BCTMP Technology: Development and Applications

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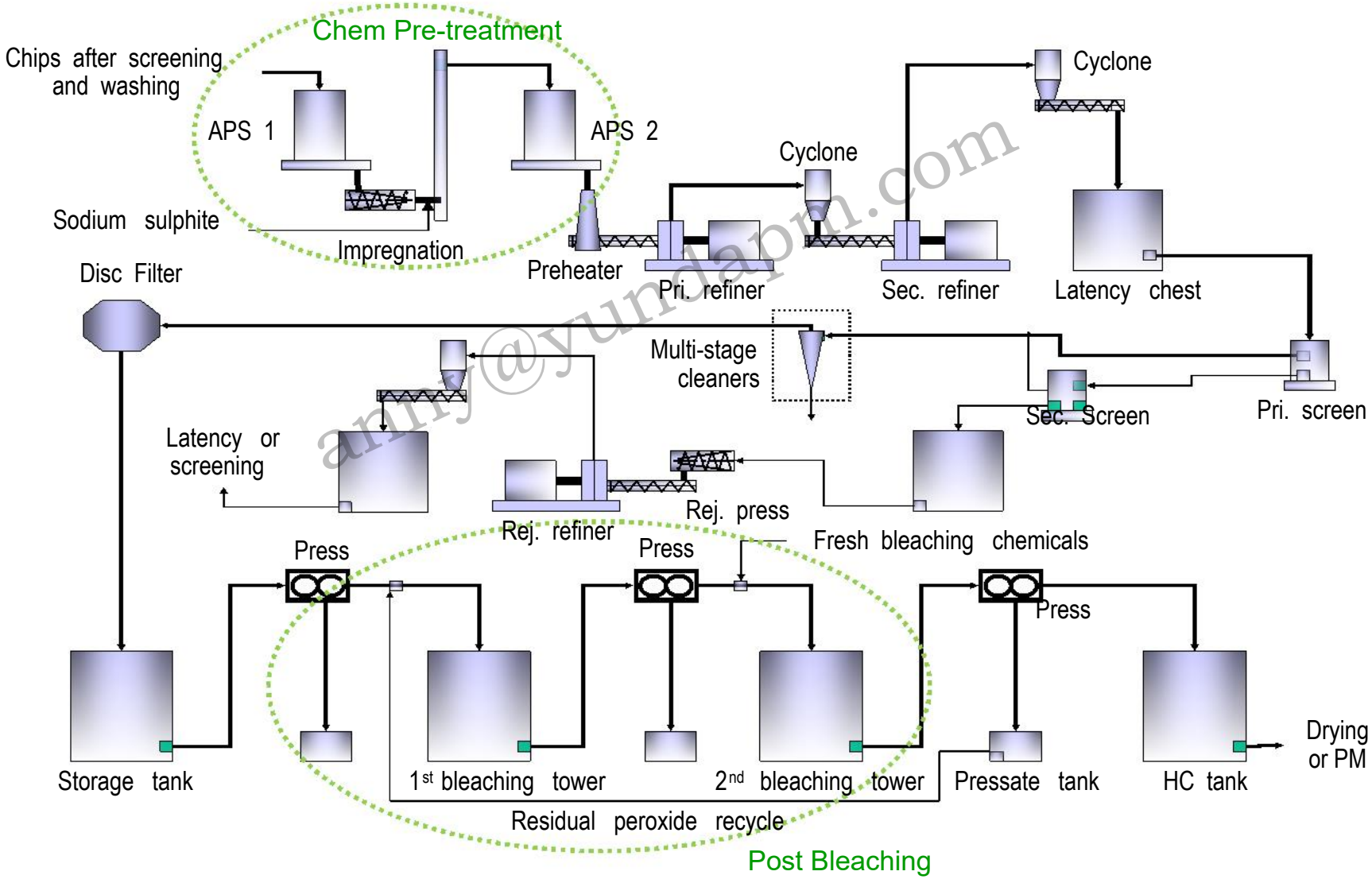
History of BCTMP Development: 1st Generation (1G)

1G BCTMP（started in 1980's): C+TMP+B

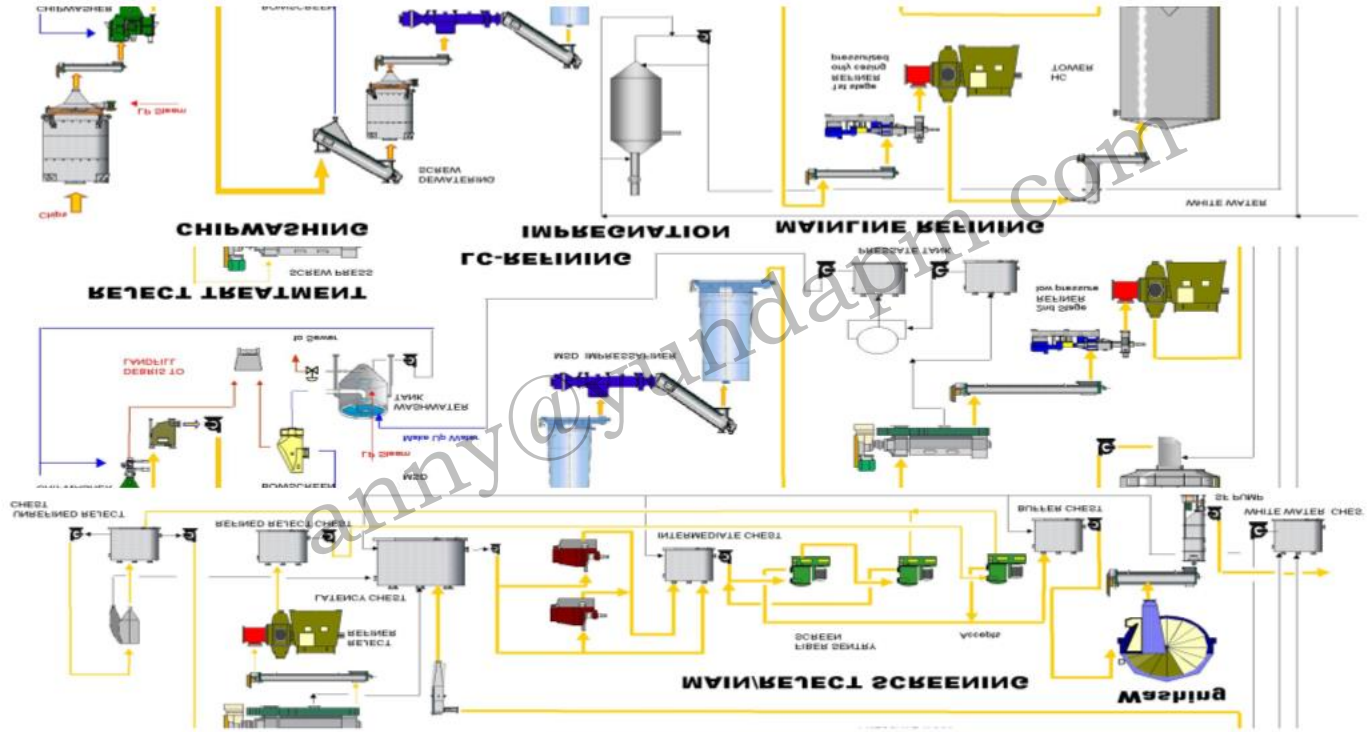
AS Pretreatment ➡ **HC Refining** ➡ **HC Refing** ➡ **Bleaching**



History of BCTMP Development: 2nd Generation (2G)

2G BCTMP (started in 2000's，Yueyang P-RC APMP):

AP Pretreatment → **HC Refining** → **Bleaching** → **Refing**

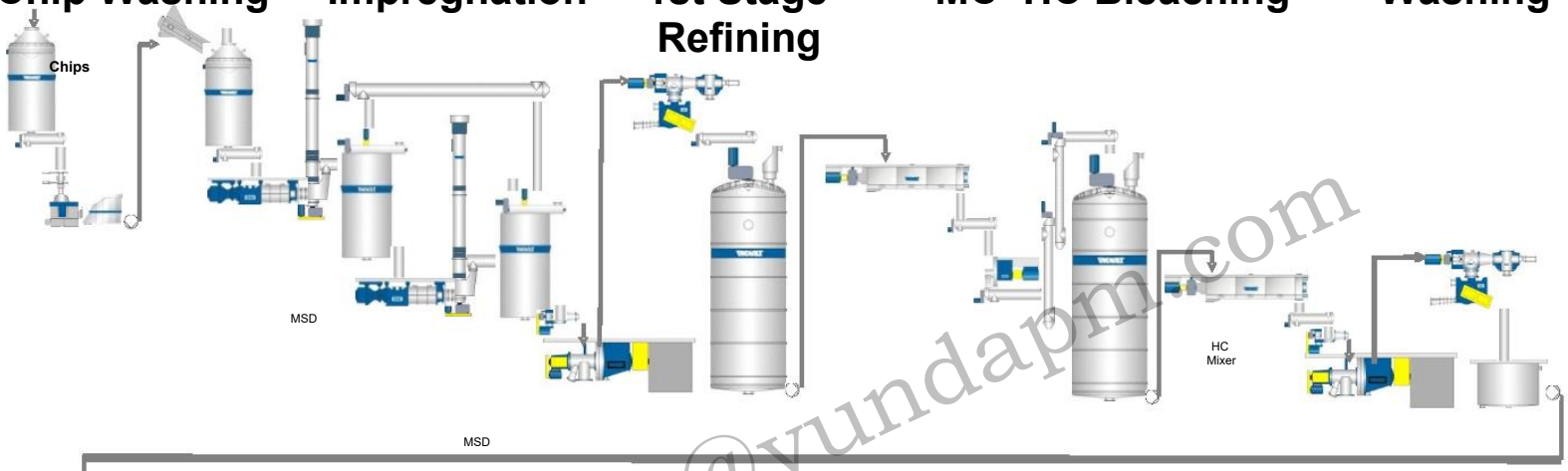


- Xu, E.C., "*A New Concept In Alkaline Peroxide Refiner Mechanical Pulping*", International Mechanical Pulping Conference, Houston, USA, (May 24--26, 1999).
- Zhang, D.-J., Guo, Y.-W. & Xu, E. C. "*Successful Start-Up And Commercial Operation Experience With P-RC APMP At Yueyang Paper Mill*", Proceeding of 2005 International Mechanical Pulping Conference, Oslo, Norway, (June 6-9, 2005).

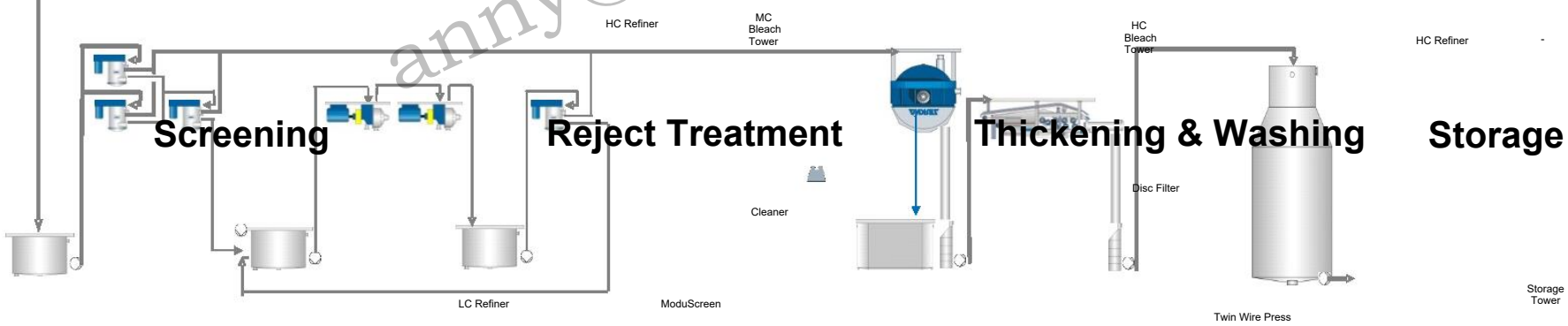
A 2G BCTMP: P-RC APMP with 2xPT+2xBleaching

AP Pretreatment → **HC Refining** → **Bleaching** → **HC Refing**

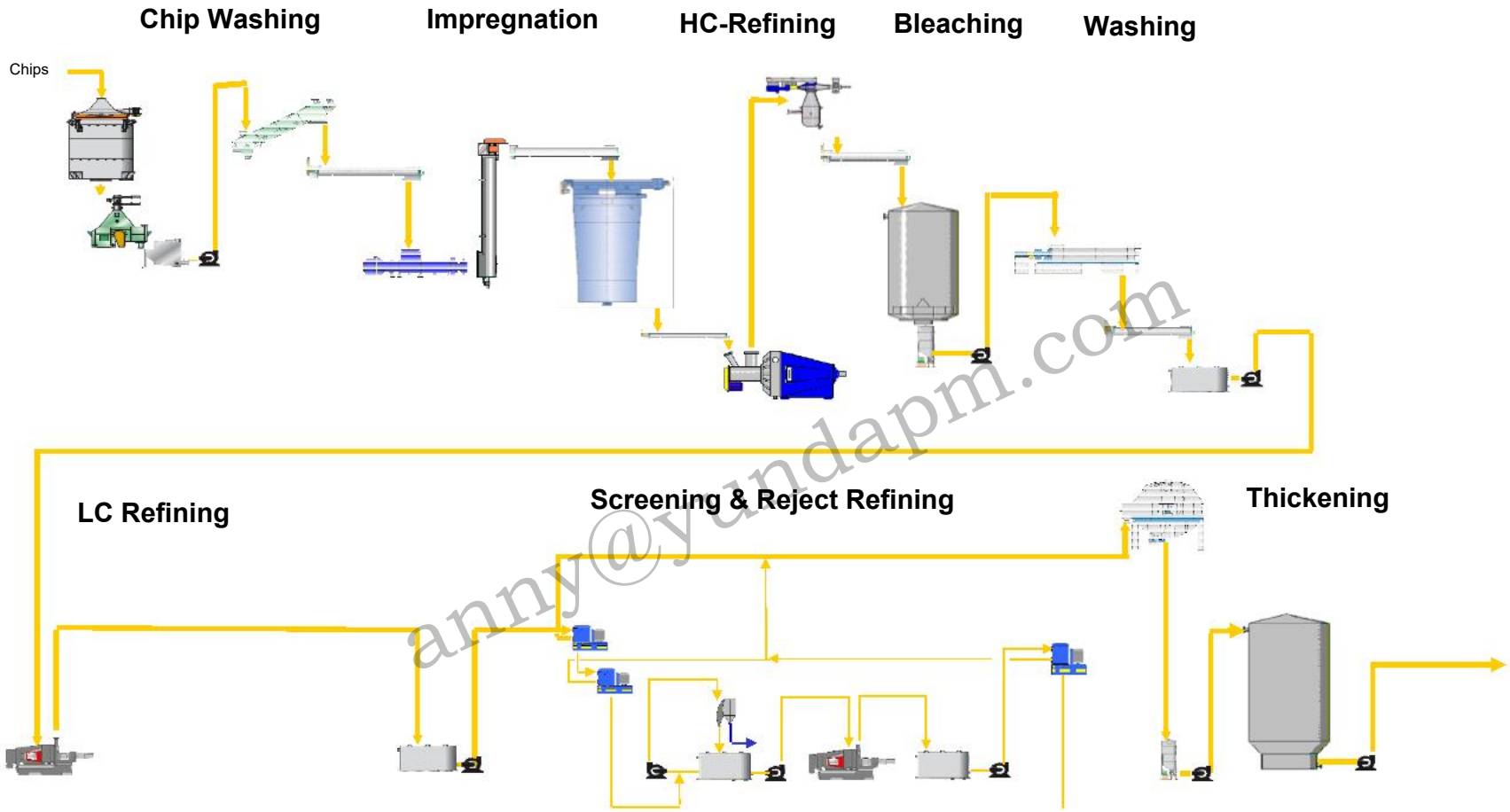
Chip Washing **Impregnation** **1st Stage Refining** **MC+HC Bleaching** **Washing** **2nd Stage Refining**



Screening **Reject Treatment** **Thickening & Washing** **Storage**



Devoplment of 2G BCTMP: LCR at 2nd Stage Refining

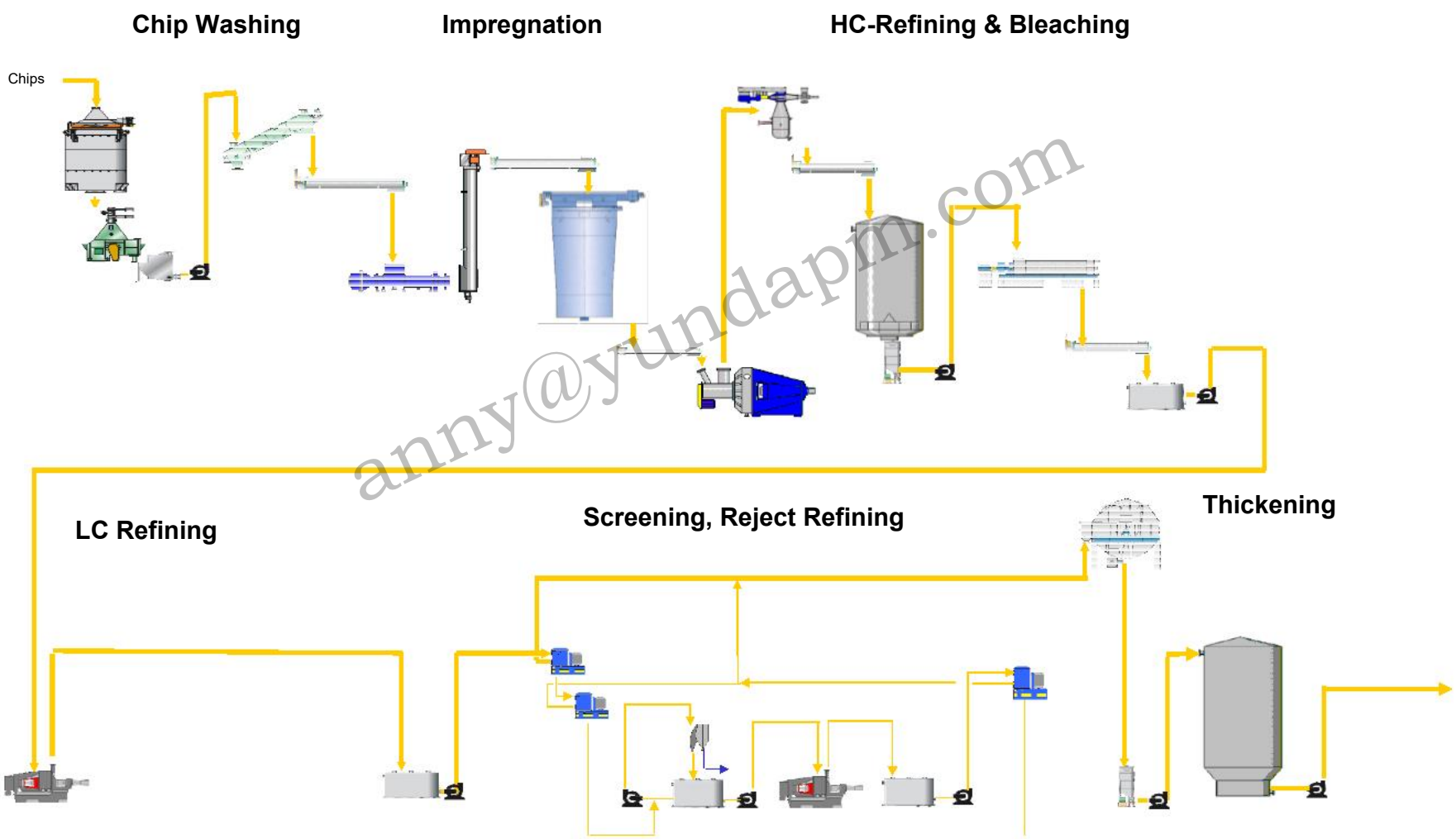


Xu, E.C, Koefler H. and Antensteiner P., "*Some Latest Developments In Alkaline Peroxide Mechanical Pulping, Part 2: Lower Consistency Refining at Secondary*", Preprint of 88th Annual Meeting of PPTA of Canada (Jan. 28-Feb. 1, 2002).

Guo, Y., Xu, E.C. and Teubner D., "*Comparison Between High and Low Consistency Refining at Yueyang P-RC APMP Mill*", Proceedings of 2009 IMPC, Sweden, (May 31 - June 4, 2009)

Common 2G BCTMP Flowsheet: (Simplified)

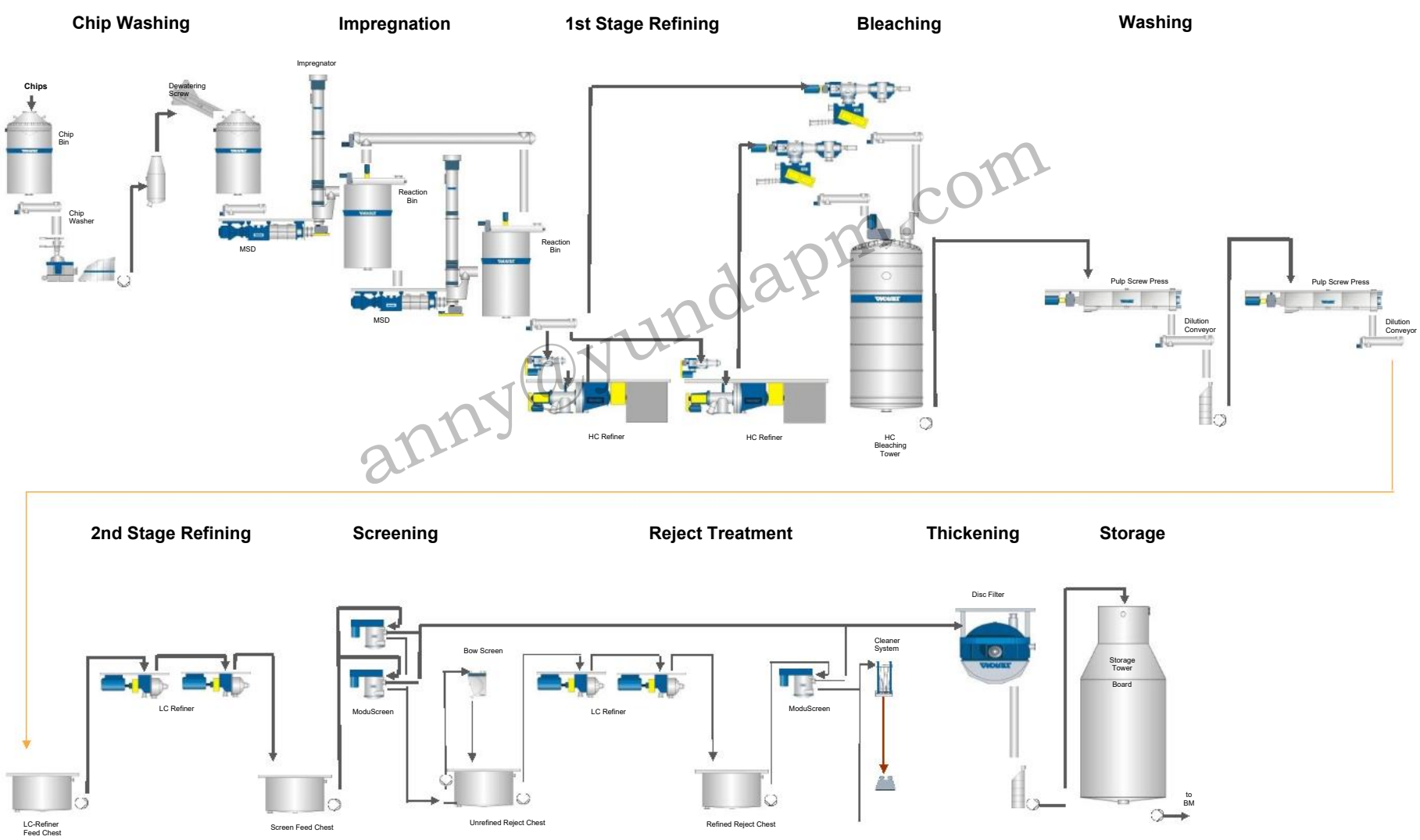
AP Pretreatment → **HC Refining** → **Bleaching** → **LC Refing**



A 2G BCTMP Fiber Line: (P-RC APMP)

- *APP-Jingui, China, (750-1000adt/d, 2010)*

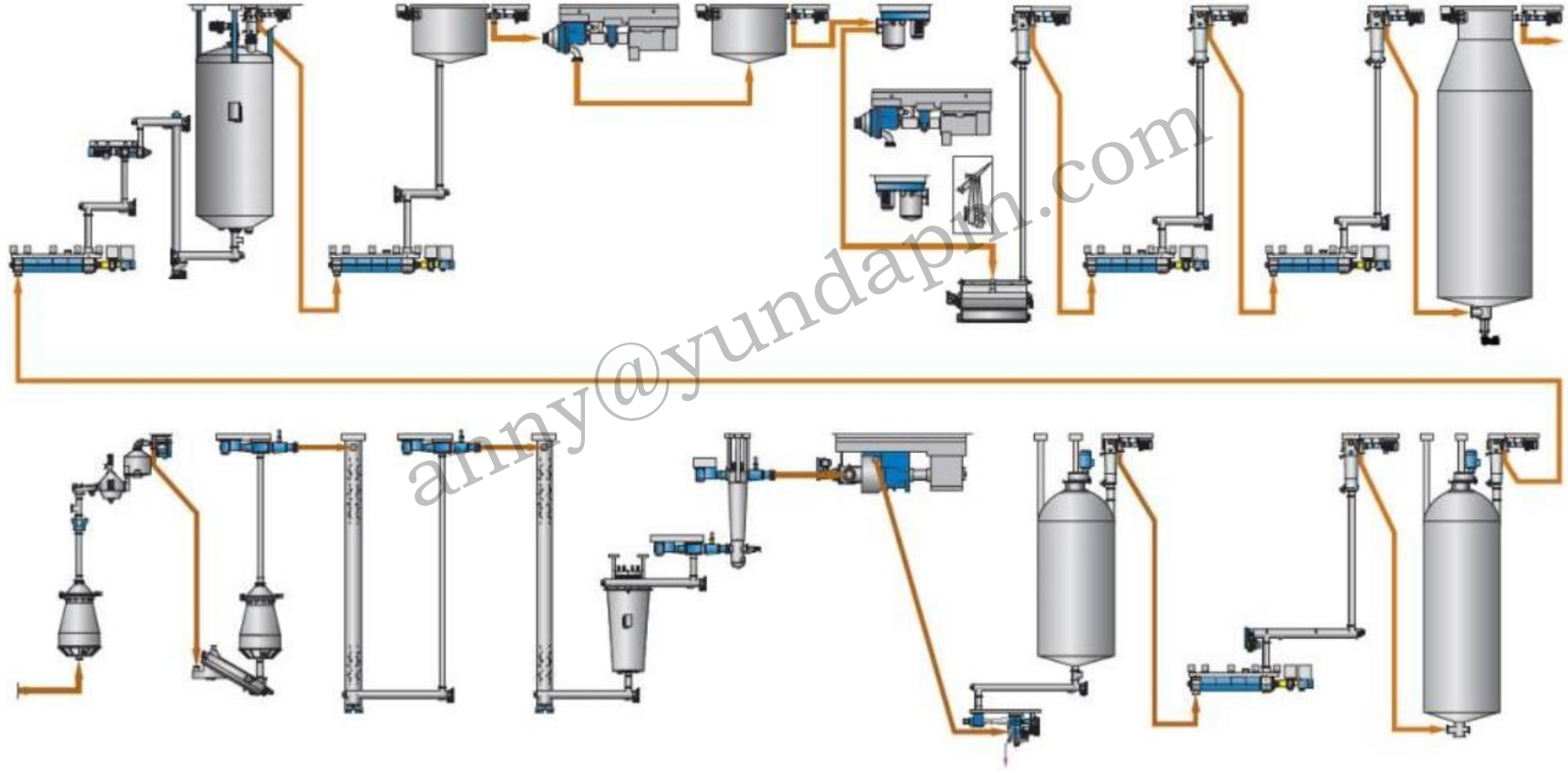
AP Pretreatment → **HC Refining** → **Bleaching** → **LC Refing**



V 2G BCTMP Fiber Line:

- SE-Beihai, China (700-850adt/d)

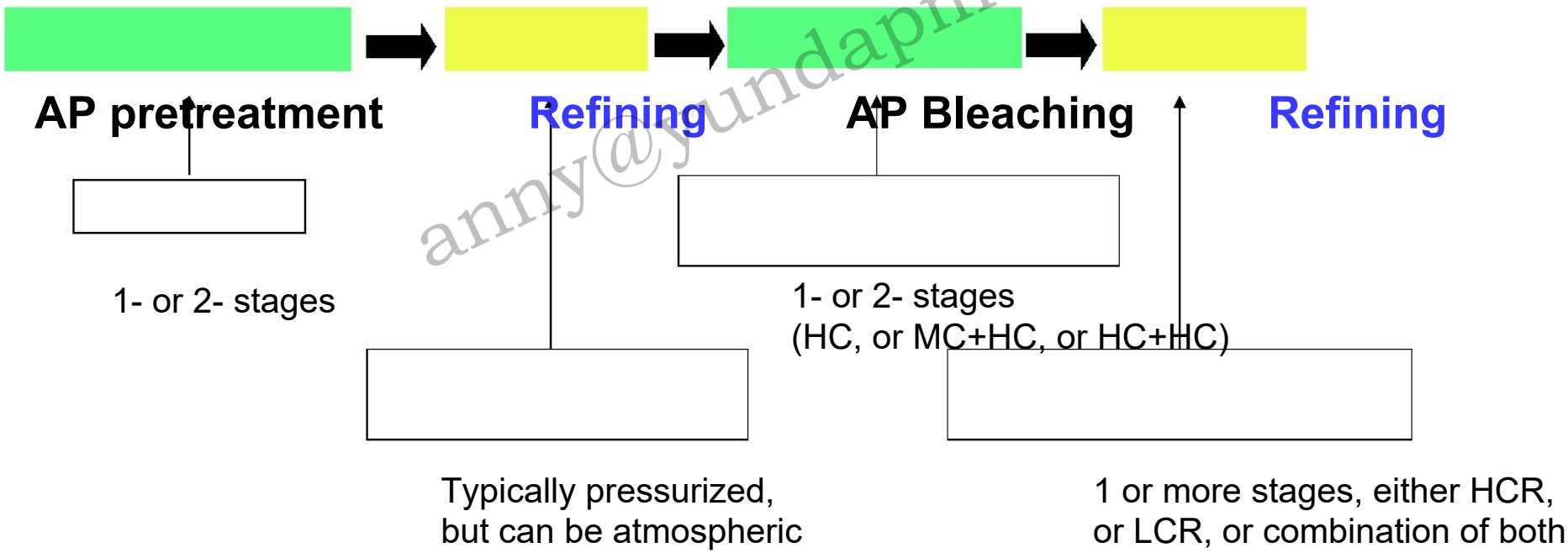
AP Pretreatment → **HC Refining** → **Bleaching** → **LC Refing**



(Peng, IMPC 2018)

Main Characteristics of 2G BCTMP Technology

- **Use less energy than 1G BCTMP**
- Consist of 4 basic treatment steps:
  Chemical -> Mechanical -> Chemical -> Mechanical
- How to do each step depends on nature of raw matrial used, product quality, investment and others...



Why 2G BCTMP use less energy than 1G BCTMP

Applied 2 basic and well-known important “rules” in HWD BCTMP pulping:

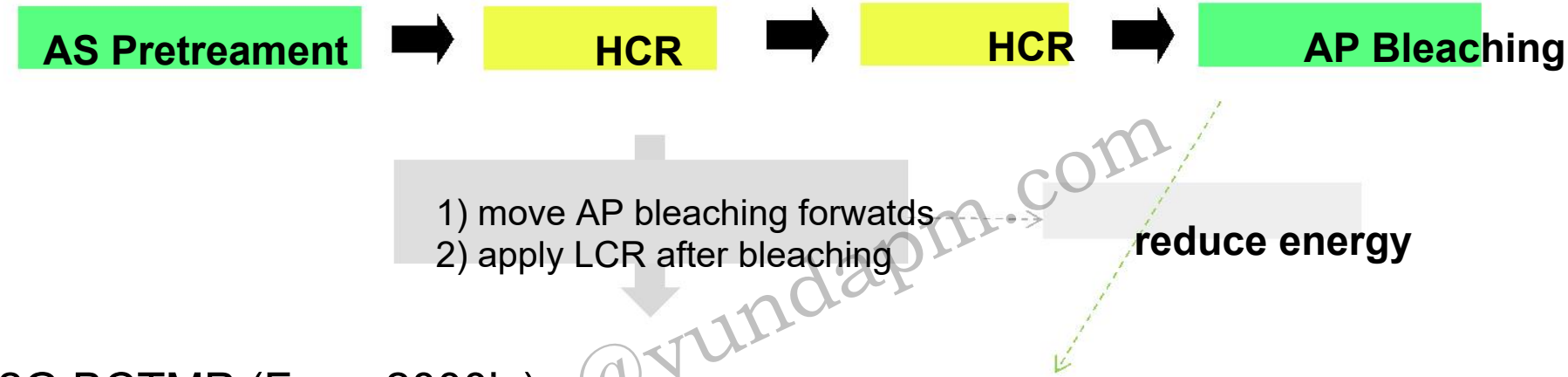
- Alkali peroxide treatment reduces refining energy:
  - fibers are easier to be separated and fibrillized
  - more and ealier used -> lesser energy consumed

- High intensity refining uses less energy than low intensity refining:
  - LCR has much higher refining intensity than HCR
  - More LCR -> lesser energy consumption

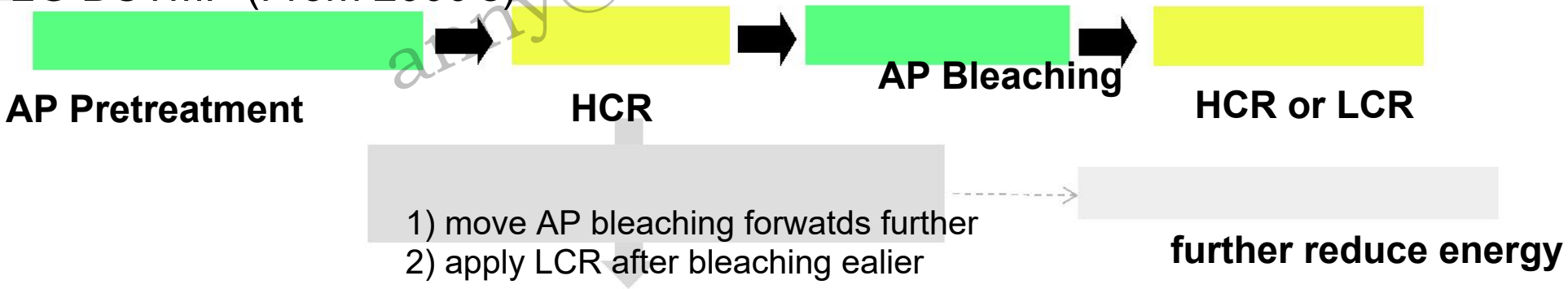
From 1G to 2G:

history of how to better use chemical and refining intensy

- 1G BCTMP (From 1980's):



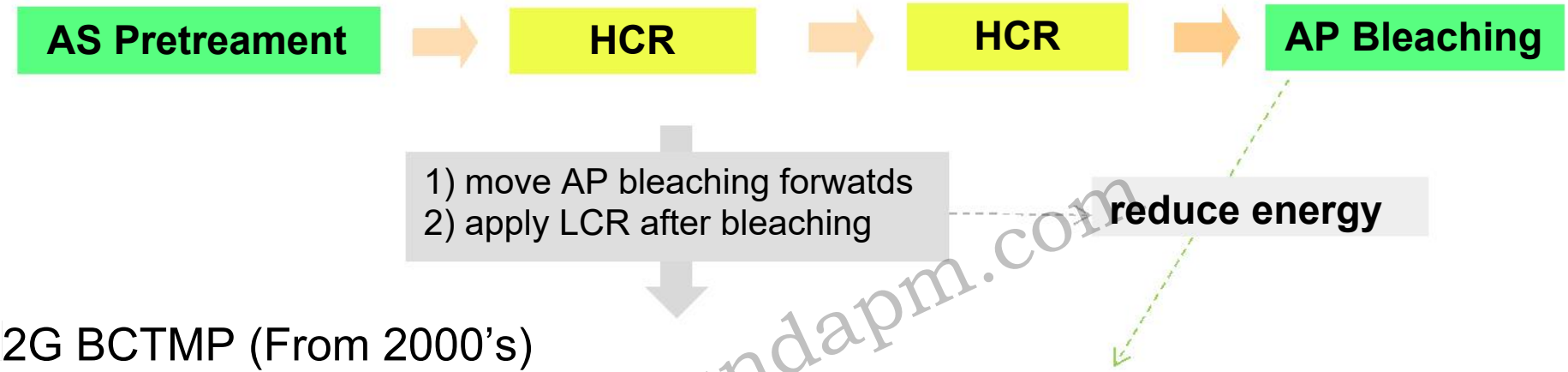
- 2G BCTMP (From 2000's)



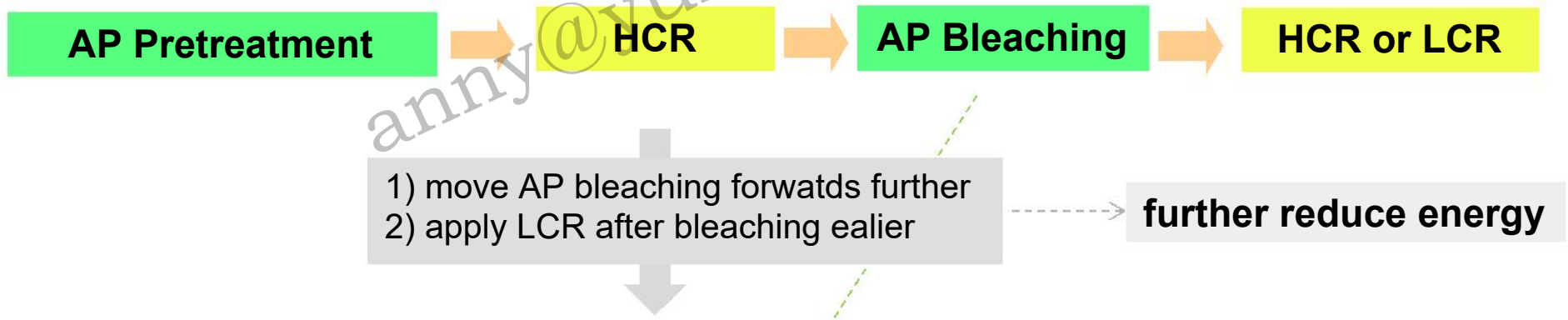
3G? how?

From 2G to 3G: logical development of BCTMP history

- 1G BCTMP (From 1980's):



- 2G BCTMP (From 2000's)



- 3G BCTMP (i-BCTMP, 2020's):

From Chip to Pulp：Historical Change in AP Bleaching

1G BCTMP
(from 1980's)

Chips | Pressed Chips | Shreds | Primary Pulp | Final Pulp

From Chip to Pulp：Historical Change in AP Bleaching

2G BCTMP
(from 2000's)

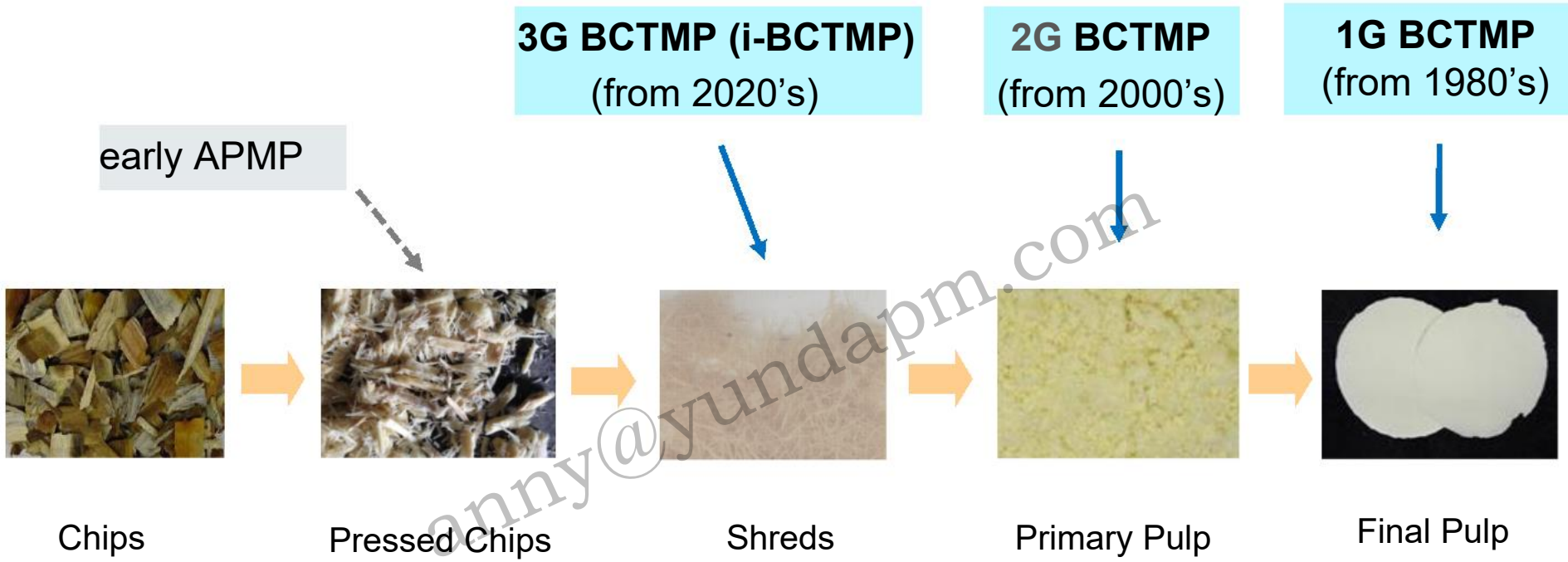
Chips | Pressed Chips | Shreds | Primary Pulp | Final Pulp

From Chip to Pulp：Historical Change in AP Bleaching

3G BCTMP (i-BCTMP)
(from 2020's)

Chips → Pressed Chips → Shreds → Primary Pulp → Final Pulp

From Chip to Pulp：Historical Change in AP Bleaching

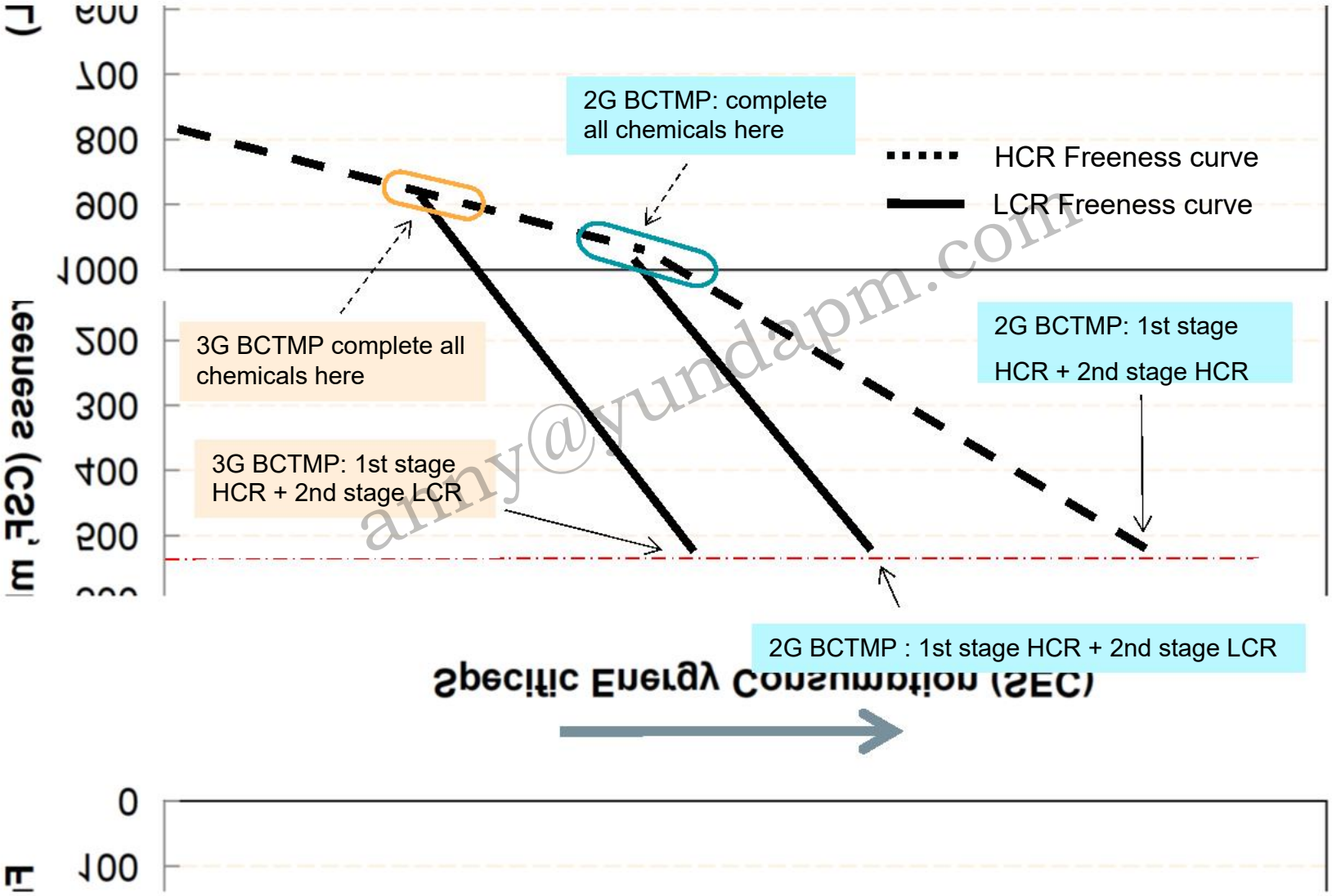


From 1G to 3G BCTMP：

Moving bleaching chemcial treatment earlier in pulp development process, helps utilise more chemical effest and more LC refining to reduce more energy consumption

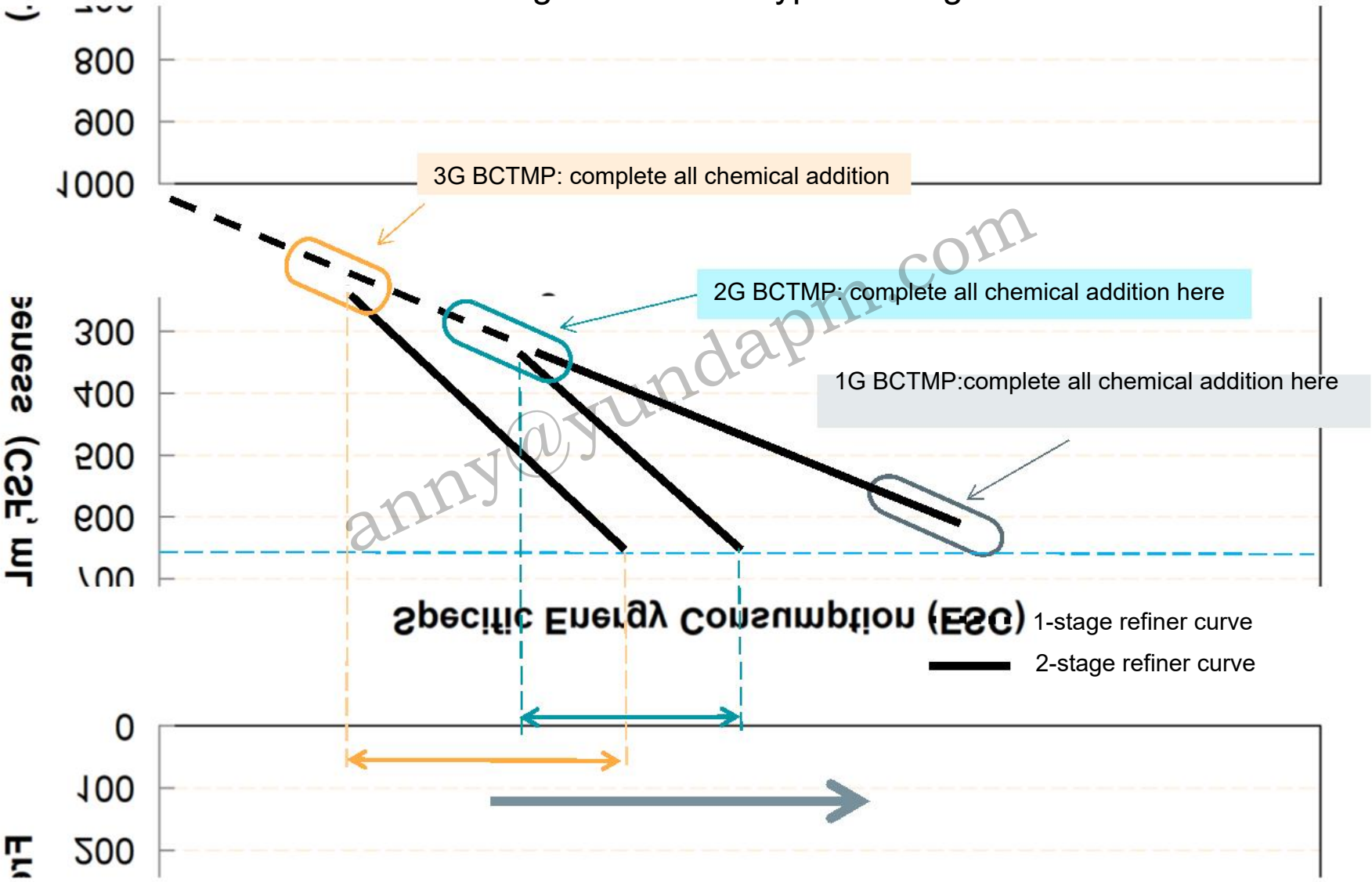
Different Generation of BCTMP: Using LC Refining

- **200mL CSF as example**



Different Generation of BCTMP

- Earlier the bleaching, the less energy consumption（“freeness/SEC slope” is steeper)
- Based on same total chemical charge and same type refining



Why i-BCTMP is better than 2G BCTMP

- Combine chip press and primary refiner in one step, using thermal shreder to generate wood shreds
  - wood structure is more open than pressed and macerated chips
    - easier for chemical penetration and distribution
    - use less energy than conbinaiton of primary refining and MSD
  - wood shreds should not be too large to cause problems with chemical penetration; and not too small to use too much energy
- Apply most or all the chemicals on the wood shreds to
  - Maximize the chemical effect on energy saving
  - Improve chemical efficiency
- Energy distribution (one example for HCR at 2nd stage):
  - 2G BCTMP

MSD+Primary: 500-600kwh/t	Post Refining: 250-600kwh/t)

  - 3G BCTMP (i-BCTMP)

TS: 150-350 kwh/t	Post Refining: 350-650kwh/t

Basic Principles of 3G BCTMP (i-BCTMP) Technology

- Use high pressure (high temperature) saturated steam and Thermal Shredder (TS), to produce softened wood shreds:
  - wood chips are softened first at high tempreture to prevent or reduce damages to wood fibers during shredding
  - shred size should be controlled and not be too big or too coarse
  - to avoid excessive energy consumption and damages to the fibers
- Chemical treatment can be made before, during and after the shredding, depending on nature of chemical treatment and product
- To maximize chemical efficiency and reduce energy consumption and, hence, improce pulp yield.

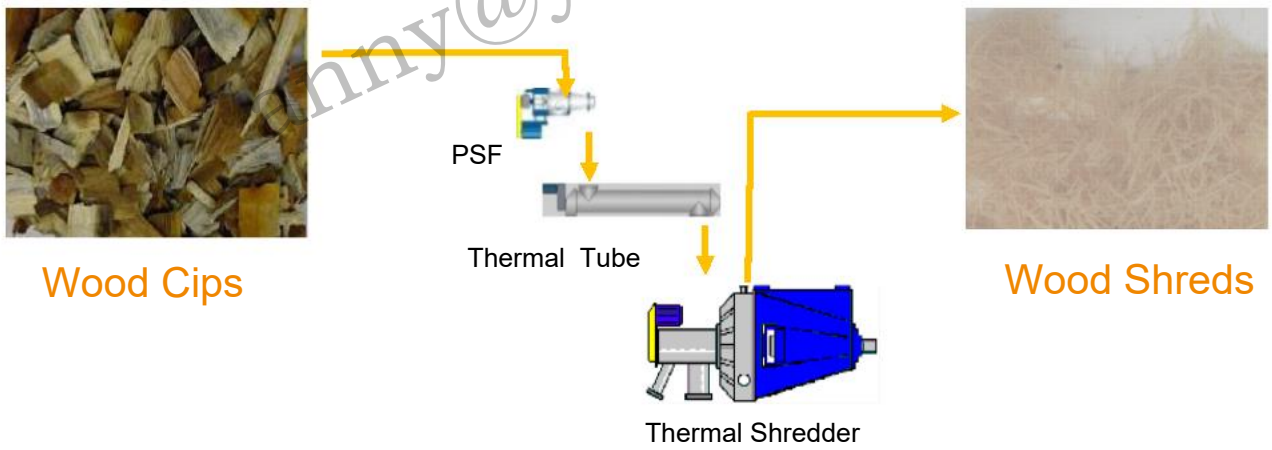
- After chemical treatment: washing, refining and screening

Wood Shreds

Key Component of i-BCTMP: Thermal Shredder System

- Thermal Shredder system consist of PSF, thermal tube, thermal shredder：
  - SPF：feed matrial and keep saturated steam
  - Thermal Tube: soften wood chips (can be horizontal or vertical)
  - Thermal Shredder：shred wood chips into wood shreds

- Saturated Steam：pressure/temperature and time need to be properly controlled

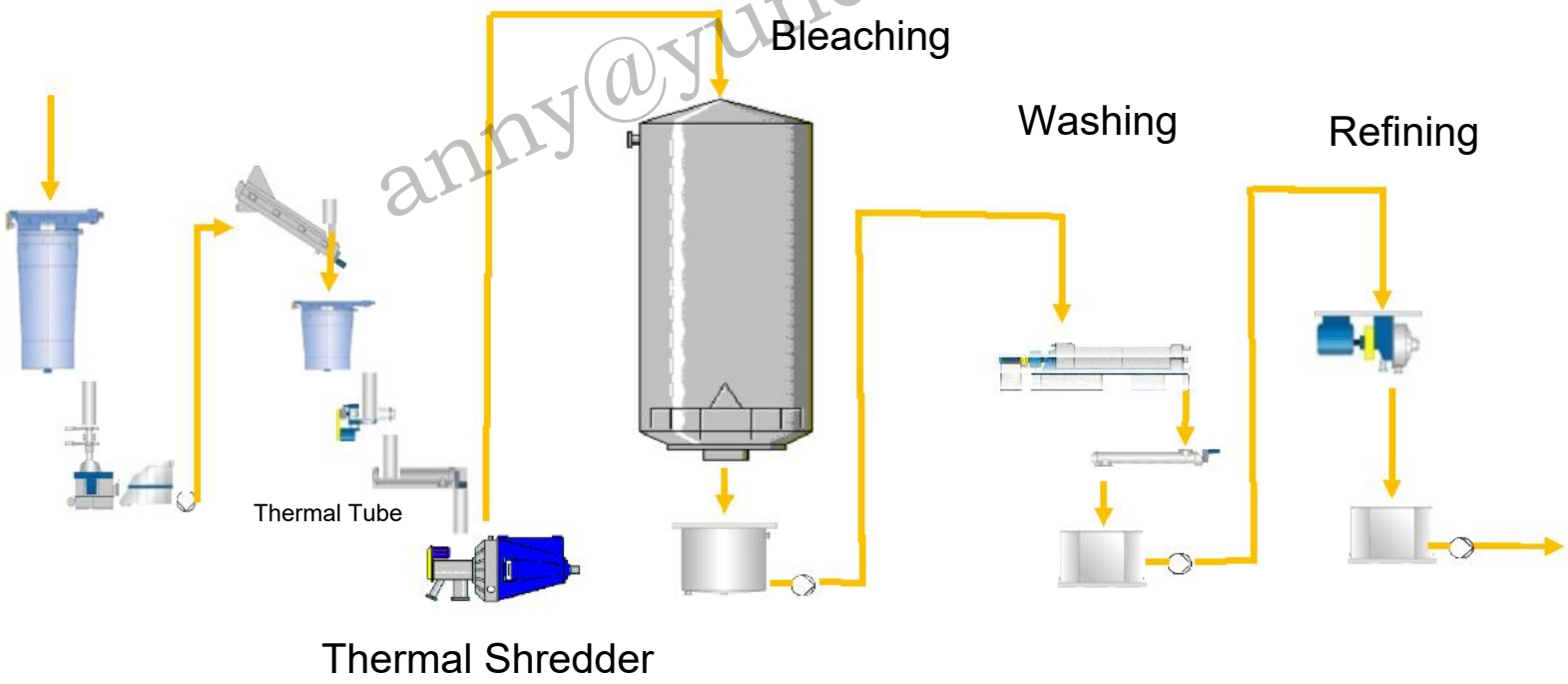


Thermal Shredder Sytem

Application of i-CTMP in BCTMP)：i-BCTMP

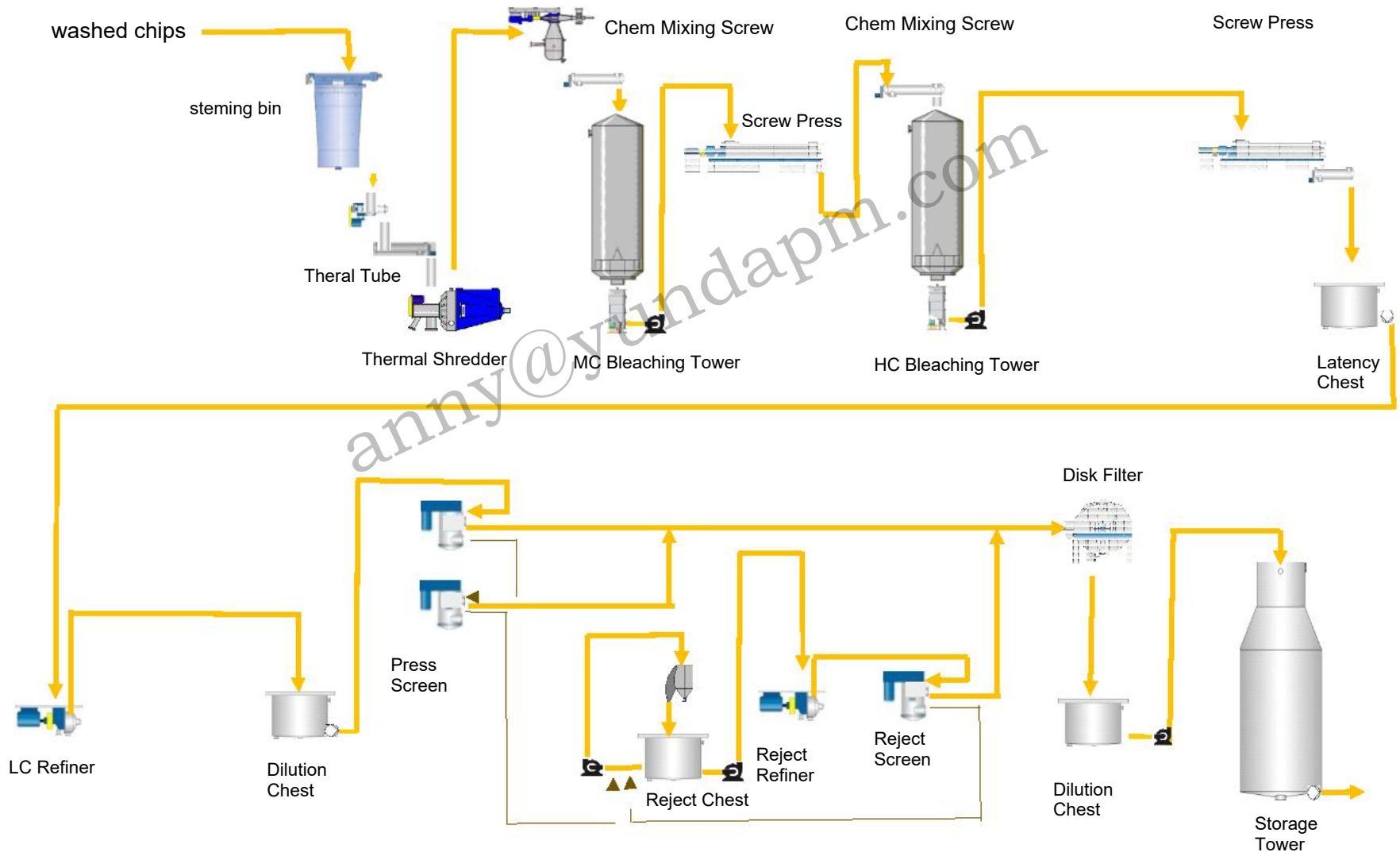
i-BCTMP:

- i - improved/innovated
- B - bleached
- C - chemical
- T - therma
- M - mechanical
- P - pulping



Typical 3G BCTMP (i-BCTMP) Flowsheet: simplified

Thermal Shreding → **Bleaching** → **HC or LC Refining**



3G vs 2G BCTMP: different pulp development road

2G BCTMP:

Chip Press → Reaction bin → HCR → Bleaching → LCR/HCR

3G BCTMP (i-BCTMP):

Thermal Shredder → MC dilution → Washing Press → Bleaching → LCR/HCR

Comparison Between 3G ad 2G BCTMP: (Simplified)

- Less energy & chemical consumption, and higher pulp yield (lower production cost)
- Simpler flowsheet and less equipment (less investment cost)
- Easier to operate and less wear and tear on equipment (less operation cost)
- Can handle more different raw materials and wider changes in raw materials