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CNPq Conselho Nacional de Desenvolvimento Científico e Tecnológico

Potential of Aqueous Two-Phase Systems(ATPS) to Remove colloidal stickies from Recycling Papermaking Process

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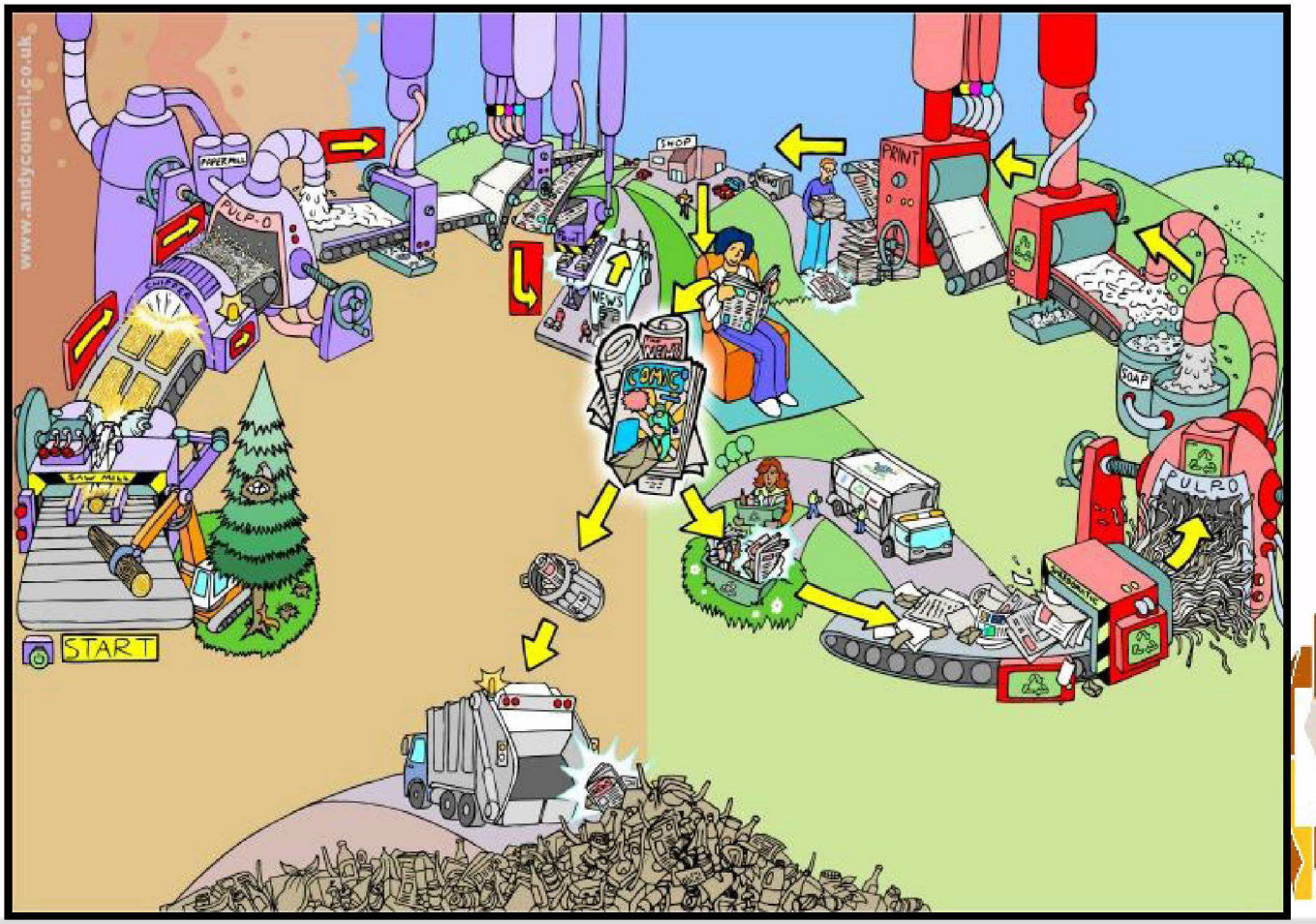
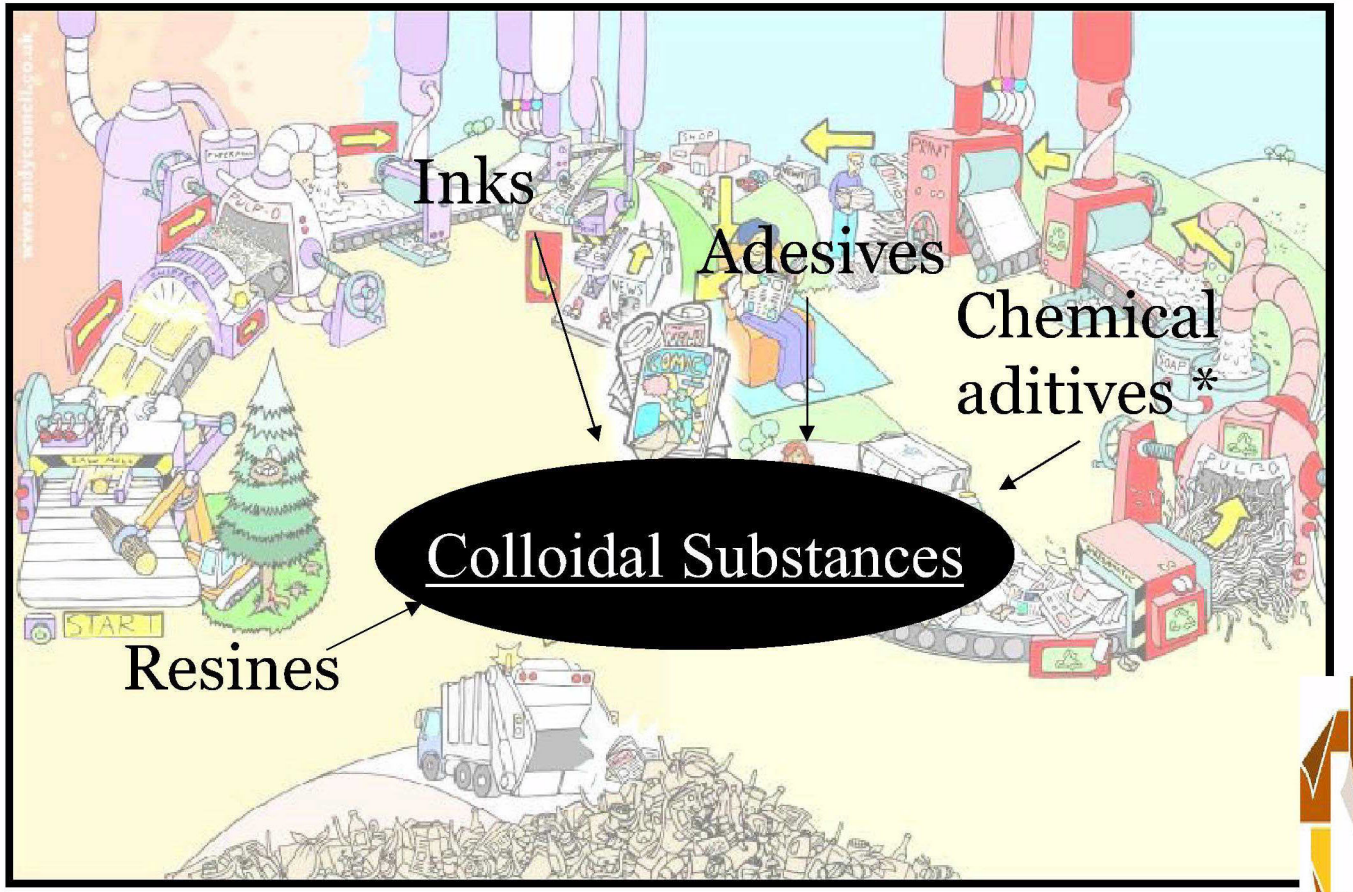
Red Iberoamericana para la revalorización del reciclado celulósico

INTRODUCTION

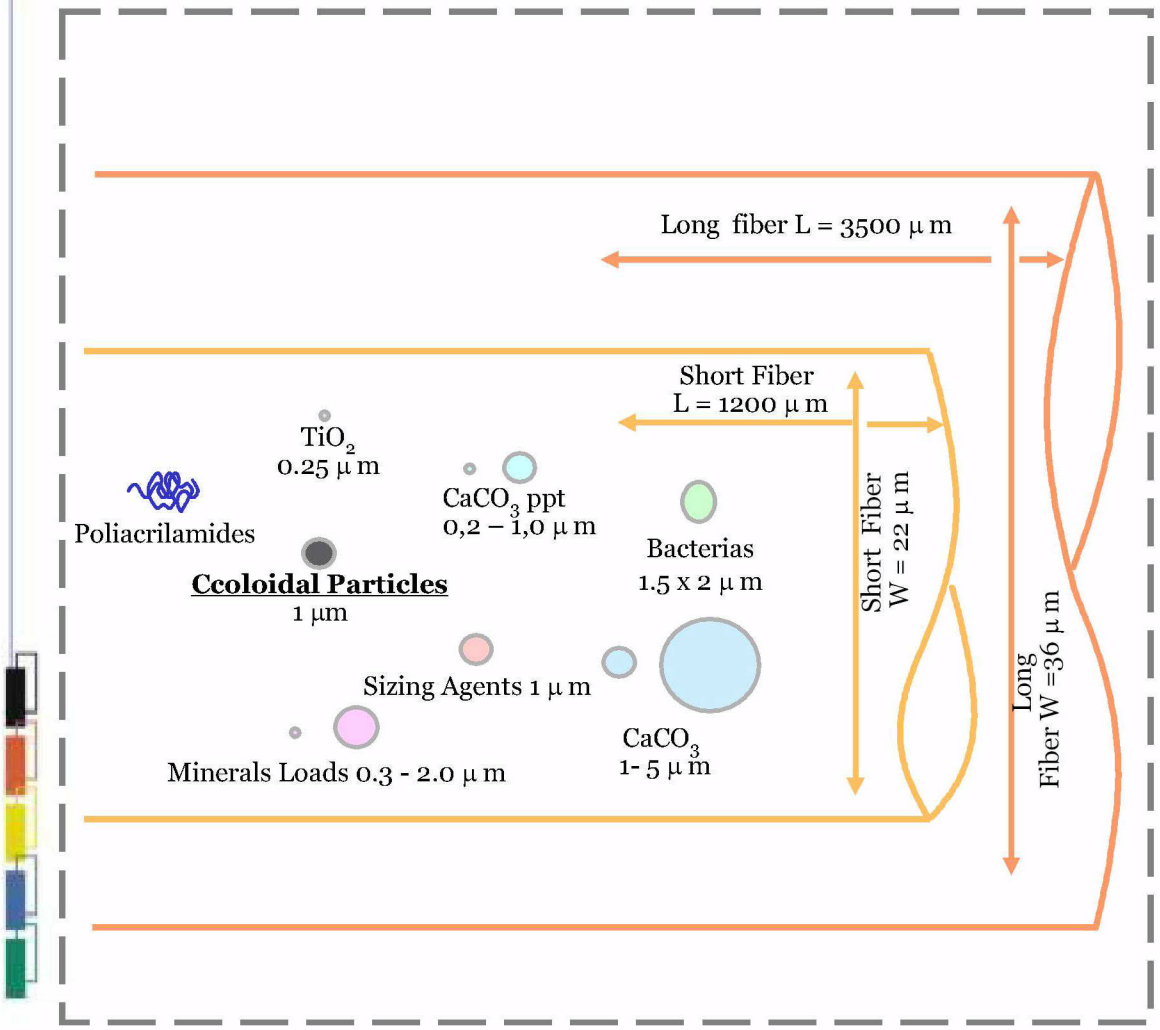


INTRODUCTION



* Sizing Agents, Surfactants, Wet-end resines, etc.

INTRODUCTION



Dashed Line Boundary is equivalente a wire aperture of 70 µm !!!

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Stickies formation and deposites

Desagregation and Defibrilation

↓

Liberation of undesirable materials

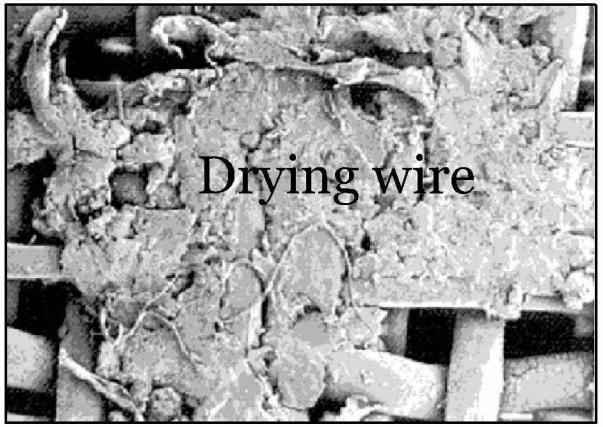
↓

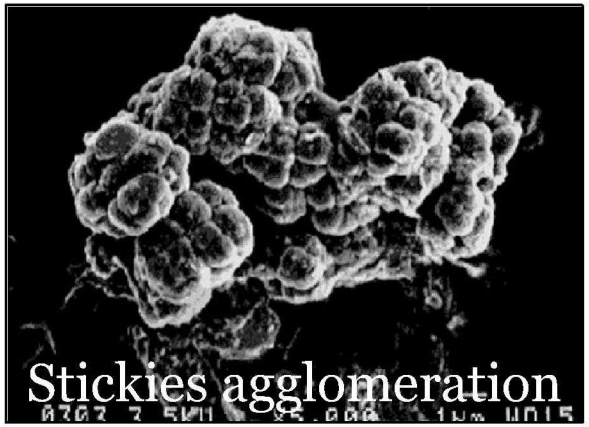
Physical and chemical unbalance

↓

Deposite formation and agglomeration

INTRODUCTION





Stickies Composition

Heterogeneous:

- organic or inorganic
- naturals or sintetics

Zule e Dolene (2004): The most of prejudicial components of colloidal particles are hidrofobics

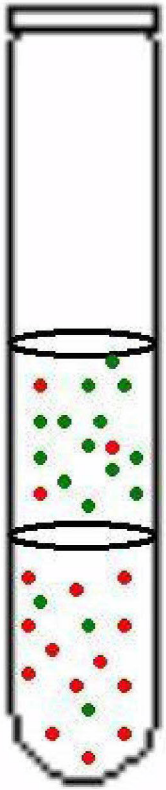
To control stickies

Basicall we need to remove contaminants: It is responsible for a great portion of COT related paper recycling!!!

☹ Unfortunately there is no method 100% efficient...

Aquosos two-phase systems (ATPS)

Major component: **Water**



Superior Phase
- Polimer

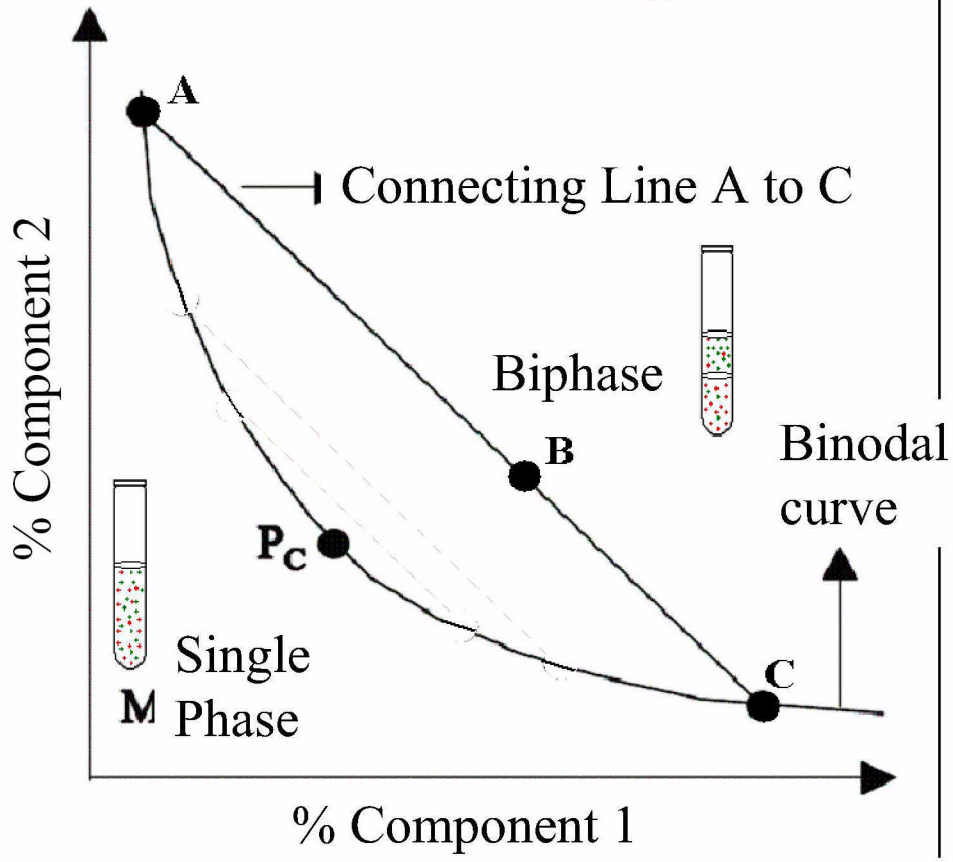
Inferior phase
- Salt

In equilibrium!!!

Aqueous two-phase systems (ATPS)

- Non toxic component
- Environmental safety
- Low costs
- Selective partition
- It can be applied in continuous process
- Easy to prepare

Phase Diagram



$$CLA = \left[\left(C_P^S - C_P^I \right)^2 + \left(C_S^S - C_S^I \right)^2 \right]^{\frac{1}{2}}$$

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OBJECTIVES

- ✓Evaluate the effect of temperature and salt characteristic on the extraction of colloidal particles in white water from paper packaging machine using Aqueous two phase systems-ATPS technique

METODOLOGY

- copolymer triblock L35
- Na_2SO_4 ou Li_2SO_4
- industrial white water

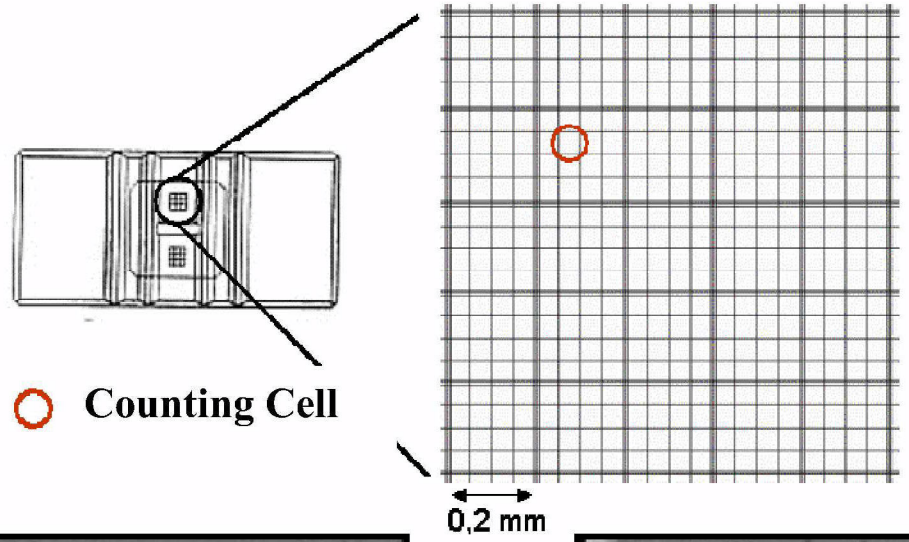
25°C
35°C
45°C

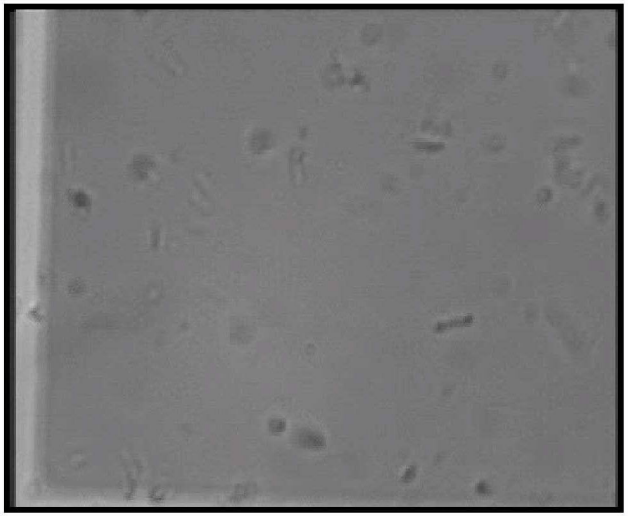
Temperature controled In water bath

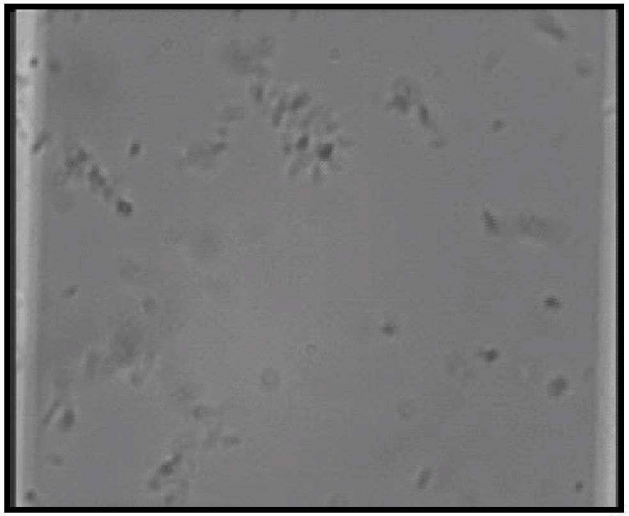
$$\%E = 1 - \frac{P_I}{P_T}$$

✓Samples were colected from superior and inferior phases at temperature equilibrium

METODOLOGY



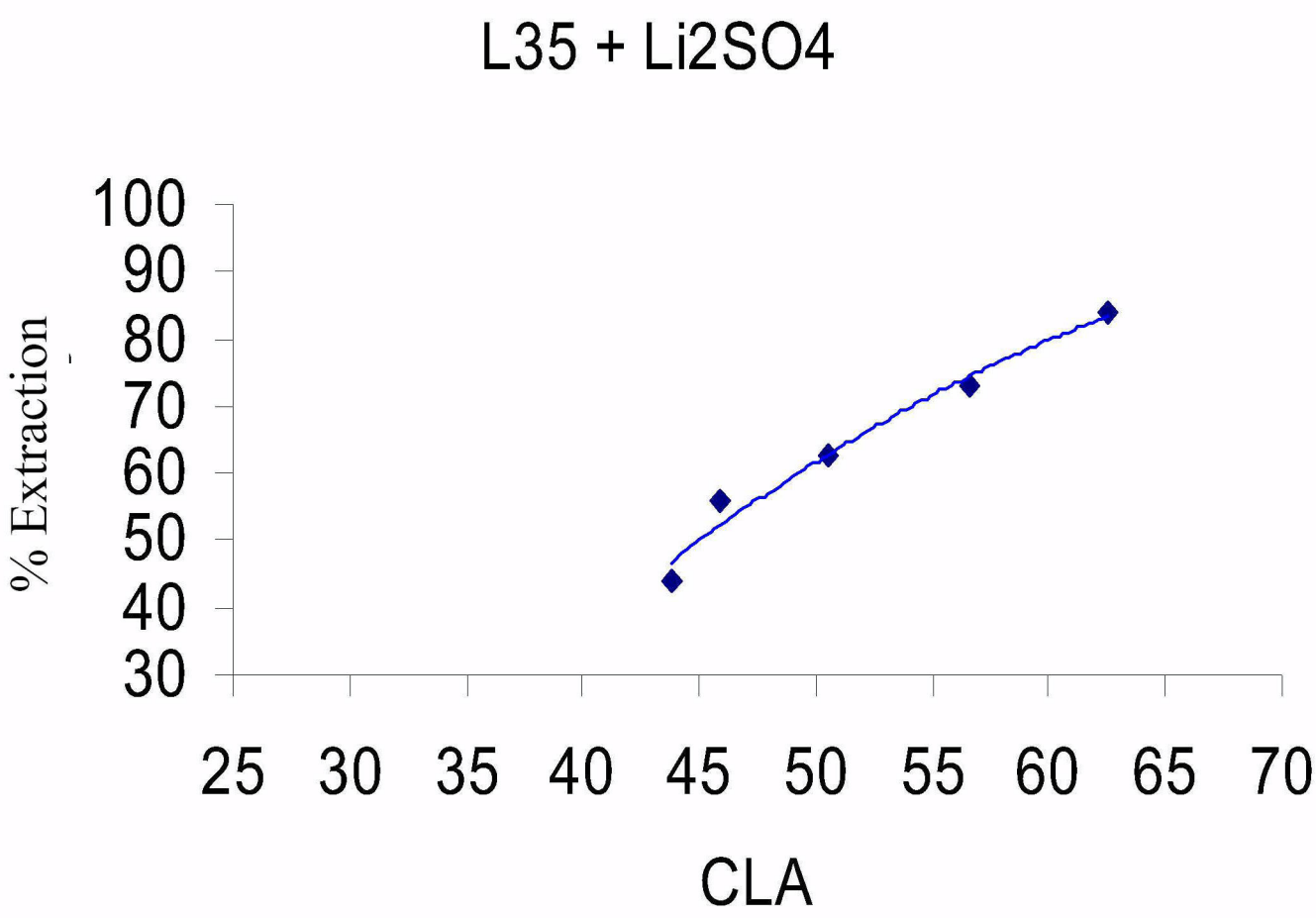




RESULTS

The colloidals particles concentrated in the inferior phase (rich in salt) and on the surface of interphase.

RESULTS


L35 + Li2SO4
% Extraction
100
90
80
70
60
50
40
30
25
30
35
40
45
50
55
60
65
70
CLA

Haynes Models

$$\ln K_s = -\frac{A_s}{RT}\left[\sum_{i-1}^{3}\left(\Phi_i^{fs} - \Phi_i^{fi}\right)W_{iS} - \sum_{i=1}^{2}\sum_{j=2}^{3}\left(\Phi_i^{fs}\Phi_j^{fs} - \Phi_i^{fi}\Phi_j^{fi}\right)W_{ij}\right] + \frac{A_s}{\rho}\left(\frac{n^{fs}}{V^{fs}} - \frac{n^{fi}}{V^{fi}}\right)$$

entalpy

entropy

$\ln K_s$ = coefficient of colloidal particle partition

The Entalpy component

$$\ln K_s = -\frac{A_s}{RT}\left[\sum_{i-1}^{3}\left(\Phi_i^{fs} - \Phi_i^{fi}\right)W_{iS} - \sum_{i=1}^{2}\sum_{j=2}^{3}\left(\Phi_i^{fs}\Phi_j^{fs} - \Phi_i^{fi}\Phi_j^{fi}\right)W_{ij}\right]$$

Φ_i^{fs} e Φ_i^{fi} : Volumetric fraction of the "i" Component. ATPS former (copolymer, salt or water).

W_{iS} = Potential efective pair

$$W_{iS} = Z\left[\varepsilon_{iS} - \frac{1}{2}\left(\varepsilon_{ii} + \varepsilon_{SS}\right)\right]$$

Z: Total number of potential pairs formed by "i"or "s"in the medium

ε_{xx} : Potencial pairs "i-i, i-s ou s-s"

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The Entropy Component

$$\ln K_s = \frac{A_s}{\rho}\left(\frac{n^{fs}}{V^{fs}} - \frac{n^{fi}}{V^{fi}}\right)$$

n^{fi} e n^{fs} : Total n# of molecules in the inferior and superior phases

A_s : Superficial area of colloidal particles;

ρ: Molecular number density of the global phases in the medium;

V^{fi} e V^{fs}:volume of inferior and superior phases.

The entropy was the moving force to cause partition of the colloidal particles in the ATPS studied!!!

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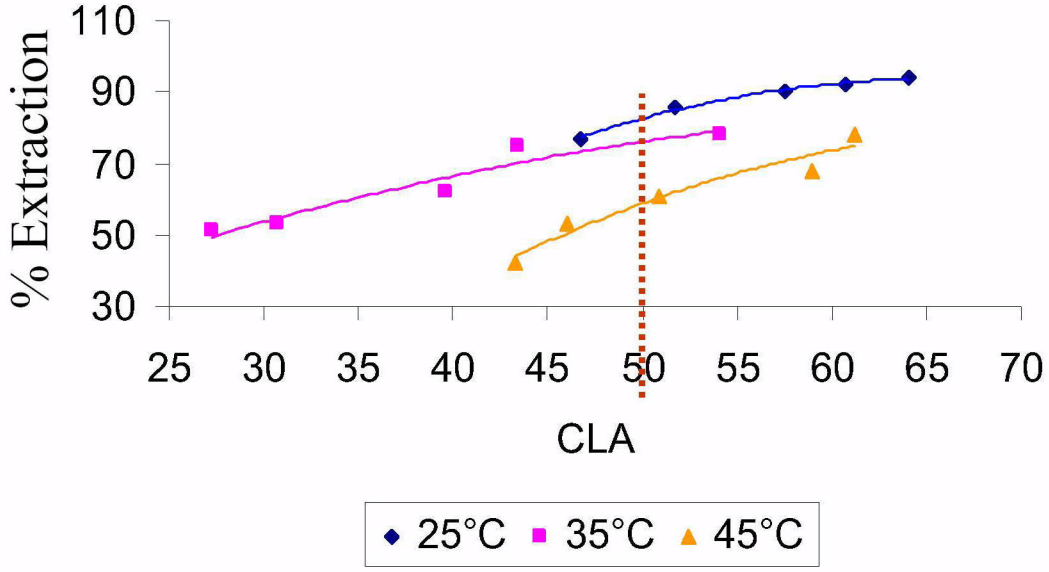
The temperature effect

L35 + Na_2SO_4

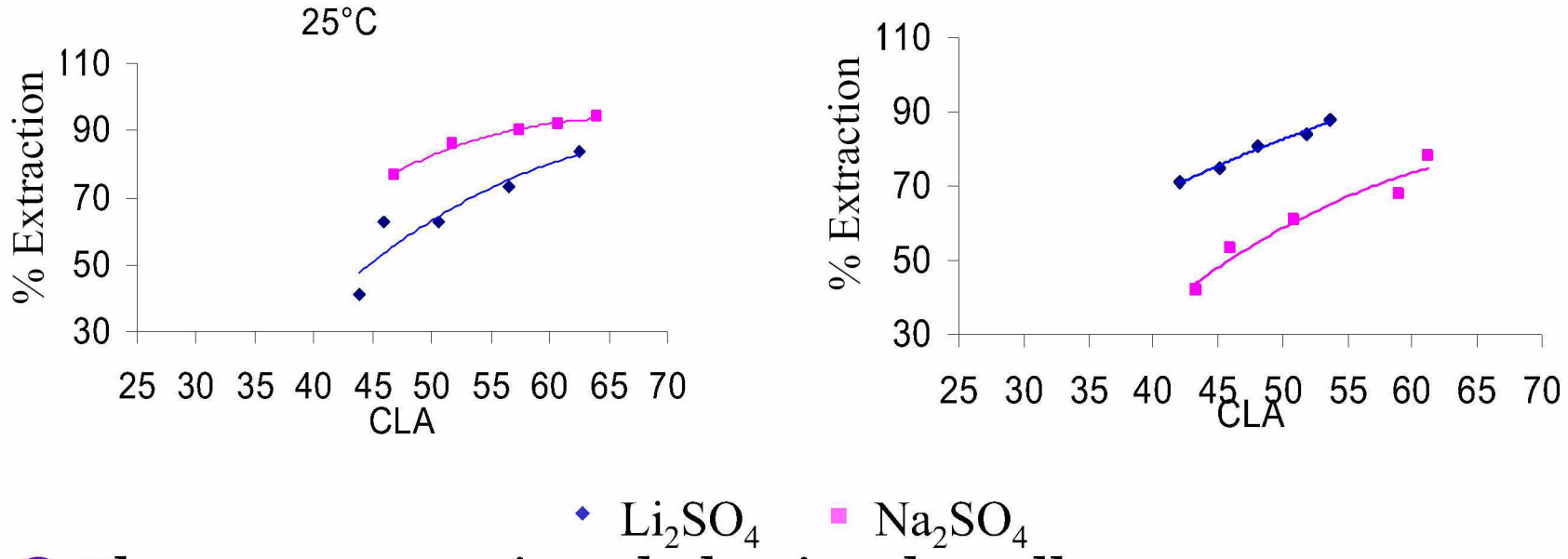


↑ Temperature: ↓ Hidration degre copolimer molecule.

↓

liberation of H_2O to inferior phase

The effect of salt characteristic



😐 There was no unique behavior that allow us to explain the Chemical polieletrolite nature of the salt in the extration (%E) of he colloidal particles for the ATPS studied.

CONCLUSIONS

- ✓The aqueous two-phase systems presents great potential to extract colloidal particle from papermaking white water
- ✓The colloidal particles concentrated mainly in the inferior phase and at interface surface of the ATPS
- ✓The ATPS composed of Sodium Sulfate were more efficient at 25°C and 35°C.
- ✓The ATPS composed of Litium Sulfate were more efficient at 45°C.