

Chapter 1

Technical Development Tendency of Pulp and Paper Industry

1.1 General Development Tendency of Paper Science and Technology

- **Large scale, Automation, Informationality, High efficiency**
- **Optimized and simplified process system, integration and intelligence of process control**
- **Reduce investment and energy consumption, improve product quality and decrease production cost**
- **Develop greatly to the recycled economy and clean production, utilize resources more efficiently, reduce environment pollution, promote the sustainable development of paper industry**

1.2 Development Tendency of Chemical Pulping

Main Methods: Kraft and Soda-AQ

Main Processes: RDH, Super-Batch, EMCC,
Lo-Solids, DDS

Purpose achieved: High efficient delignification

Good delignifying selectivity

Low energy consumption

Less environmental impact

**Chemicals used: NaOH Na₂S AQ Polysulfide
(Na₂Sn)**

Minor Methods: SP, AS, NS, AS-AQ

Production scale: single line 1 million t/a of wood pulp
3500 t/d of wood pulp
750 t/d of bamboo pulp

New Technologies: Kvaerner—Compact cooking
Dualox two—stage oxygen
delignification
Andritz—Lo-Solids cooking
Metso—Super Batch cooking
Oxytrac two-stage oxygen
delignification

1.3 Development Tendency of Mechanical and Chemimechanical Pulping

Processes used: TMP

CTMP

BCTMP

APMP, PRC-APMP

CMP, Bio-CMP

Chemicals used:

Na_2SO_3

NaOH , H_2O_2

Enzyme

Chelating agents:

EDTA, DTPA, DTPMPA

Purpose achieved:

High yield

Good strength

Good brightness

Low pollution

PRC—APMP

- **P—Preconditioning**
- **RC—Refiner chemical**
- **APMP—Alkaline Peroxide Mechanical Pulp**

Projects built or being constructed

- | | |
|-------------------------|------------|
| • Hunan Yueyang | 100000 t/a |
| • Henan Puyang Longfeng | 100000 t/a |
| Xinxiang Xinya | 100000 t/a |
| Jiaozuo Ruifeng | 150000 t/a |
| • Ningxia Meili | 100000 t/a |

PRC—APMP Quality

- Controllable pulp quality which can meet the demand of different species of paper
- Poplar PRC—APMP: beating degree 55—80°SR (Schopper Riegler)

Canadian Standard Freeness (CSF) 80-150mL

- Breaking Length > 3200m (Max 6000m)
- Brightness 78—80%ISO (Max 82%ISO)
- Light Scattering Coefficient 45m²/kg (Max 54m²/kg)
- At the condition of high breaking length, keeping high bulk, average 2.2 cm³/g , max 3.0 cm³/g
- Low content of shive, average 0.1%

1.4 Development Tendency of Pulp Bleaching

Bleaching sequences:

For Chemical Pulp: OQP

DQP

D(EOP)D

OD(EO)P, OD(EP)D, OD(EOP)D

C(EP)H, C(EP)HP

OHQP

For TMP, CTMP, DIP:

**P, Y, FAS (Formamidine
sulphinic acid)**

PY

P-FAS

Stage probably used:

X, Pa, Px

Chemicals used: ClO_2

O_2

H_2O_2

NaOH , Na_2SiO_3

DTPA, EDTA

Pa, Px, Pxa

Xylanase

Advanced Bleaching Sequences

- **Germany Stendal Pulp Mill** 0.6M•t/a softwood pulp
87—89%ISO
ECF: Q—(OP)—D—(PO)
TCF: Q—(OP)—Pa—(PO)
- **Sweden Ostrand**
TCF: Q—(OP)—(ZQ)—(PO)
88-90%ISO, Effluent discharged 5-6m³/t pulp
- **Finland one pulp mill short—sequence bleaching** :D(EOP)D,
Brightness 85%, 88%ISO and 90%ISO
- **Guizhou Chitianhua: bamboo pulp** TCF: Q—(OP)—Q—(PO)
ECF: Q—(OP)—D—(PO)

Purpose achieved: High brightness

High brightness stability

High bleached pulp yield

Low viscosity loss

Low energy and water consumption

Low pollution load (COD, BOD, SS, AOX)

1.5 Development Tendency of Waste Paper Recycling

- **Drum Pulper: low shear force,
high consistency 15-18%**
- **High efficient screening and cleaning**
Screening with low and medium consistency, slot $\leq 0.15\text{mm}$
Cleaner for heavy or light contaminants
Effective removal of stickies
- **High efficient dispersing technique**
- **High efficient, low energy consumption floatation equipment**
- **Oxidative—reductive bleaching: P、 Y、 FAS or combined**
- **High efficient waste water treatment system**
Fresh water consumption $\leq 5\text{m}^3/\text{t pulp}$

1.6 Development Tendency of Papermaking

For papermaking, stress on the development of production techniques characterized by **low basis-weight, high quality, low consumption and high efficiency**

✚ For papermachine and paperboard machine, turn towards wide width, high speed, high efficiency, low consumption, and the increase of unit production capacity as well as the new technique of paper surface treatment.

(b) Purposes achieved:

- **Improvement of paper machine runnability**
- **Increase of paper and paperboard production**
- **Improvement of product quality**
- **Enhancement of enterprise competitive power**

Paper machine

- ◆ Max width of newsprint machine and supercalender: 11.3m
- ◆ Closed operation from sheet formation to drying, automatic sheet transferring, automatic reel changing
- ◆ Changes of coating and calendering from outer machine to inner machine
- ◆ Energy and water saving

Newsprint steam consumption 1.1—1.4t/t

water consumption 10—12 m³/t

- ◆ Improved quality
 - ◆ Future development focus on higher speed, but no wider
- The paper machine speed will reach 3000m/min in the next 10 years

New techniques in culture paper machine

- ◆ **High efficient, compact stock flow system**

Smaller volume, shorter flow path, better mixing and degassing, more accurate furnish and consistency control

- ◆ **Hydraulic head box with diluted water cross basis weight control**

- ◆ **New generation of twin wire former with vacuum forming roll and pressurized dewatering plate**

- ◆ **Shoe press**

Increase the machine speed to 1500m/min→1800m/min

Increase the dryness of wet web 3~8%

Save the drying energy 12—32%

Improve bulk, cross moisture profile

Drying Technique

- ◆ Single row dryer
- ◆ Rope free sheet transferring
- ◆ Single felt (dry screen) operation
- ◆ Improve the uniformity of cross shrinkage
- ◆ Increase drying capacity

Coating and Calendering Techniques

- ◆ Merge papermaking, coating and calendering into a machine, realize the on-line production of coated paper
- ◆ Premeasurement sizing press
- ◆ Double roll soft calendering technique
- ◆ Supercalender covered with polymer
- ◆ Curtain coating, spray coating
- ◆ Engineering pigment, nanometer pigment

(c) Technologies and products focused on

- **High efficiency, low energy consumption, medium consistency pulp beating (especially for non-wood and recycled pulp)**
- **New technique of producing high grade, light-coated writing and printing paper (offset newsprint, offset printing paper, light-weight coated paper, China's art paper, etc)**

❖ Coating formation and advanced coating technology of paper and paperboard

❖ New technique of producing high grade packaging paper and paperboard (coated folding board, coated white board, Kraft liner board, high strength corrugating medium, etc)

❖ **Advanced technology of producing specialty paper, functional paper product and paper-base composite (carbonless copy paper, thermosensitive paper, pressure sensitive paper, computer-printing paper, special synthetic paper, pulp mould products)**

❖ **Advanced technology of producing high grade tissue paper and disposable products**

(d) Paper Chemicals used:

- **Sizing agents**

 - Dispersing rosin size**

 - Alkyl ketone dimmer (AKD)**

 - Alkenyl succinic anhydride (ASA)**

- **White mineral pigments**

 - Calcium carbonate(GCC, PCC)**

 - Titanium dioxide**

 - Kaolin**

 - Talc**

● Paper strength agents

Starch (OS, CS, AS, AmS)

PAM (CPAM, APAM, AmPAM)

PVA (Polyvinyl alcohol)

PAE (Polyamideamine-epichlorohydrine)

PEI (Polyethyleneimine)

- **Retention-aids and drainage-aids**

Compozil™

CPAM

APAM

CS (Cationic Starch)

PEO (polyethylene oxide)

PEO/CF (co-factor)

Some Co-factors:

PFR (phenolformaldehyde resin)

MPFR (Modified phenolformaldehyde resin)

SNS (Sodium naphalence sulphonate)

1.7 Development Tendency in Pollution Control and Environmental Protection

More and more attention will be paid in pollution control and environmental protection in the future.

- 3R—Reduce, Reuse, Recycle**
- Pulp and paper clean production**
- Alkali recovery from black liquor of both wood and non-wood pulp**
- Biorefinery- a new way of fully utilization of plant fiber resources**

- **Lignin modification and utilization**
- **Treatment and utilization of solid-waste**
- **Treatment of screening, cleaning and bleaching effluent with coagulating-biochemical process**
- **Treatment and reusing of white water in paper making process**

1.8 Development Tendency in Process Energy Saving and Carbon Reducing

- **Energy saving and heat recovery in chemical pulping**
- **Energy saving and heat recovery in mechanical pulping and chemimechanical pulping**
- **Energy saving in pulp washing, screening and bleaching**
- **Energy saving and heat recovery in alkali recovery system**
- **Energy saving and resource comprehensive utilization of secondary fiber recycling**
- **Energy saving and heat recovery in papermaking**
- **Energy saving in paper converting**

1.9 Development Tendency Information and Computer Techniques

- ◆ **DCS—Distribution Control System**
- ◆ **QCS—Quality Control System**
- ◆ **MMS—Machinery Management System**
- ◆ **MCC—Motor Control Center**
- ◆ **MIS—Management Information System**
- ◆ **CIPS—Computer Integrated Production Management and Control System**

Summary

- (1) Advanced technologies in pulping, bleaching and papermaking will promote the **modernization** of China's paper industry
- (2) More and more high efficient, cost-effective and environmental friendly **paper chemicals** will be used in China's paper industry, which will create a large market for the paper chemical producers.