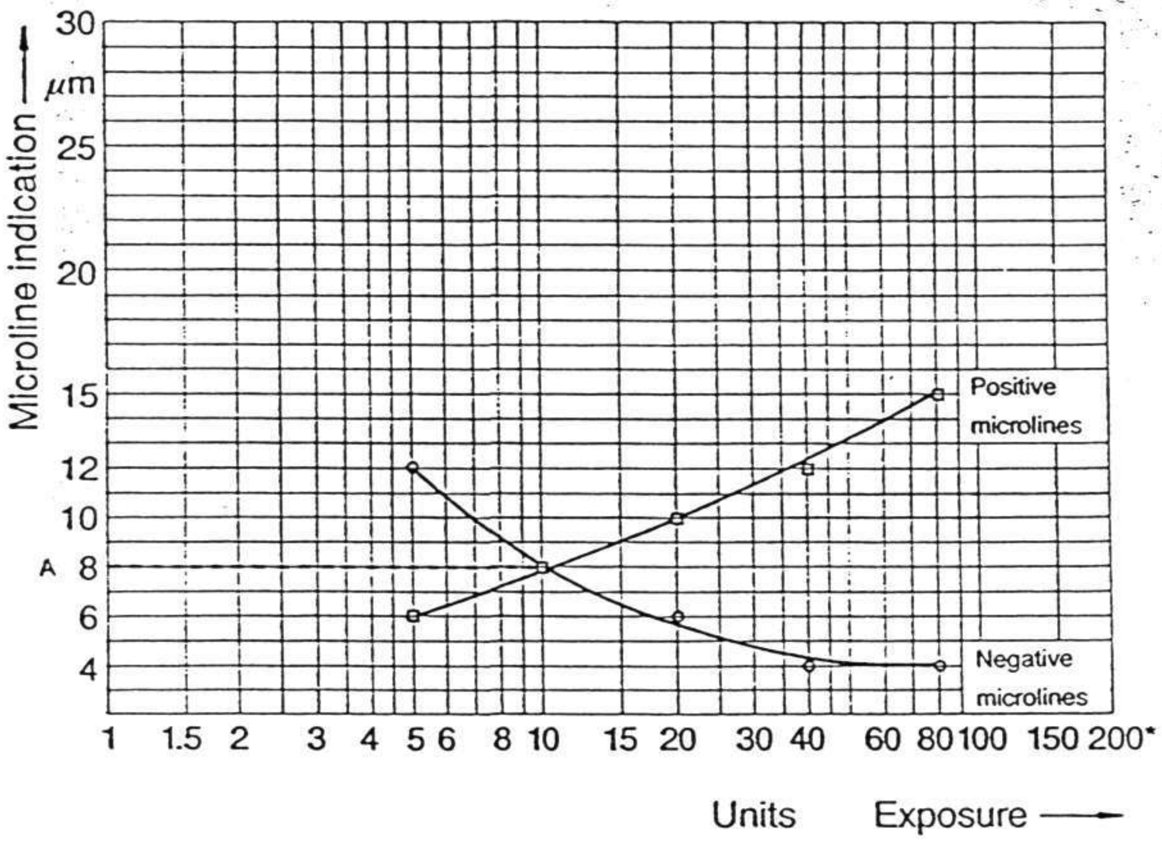
Exposure (units)	5	10	20	40	80
Finest negative microline subtarget (μm)	12	8	6	4	4
Finest positive microline subtarget (μm)	6	8	10	12	15



CTP-PLATES

Until the recent years, it has been impossible to combine the needs of CTP in terms of sensitivity and run length of the plate.

Hoechst (Kalle N90) was a pioneer in this sense (photopolymer based)
Now also DuPont with their Silverlith has come up with a good product (silver halide based)
Polychrome as well.

Photopolymer requires light sensitive developing liquids and heating the plate after exposure.

So far silver halide has had very low run length, but the latest versions have no problems to print over 100.000 revs

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BLANKETS

The blanket in an offset press is often called "the soul" of the press.

It has to fulfil at least two requirements:

1. The surface must transfer the print image from plate to the paper

2. It must be sufficiently elastic to compensate for thickness variations of paper, blanket and plate (and CIC)

The surface structure (smoothness) of the blankets vary. Smoother ones have better ink transfer but cause more linting.

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Results from an IFRA study comparing 20 different blankets in laboratory and full scale tests show:

- surface hardness and compressibility are the parametersthat have gratest influence on print quality
- a hard and less compressible blanket gives a better subjective print quality
- the surface structure has most effect on the print contrast
- the washing agent must be selected so that it causes little swelling

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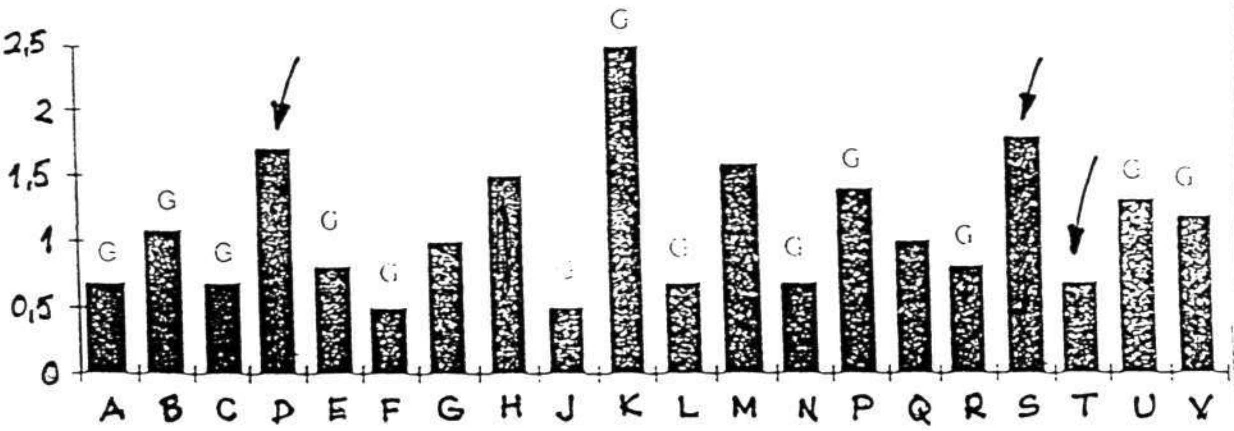
Sample	Dot gain40%	Dot gain80%	Print Contrast
Full-scale trial 1			
Blanket D	28	15	28
Blanket S	33	16	26
Blanket T	30	15	25
Full-scale trial 2			
Blanket D	28	15	28
Blanket S	33	16	26
Blanket T	30	15	25

Surface structure, Ra-value (µm)



Micro-Hardness (IRHD)

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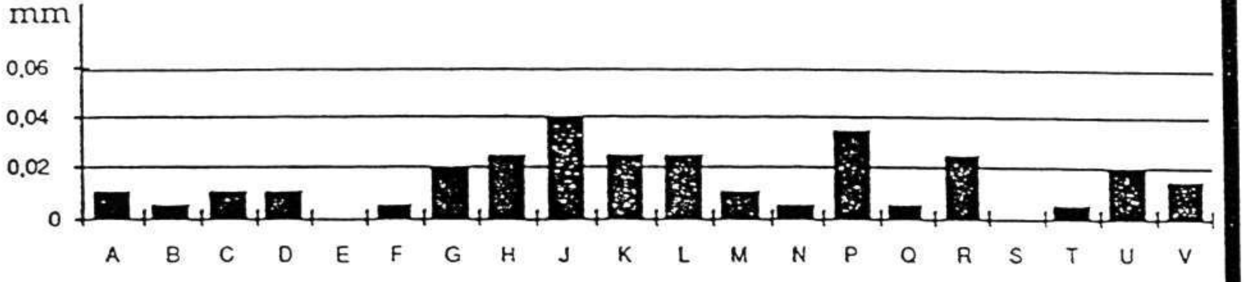
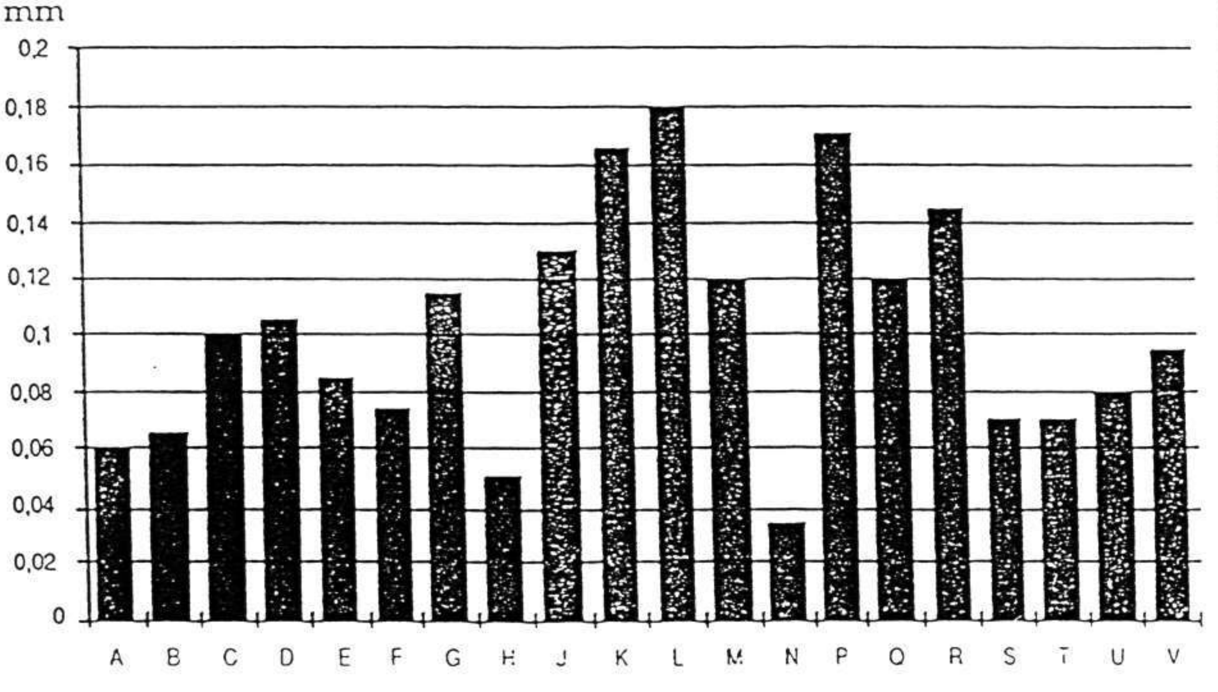
2.2.6 Swelling

The change in thickness of the blankets due to exposure to the four washing agents is shown in figure 16.

Agent 1. Low-volatile petrochemical agent.



Agent 2. Citrus terpene washing agent



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FOUNTAIN SOLUTION

Fountain solution in offset printing has the following tasks and requirements

TASKS

- to keep the non-image areas free from printing ink
- to act as a cooling vehicle
- to act as an anti-friction vehicle

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REQUIREMENTS

- Ability to spread quickly and evenly. The better the spreading, the less water is needed to cover non-image areas > less back transfer to the inking unit, less water marks

- Ability to form a homogeneous emulsion with the printing ink to form an ink/water balance. Correct emulsification

- Ability to achieve stable correct pH (4.8 - 5.3)

- Ability to resist slime formation

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COMPOSITION OF THE DAMPING SOLUTION

Type of component	Function
Surfactant, alcohol	Decreasing surface tension, improving wettability, incresing emulsification
Buffer system	Maintaining the pH value
Gum arabicum	Plate protection
Biocides	Slime prevention
Anti-corrosion agents	Corrosion prevention
Anti-foam agents	Foam prevention
Complex former (EDTA)	Inactivation of calcium and other metal ions

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Tap Water:

< 3°d, < 30 mg/l chloride

Comment:

Danger of corrosion

Contact damping systems

Settling of ink on damping rollers

What to do:

Add 0.5 % conditioning concentrate

Tap Water:

7 -12 °d, < 30 mg/l chloride

Comment:

Perfect for printing

Water treatment:

Not necessary

Tap Water:
15 -20 °d, < 30 mg/l chloride

Comment:
Having small printing areas on plate (cyan, magenta)
Too much damping solution into ink
Ink splitting will be worth
Ink density of the printed paper goes down
Precipitates (white) on the damping rollers
Stripping of ink rollers

What to do:
1. Deharden water to 7 - 12 °d (chloride will not be removed)

or

2. Reversed osmosis (removes 95% of all ions and all fungis and bacterias), then mixing with tap water to give 7 - 12 °d,
or better (when tap water quality is not constant: add 0.5% conditioning concentrate)

Tap Water:

> 50 mg/l chloride

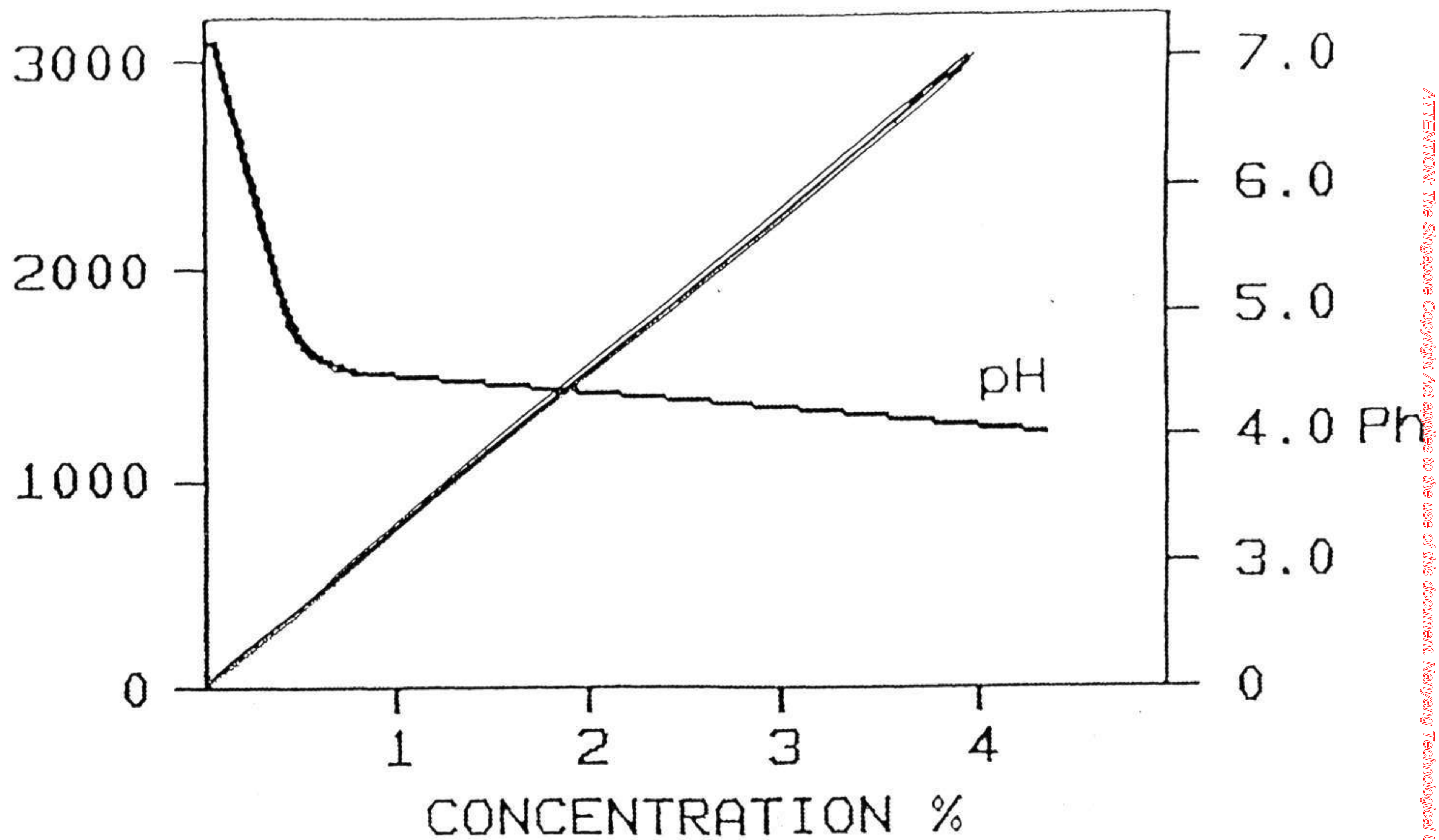
Comment:

Danger of corrosion

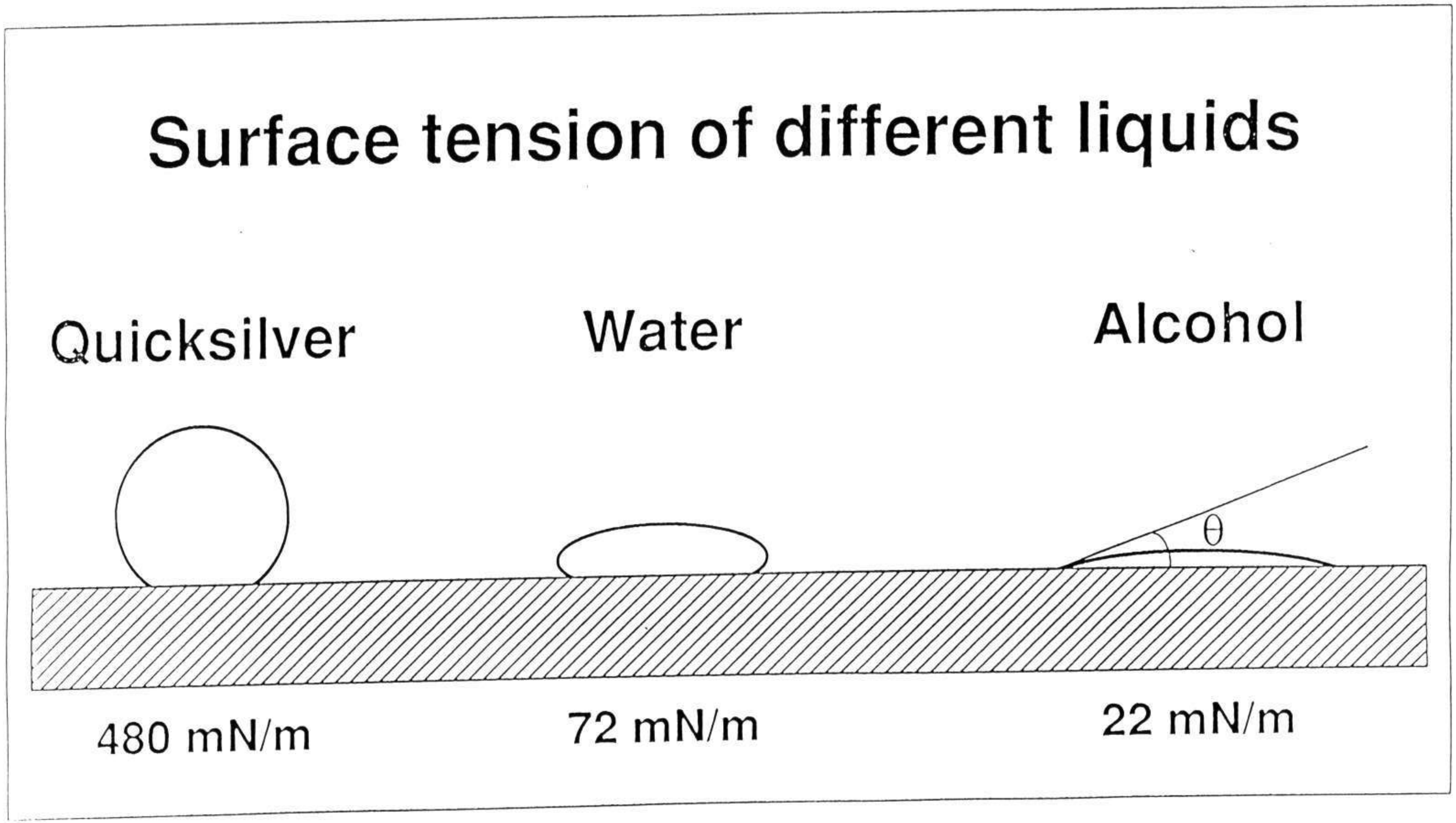
What to do:

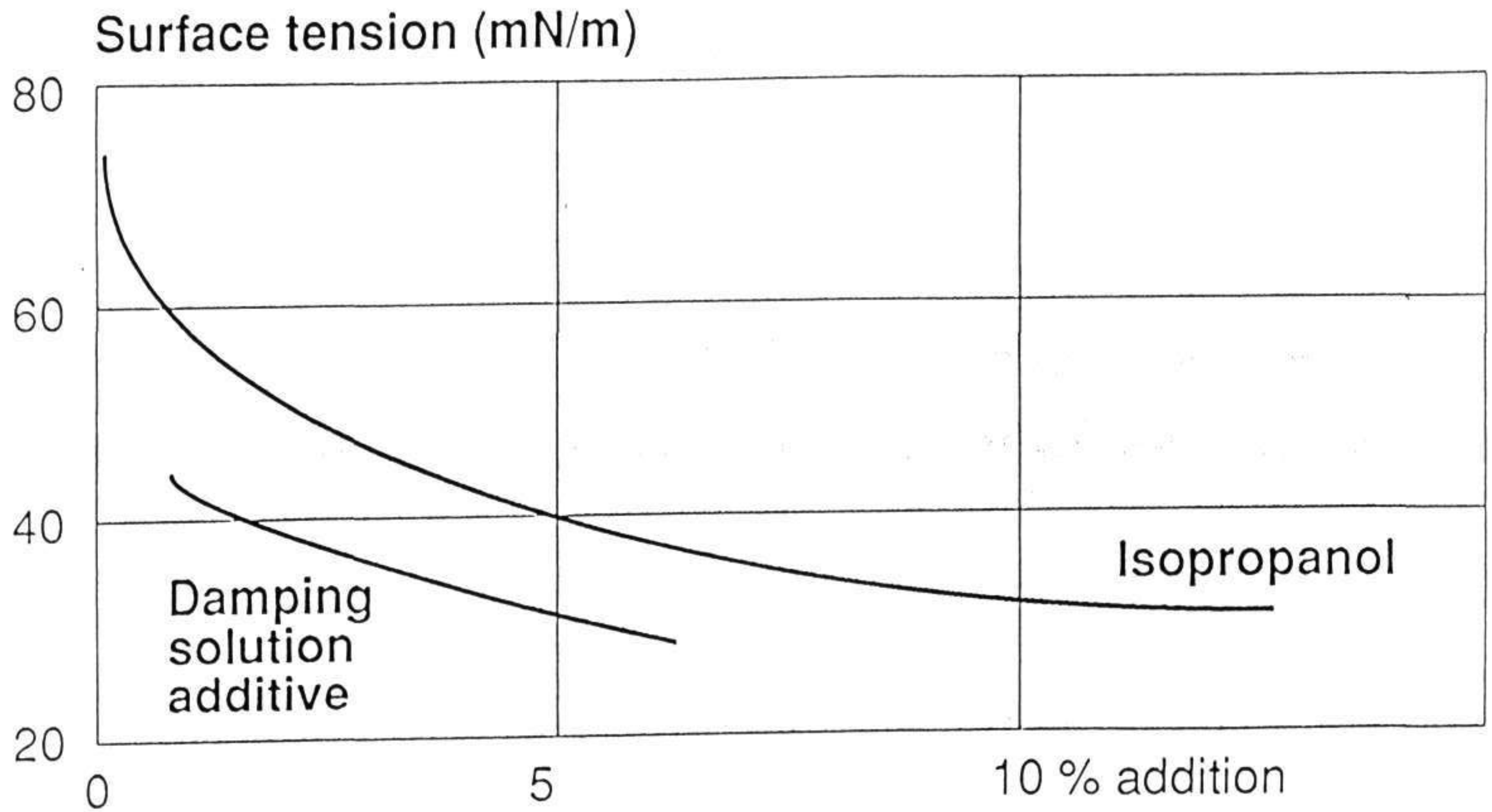
Reversed osmosis (removes 95% of all ions and all fungis and bacterias), then mixing with tap water to give 7 - 12 °d,

or better (when tap water quality is not constant: add 0.5% conditioning concentrate)



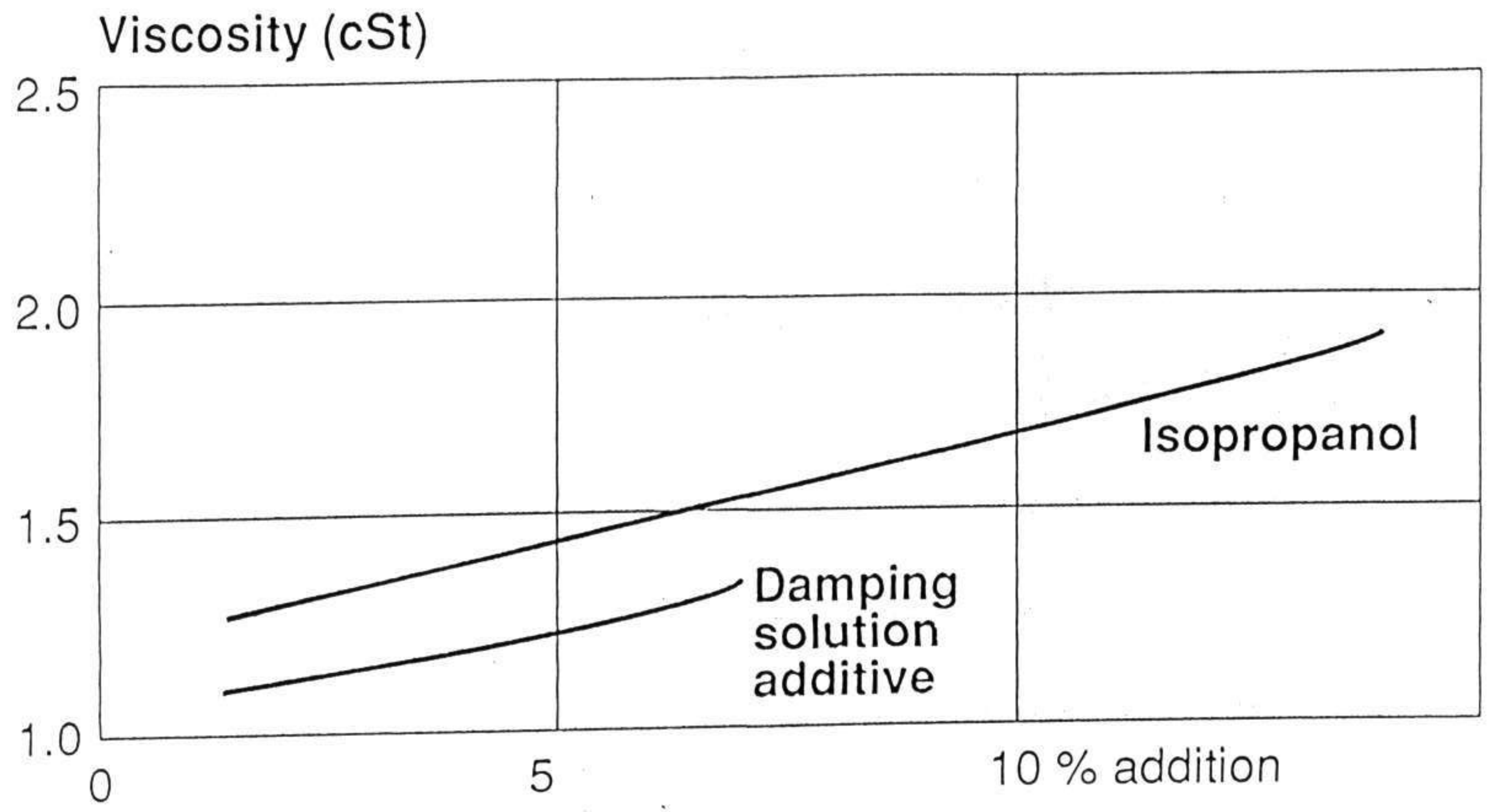
A comparisson of Conductivity and pH curves.


Surface tension of different liquids
Quicksilver
Water
Alcohol
θ
480 mN/m
72 mN/m
22 mN/m



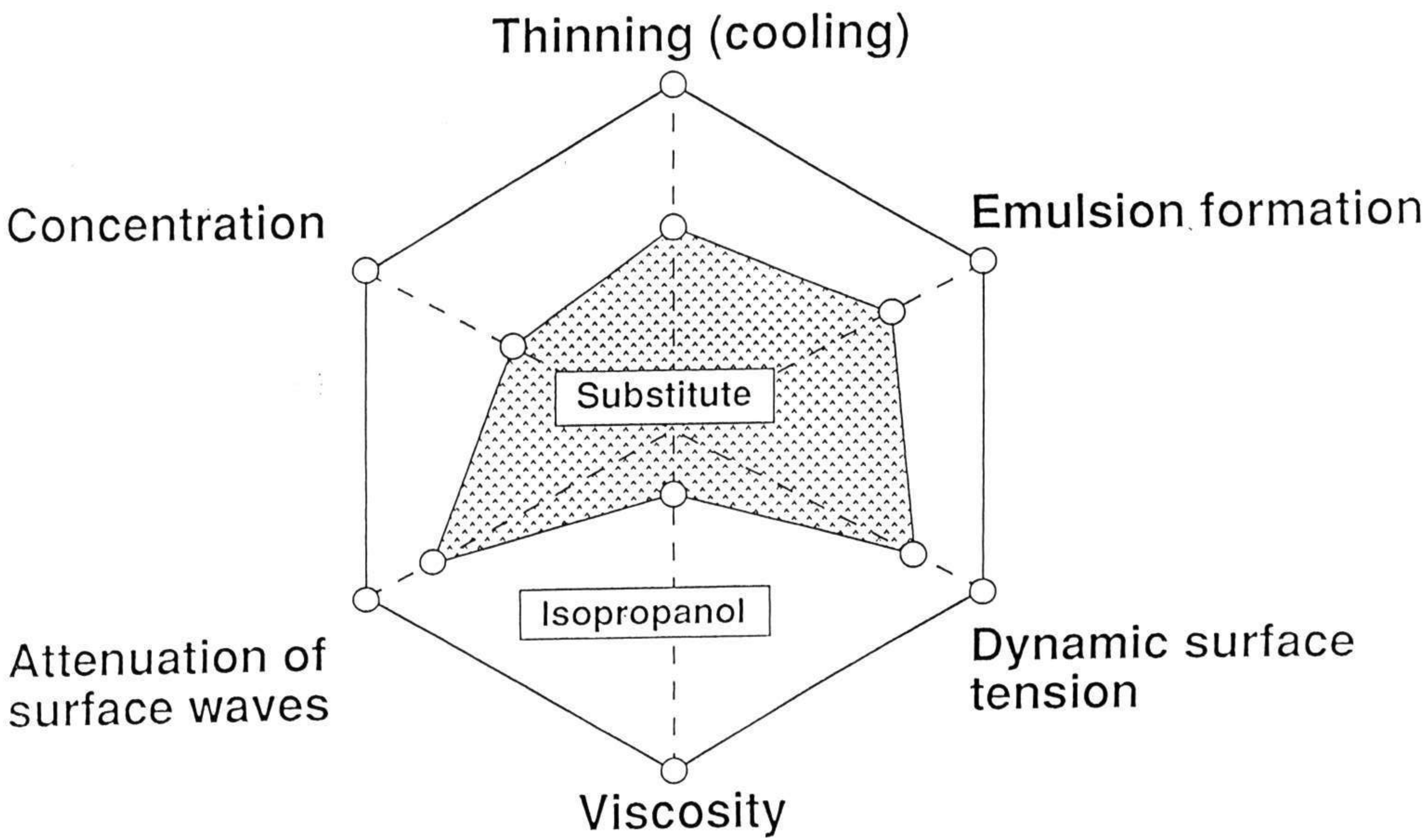
Isopropanol: moderate reduction of the surface tension

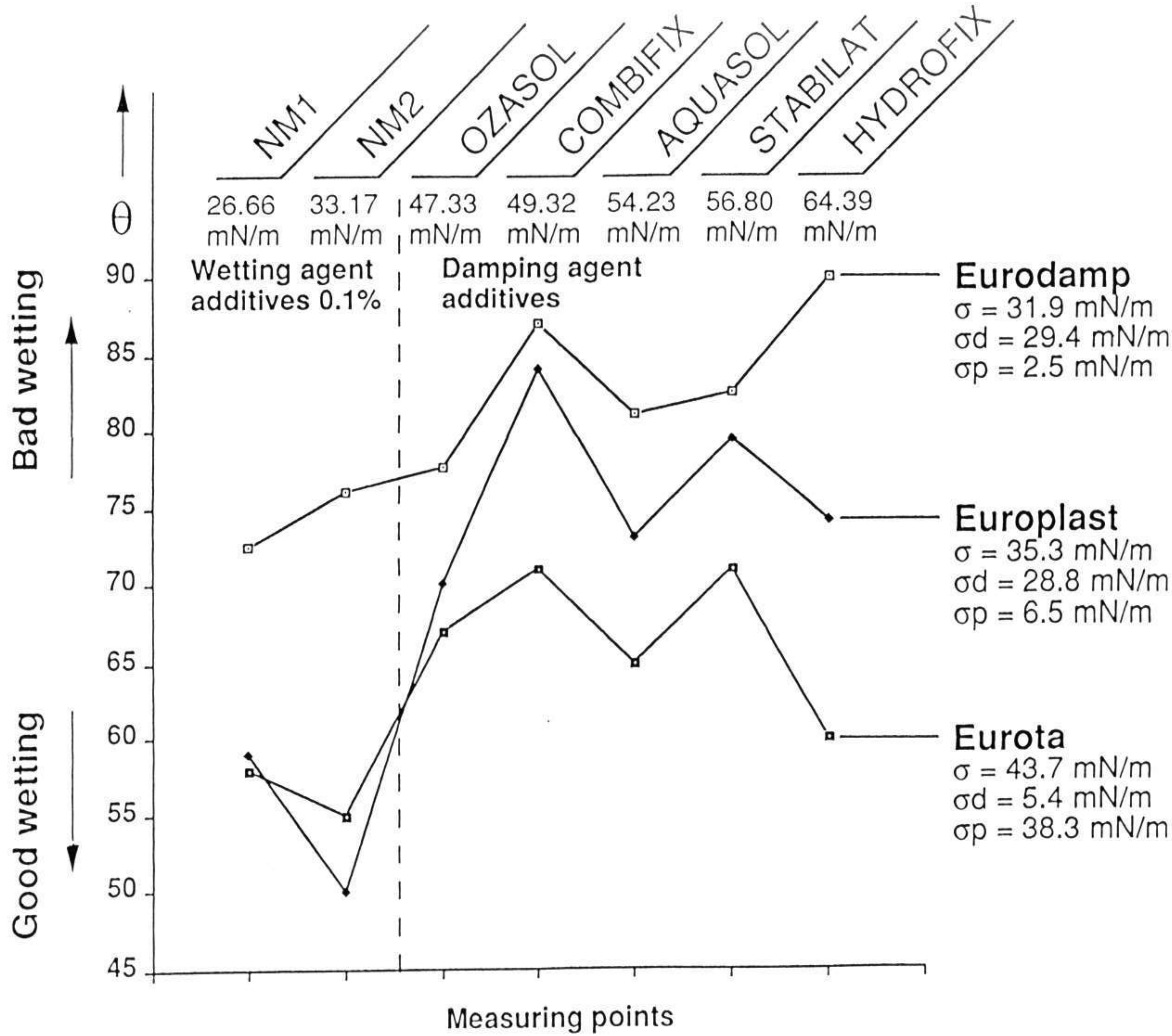
Damping solution additive: strong reduction of the surface tension



Isopropanol: clear viscosity increase

Damping solution additive: smaller viscosity increase


Thinning (cooling)
Concentration
Emulsion formation
Substitute
Isopropanol
Attenuation of surface waves
Dynamic surface tension
Viscosity


NM1
NM2
OZASOL
COMBIFIX
AQUASOL
STABILAT
HYDROFIX
θ
26.66 mN/m
33.17 mN/m
47.33 mN/m
49.32 mN/m
54.23 mN/m
56.80 mN/m
64.39 mN/m
Wetting agent additives 0.1%
Damping agent additives
Bad wetting
Good wetting
90
85
80
75
70
65
60
55
50
45
Eurodamp
σ = 31.9 mN/m
σd = 29.4 mN/m
σp = 2.5 mN/m
Europlast
σ = 35.3 mN/m
σd = 28.8 mN/m
σp = 6.5 mN/m
Eurota
σ = 43.7 mN/m
σd = 5.4 mN/m
σp = 38.3 mN/m
Measuring points

QUALITY PARAMETERS IN NEWSPAPER PRINTING

QUALITY PARAMETERS AND THEIR USEAGE IN EVALUATIONS

Even halftone areas (D)	100 %
Even solid tones (D)	88
Tonal reproduction	75
Colour accuracy	63
Detail rendition	63
Density of solids (D)	50
Sharpness	50
Register	38
Screen ruling	25
Paper shade	25
Paper brightness	25
Saturation of colours	13
Grey balance	13

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Even halftone and solid areas require correct: INKING

Even inking - **within one copy and throughout one run** - is one of the most important key issues to print quality.

In a conventional inking unit - comprising of up to 25 rollers - variations must be kept in a low level to ensure consistency. Once the variation increases, it is impossible to stabilise within a reasonable time.

To be able to stabilise the inking, the printer needs **target elements** to measure or to visually evaluate.

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Emulsification is a key factor to achieve consistency in halftone areas. During printing, the fountain solution mixes with the ink forming an ink-water emulsion. The amount of water in this emulsion can be up to 40 %.

Emulsification:

- reduces the viscosity of the ink (overshot / undershot)
- reduces the relative pigment amount
- more ink is needed to achieve same density
- increases dot gain because of lower viscosity

A stable state of emulsification should be reached fast and it should be on a correct level.

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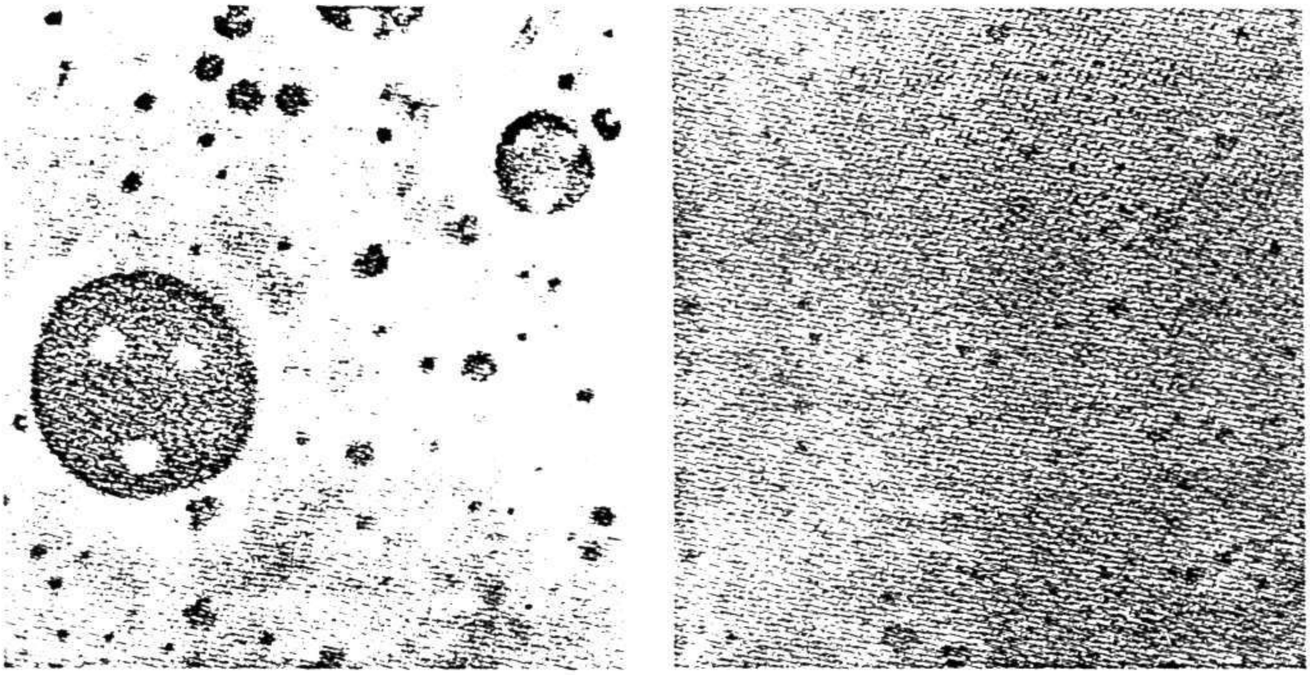

a. Inked area after passage of damping roll.

b. Figure 1a followed by inking roll

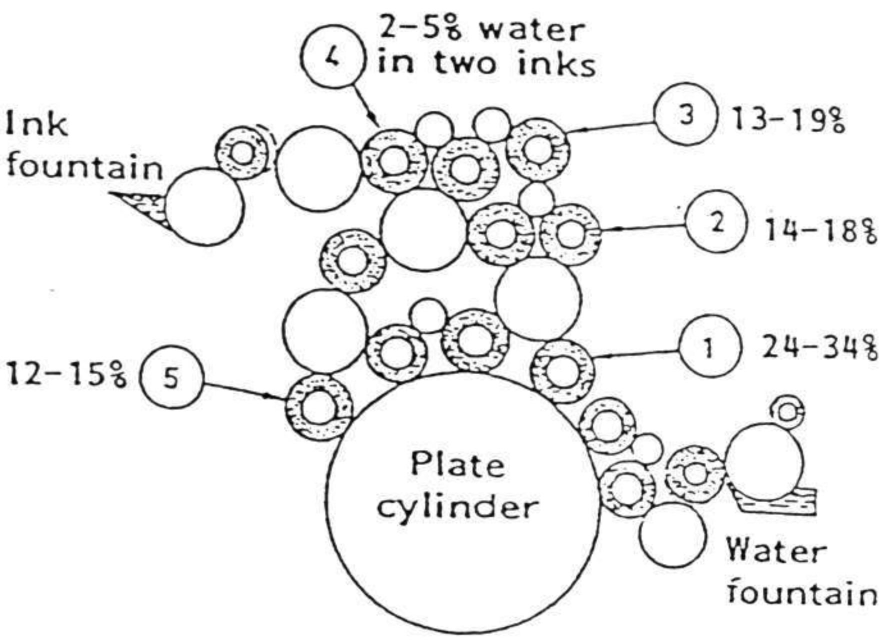

Figure 3. Water content at five sampling points in the inking unit of a newspress. (Figure 1 and selected data from Table 1, Lindqvist, *Graphic Arts in Finland*, 1976)

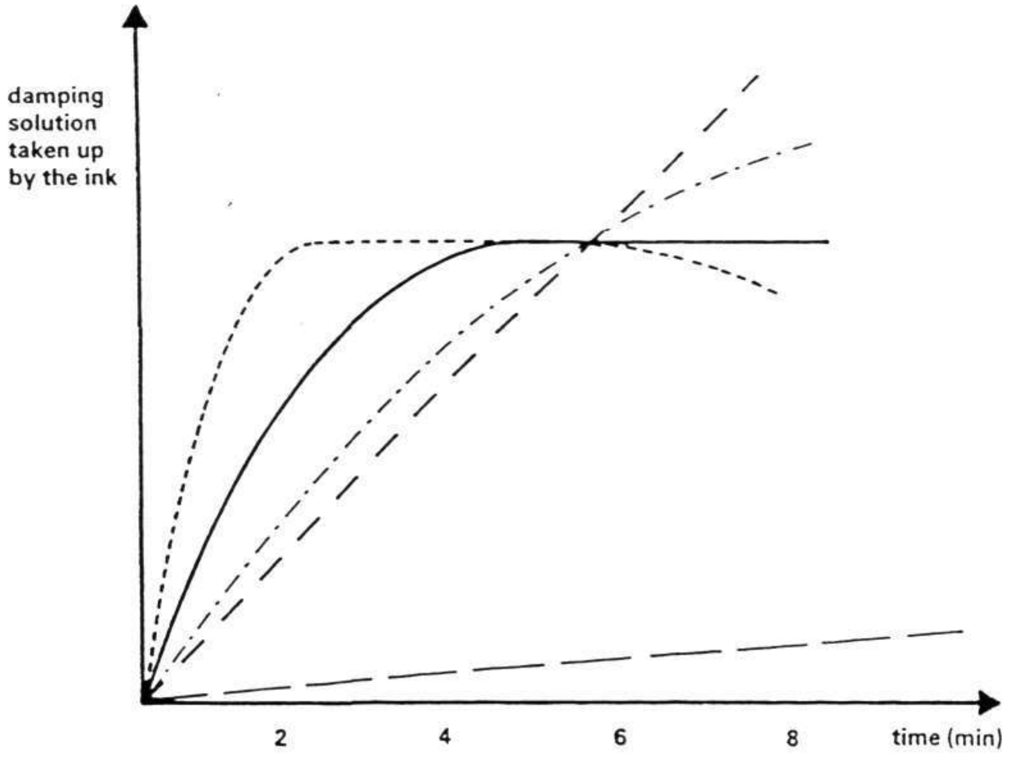

Figure 1. Typical emulsification curves for different offset inks according to Surland's test.

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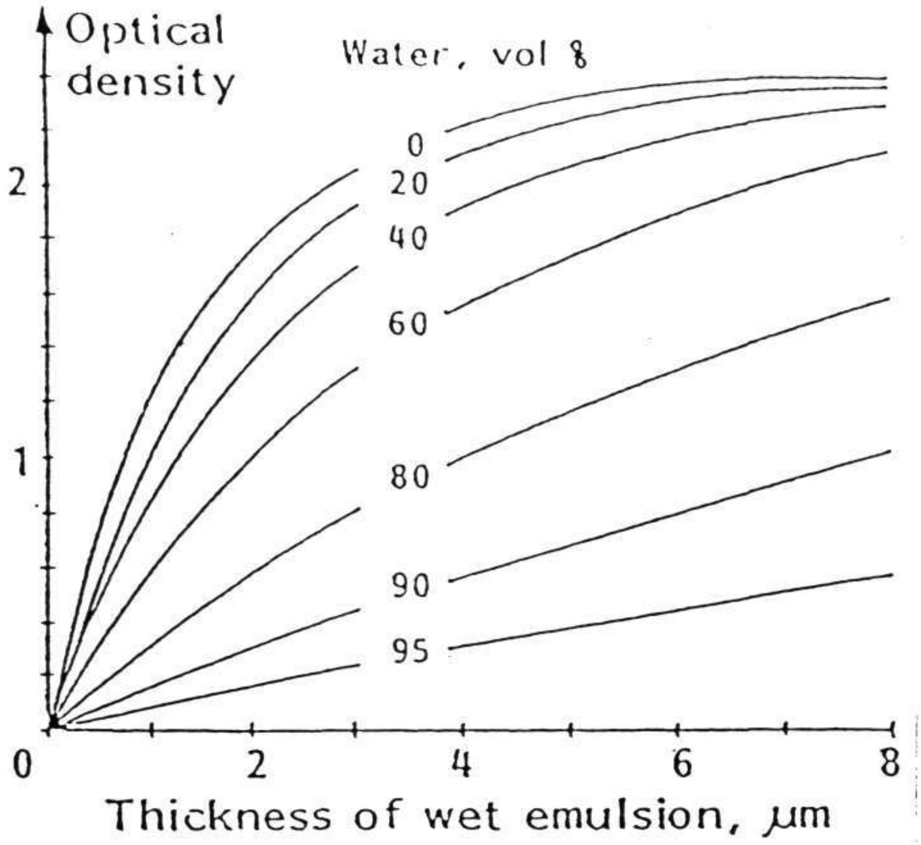

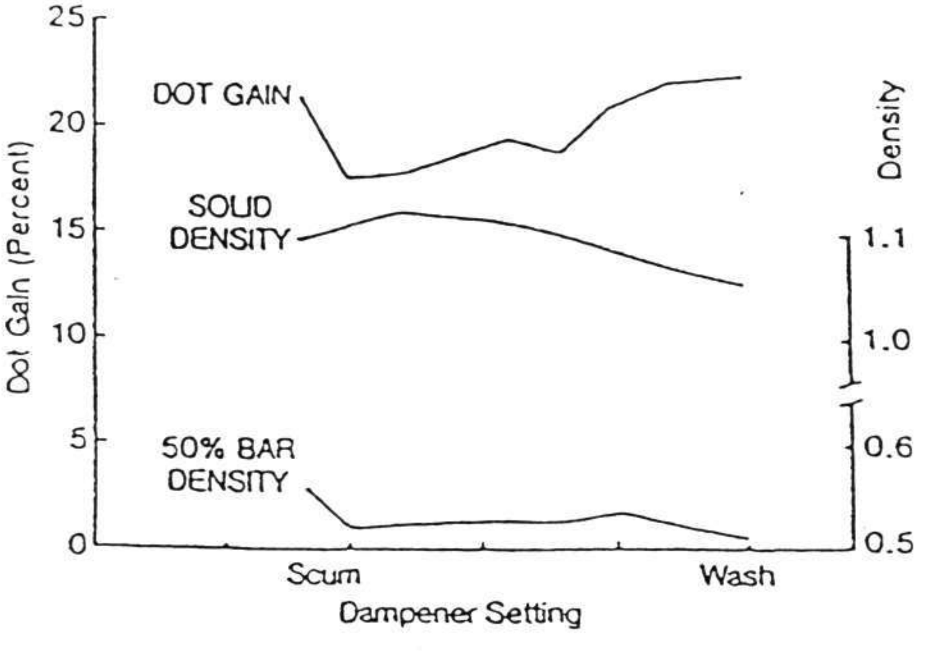

Figure 21. Apparent dot gain and solid optical density versus dampener setting on a newspress. (Figure 10, DePaoli, *Taga Proceedings*, 1981)

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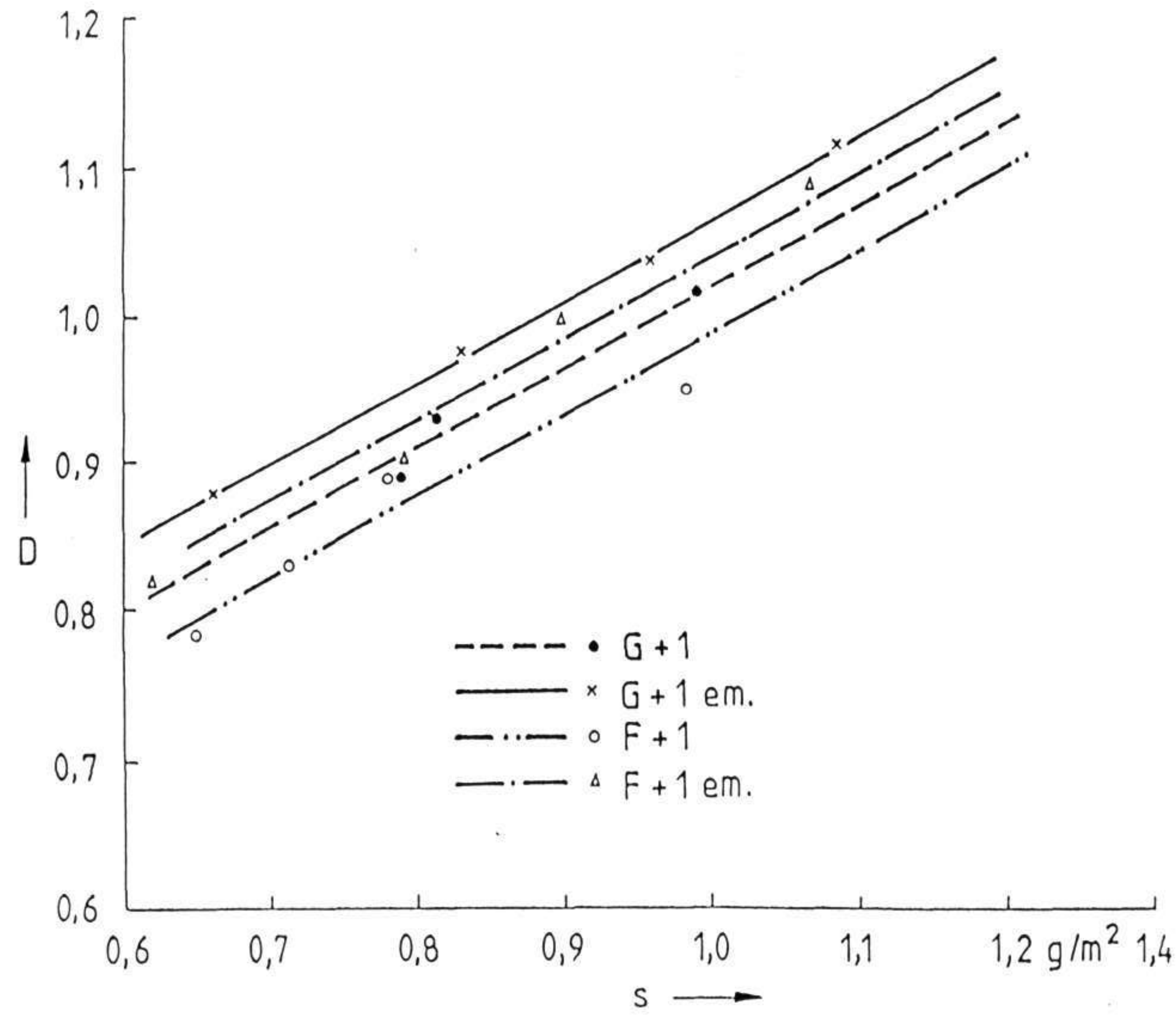


Comparision of the optical densities of pure and emulsified inks

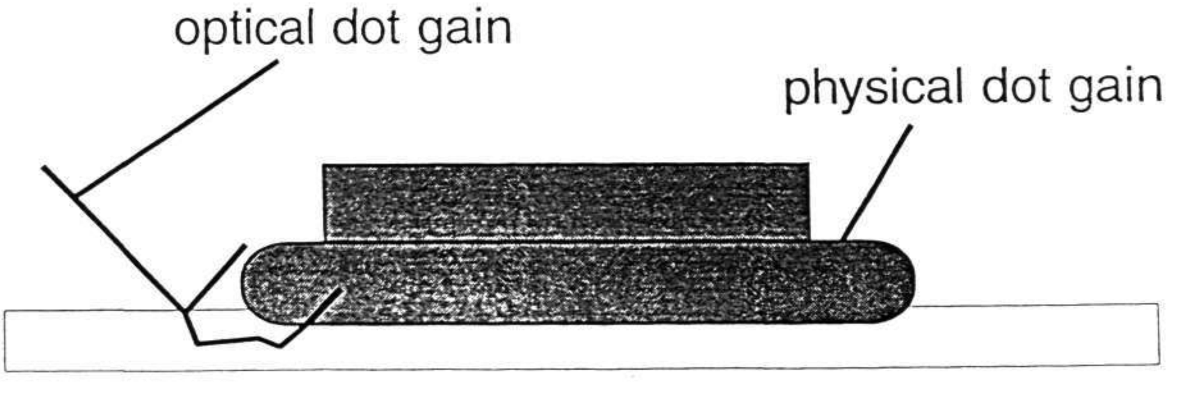
Institut für Polygrafische Technik	IFRA-Research project 1994 "High-pigmented offset news inks"	5.0	

DOT GAIN

When ink is applied on paper, each individual halftone dot increases in size - this is called dot gain.

There are two factors causing dot gain:

- physical enlargement of dots **(physical dot gain)**
- caused by wet ink penetrating into the paper
- optical enlargement of dots **(optical dot gain)**
- caused by light traveling in the paper and reflecting to areas covered with ink



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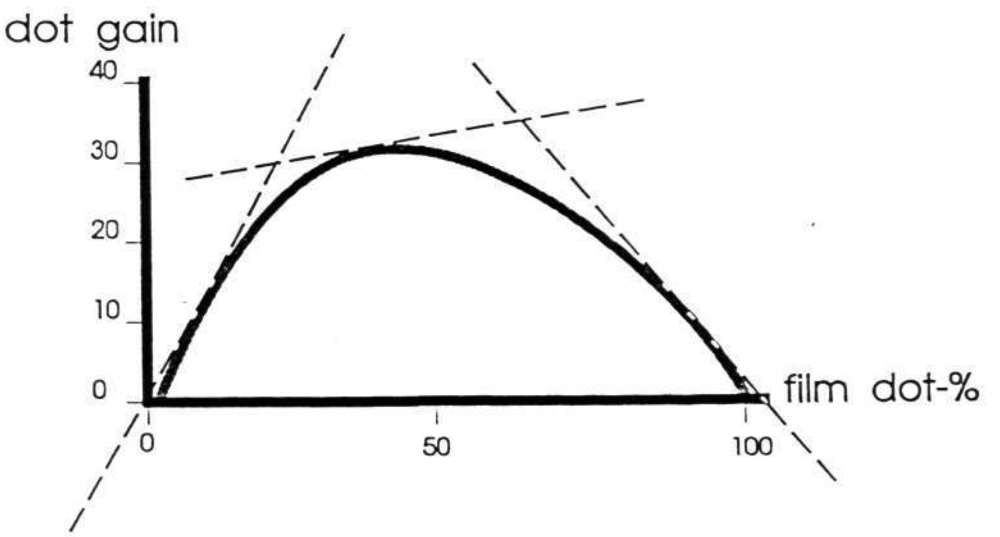
Factor	Change in dot-%
PLATEMAKING Under cutting of light	+ 3
PRINTING Optical dot gain **Physical dot gain**	 + 20 **+ 6**
TOTALLY	+ 29



Dot gain in highlights increases contrast, in the middle tones maintains contrast and in the shadows reduces contrast.

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Factors affecting dot gain:

ink
paper
screen ruling
dot shape
amount of ink
amount of water
fountain solution
blanket
impression
temperature
plate
film type (negative/positive)
humidity
press speed
ink sequence

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The key issues in minimising and stabilising dot gain are:

- establish a good ink-water balance
- maintain constant inking through measuring
- do not use too rough paper, especially with inks of low viscosity
- do not use too high impression settings
- use elastic blankets
- control the platemaking

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DENSITY OF SOLIDS

The density of solid tone areas is determined by:

- maximum contrast
- the amount of rub-off and set-off

Maximum contrast is defined by using the NCI-test (Normal Colour Intensity)

$$K_r = D_s - D_h / D_s$$

K_r = relative contrast
D_s = solid density
D_h = halftone density (usually 70% halftone)

In very many practical cases, the optimal inking level determined by NCI has been decreased to avoid rub-off and set-off.

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Set-off is ink attaching to other surfaces (cylinders, roller bars, opposite page) *immediately after printing*.

Tested in a test device which has two nips. The first to apply ink and the second to bring a test paper in contact with the ink. Density of the test paper is measured.

Rub-off is ink attaching to other surfaces when the surface is rubbed *1 - 24 after hours printing.*

Tested by a special device where a specified weight (50gr.) is covered with paper and rubbed against the printed surface.Density of the rubbing paper is measured.

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For black inks, low-rub inks have been developed and they produce satisfactory results. For colour, it is more difficult.

IFRA is running a project on high pigmented newsinks where:

- the pigment concentration of ink is increased from 14 - 16 % to 18 - 22%
- more pigments requires less ink to produce high density
- the rub-off behaviour of these inks are tested

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CONCLUSIONS

Laboratory scale tests can be used to a limited extent only.

They are well suited for monitoring the consistency of an ink or paper - not for finding the optimal solution for your press.

Pilot scale tests can for certain parameters be used for optimising and comparing the products. However, results must always be verified by full scale tests.

Use full scale tests as often as you can. Keep printing conditions constant and change only one parameter at a time.

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PRINT THROUGH: STRIKE THROUGH and SHOW THROUGH

Print through is ink becoming visible on the reverse side of the paper. It is caused by strike through and show through.

In a test of 32 European newsinks print through varied from 0.044 to 0.070 with ink densities of 0.85 - 0.95. (45 gr. newsprint of opacity 93.0)

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Strike through is caused by ink penetrating deep into the poures of the paper.

It is measured by zeroing the densitometer on the paper and by measuring the density on the reverse side of a solid tone.

Strike through should be kept in a good region by:

good ink-water balance
not too low viscous inks
not too porous paper
correct densities
not too high impression settings

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Show through is ink becoming visible on the reverse side because of low opacity (high transparency) of the paper.

Opacity is a measure of the ability of the paper not to transmit light.

Correct values for opacity are:

grammage	opacity %
48.8	93.5
45.0	92
40.0	90

(all with Y-value of 64.5)

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LINTING, FAN-OUT

Linting is cumulative build-up of small fibre particles on the rubber blanket.
It causes density variations, mottling and marking.

Linting is strongly affected:
- by the linting prospensity of the paper (amount of loose fibres or fillers)
- by the ink (tack and viscosity)
- by the printing conditions

To avoid linting:
- use rough paper
- use lower viscosity ink
- use lower tack ink
- use good blankets

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Fan-out is dimensional change in paper caused by the applied water and ink.

The direction of the dimensional change depends on the **fibre orientation.**

The fibres swell more than they increase their length >
high orientation in MD (Machine Direction) causes larger changes in width

The amount of fan-out should never be more than **0.1 % of paper width.**

Because fan-out varies from mill to mill, from paper to paper and from reel to reel, it should be compensated in the press (and/or prepress)

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A basic adjustment can be done in prepress or by positioning of the plates.

Variations from that basic adjustment should be carried out in the press.

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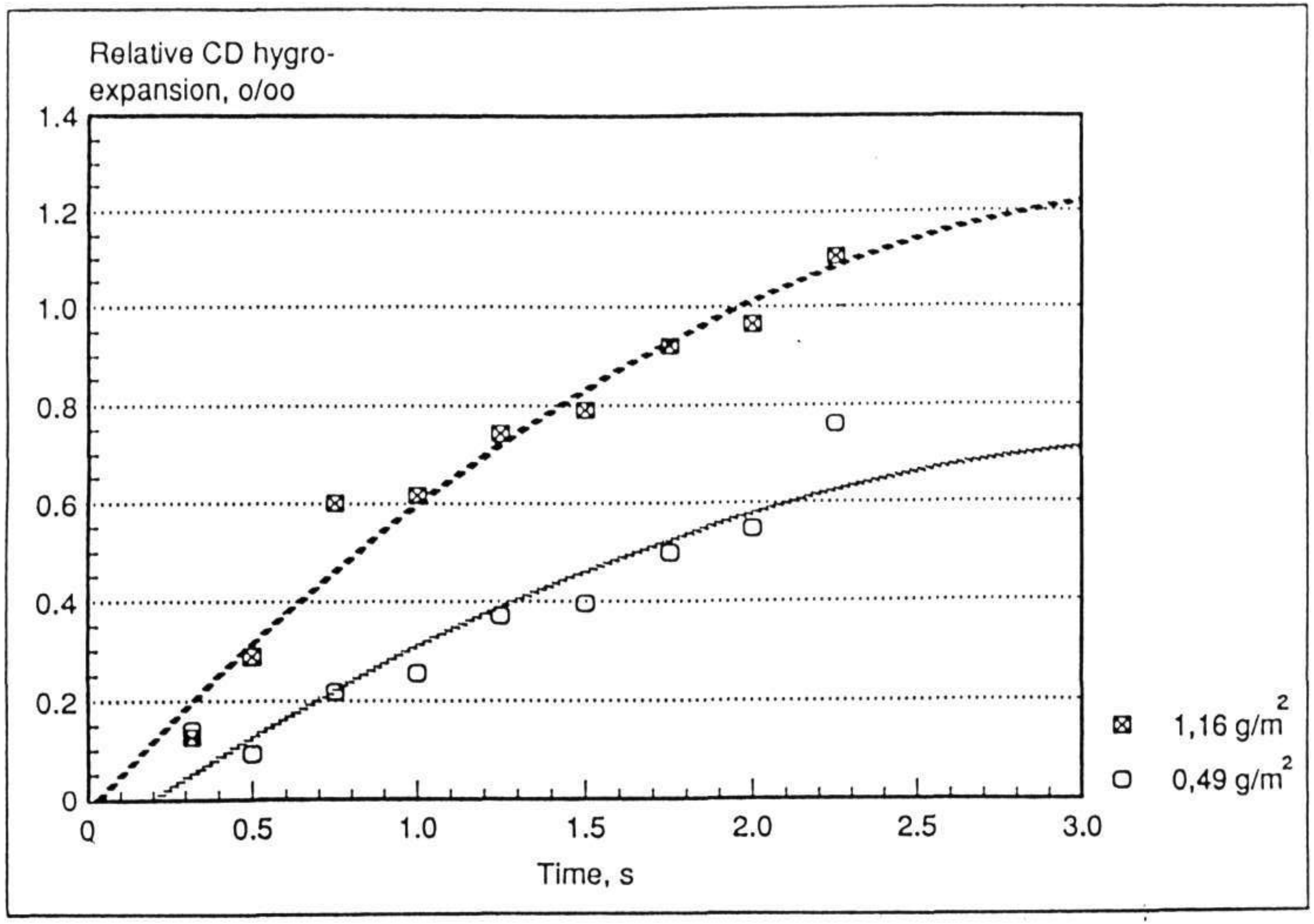

Figure 17. *Time dependance of the dynamic CD hygroexpansion of newsprint at two amounts of applied water. Results from pilot scale trials.*

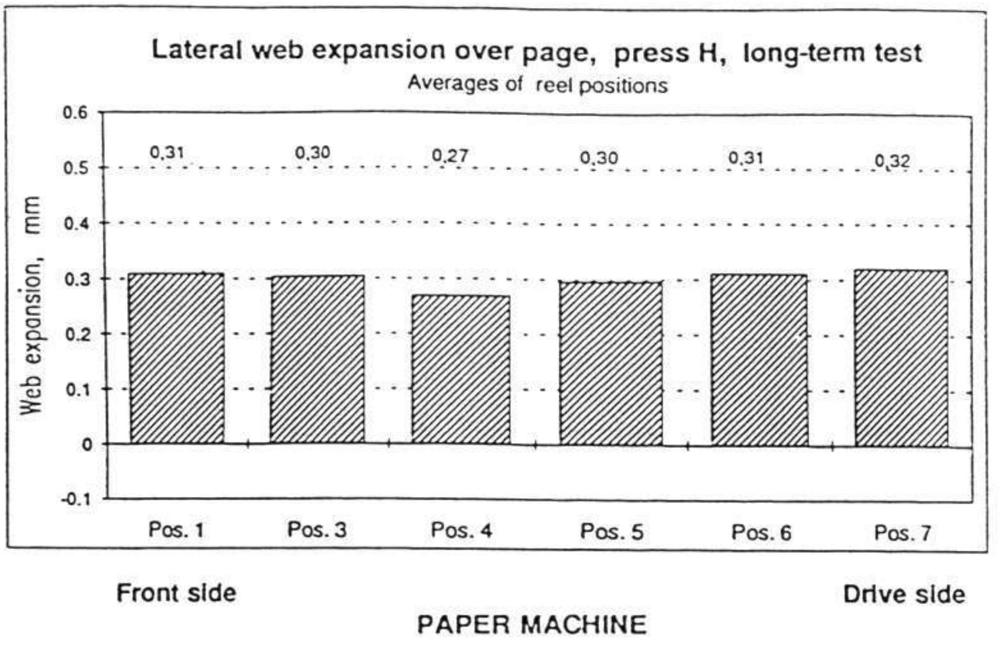

Figure 1. *The average lateral web expansion over the page in press H was 0.305 mm. Only position 4 deviates significantly from position 7. No other significant differences between reel positions were found.*

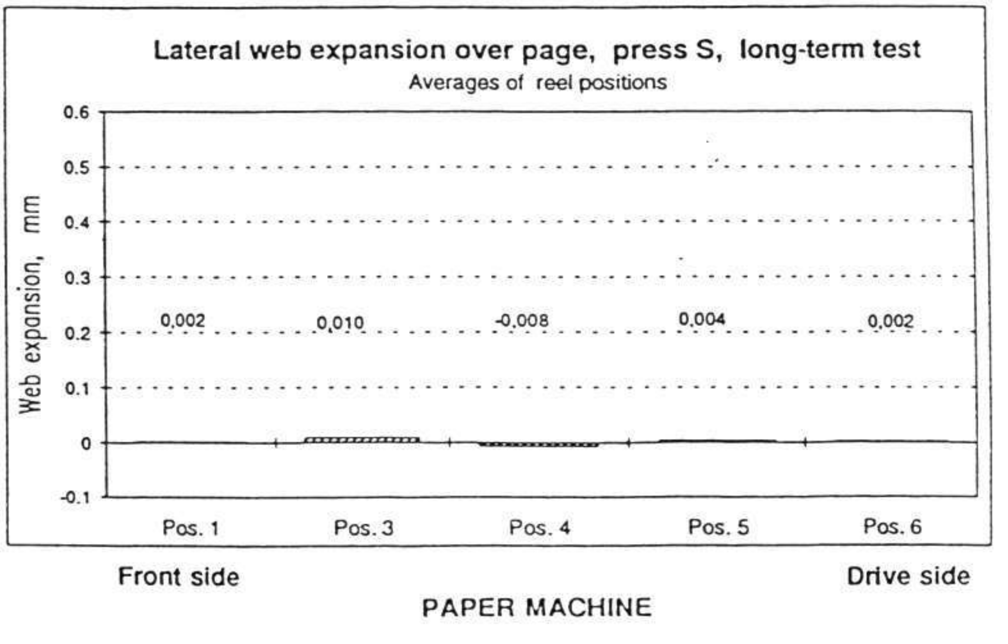

Figure 2. *The average lateral web expansion over the page in press S was 0.002 mm. No significant differences between reel positions were found.*

REGISTER CONTROL

Accurate register is a precondition to good colour.

Micro register is a precondition to sharp crisp bright images.

Register errors are caused by:
- sudden changes in web tension
- constant movement of the web
- register errors in films, plates, separations

Sudden changes are caused by web tension changes after reel changes, during speed alterations, because of material variation etc. There causes should be minimised and bad copies ejected.

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Constant movement of the web cannot be avoided. The press should be adjusted so that the movement is within tolerable limits (< 0.05 mm)

Register errors of plates, films and separations should be avoided altogether.

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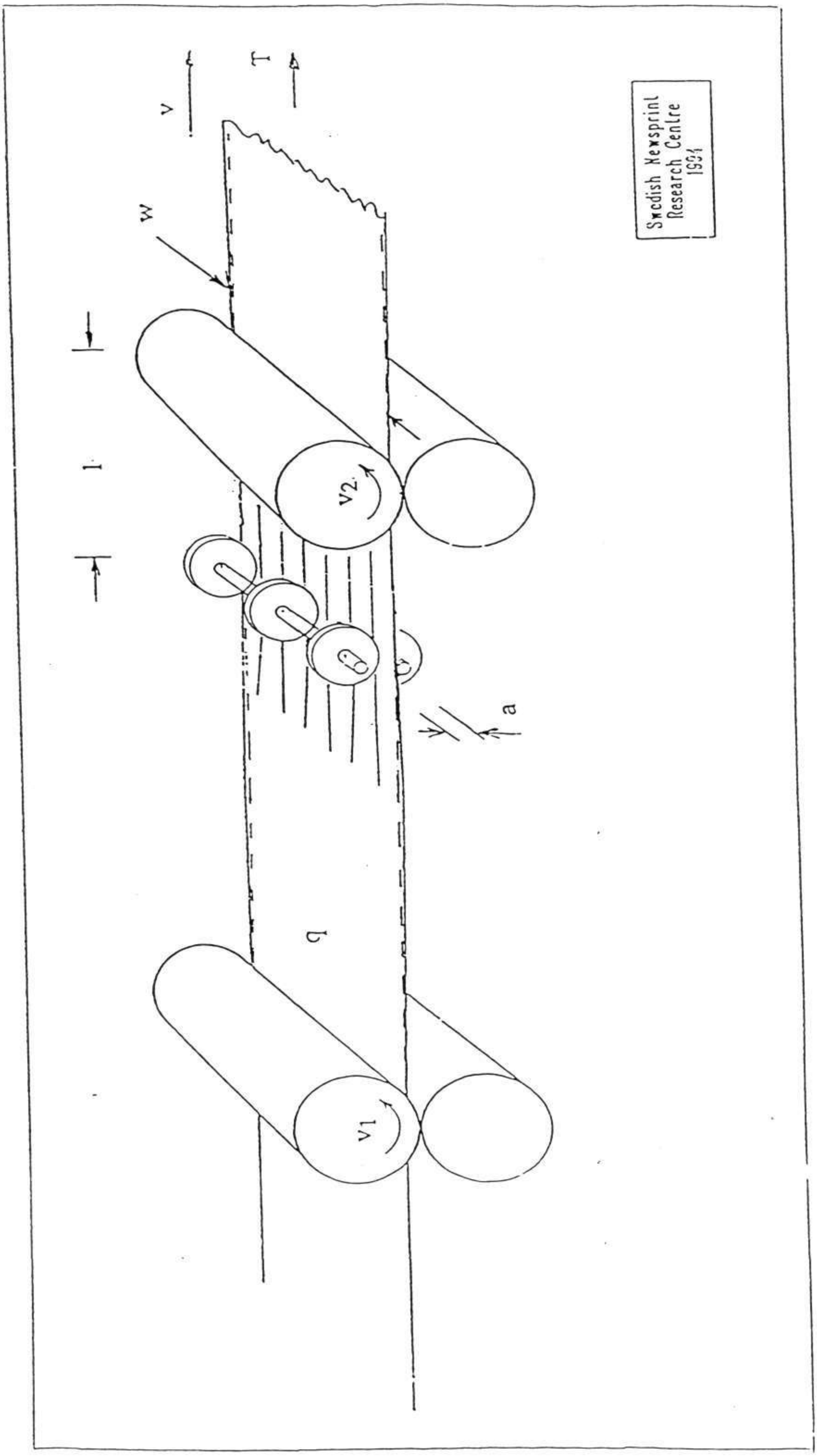
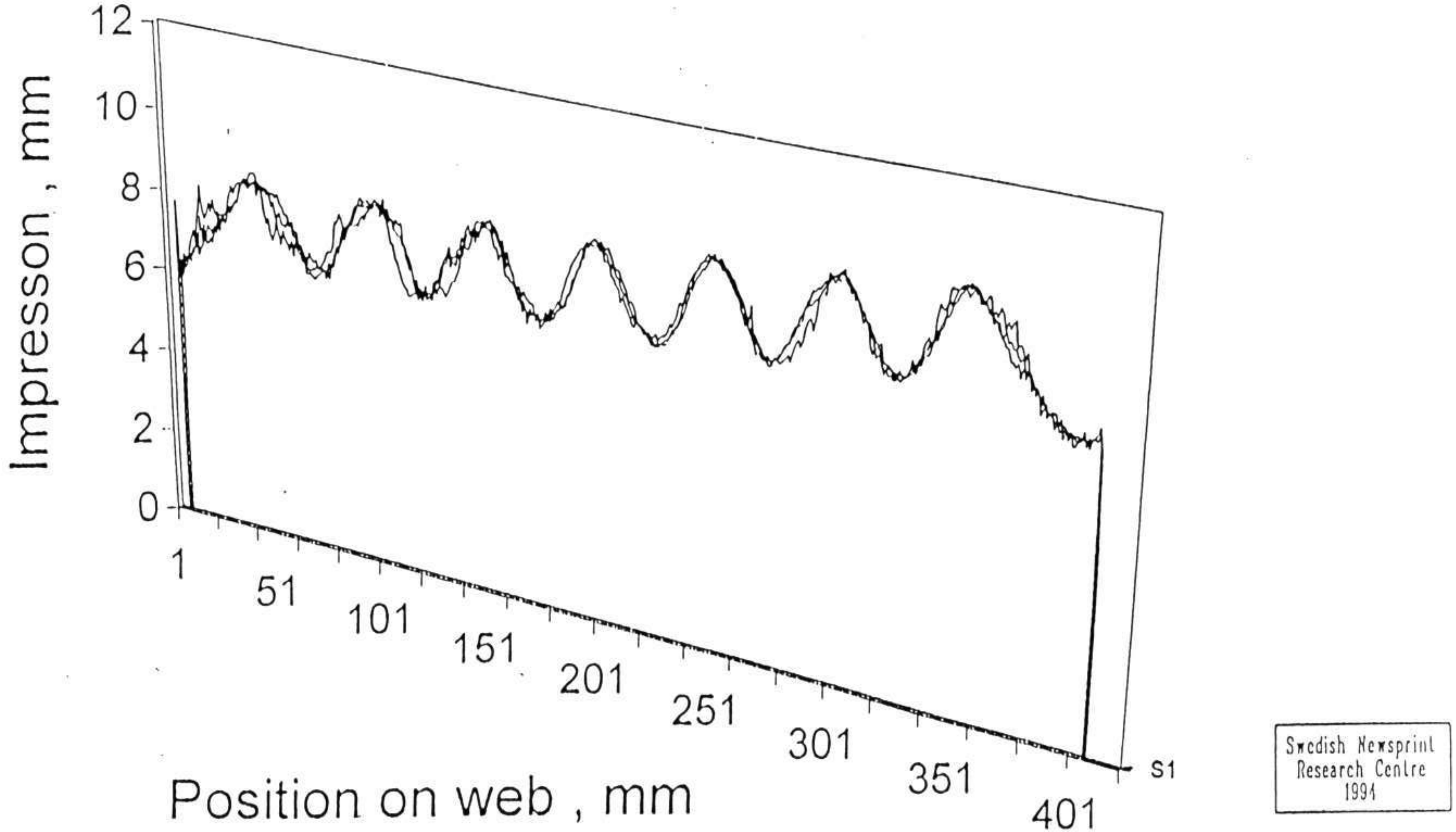
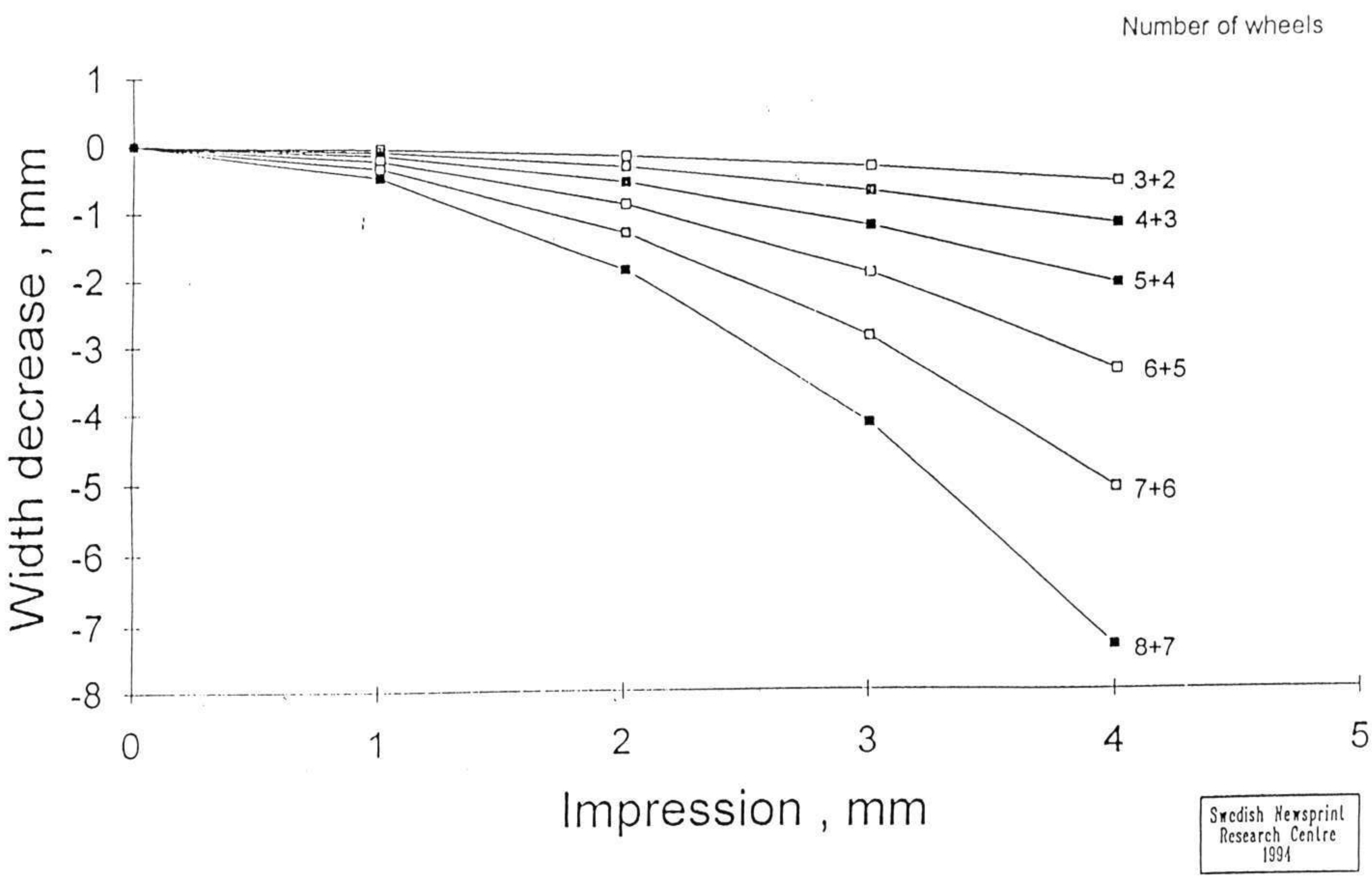

v
T
w
l
v2
v1
a
b
Swedish Newsprint
Research Centre



The wave form across the paper web 10 cm after the anti fan-out rollers at the impression of 2 mm. Number of wheels 7 + 8.

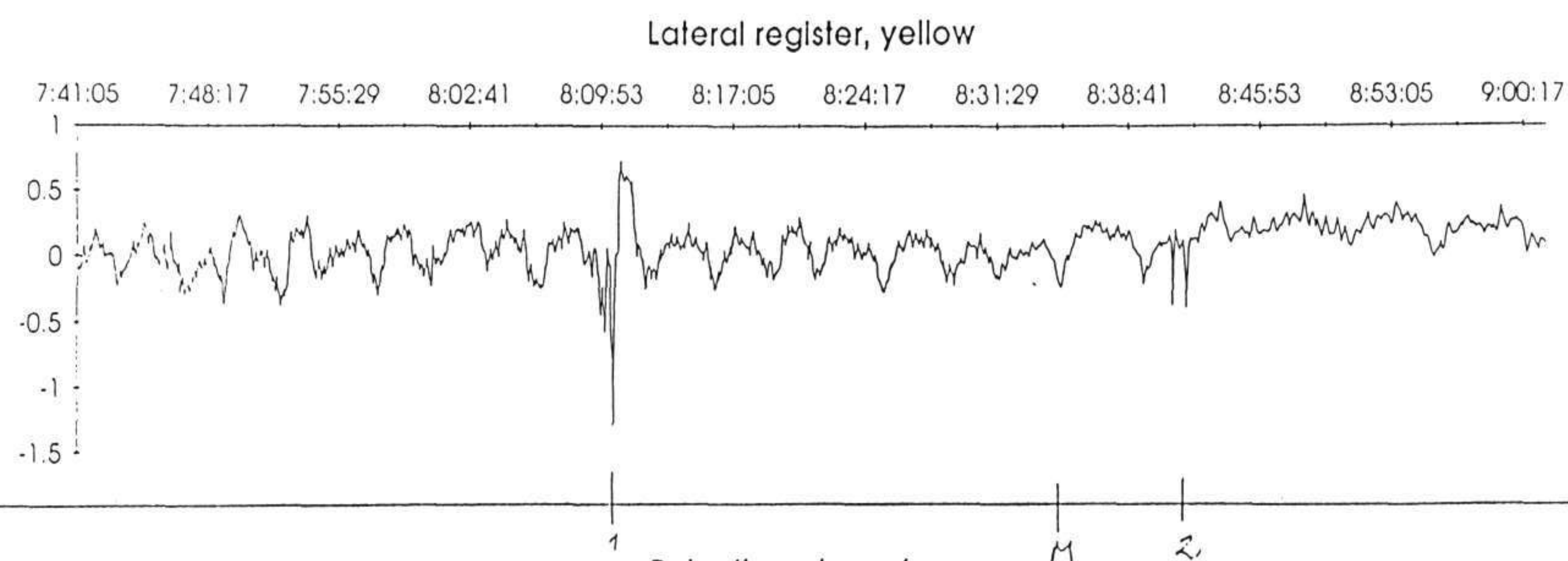
1994-05-04

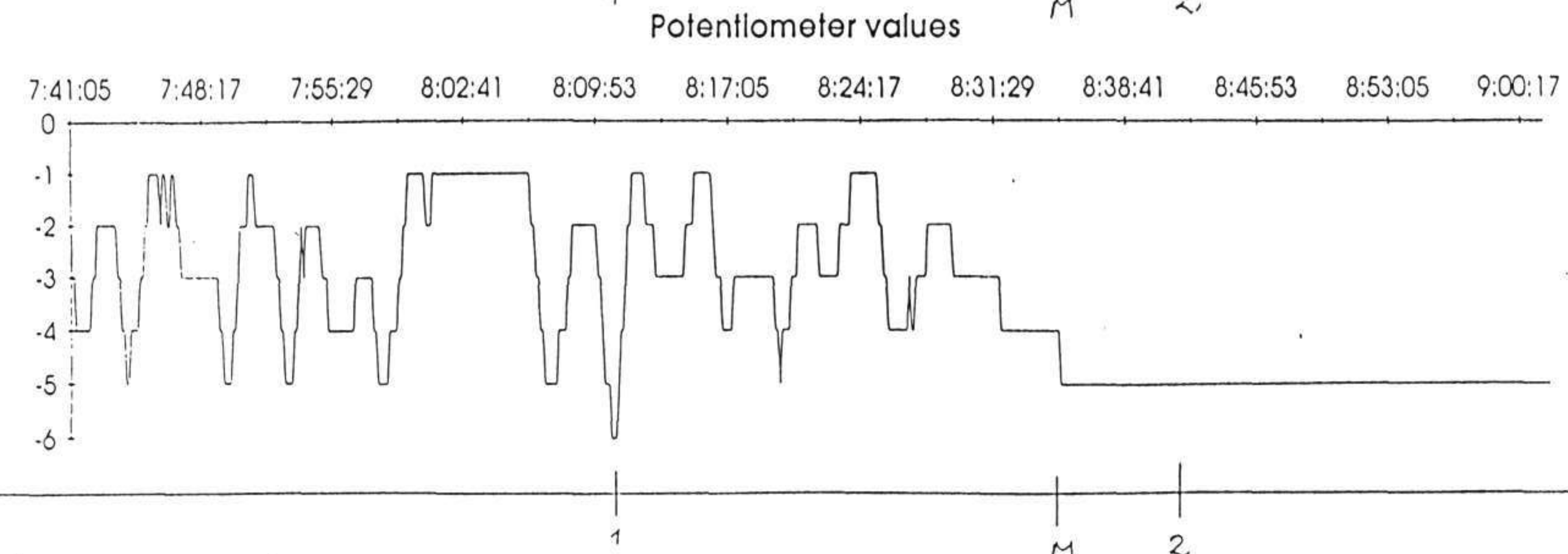


The width decrease of the paper web (calculated) as a function of the impression in the paper at different number of anti fan-out wheels.

1994-05-03

Appendix 2

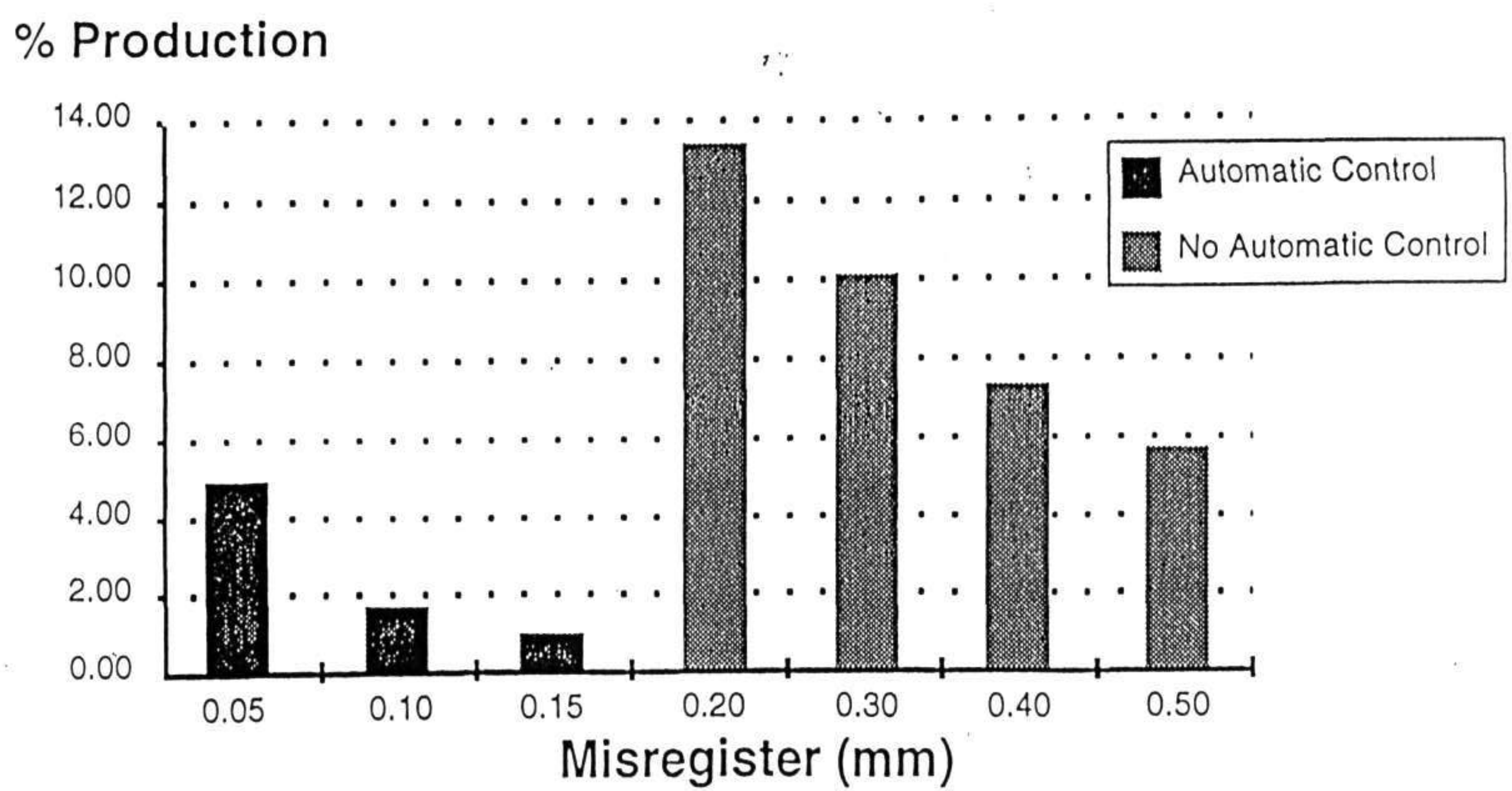




1 Splice, manual move
2 Splice
M: System to manual

News International

Analysis of Misregister With and Without Automatic Register Control



WHAT IS PRINT QUALITY AND HOW TO EVALUATE IT ?

In simple terms:

Print quality is applying the correct amount of ink on wanted image and text areas while maintaining the non-image areas unchanged.

This is evaluated visually.

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VISUAL ASSESSEMENT

Visual assessement is the only assessement that really counts.

Who cares what the numbers from a measuring device are, if the printed sample looks good.

However, to reach that point (good printed results), usually a number of measurements have to be done.

In visual assessement, the **lighting conditions** have to be correct:

- neutral surrounding (white or grey)
- correct temperature of light (5000 - 6500 K)
- enough light (~ 1000 lux)

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Colour temperatures of some light sources:	
candle	1900 K
sunlight at sunset	2000 K
light bulb	2900 K
halogene light	3300 K
moonlight	4100 K
mid day sunlight	5000 K
xenon lamp	6000 K

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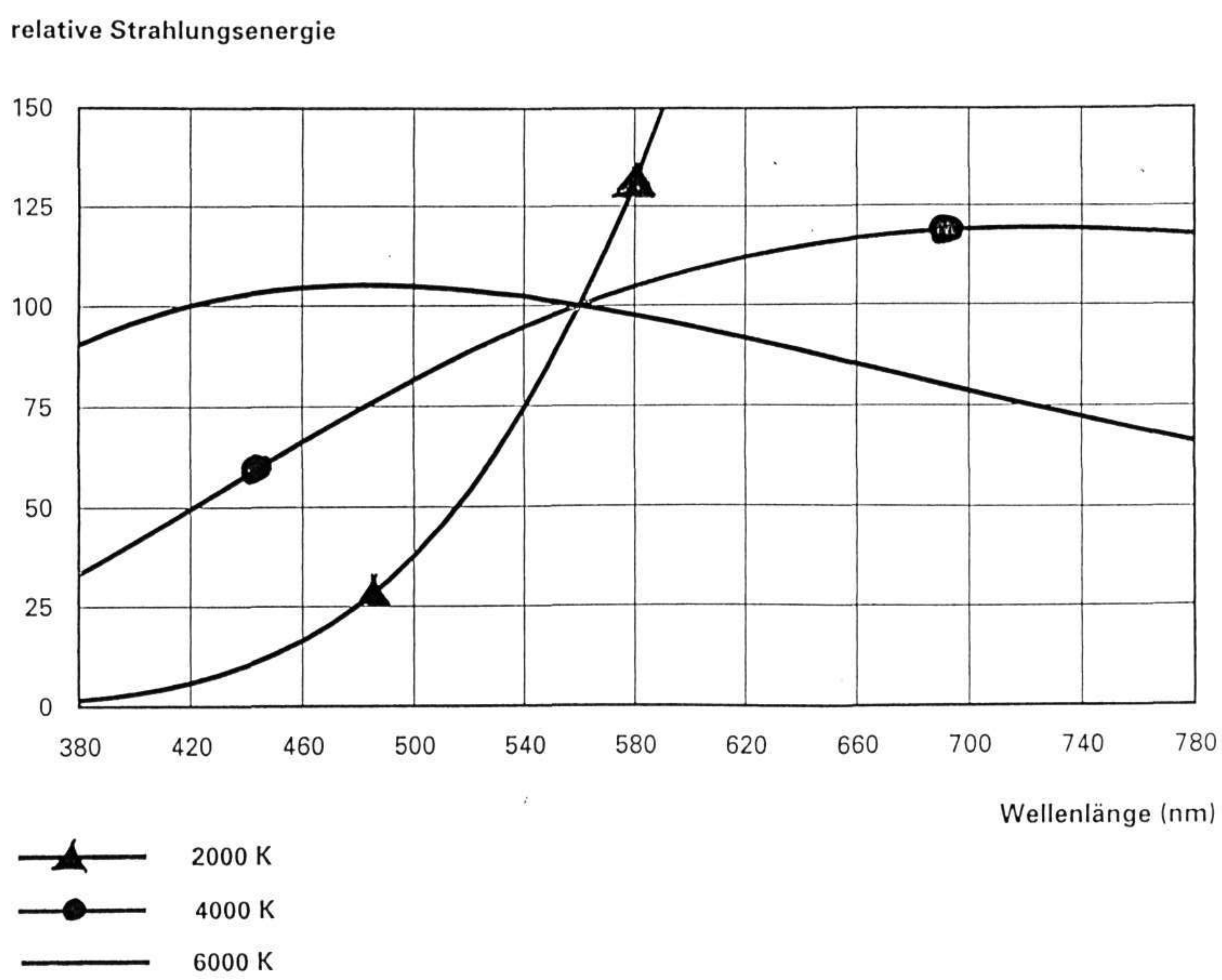
relative Strahlungsenergie
150
125
100
75
50
25
0
380
420
460
500
540
580
620
660
700
740
780
Wellenlänge (nm)
2000 K
4000 K
6000 K

TEST PRINTING

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LABORATORY SCALE

1. IGT PRINTABILITY TESTER

- suitable for comparisons of different paper/ink combinations
    - rub-off
    - set-off
    - ink requirement
    - ink hue
    - delamination
- does not cover emulsified inks

2. PRÜFBAU TESTPRINTER

- paper width	4cm
- impression	200 - 1600 N
- speed	0.5 - 6 m/s
- temperatute	15 - 40 C
- extra modules:	damping
	drying

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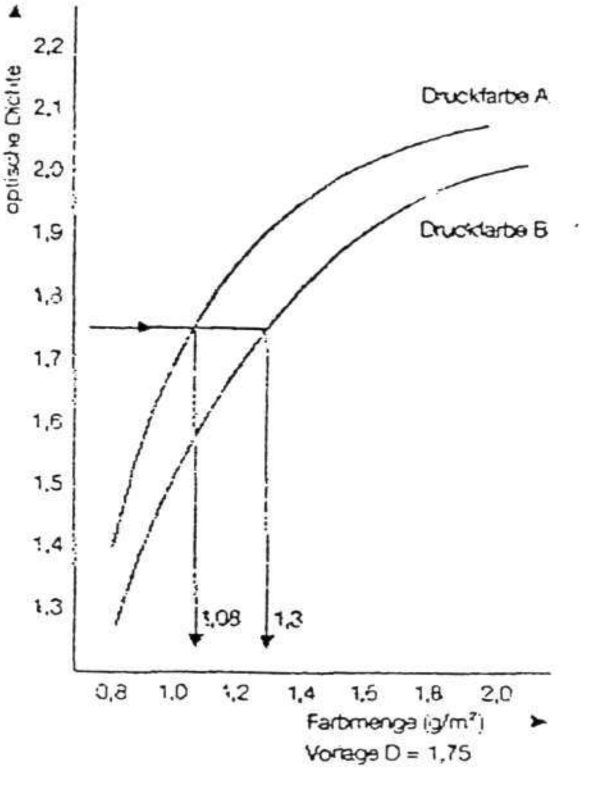
TYPICAL MEASUREMENTS

- as with IGT
- tack
- ink penetration
- picking
- coating behaviour in general



ifra

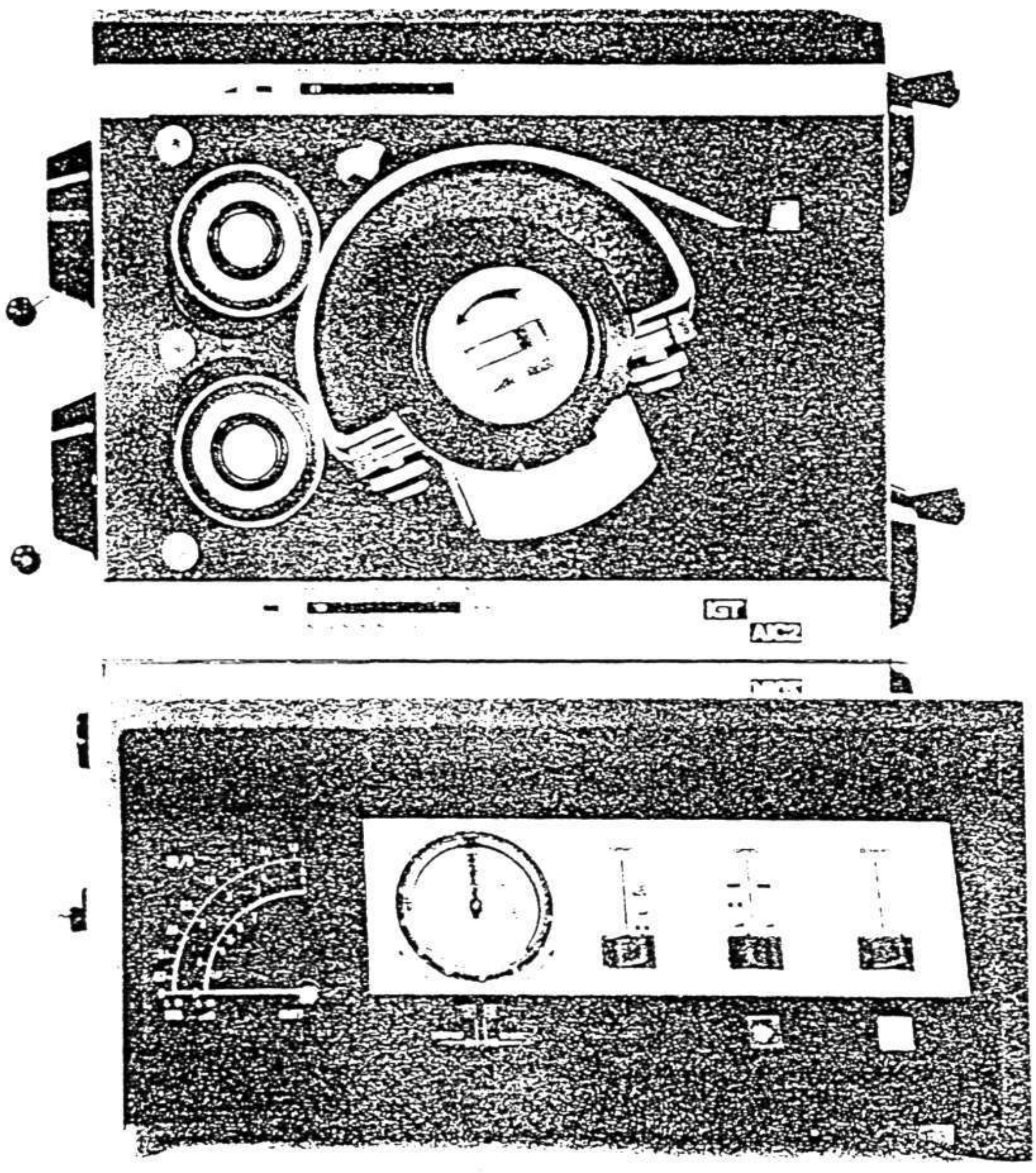
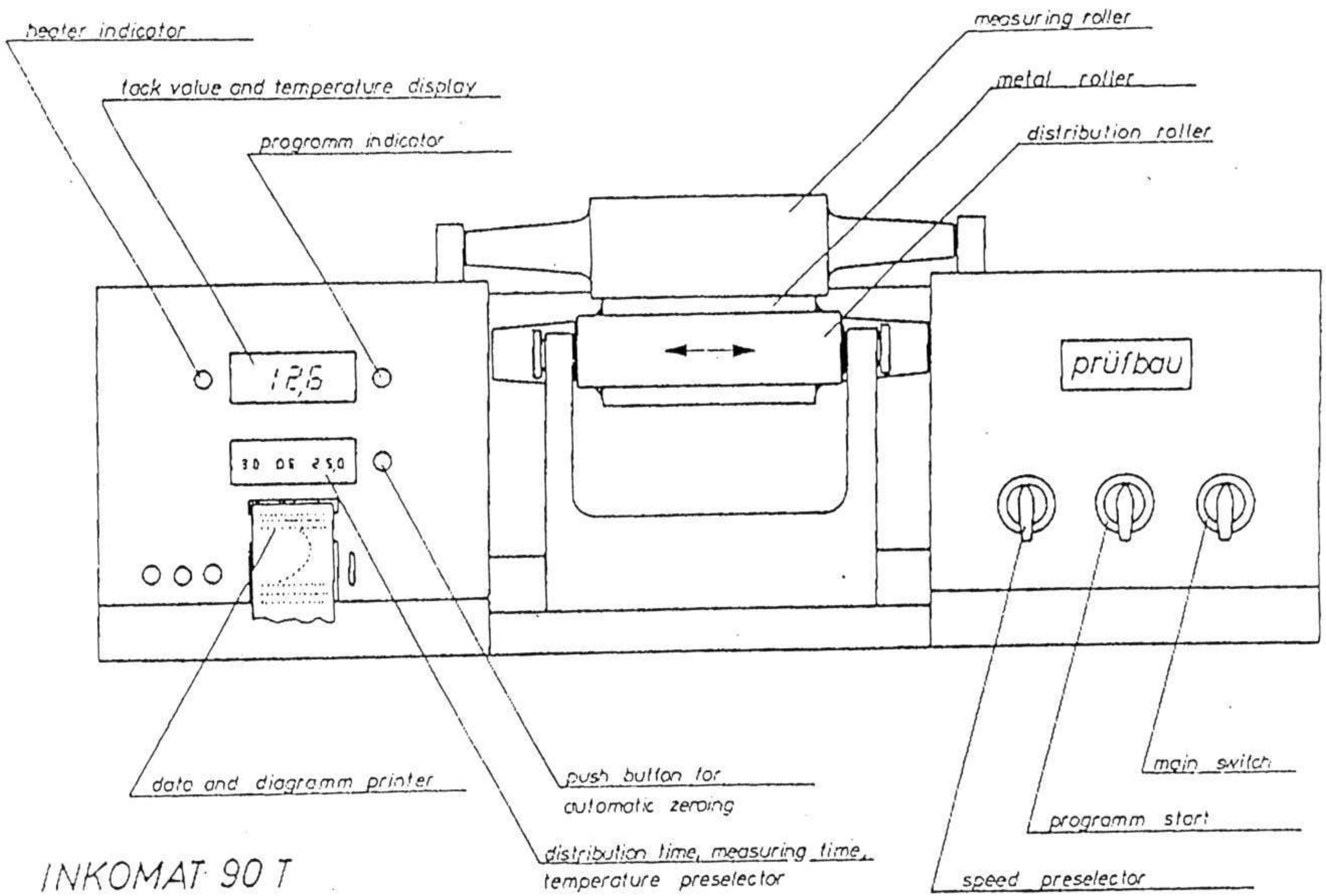


Fig. 12.24. The print unit of an AIC2 IGT printability tester


heater indicator
tack value and temperature display
programm indicator
measuring roller
metal roller
distribution roller
12,6
3.0 0.5 25.0
prüfbau
data and diagramm printer
push button for
automatic zeroing
distribution time, measuring time,
temperature preselector
main switch
programm start
speed preselector
INKOMAT 90 T

PILOT SCALE

In pilot scale testing, following types of equipment (presses) are used:

- experimental presses
- small full scale presses
- units of full scale presses
- sheet-fed presses

Pilot scale presses (usually) include a damping unit. Thus printing with **emulsified inks**.

Should be capable of operating under reproducible printing conditions.

Equipped with extra control devices:

- print density
- ink film thickness
- water film thickness

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In order to obtain representative results, each test should be carried out **in optimal conditions** adjusted to the paper/ink combination in question. Otherwise, single printing conditions are tested and the results are not valid.

Optimisation is carried out by:

- doing the NCI-test
- optimising the nip condition (true rolling)
- optimising the water feed (visually - no tinting, no water marks)

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Runnability issues cannot be predicted:

Rheological properties (viscosity, tack, thixotropy): suitable for trouble shooting for a given type of press/ materials condition. Not as a general quantitative recommendation.

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CORRELATION BETWEEN LABORATORY TESTS AND PRINTED RESULTS

IFRA Special Report 1.7 "Correlations between ink measuring methods and printing results"

Results from the project:
Printability issues can to a certain degree be predicted:

Rub-off:	Correlation is significant
Set-off:	To some degree predictable
Print-through:	To some degree predicatble
Water take-up:	To some extent predictable
Ink mileage:	Predictable
Colour hue:	Predictable

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FULL SCALE

Full scale tests are regarded as being the only reliable end use test in product development end work.

A few preconditions have to be kept in mind:
- printed samples must be representative
- the press has to be warmed up
- stable conditions have to be achieved (ink, water)

Printing under constant density is **not** recommended as this gives results from one specific condition only. A **simplified NCI-method** is recommended.

Example: IFRA Colour Testforme.

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