Chemical Mechanical Pulping Of Eucalyptus
- Latest Development & Comparison

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Different Pulping Processes (For Virgin Fibers)

- Mechanical Pulping
  - Stone Ground Wood (SGW, PGW…)
  - Refiner Mechanical Pulping (RMP, TMP)
- **Chemical Mechanical Pulping (CMP)**
  - Chemical Pretreatment + Refining

- Chemical Pulping
  - Kraft (sulfate)
  - Sulfite
  - Others

Why CMP For Hardwoods? (1)

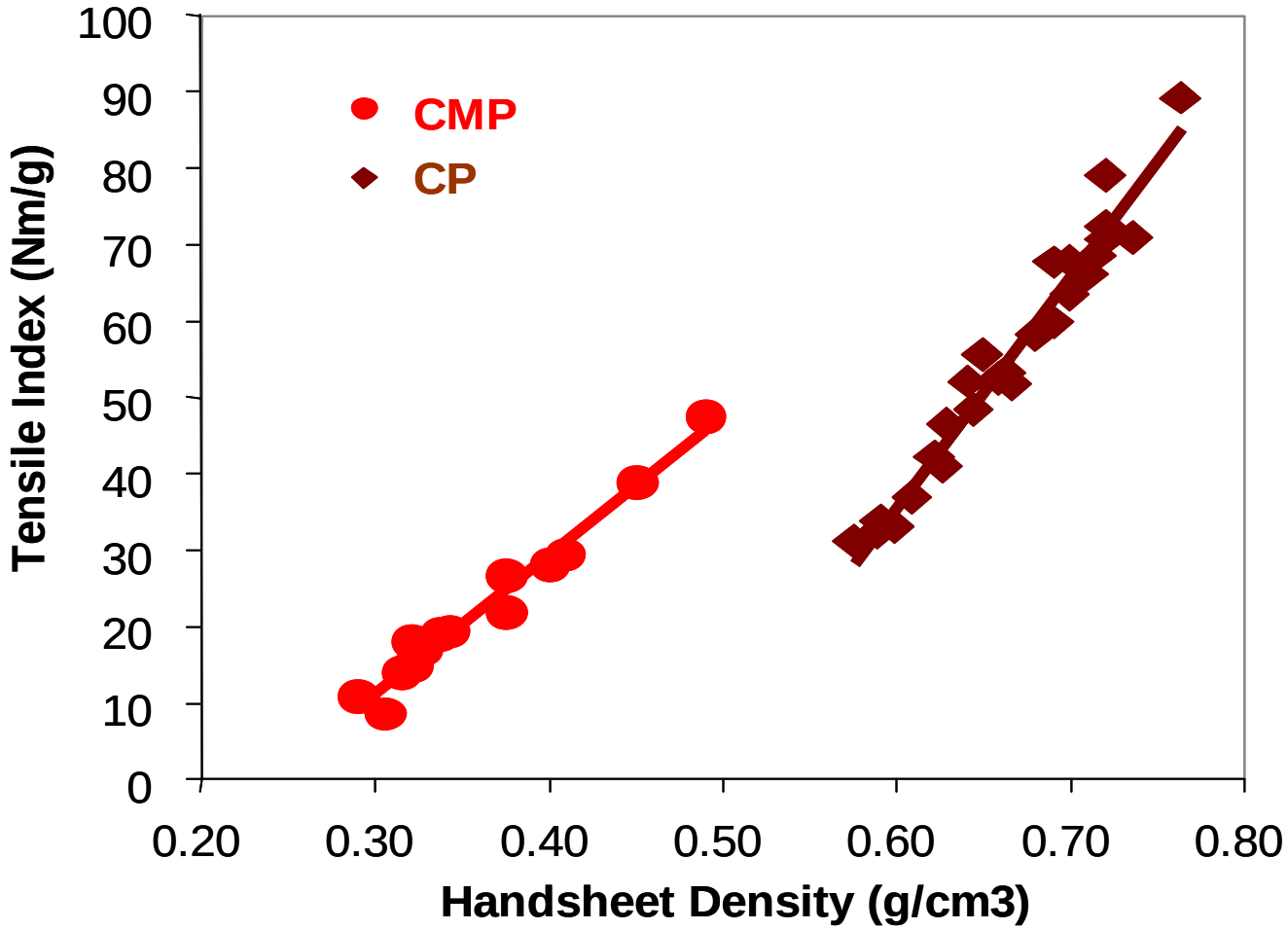
- Small - large capacity (100 to >500 t/d)
- Lower capital/investment cost
- Higher return from wood resource (higher yield…)
- Hardwoods are easy to react with chemicals
- Hardwoods need chemical treatment to develop strength
- Process is very *flexible*

"Flexible" means it can use different raw materials and produce different products

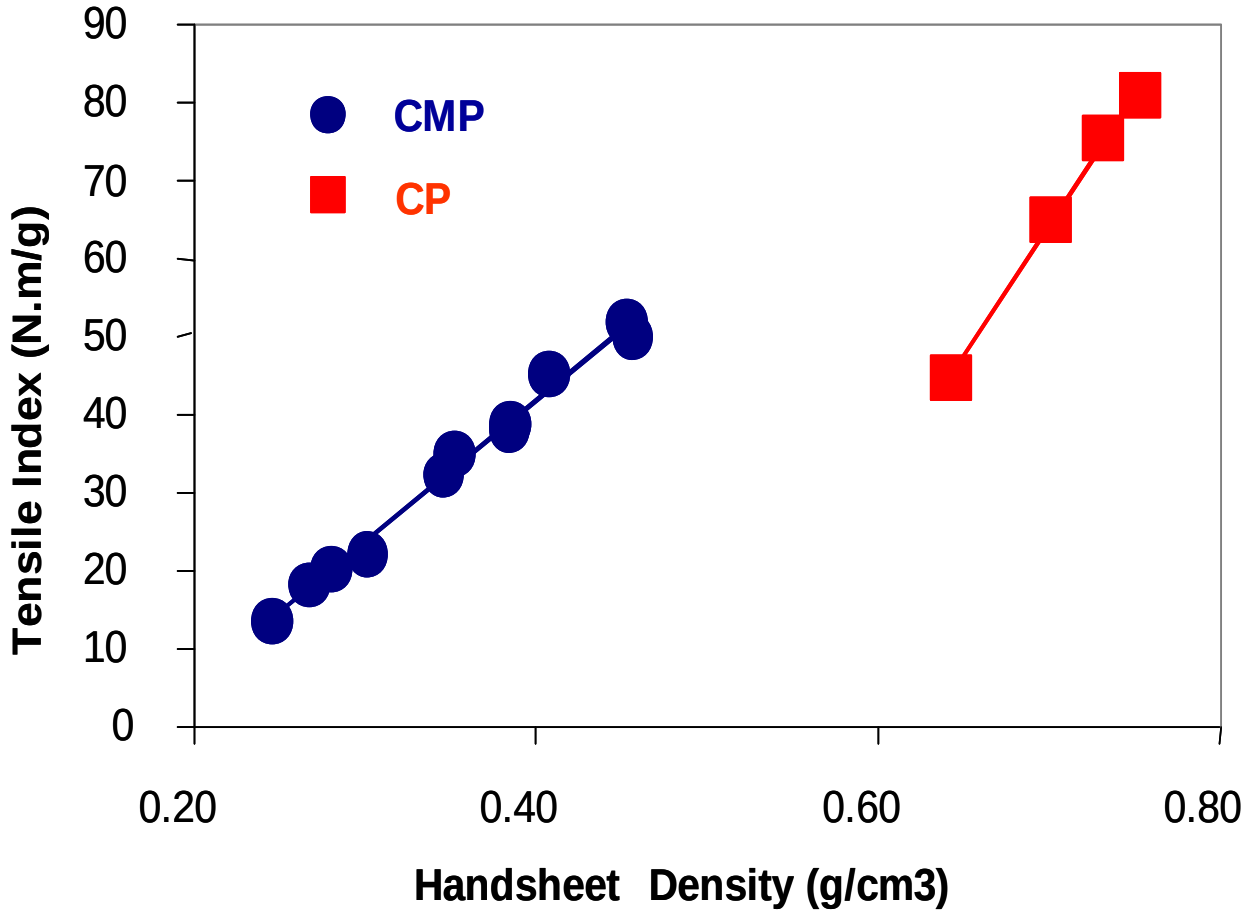
Why CMP For Hardwoods?(2)

- HWD CMP have been used in many applications:
  - Printing/Writing
    - coated papers
    - supper calendared
    - wood free grades
  - Paper Board
  - Tissue/fluff
  - Newsprint

CMP *vs.* CP from Aspen (pulp intrinsic property)



CMP *vs.* CP from *e. grandis* (pulp intrinsic property)

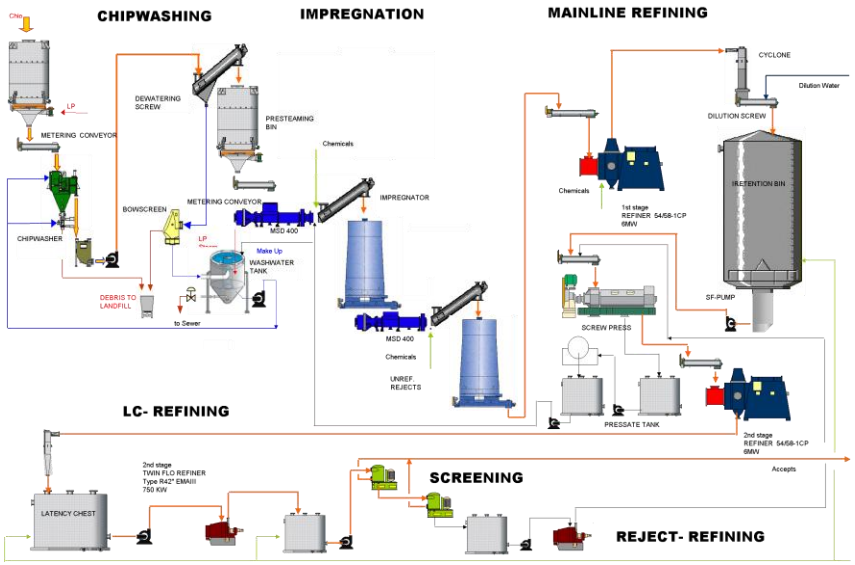


Synergy Between Aspen CMP and CP

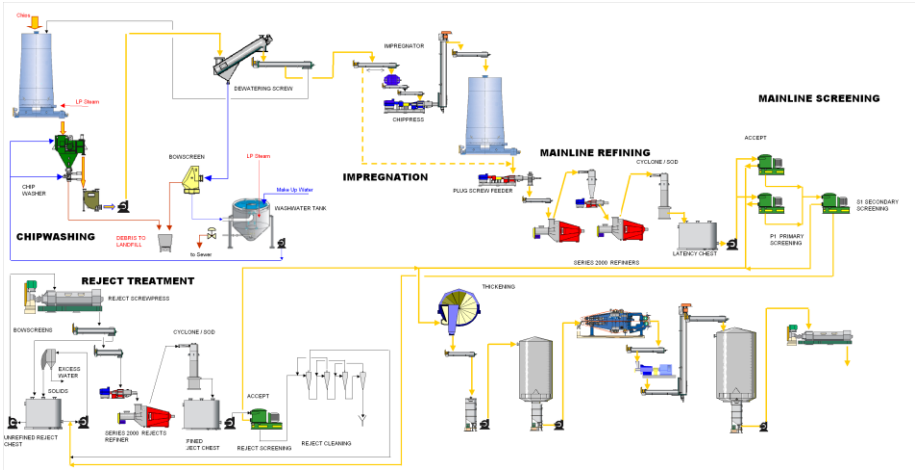
PULP SAMPLE	**Aspen CP**		**Aspen CMP**		**Mixture**	
PULP SAMPLE ID	K1	K2	H1 (HB)	H2 (HT)	C1 20%H1 80%K2	C2 20%H2 80%K2
FREENESS (CSF)	320	274	345	210	312	280
BULK (cm3/g)	1.47	1.43	2.35	1.67	1.62	1.47
TENSILE INDEX (N.m/g)	**47.0**	**50.1**	**24.3**	**52.6**	**45.8**	**59.3**
%STRETCH	2.1	2.2	1.0	2.1	2.4	3.2
T.E.A.(J/m2)	**44.0**	**48.6**	**9.1**	**41.8**	**45.1**	**80.1**
% OPACITY	73.0	72.3	83.6	73.9	76.3	73.0
SCATT. COEFF. (m2/kg)	33.0	32.3	50.0	31.7	35.8	31.6

Different CMP Technologies

- **P-RC APMP**
  - alkaline peroxide treatment before and during refining
  - Latest & most advanced technology



- **BCTMP (sulfite)**
  - sulfite pretreatment before refining + post bleaching
  - Old technology



Comparison Between P-RC APMP & BCTMP

P-RC APMP:

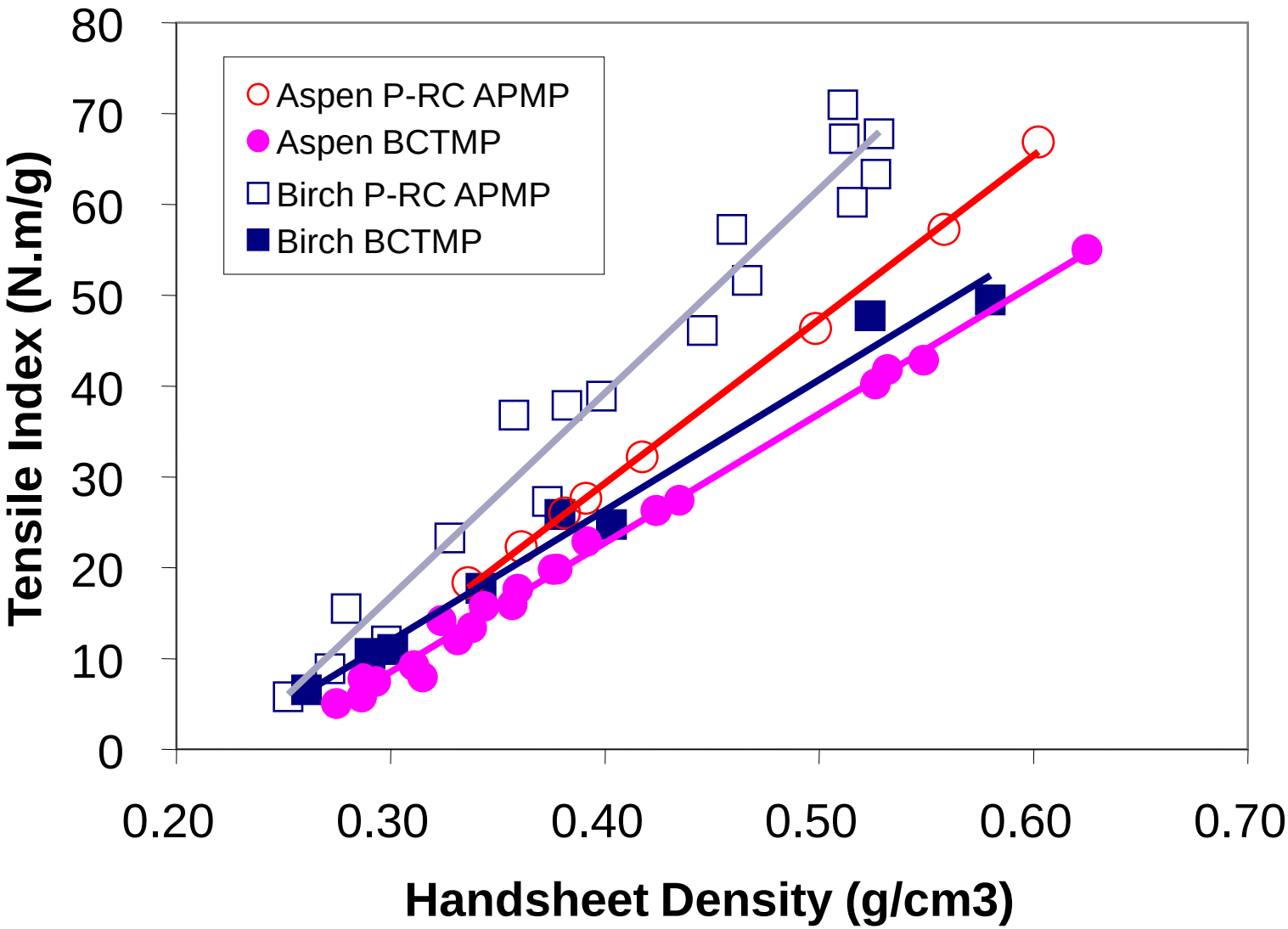
AP Chip Pretreatment → Pri. Refining (Atm. Inlet) → Interstage HC Tower → Press Washing → Sec. Refining → Screening and Cleaning

BCTMP:

Sulfite Chip Pretreatment → Press. Pri . Refining → Press. Sec. Refining → Screening and/or Cleaning → AP Post Bleaching + Washing

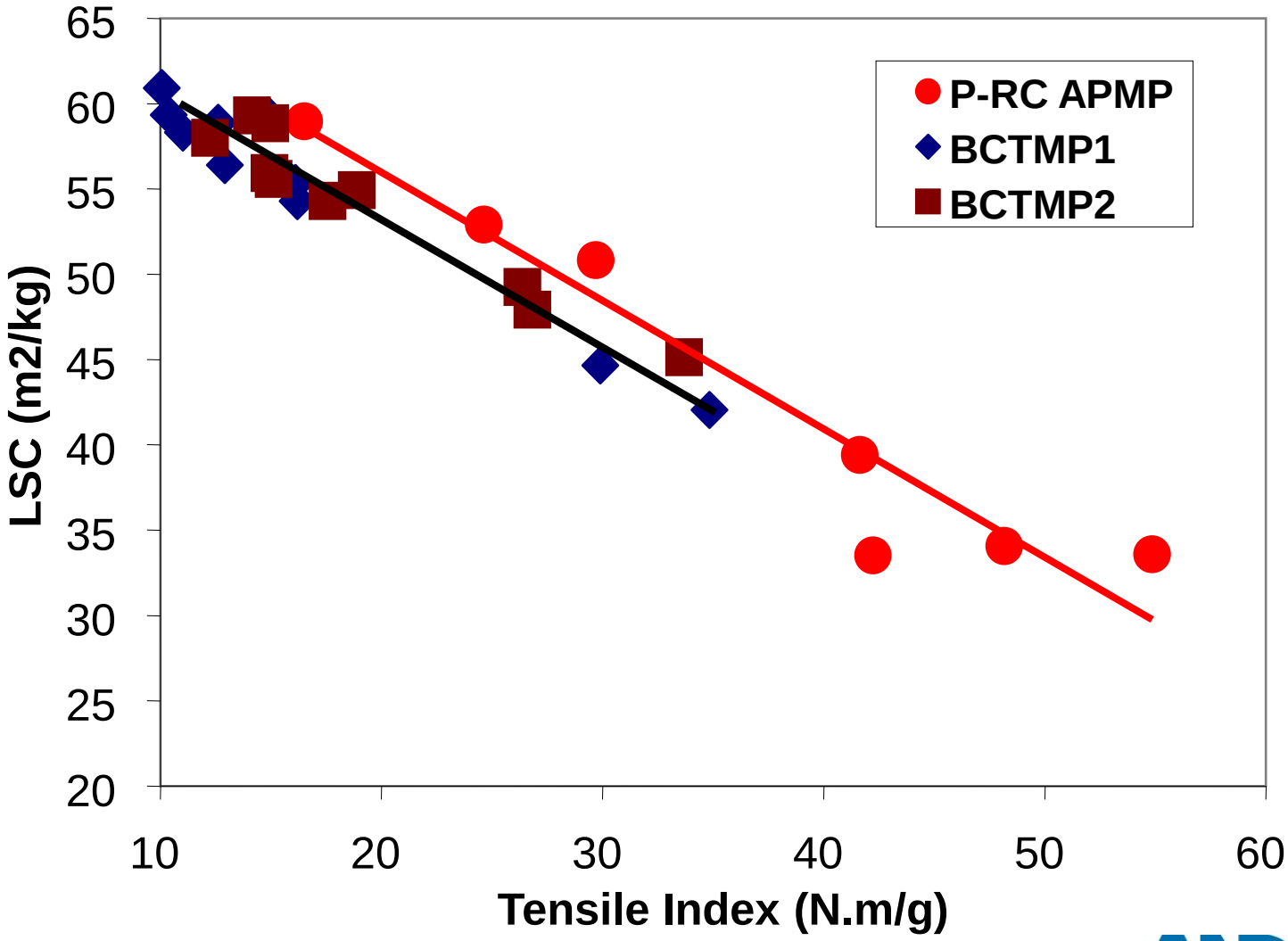
They use similar equipment and main chemicals (alkali + peroxide), but in different ways…

Intrinsic Property: *P-RC APMP pulps are better…*

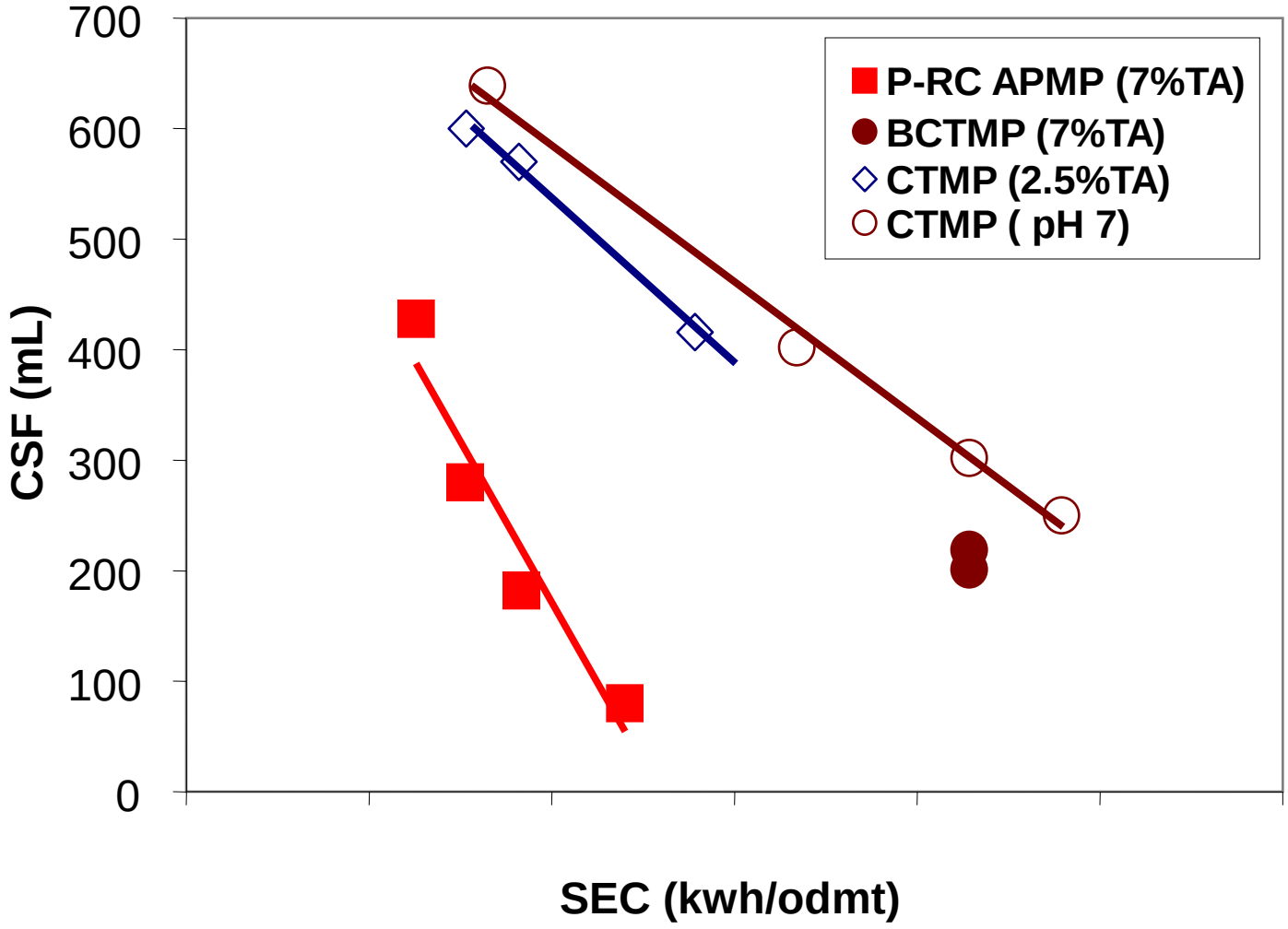


Light Scattering: *P-RC APMP pulps are higher…*

- all pulps at 300 mL CSF (from mixed NA HWD)



Energy: *P-RC APMP uses much less…*



Chemical Consumption: *P-RC APMP uses less…*

(birch from Europe)

	P-RC APMP		BCTMP	
% Total NaOH	**6.0**	**6.5**	**7.0**	**6.5**
% H_2O_2	**5.0**	**5.0**	**5.0**	**5.0**
% Na_2SO_3			**3.0**	**3.0**
FREENESS (CSF, mL)	301	308	306	306
BULK (cm^3/g)	2.22	2.18	1.72	1.91
TENSILE INDEX (N.m/g)	46.8	48.7	49.5	47.7
%ISO BRIGHTNESS	86.4	87.1	86.1	87.1

Different CMP: P -RC APMP *vs*. BCTMP (HWD)

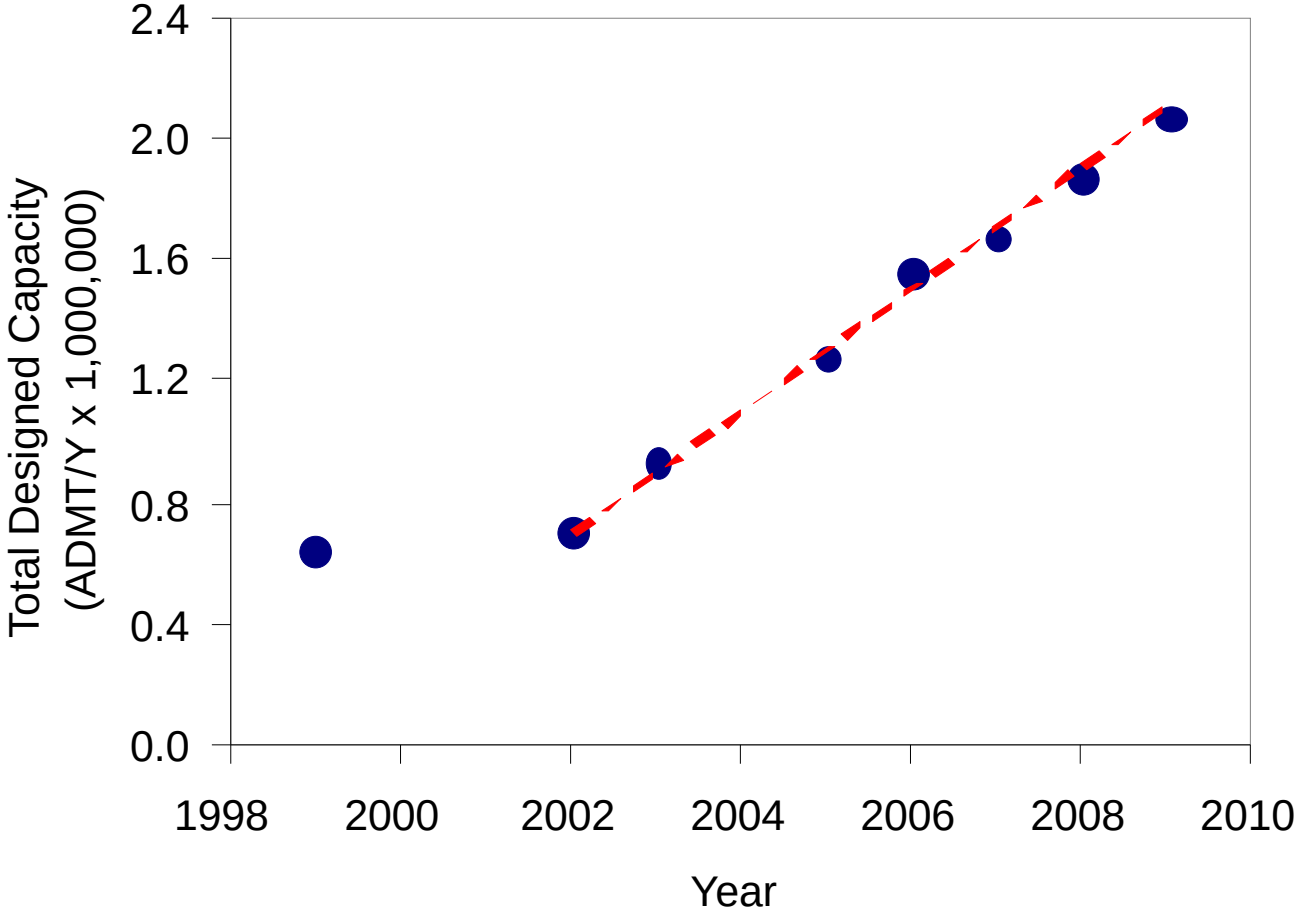
Pulp Quality

Strength:	equal or higher
Bulk:	equal or higher
LSC:	same or better
Bleachability:	same or better

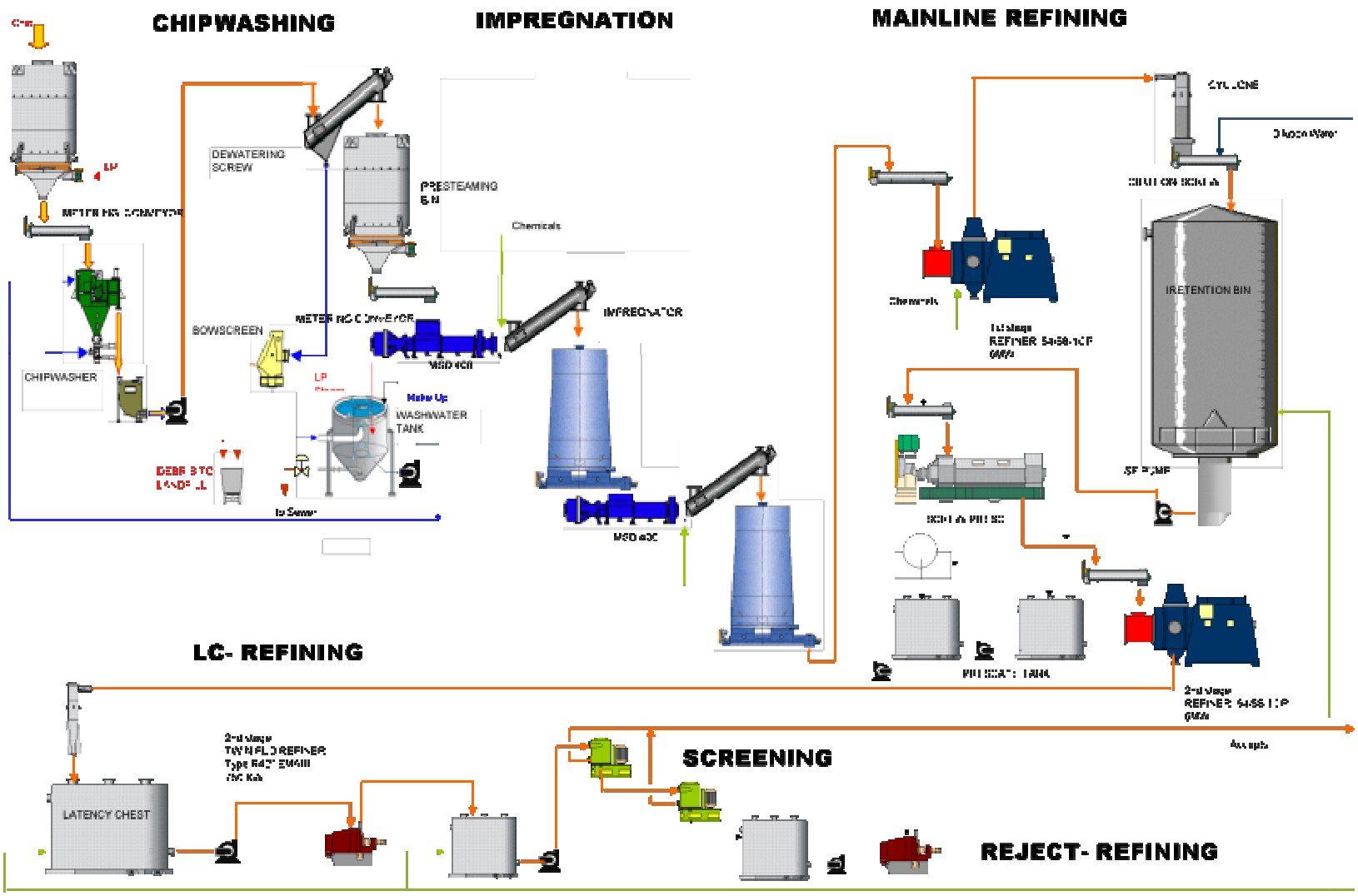
Process

Capital Cost:	lower *(no post bleaching)*
Energy:	lower (normally by 30% or more)
Chemical Cost:	same or lower
Yield:	higher
Effluent:	easier to treat

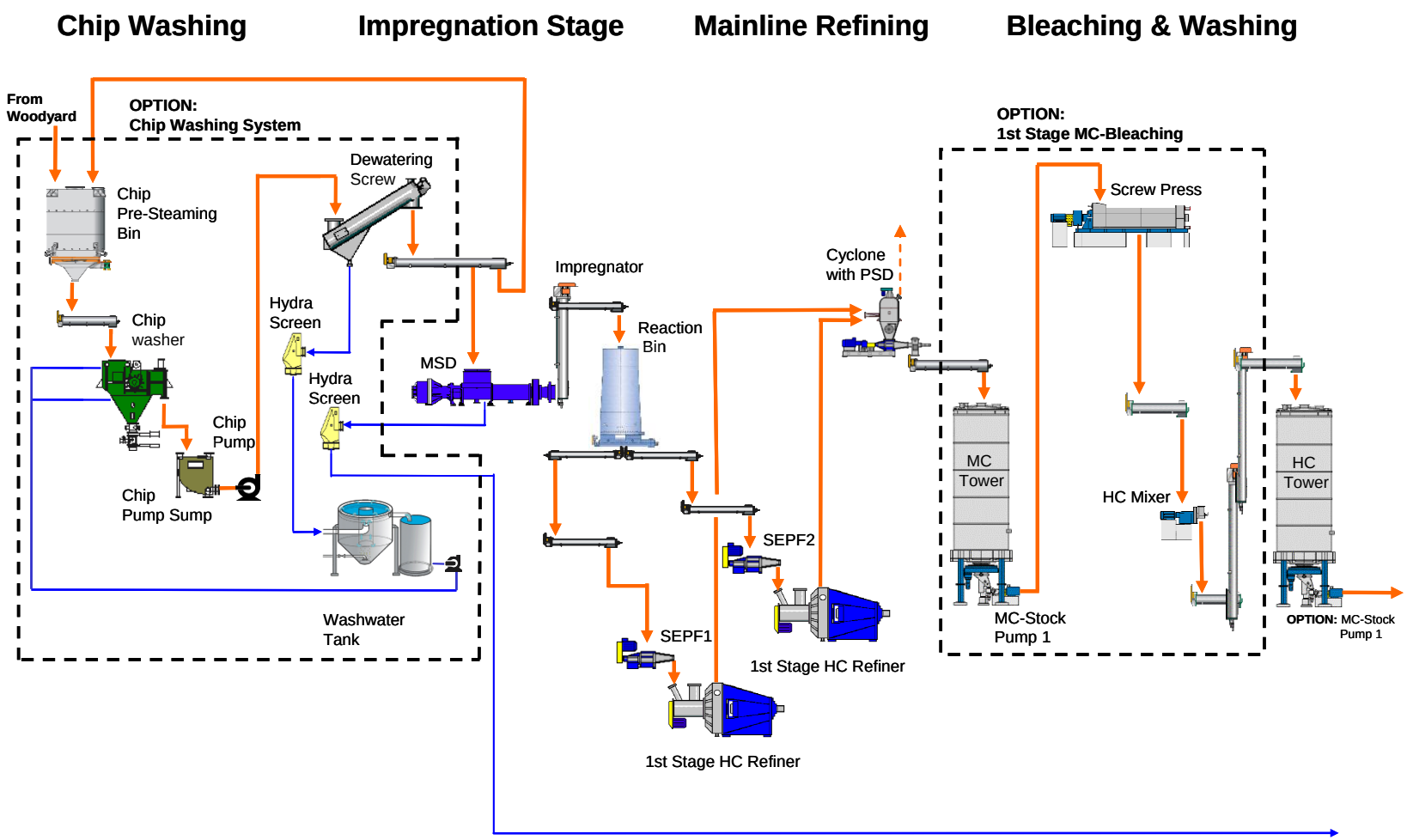
Global Total APMP Design Capacity



Example of P-RC APMP System (1)

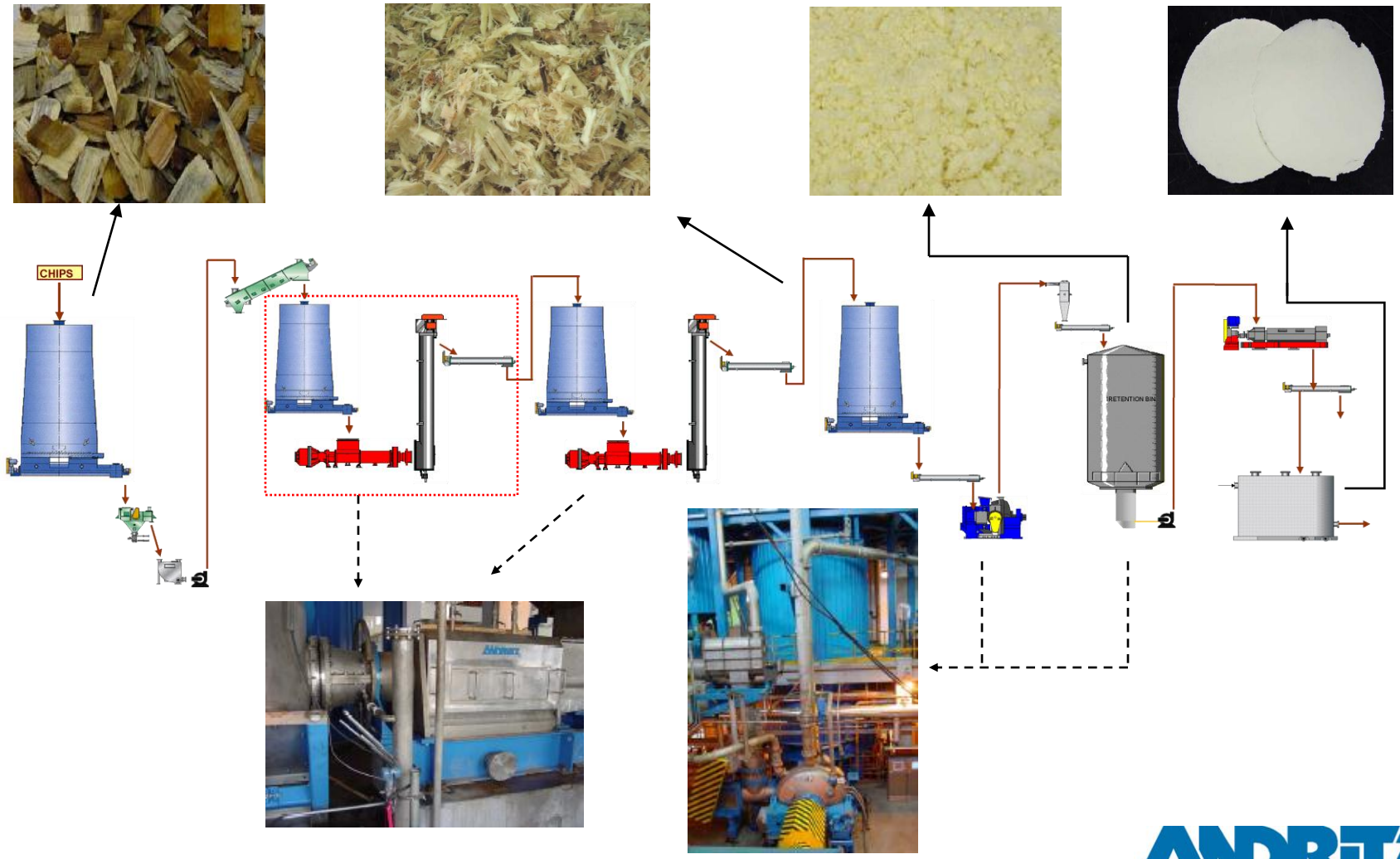


Example of P-RC APMP System (2)



P-RC APMP: *pulp development*

Preconditioning **R**efiner **C**hemical treatment

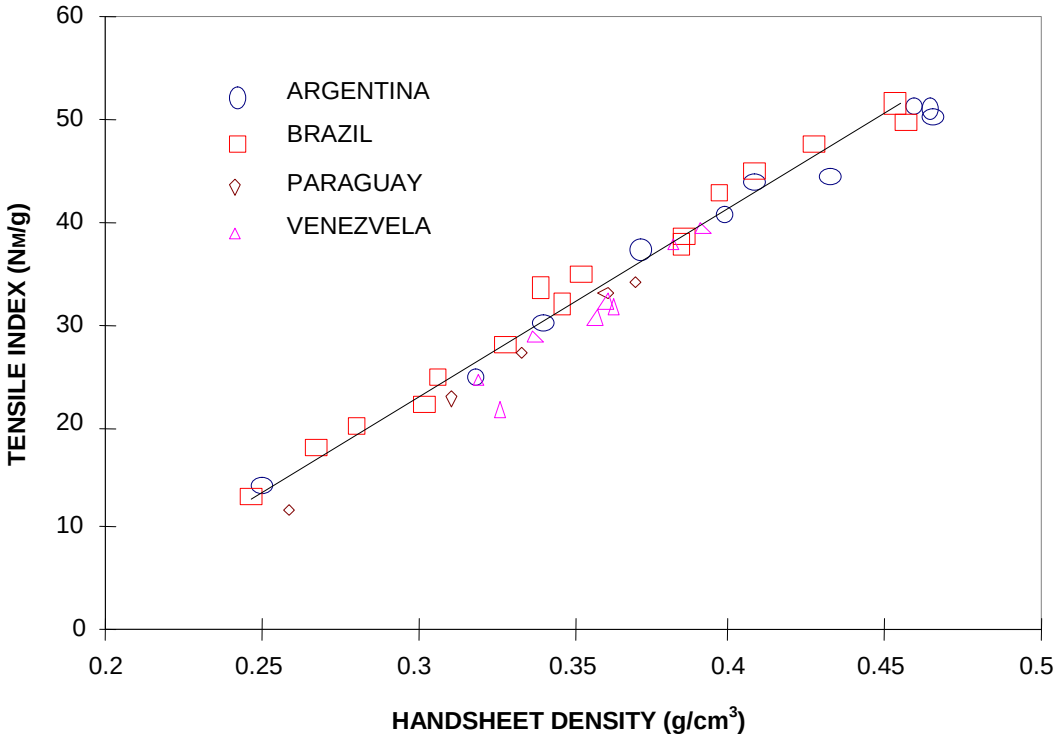


Pulp Property Development of Different Eucalyptus Woods From South America

e. grandis from different countries in S.A.

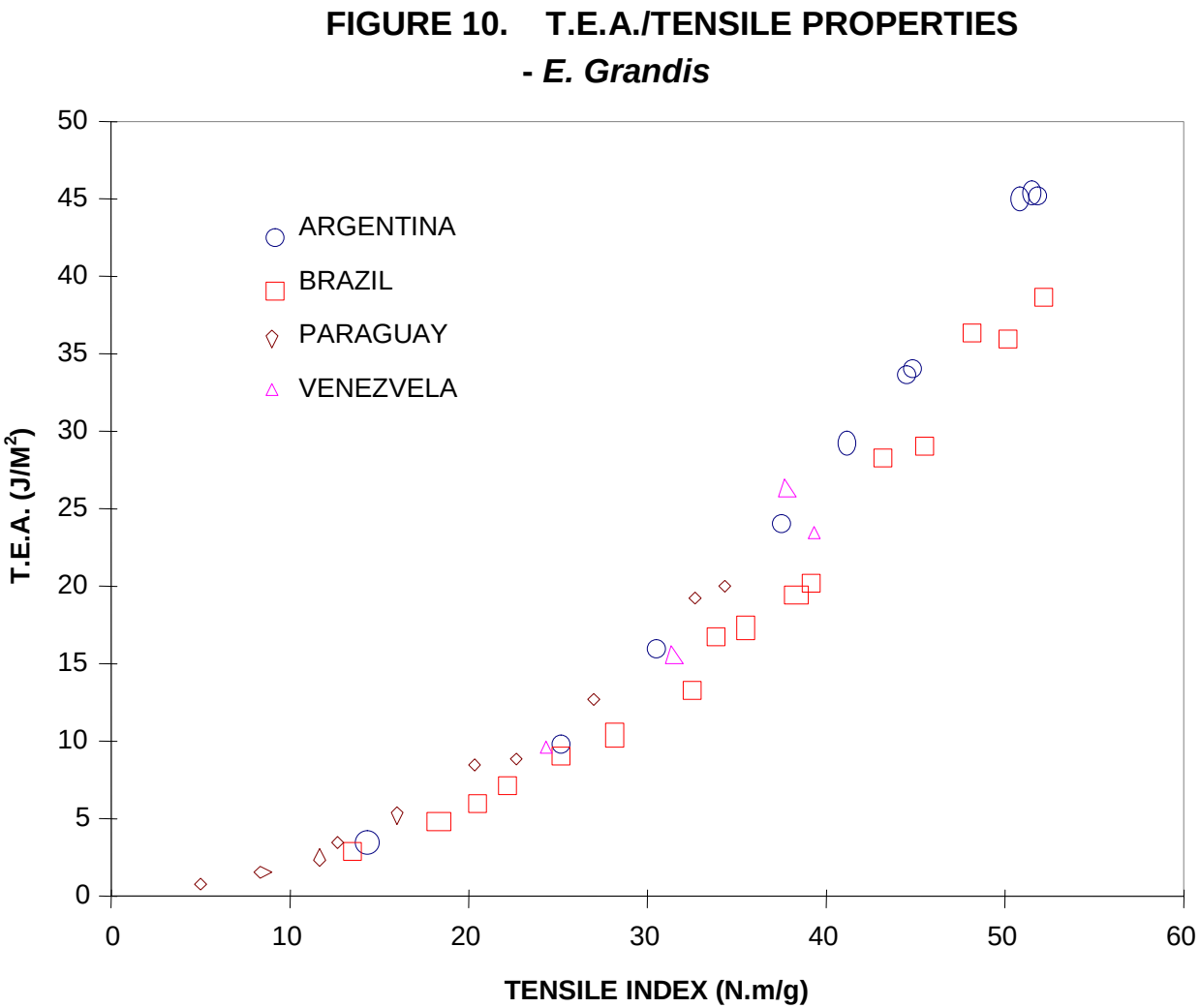
FIGURE 9. TENSILE/DENSITY PROPERTIES

- E. Grandis



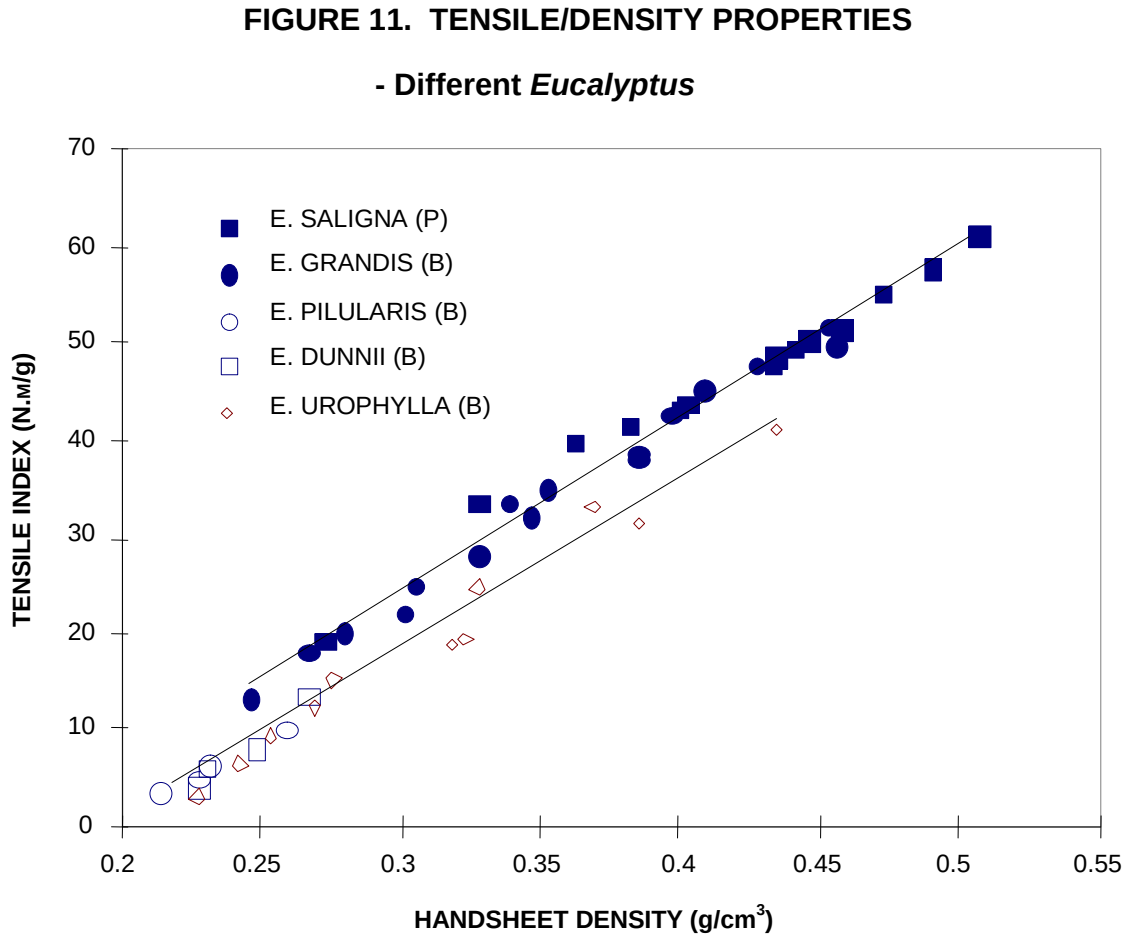
- *e. grandis* from different countries were similar in tensile/density property development
- They all can develop high tensile strength from HYP

e. grandis from different countries in S.A.



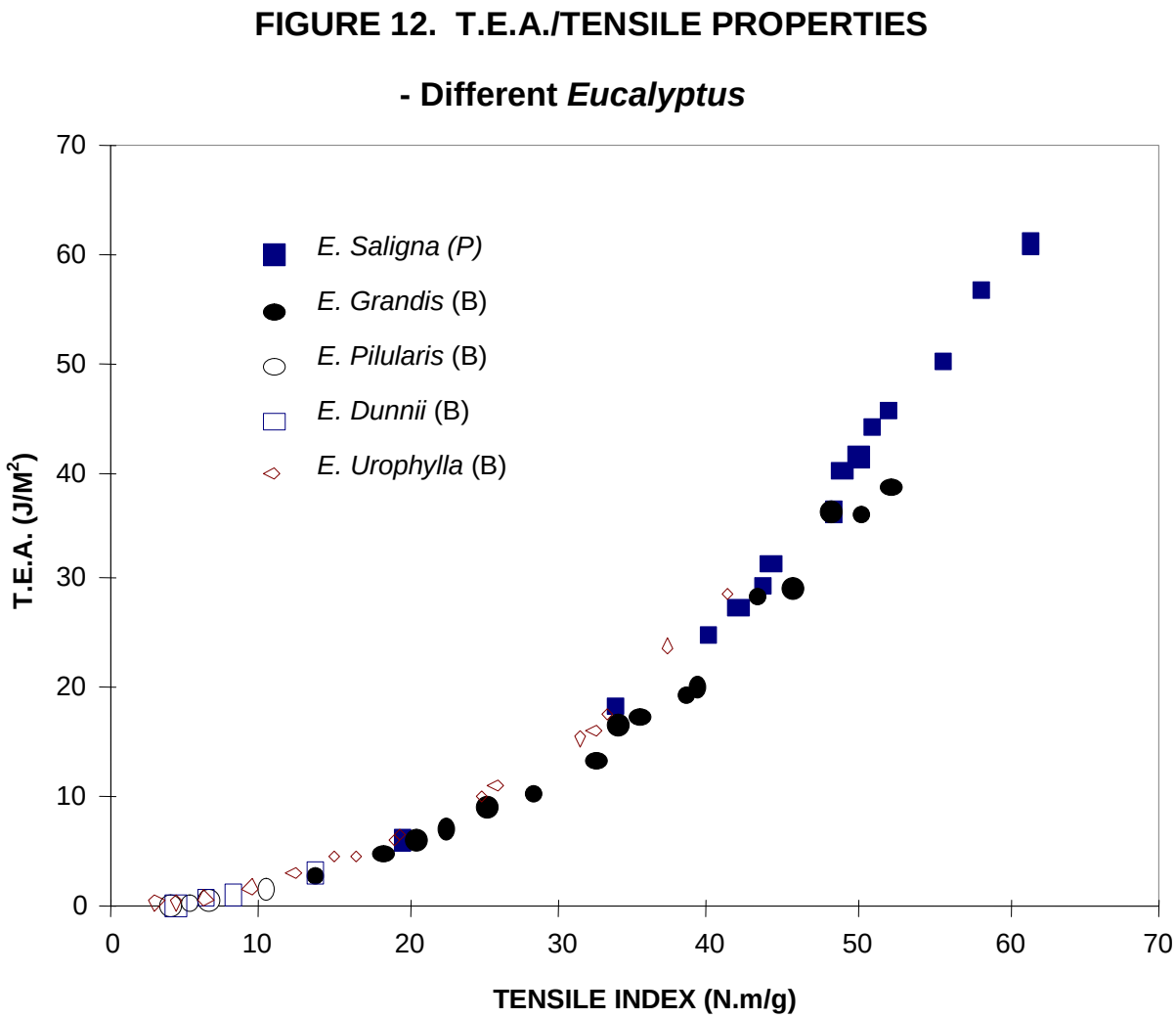
- *e. grandis* from different countries were mostly also similar in "**T**ensile **E**nergy **A**bsorption" development
- They all can develop high T.E.A. properties from HYP

Different eucalyptus species from S.A.



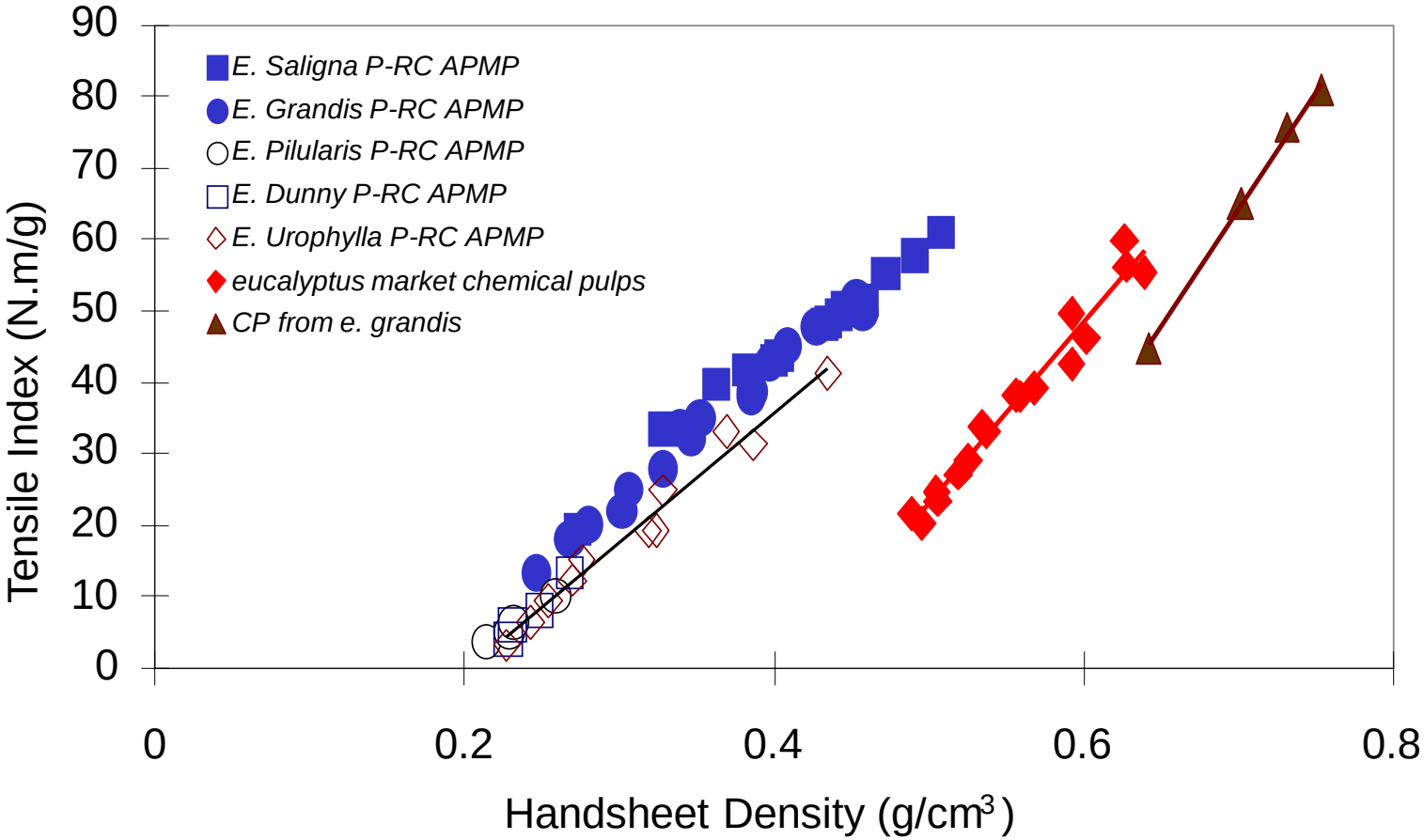
- *e. grandis* & *e. saligna* were similar in tensile/density development
- *e. pilularis*, *e. dunny* and *e. urophylla* were similar in their tensile/density development
- They all can develop high tensile properties from HYP
- *e.grandis* & *e.saligna* had better intrinsic property than the others

Different eucalyptus species from S.A.



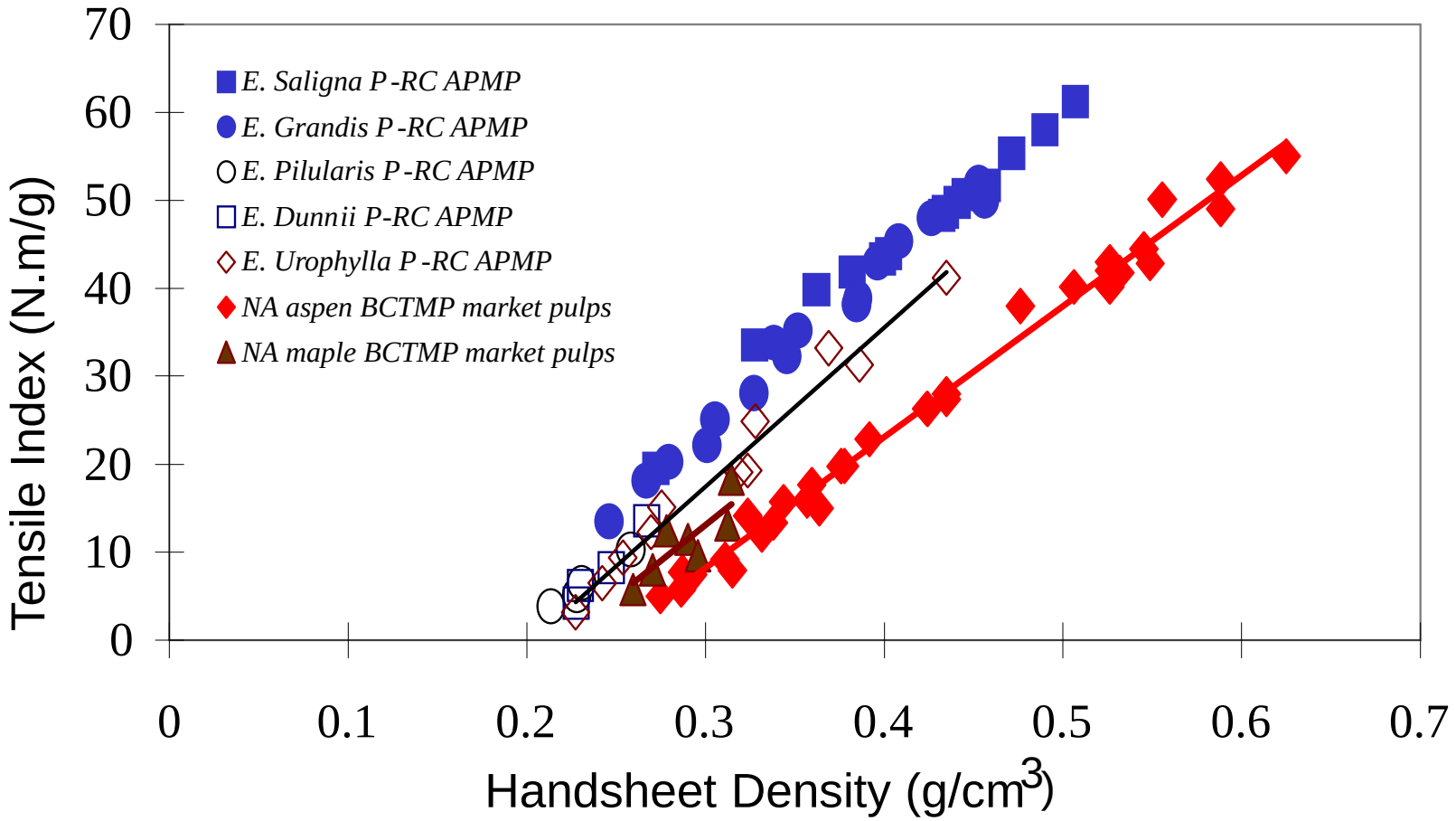
- They all seemed to have similar T.E.A. property development
- They all can develop high T.E.A. properties from HYP

CMP *vs.* chemical pulps from *eucalyptus*



- CMP have lower density (higher bulk) at same tensile or
- higher tensile at same density or bulk

eucalyptus HYP vs. aspen market BCTMP



- eucalyptus CMP have higher tensile at same density/bulk or
- higher bulk at same tensile than aspen market pulps

eucalyptus vs. aspen – printing/writing grades

Table 1. *Eucalyptus* P-RC APMP versus Aspen BCTMP Market Pulps

Wood	Aspen	South American *Eucalyptus*	
Process	BCTMP	P-RC APMP	
Freeness (CSF) (ml)	110-350	110-350	
Bulk (cm^3/g)	1.6-1.8	2.1-2.3	1.7
Density (g/cm^3)	0.63-0.56	0.48-0.44	0.59
Tensile Index (N.m/g)	48-52	50	70-80 [a]
Tear Index ($mN.m^2/g$)	5.0-5.3	5-6.5	>7 [a]
Burst Index ($kPa.m^2/g$)	2.4-2.7	2.4	> 3.5 [a]
Brightness (% ISO)	85	85	85 [a]
Opacity (%)	76-77	80-85	75-80 [b]
LSC (m^2/kg)	< 40 [B]	>45	>40 [b]

NOTE: [a] From extrapolation
[b] Estimated numbers

eucalyptus gave better overall pulp handsheet properties

eucalyptus *vs.* aspen – paperboard grades

Table 2. *Eucalyptus* P-RC APMP versus Maple BCTMP

Wood	Maple[a]	South American *Eucalyptus*
Process	BCTMP	P-RC APMP
Freeness CSF (ml)	380-400	380-400
Bulk (cm^3/g)	3.0-3.2	3.4-4.1
Density (g/cm^3)	0.31-0.33	0.245-0.295
Tensile Index (N.m/g)	15-18	15-18
Tear Index ($mN.m^2/g$)	3.0	2.5-3.0
Burst Index ($kPa.m^2/g$)	0.8-1.0	0.4-0.6
Brightness (% ISO)	78-80	78-80
% Opacity	80-83.5	84-90
LSC (m^2/kg)	-	> 50

Note: [a] from Reference [UDY, (1996)]

eucalyptus gave better overall pulp handsheet properties

Summary (1)

- CMP proven to be important pulping technology for hardwoods in paper and paperboard industry
- Hardwood CMP has better pulp intrinsic property than its CP (higher tensile at same bulk, or higher bulk at same tensile)
- There is synergistic effects between hardwood CMP and CP pulps
- Among CMP technologies, P-RC APMP is more efficient and provides same or better pulp quality

Summary (2)

- Good tensile strength properties can be developed from *eucalyptus* CMP
- Among eucalyptus species investigated, *e. grandis* and *e. saligna* have better intrinsic properties than the others
- eucalyptus CMP pulps also have better overall pulp properties than aspen market BCTMP pulps
- eucalyptus CMP pulps have good potential for paper and paperboard applications

Future Trends

- Reduce energy consumption by
  - Combination with different chemical and biological treatment
  - Combination of different refining strategies

- Simplify P-RC APMP system even more

- Combination with chemical pulping system to maximize synergies between two systems