ITC – FIQ – UNL - Argentina

Research group

- Professor: Miguel Zanuttini

Researchers:

- Victorio Marzocchi
- Paulina Mocchiutti
- M. Cristina Inalbon

Some research topics:

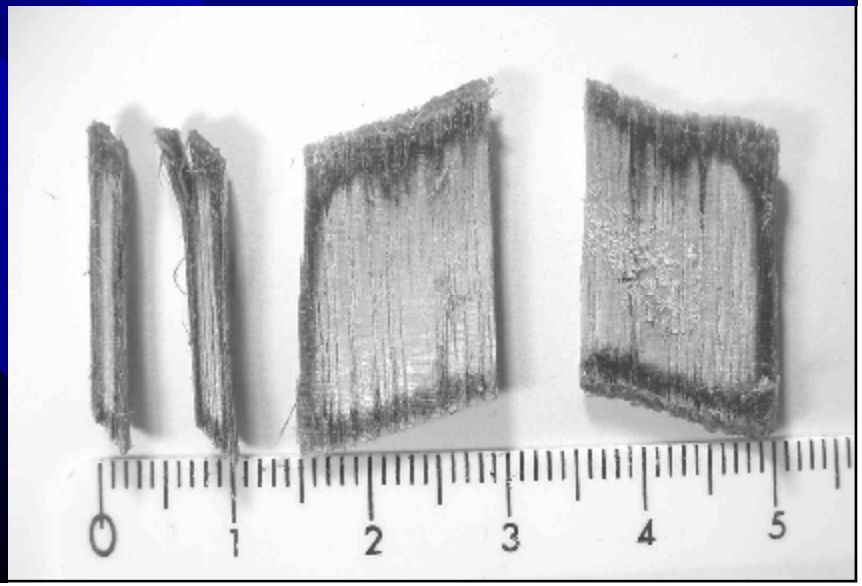
- Chemical pulping (Impregnation)
- Mechanical Pulping
- Recycling
- Fibre characterization

Alkali Impregnation

Impregnation of eucalyptus and pine wood in alkaline pulping processes. Effects of steaming and pressurized impregnation

Inalbon et al.

ABTCP Conference 2004, October, San Pablo, Brazil



Chip Impregnation for pulping

A proper

- Penetration of liquids
- Diffusion of chemicals

Both are necessary for optimal efficiency of:

- Chemical pulping
- Chemimechanical pulping

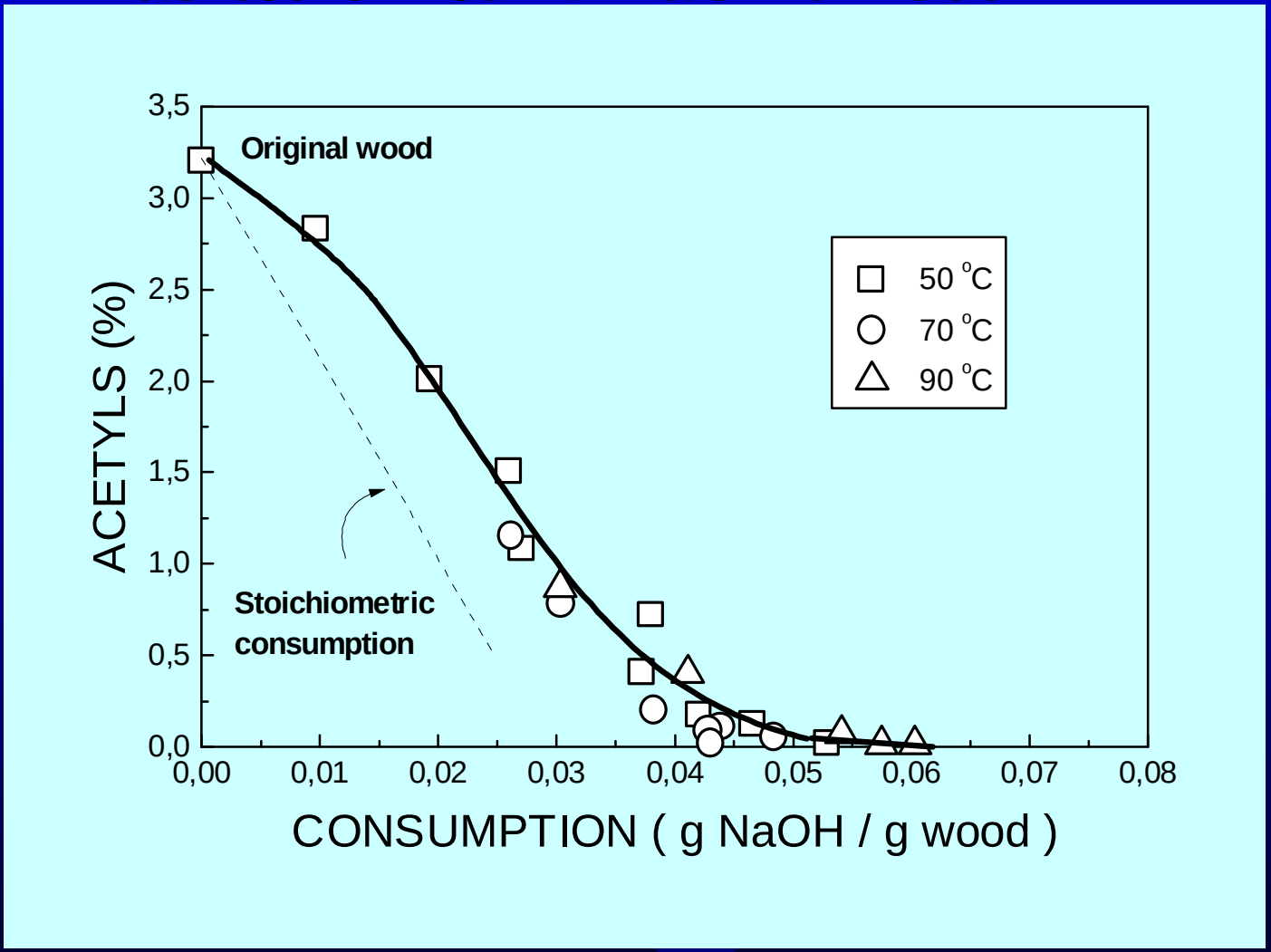
The alkaline impregnation phenomenon is complex.

It implies:

- Air removing
- Penetration in the longitudinal direction
- Diffusion in all directions.
- Chemical reactions
- Wood properties like “alkali diffusion coefficient” are chemically modified

Issues not considered in the literature

Consumption could be as high as 6.0 or 7.0 % NaOH / wood



- Deacetylation is the main reaction and is the main responsible for alkali consumption.

We determined:

The pattern of the pressurized alkaline impregnation:

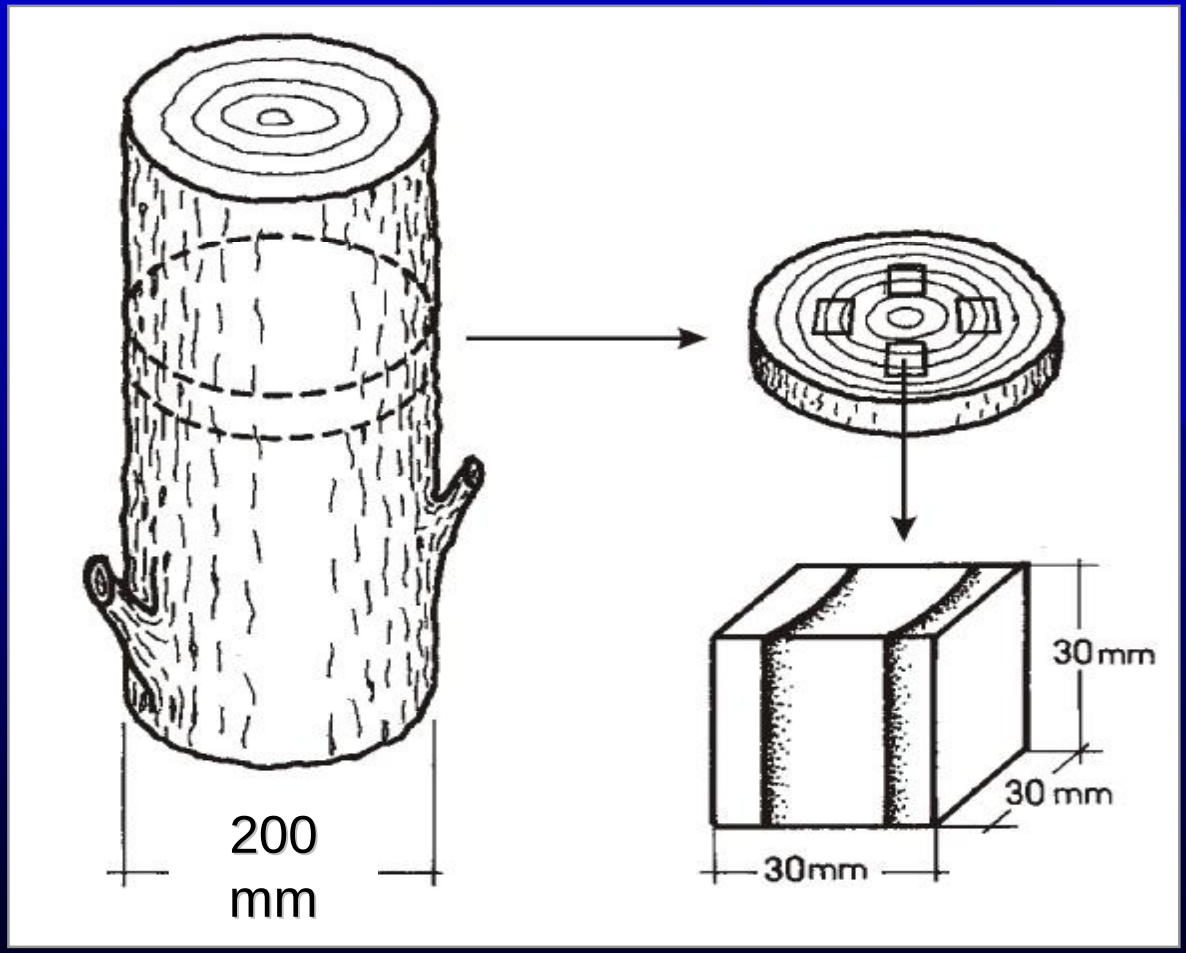
steamed wood

pine and eucalyptus wood

Profiles of:

- alkali concentration
- alkali content
- liquid content
- acetyls content

Experimental



Wood treatment

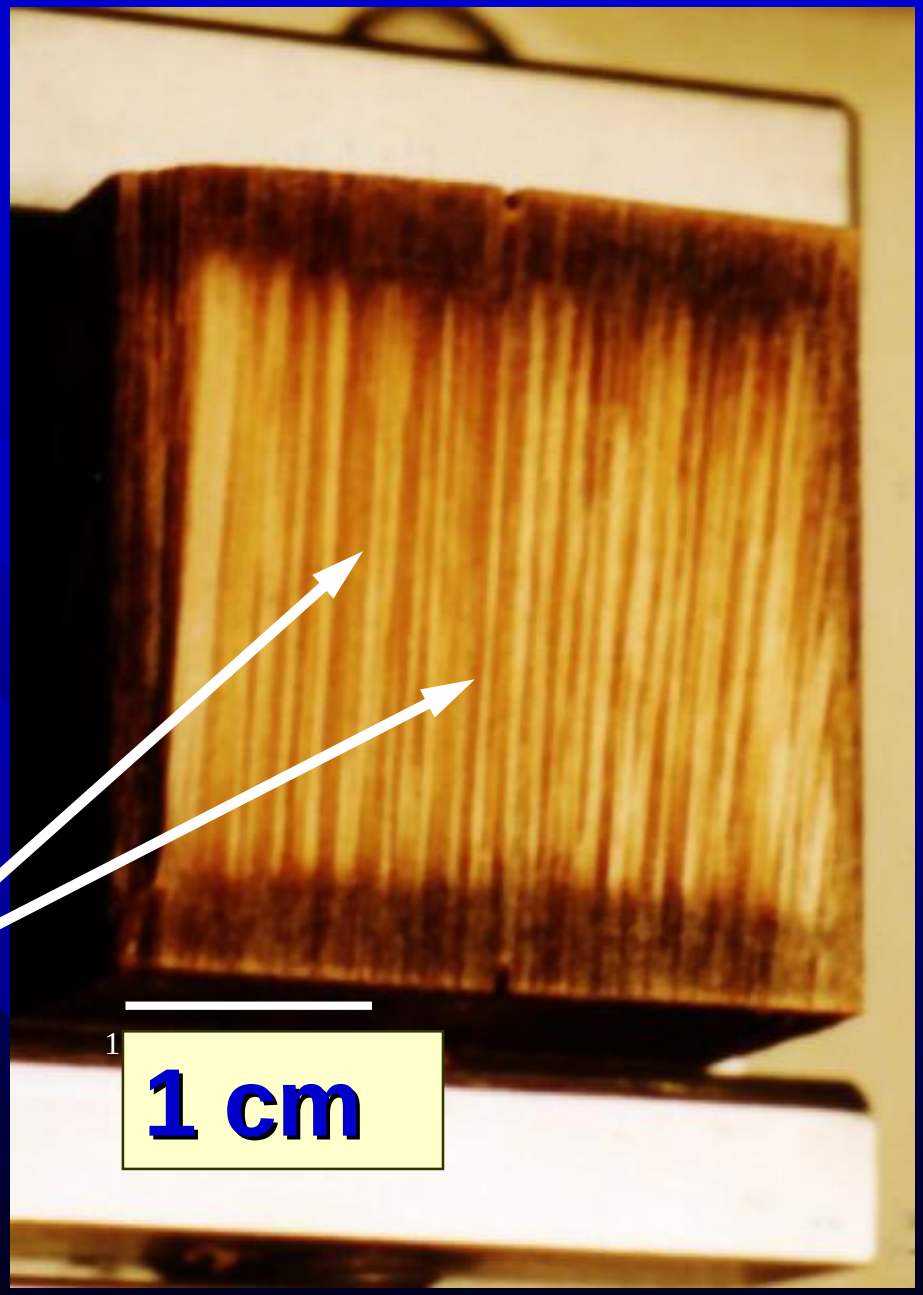
- Steaming (105oC, 10 minutes)
- Immersion in liquor (10 gNaOH/L, 110oC)
- Pressurization to 6.0 bar
- Relief of pressure while wood cube are immersed
- Take out from digester and immediate immersion of the cubes in liquid Nitrogen

Slicing of treated cubes

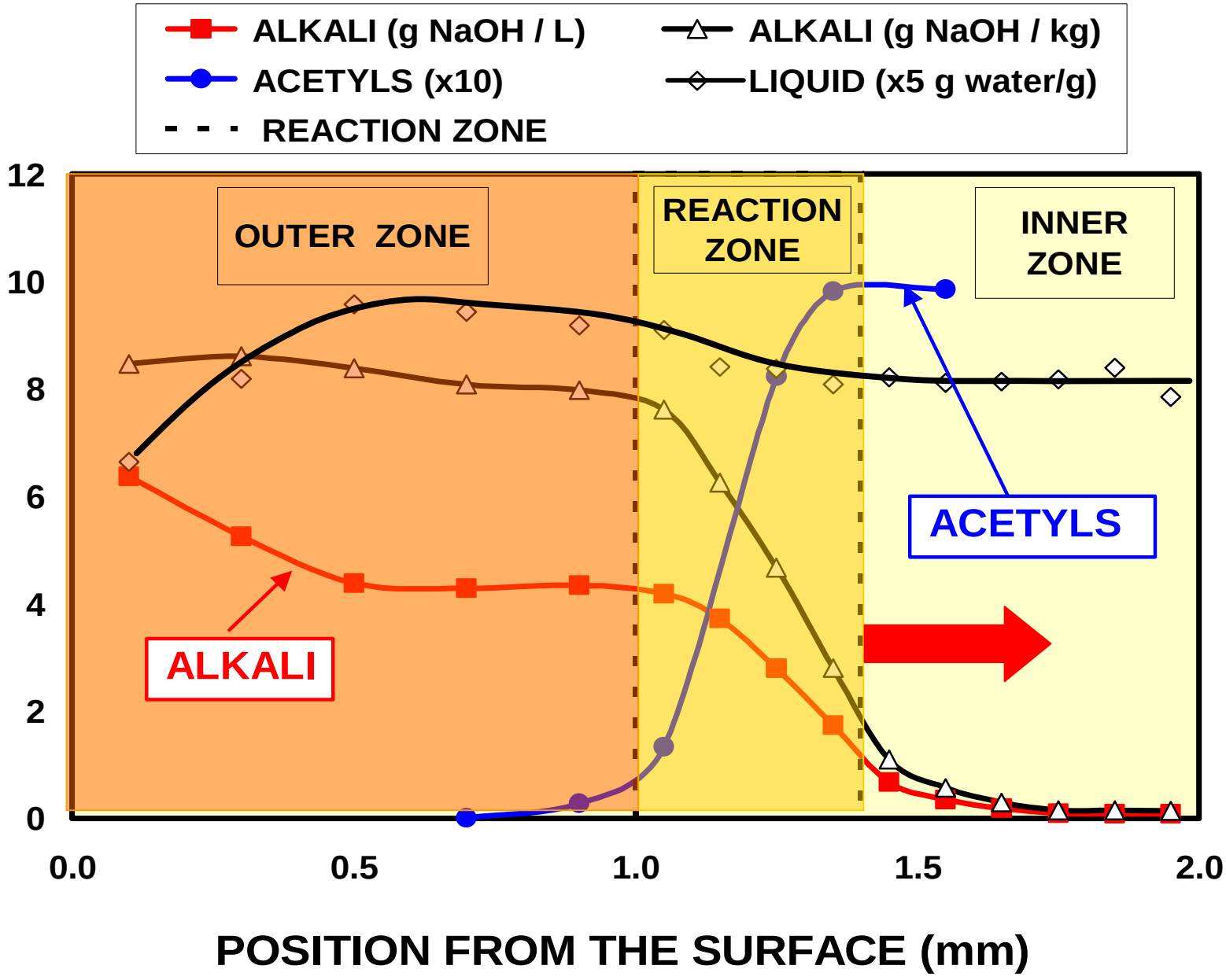
Wood sample is still frozen

Slices are weighed, and chemically analyzed

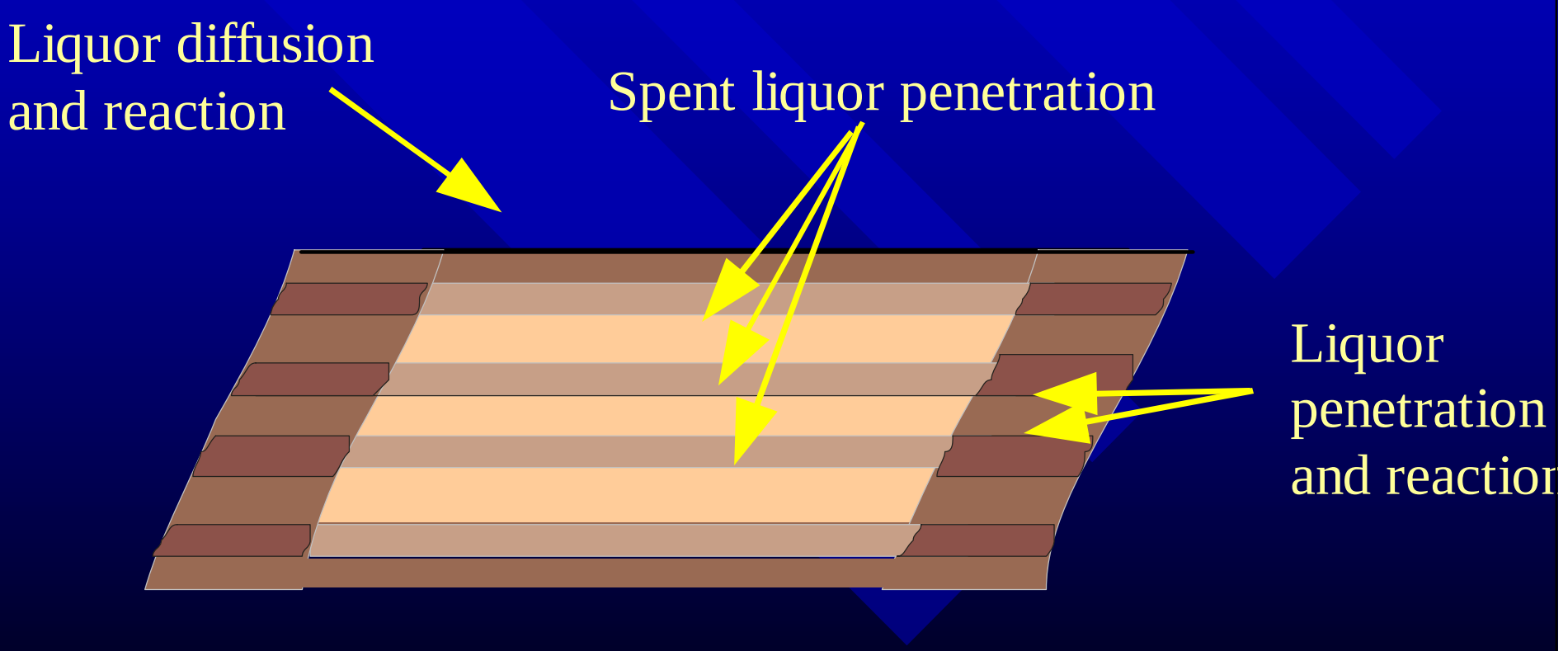
Tangential face of impregnated wood



Eucalyptus

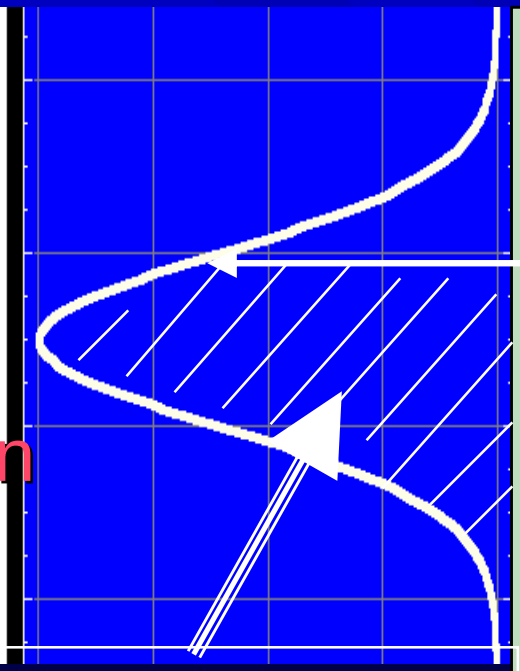

ALKALI (g NaOH / L)
ALKALI (g NaOH / kg)
ACETYLS (x10)
LIQUID (x5 g water/g)
REACTION ZONE
OUTER ZONE
REACTION ZONE
INNER ZONE
ACETYLS
ALKALI
12
10
8
6
4
2
0
0.0
0.5
1.0
1.5
2.0
POSITION FROM THE SURFACE (mm)

Mechanism of the chip impregnation

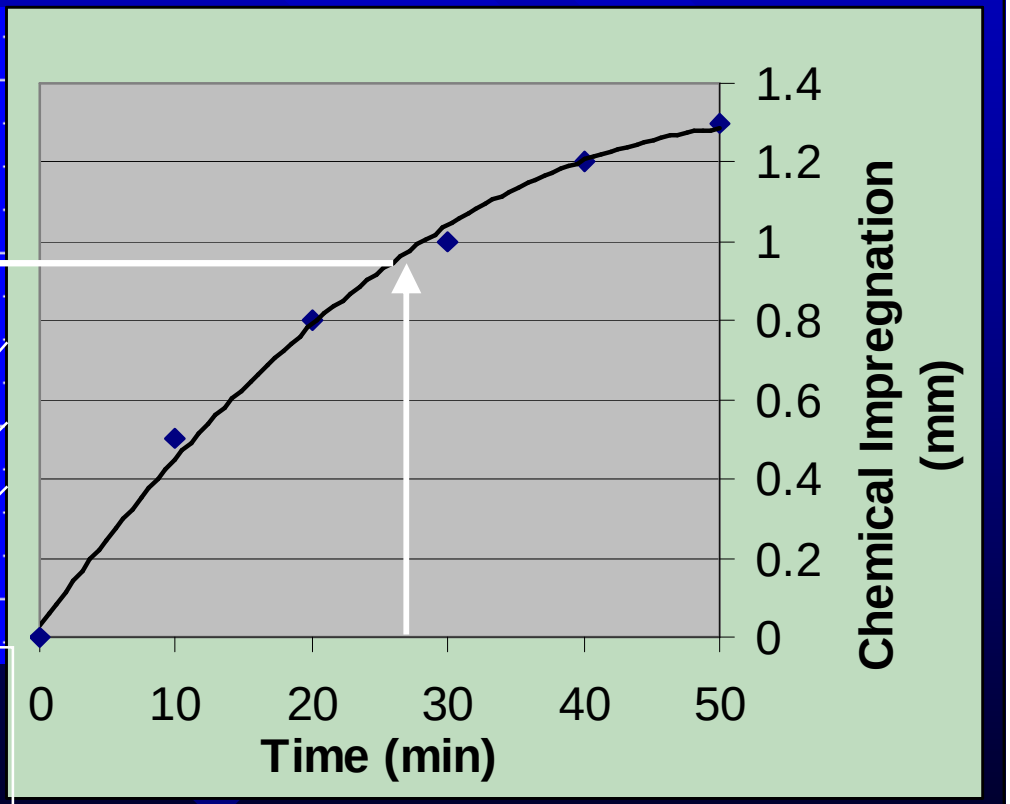


If the speed of moving front is known, the level of impregnation can be predicted

The chip half-thickness distribution



Fraction of impregnated wood



Conclusions (1)

- Steaming (5 minutes) and pressurized immersion (6 Bar) can complete liquid impregnation
- Initially alkali does not reach the core a chip
- The chemical impregnation takes place by reaction and diffusion. A front of the impregnation is always established.

Conclusion (2)

The time needed for chemical impregnation (when front reaches the center of the chip) can be predicted for a given wood and determined treatment conditions

KRAFT IMPREGNATION STUDIES FOR *EUCALYPTUS* WOOD CHIPS

Marcelo Moreira Costa – Veracel, Eunápolis - BA, Brazil

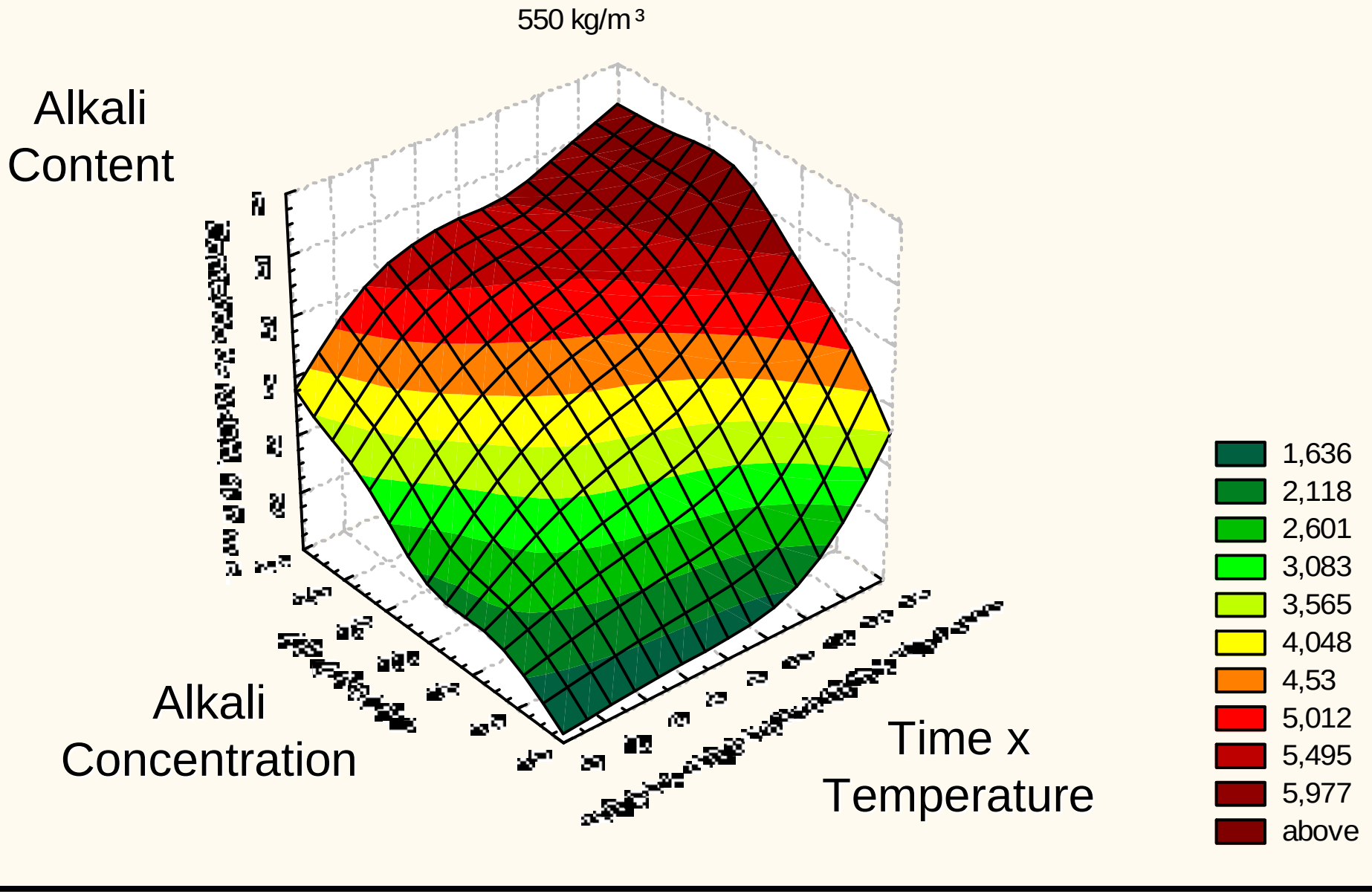
José Lívio Gomide - Universidade Federal de Viçosa, Viçosa-MG, Brazil

Miguel Zanuttini – UNL, Santa Fé, Argentina

E. Souza and *M. Neto* - Cenibra, Belo Oriente - MG, Brazil

ABTCP Conference 2004 San Pablo, Brasil

Alkali content in the center of the chip at the end of impregnation



Mechanical Pulping

Mechanical Pulping

We have studied:

- Bagasse Alkaline CMP

- Alkaline CMP from Hardwood

Effects of alkali charge in bagasse chemimechanical pulping. Part I and Part II

Zanuttini, M. ITC – Argentina

Christensen P.K. – NTH – Trondheim - Norway

Appita 44(3):191 (1991) and 44(4):257 (1991)

Study performed at NTH, Trondheim, Norway

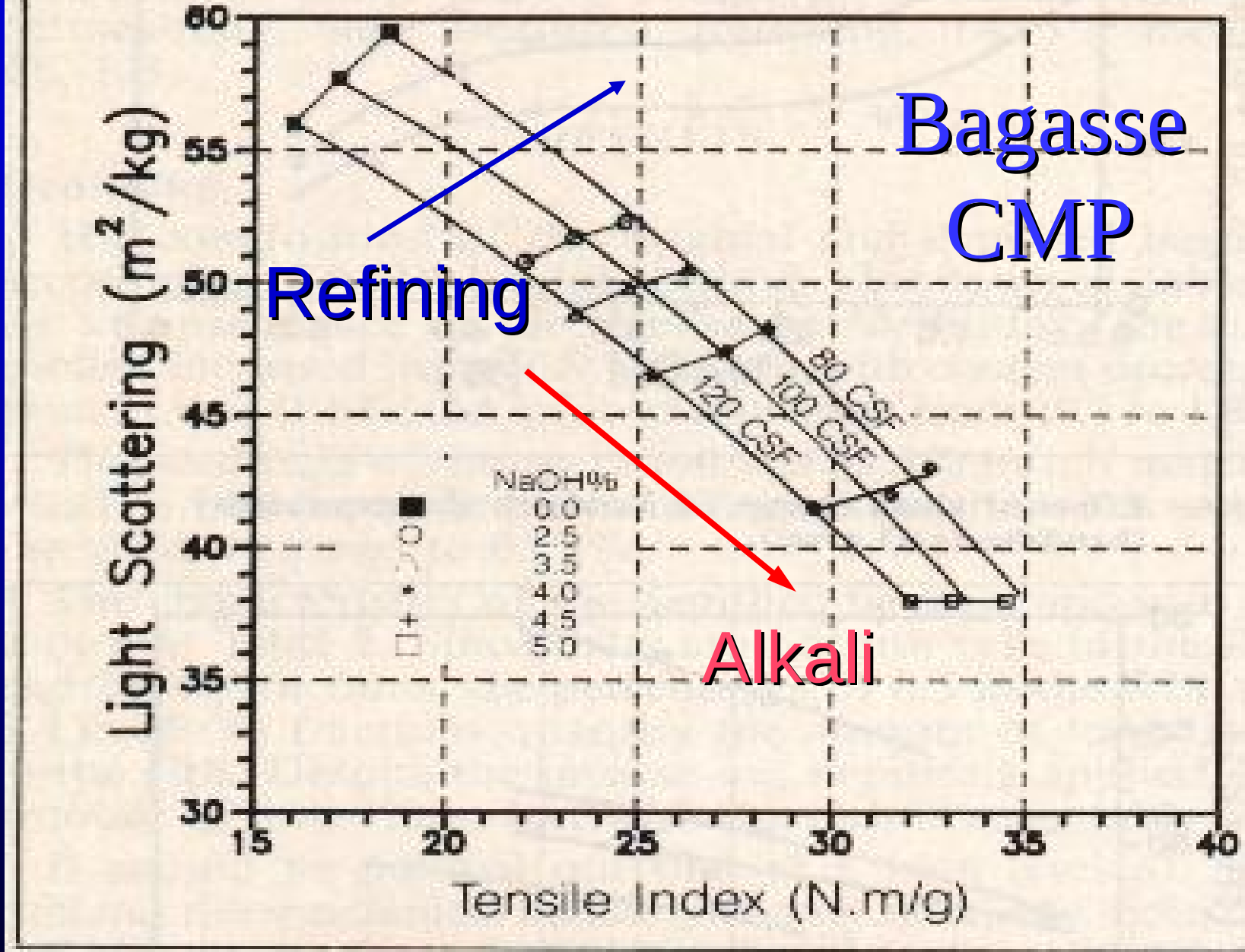


Fig. 7 — Light scattering ability versus tensile strength for freeness range 120 to 80 CSF.

- CMP was obtained using the 20“ Disk Refiner
- From different furnishes, newsprint paper was obtained for printing test

Alkaline Chemimechanical Pulp from Poplar. Relationship between Chemical State, Swelling and Properties

M. ZANUTTINI and V. MARZOCCHI

Holzforschung 57(5) 2003

- For sulphite CTMP pulp , Sulphonation degree is a chemical parameter that determines pulp properties .

- We have found that for a hardwood alkaline CMP, acetyl groups content is a parameter useful to control properties

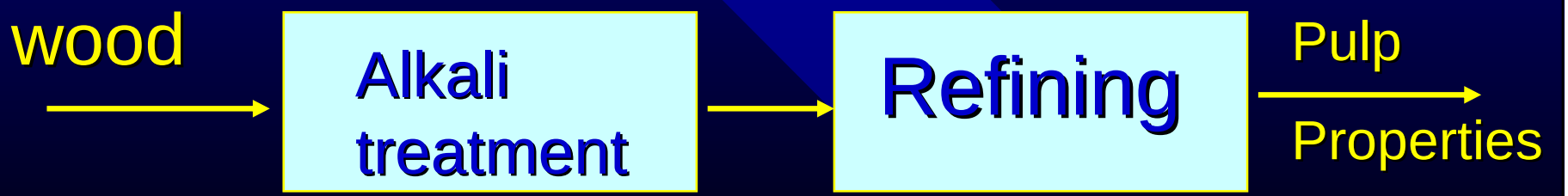
Experimental

- *Wafers of poplar wood were alkali treated.*

Variables:

Temperature and alkali concentration.

- *Treated wafers were hot defibrated in a 300-mm disk mill at 15 % consistency, and then refined in PFI mill at 20 % consistency*



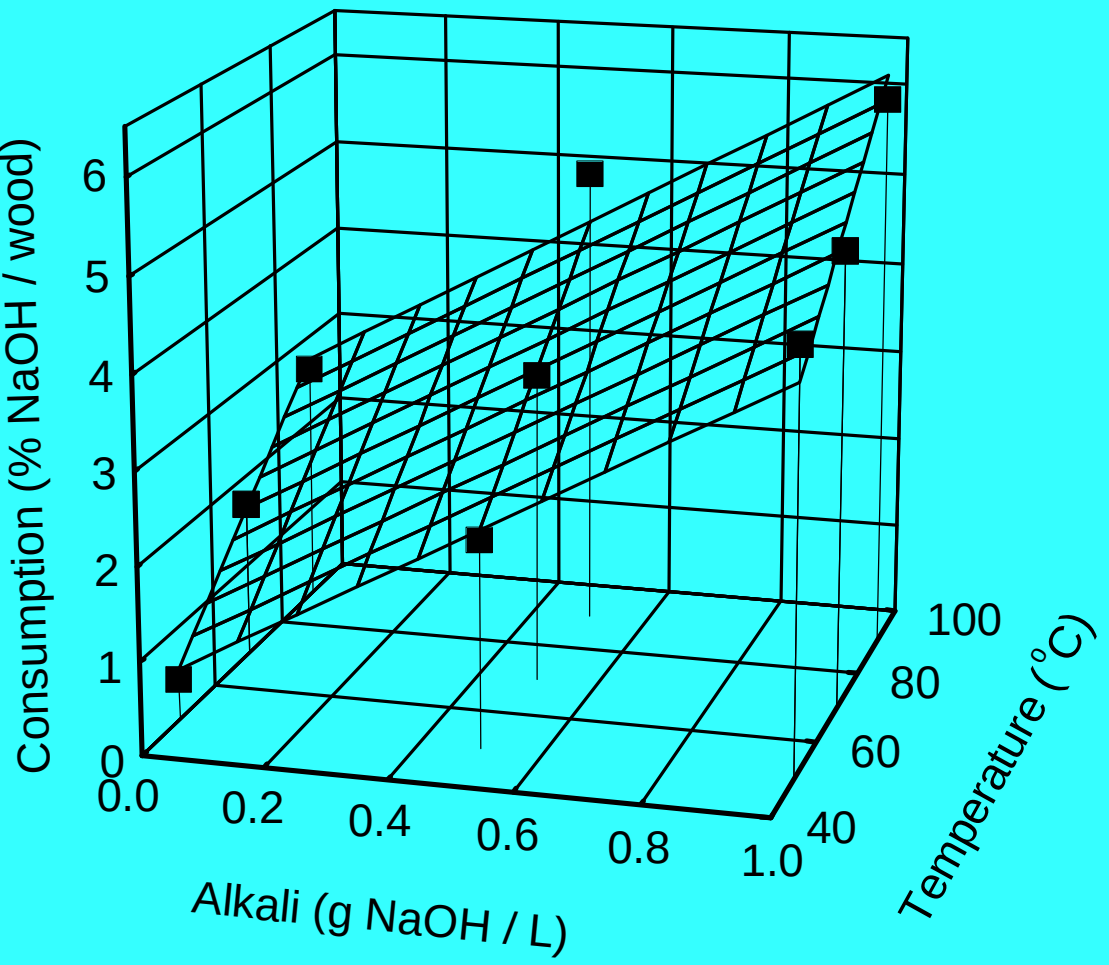
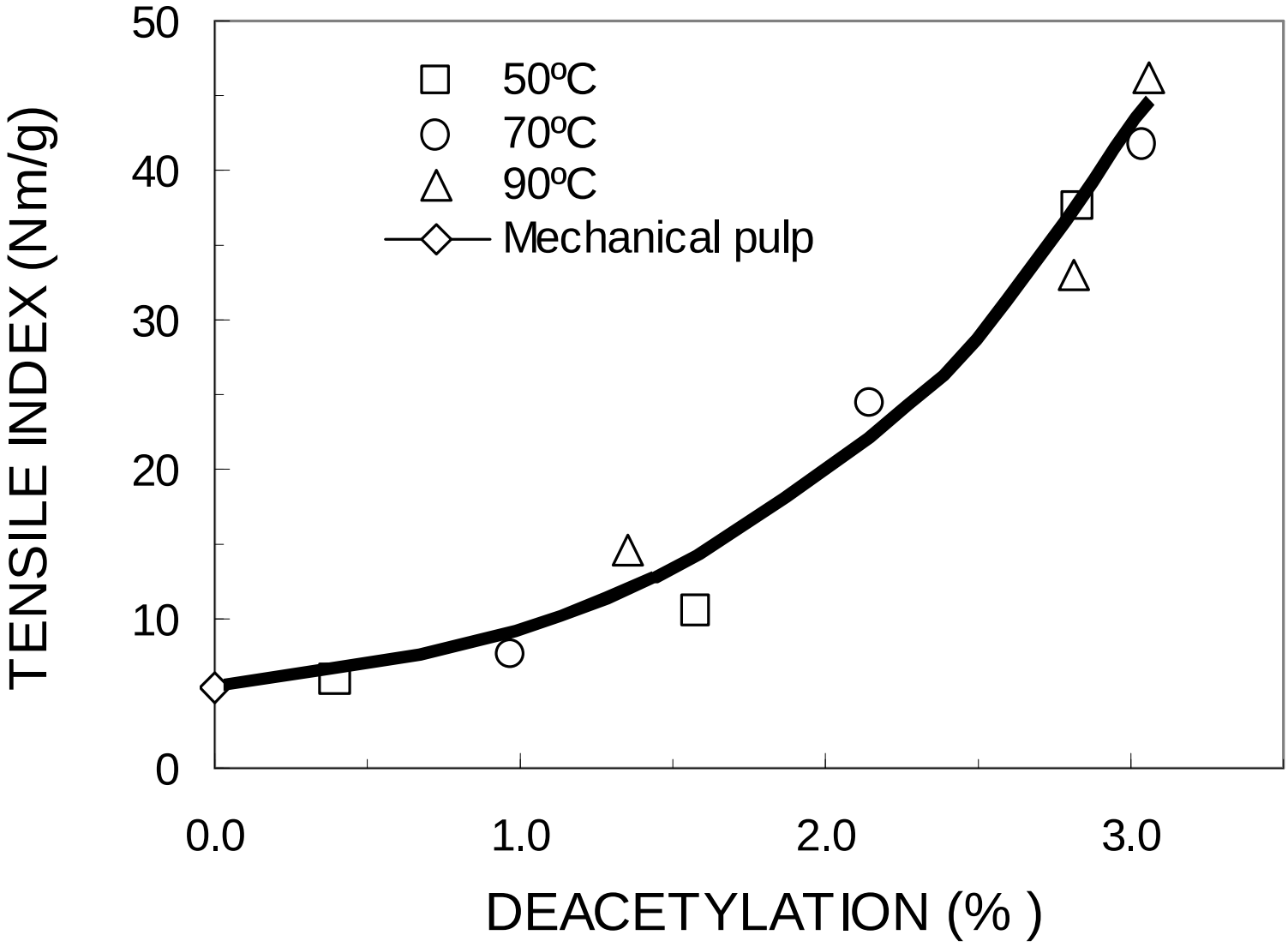


Fig. 1. Response surface of alkali consumption as function of treatment conditions. Alkali concentration is expressed in coded unit.



CMP Tensile strength – deacetylation degree

Recycling of unbleached fiber

Ozone application

Upgrading OCC Pulp by Medium-consistency Ozone Treatment

M. Zanuttini* and T. McDonough**

*** Institute of Cellulose Technology - Santa Fe - Argentina**

**** Institute of Paper Science and Technology – Atlanta - USA**

2002 ABTCP Conference, San Pablo, Brazil

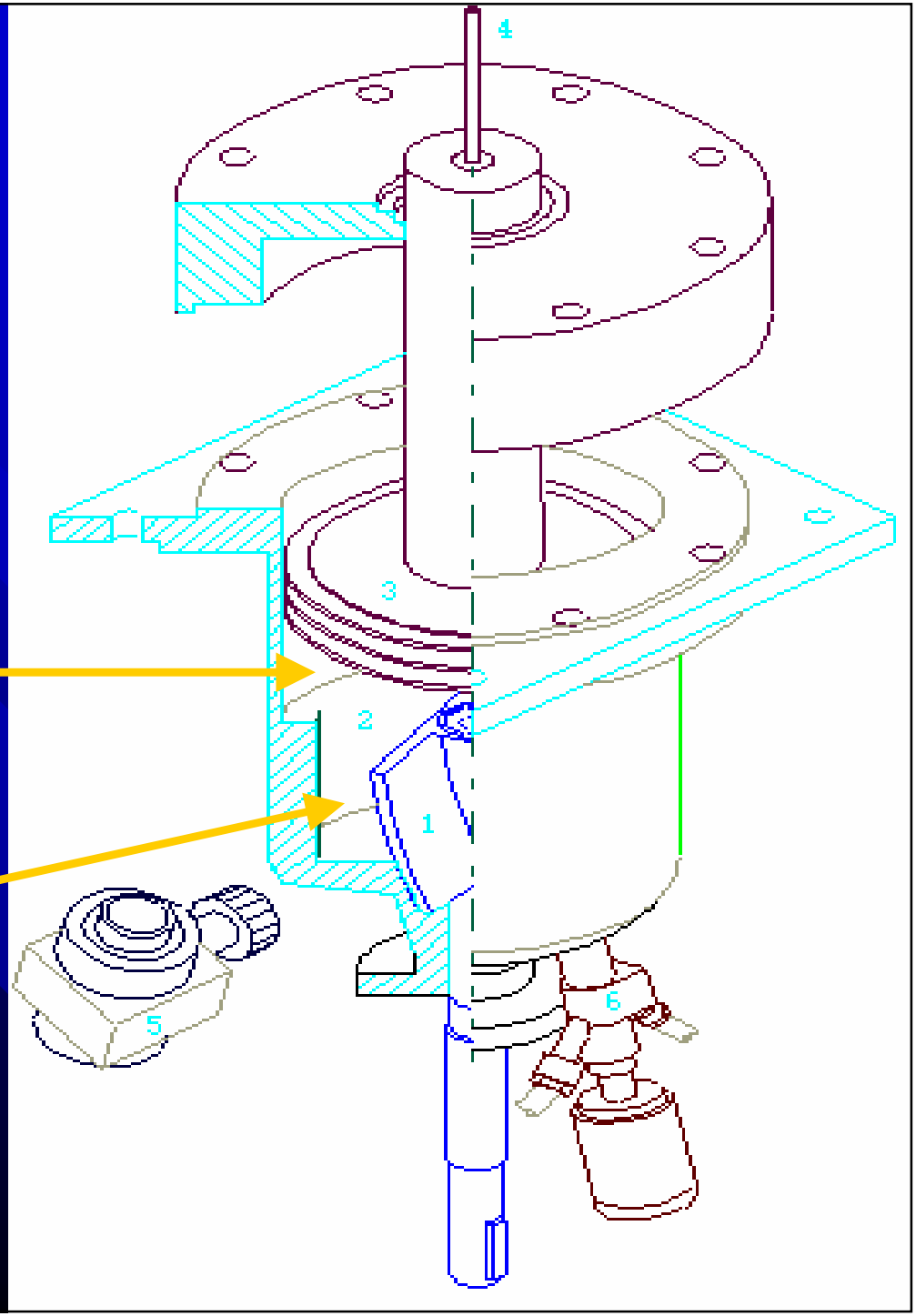
- Low levels of ozone at medium consistency was analyzed.
- Starting materials:
  - **OCC**: Industrial “Old Corrugating Container”
  - **Kraft liner**
  - **Fluting:** Corrugating medium from hardwood green liquor semichemical pulp

- A comparison is made with action of alkali and refining on **OCC** pulp

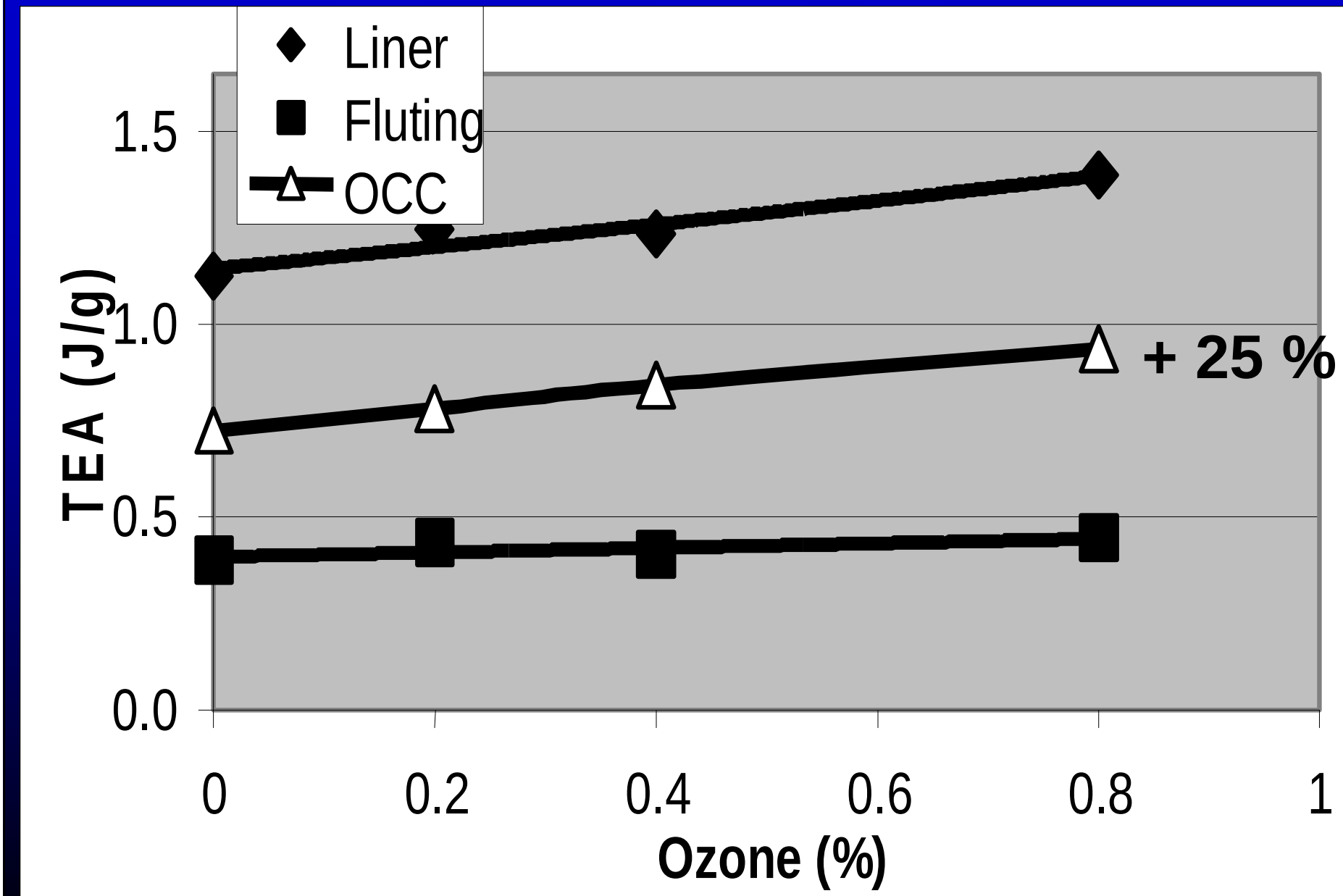
High Shear Mixer CRS Reactor (Sweden)

Expandable zone (2,5 liter)

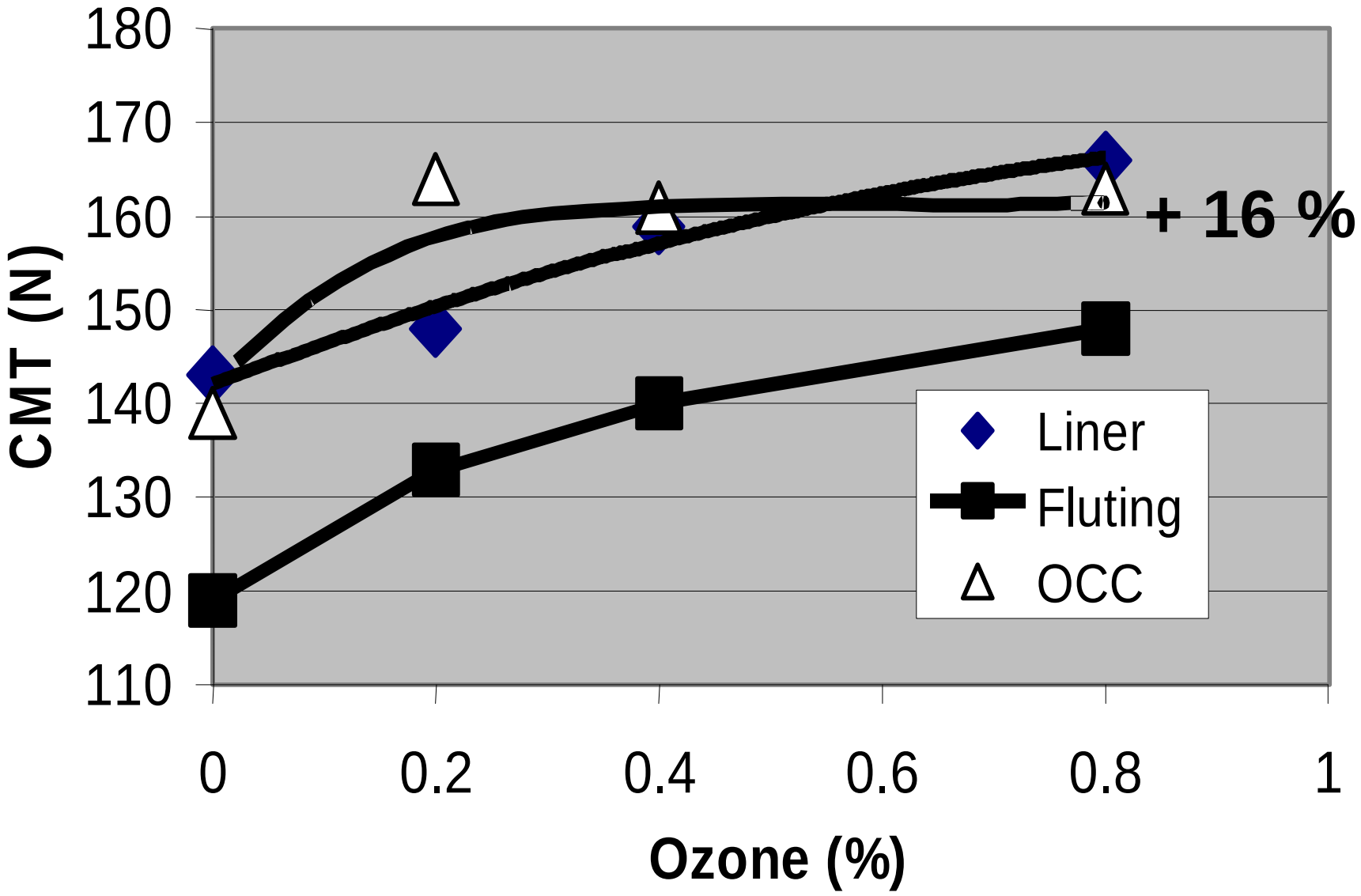
Mixing zone (2,1 liter)



Tensile Energy Absorption



Concora Crush Resistance

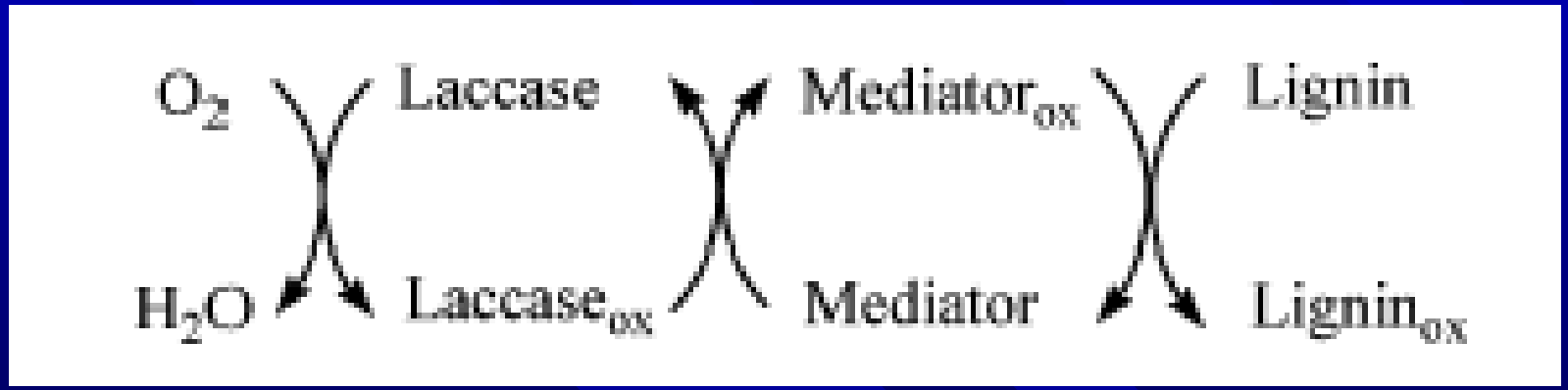


Some conclusions

The application of low level of ozone at medium consistency can notably increase **CMT**, **SSCT** and **internal bonding strength**.

Similar improvement can be obtained by alkali treatment of OCC. Alkali affects more pulp freeness and produces a higher organic load on the effluents.

Laccase application on high-lignin content pulp



Hypothesis:

Delignification and lignin modification can improve papermaking properties.

Enzymes from:

- VTT Biotechnology, Espoo, Finland
- Spegazzini Institute, La Plata, Argentine

Experimental

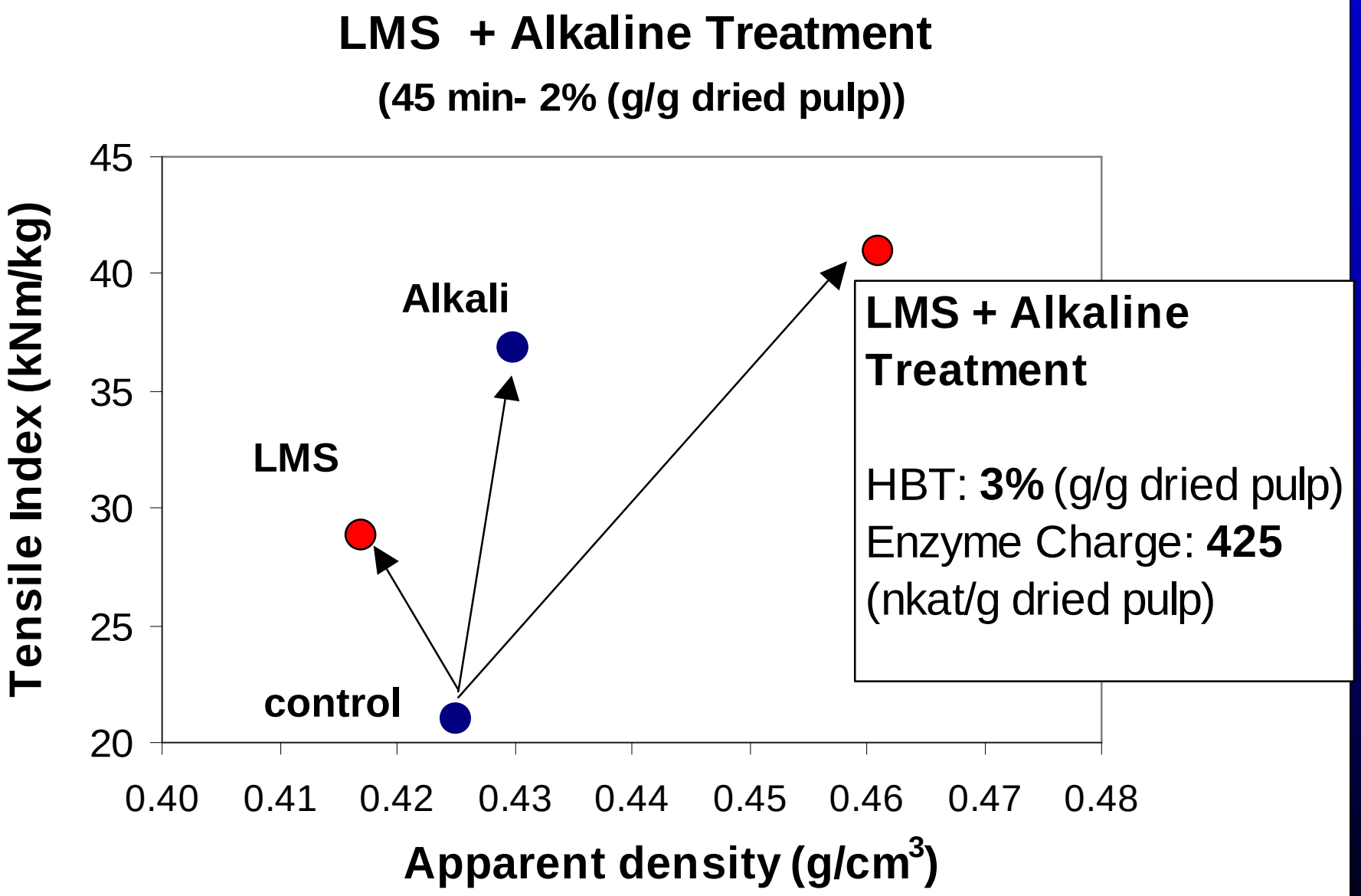
Fibers from softwood kraft pulp (kappa number 90).

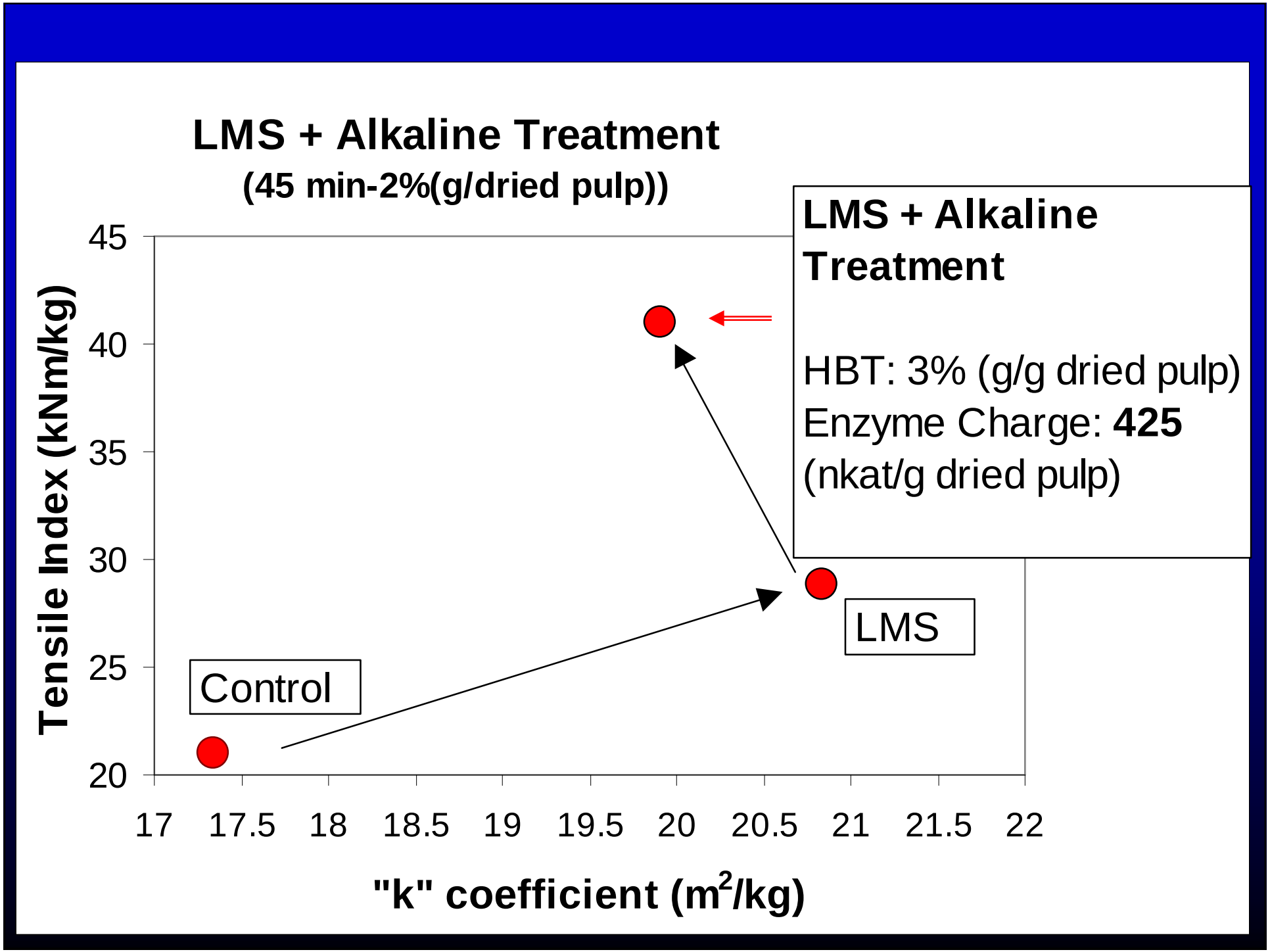
Laccase - Mediator System:

- Mediator: HBT
- Oxygen bubbling
- Control of the enzyme activity during treatment

Optimized Alkali Treatment

Results


LMS + Alkaline Treatment
(45 min- 2% (g/g dried pulp))
Tensile Index (kNm/kg)
45
40
35
30
25
20
Alkali
LMS
control
LMS + Alkaline Treatment
HBT: 3% (g/g dried pulp)
Enzyme Charge: 425 (nkat/g dried pulp)
0.40
0.41
0.42
0.43
0.44
0.45
0.46
0.47
0.48
Apparent density (g/cm3)


LMS + Alkaline Treatment
(45 min-2%(g/dried pulp))
LMS + Alkaline Treatment
HBT: 3% (g/g dried pulp)
Enzyme Charge: 425
(nkat/g dried pulp)
LMS
Control
Tensile Index (kNm/kg)
45
40
35
30
25
20
17
17.5
18
18.5
19
19.5
20
20.5
21
21.5
22
"k" coefficient (m2/kg)

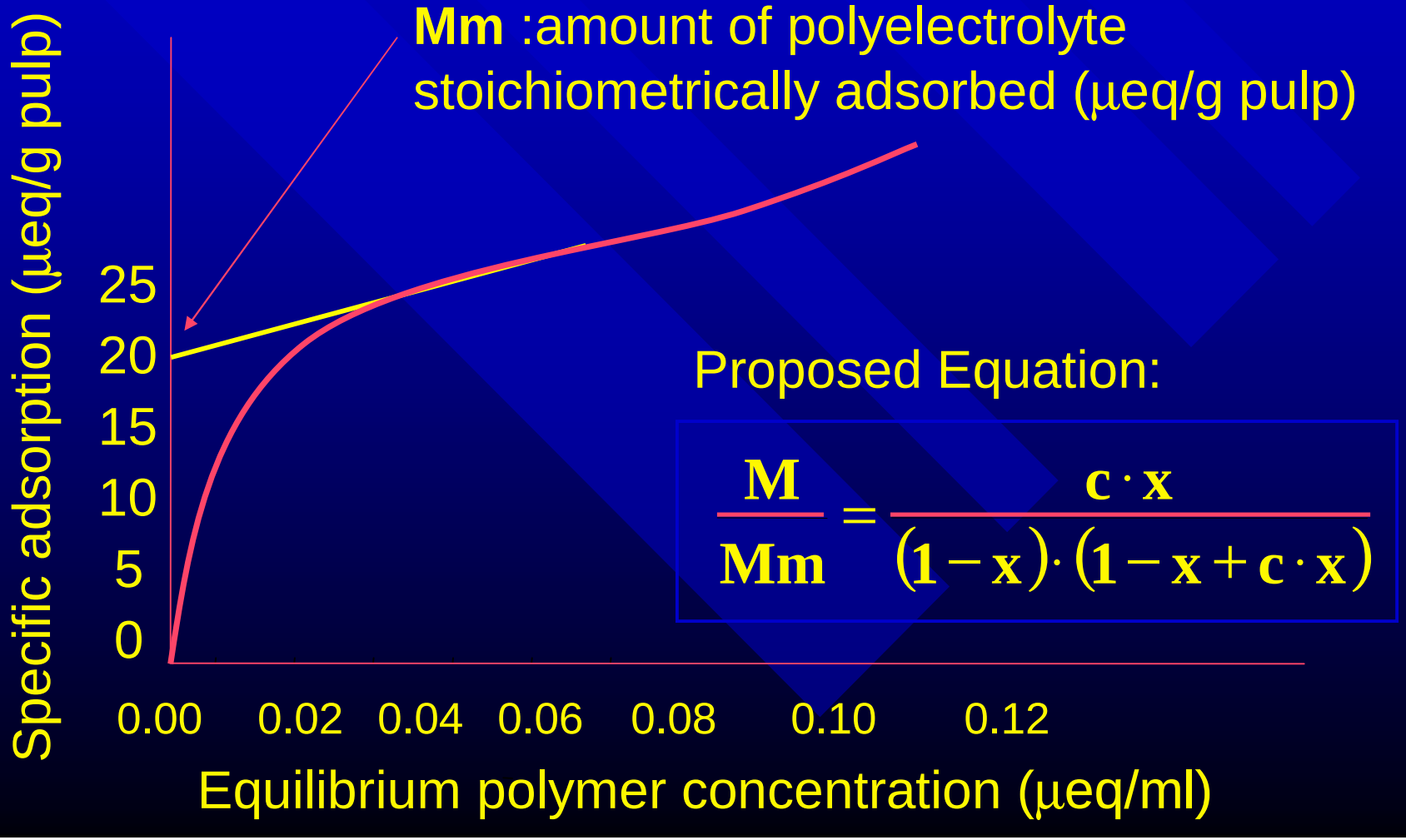
Results on lacasse aplication

- Mocchiutti, P. , M. Zanuttini, K. Kruus And A Suurnäkki. “Improvement of the Fibre Bonding Capacity of Unbleached Recycled Pulp by Laccase/Mediator Treatment”. **Tappi Journal** (10) 17-22, **2008.**

Chemical fibre characterization

Determination of Surface Acidic Groups

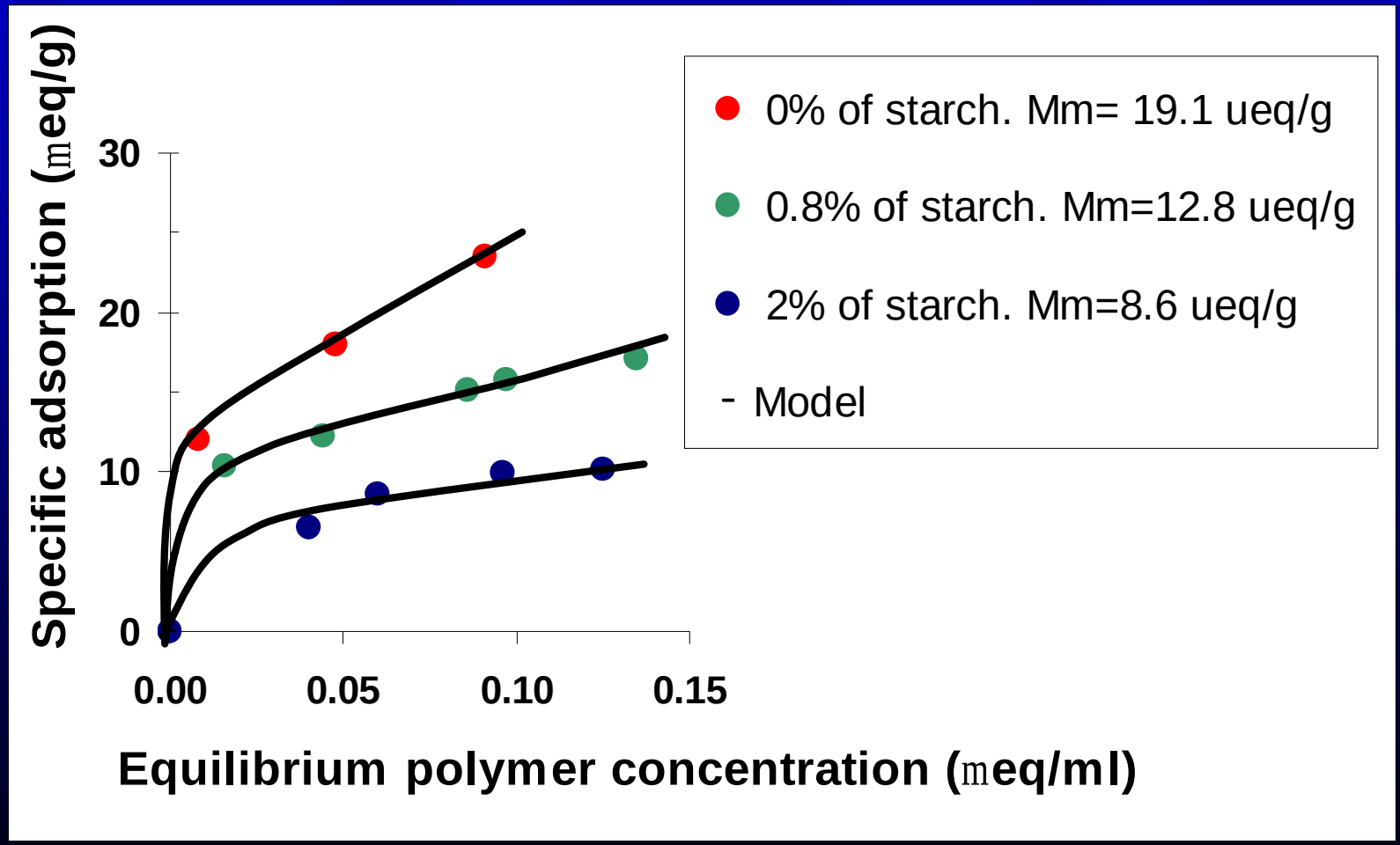
Determination of Surface Acid Groups. Specific adsorption of pDMDAAC vs. equilibrium concentration of the polymer in solution. Adsorption Isotherm.

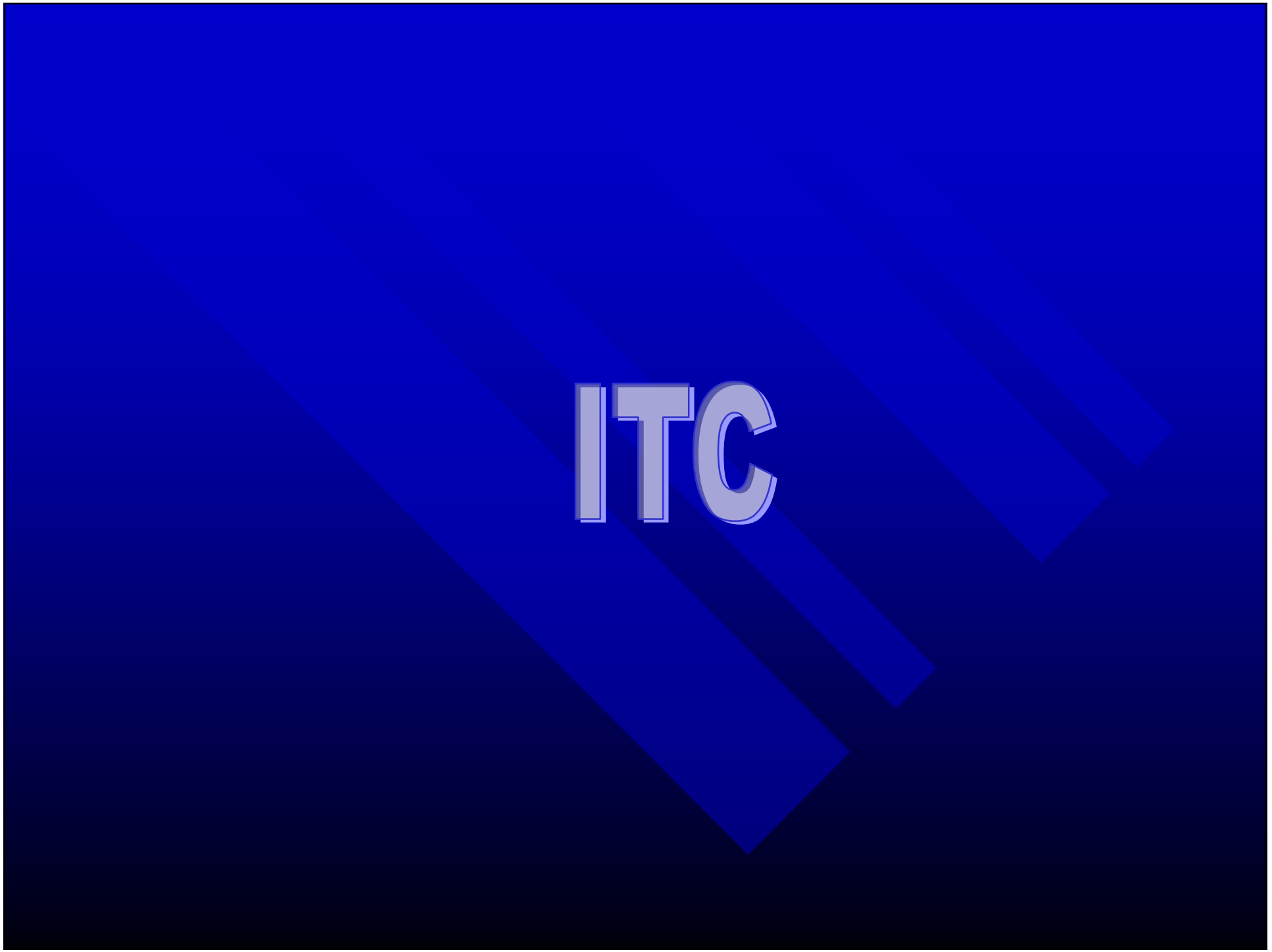


Proposed Equation:

$$\frac{M}{Mm} = \frac{c \cdot x}{(1-x)\cdot(1-x+c\cdot x)}$$

Surface Acid Groups. Specific adsorption of pDMDAAC onto the pulps dried at 60ºC for 48h *under NO restraint* with 0%, 0.8% and 2% of C.S. adsorbed




ITC

Ministerio de Cultura y Educación

UNIVERSIDAD NACIONAL DEL LITORAL

Facultad de Ingeniería Química

Sgo. Del Estero 2654 Tel- FAX .: (0342) 4520019
Santa Fe ARGENTINA