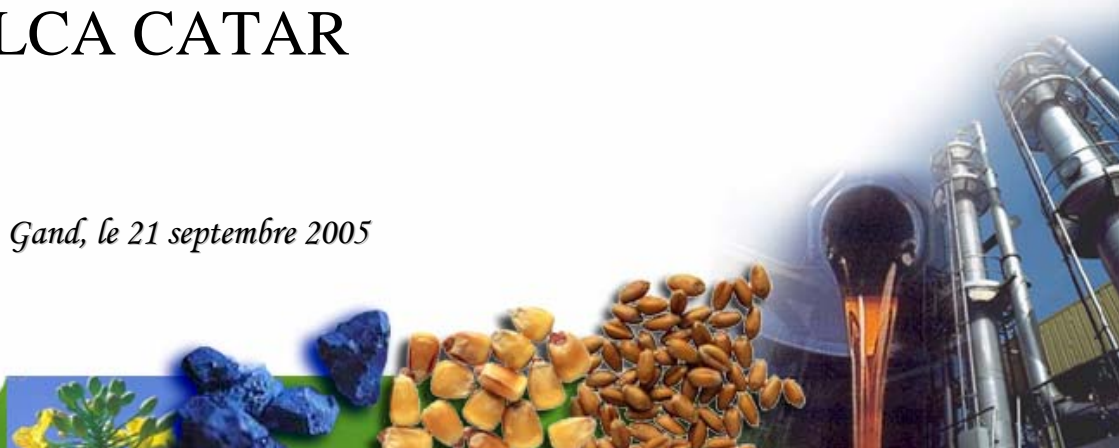


PRODUCTION OF HEMICELLULOSES BY THE COMBINATION OF TWIN SCREW EXTRUSION AND ULTRAFILTRATION

Pierre-Yves Pontalier

LCA CATAR

RRB, Gand, le 21 septembre 2005



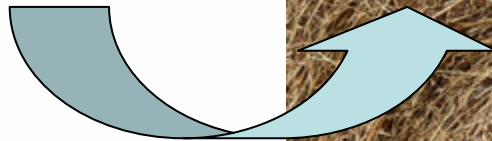
High lights

- Twin screw extraction
 - Influence of the operating conditions
 - extraction yield
 - extract purity
 - film properties
- Refining by ultrafiltration

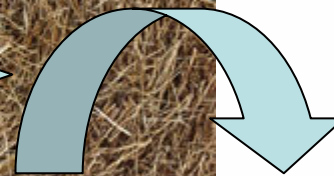
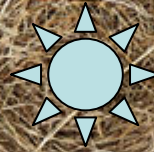


Extraction

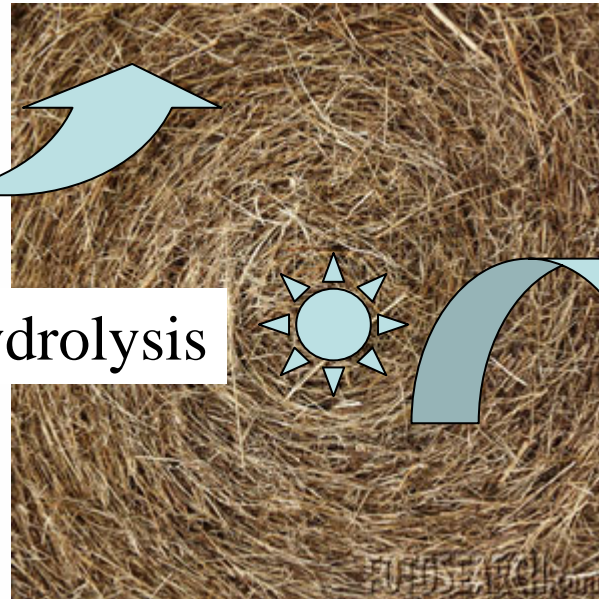
Impregnation



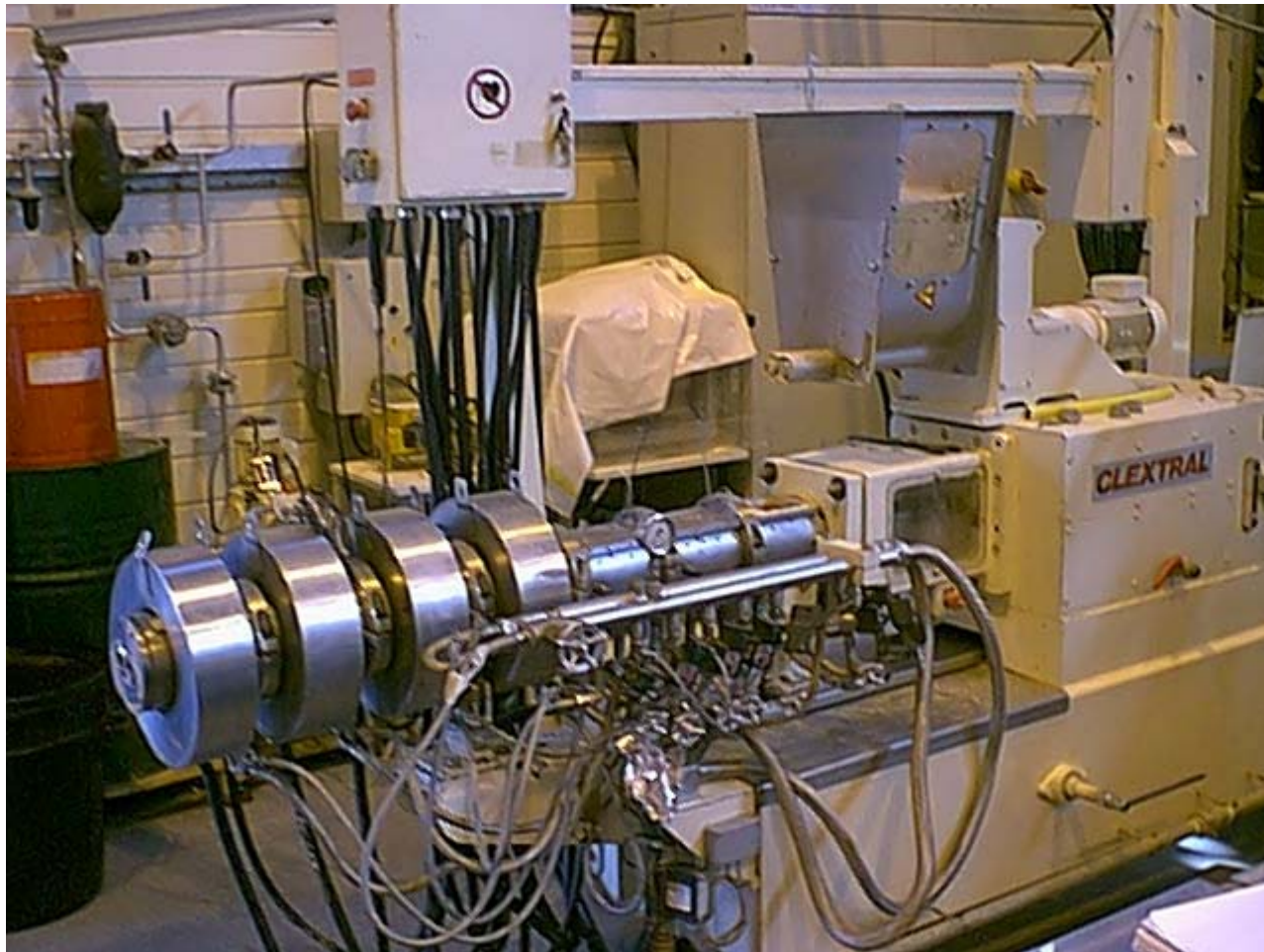
Hydrolysis



Release/Separation



Twin screw extruder



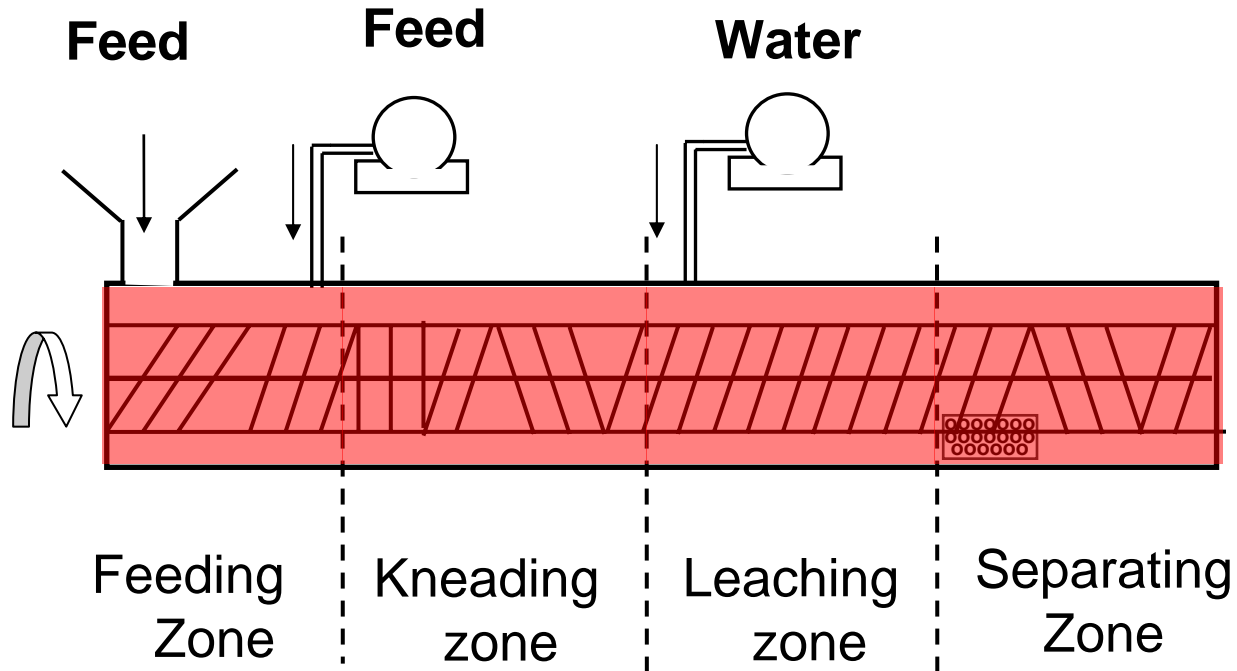
Twin screw extruder



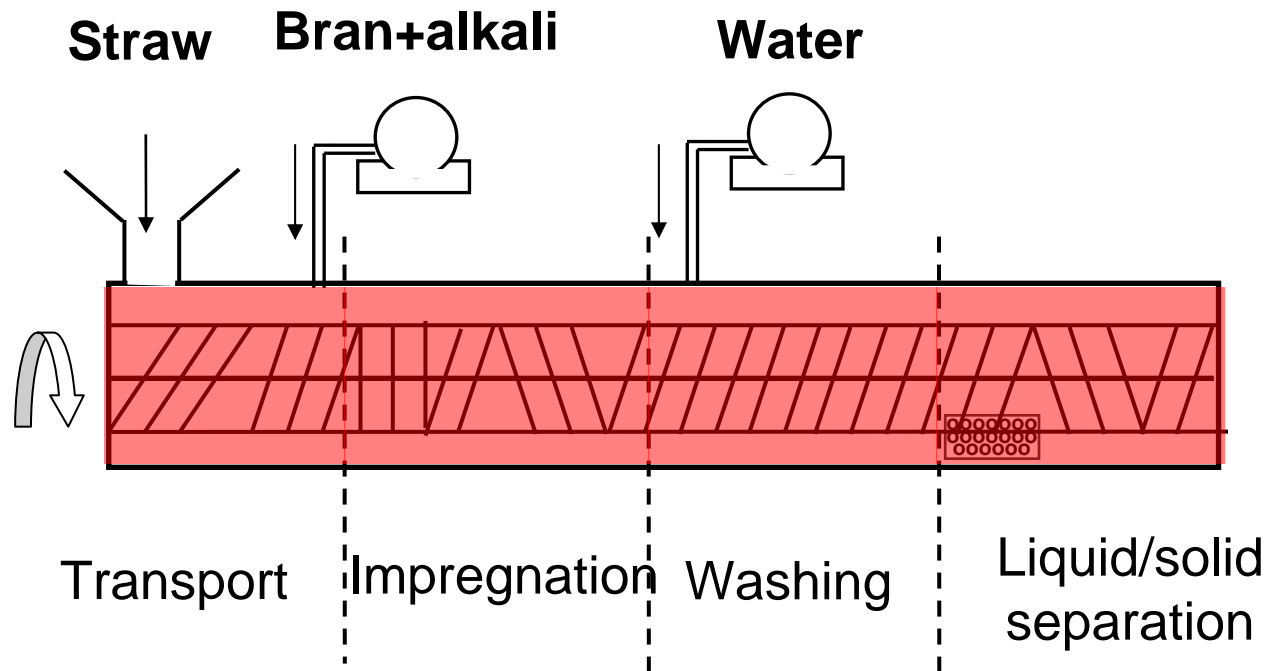
Twin screw extruder



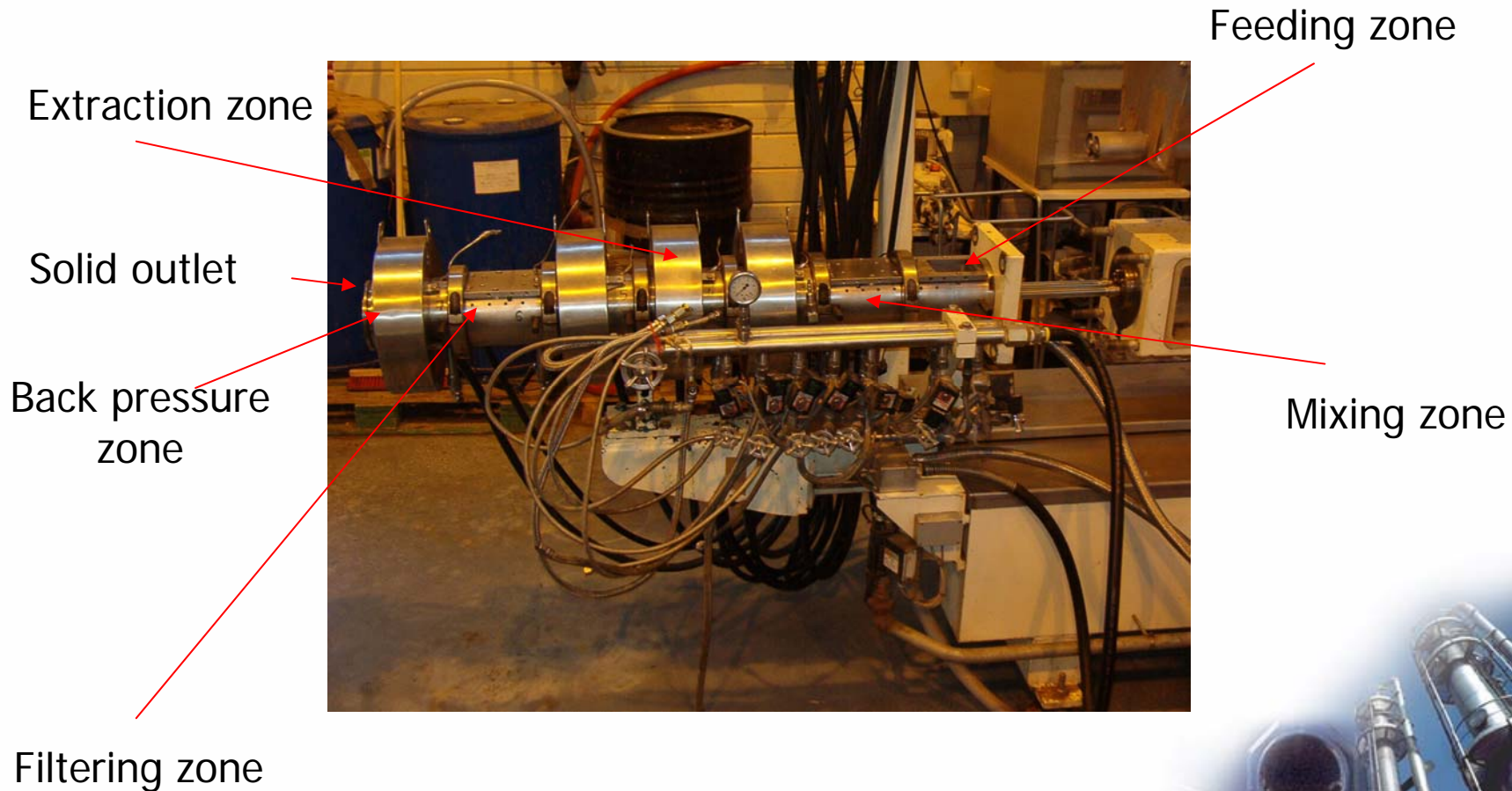
Twin screw extruder



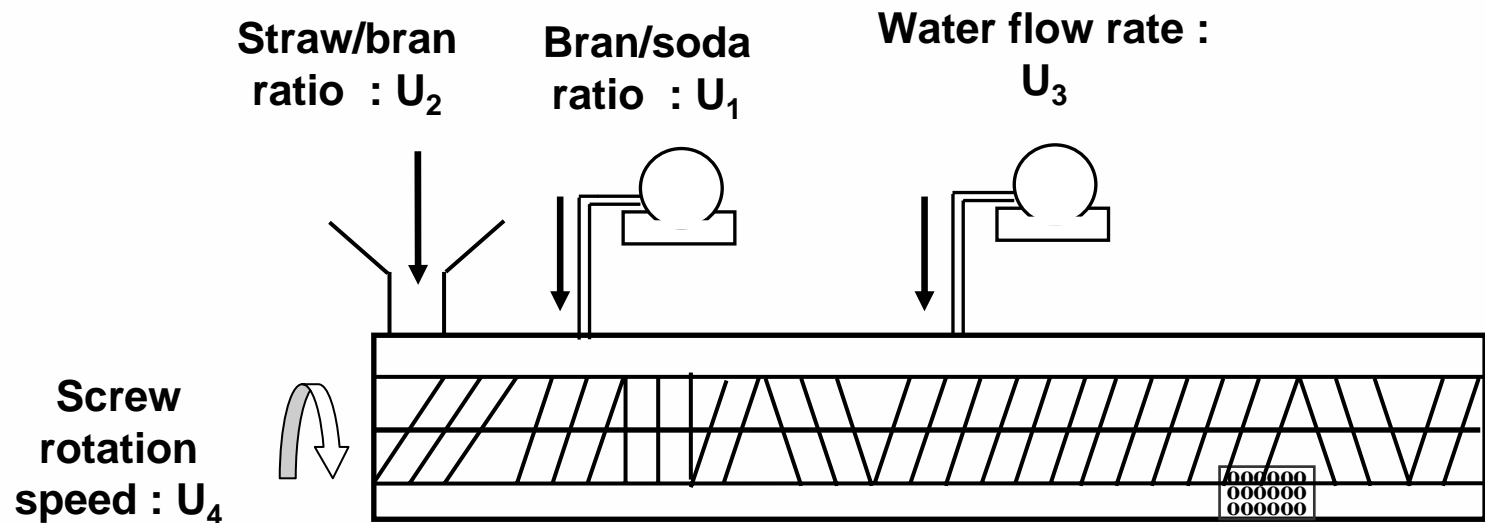
Twin screw extruder



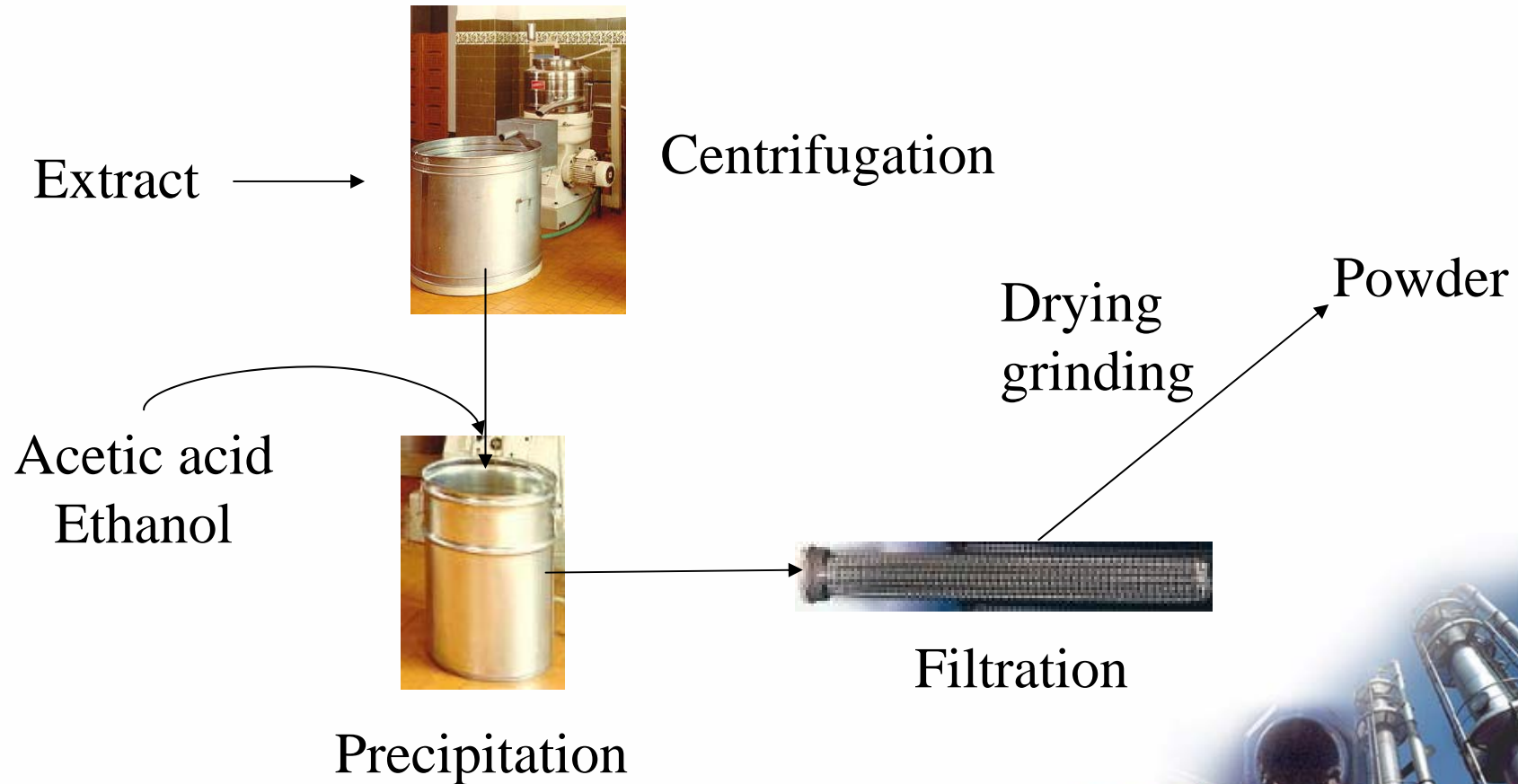
Twin screw extruder



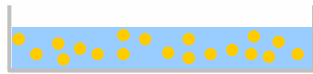
Twin screw extruder



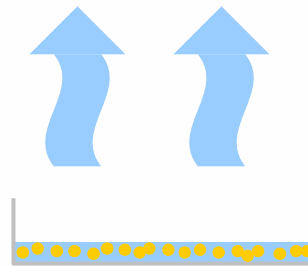
Refining



Film casting



**Initial
suspension**



**Solvent
evaporation**



Film



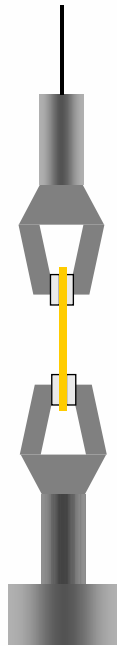
Film properties

Rhéo TA-XT2 texturometer

Normalized specimen



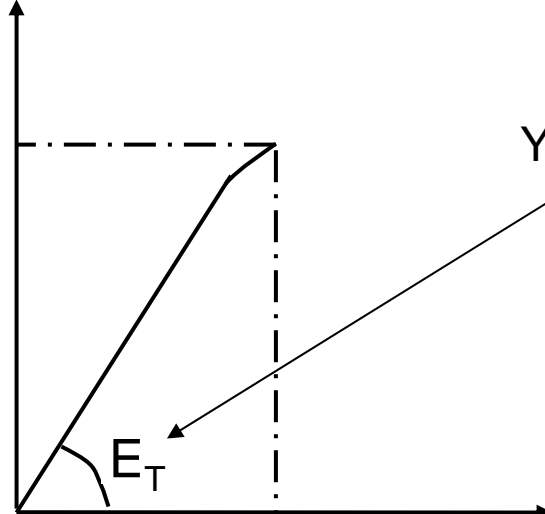
Speed : 0,1 mm/s



Tensile strength σ

σ_R

Young's modulus



ϵ_R

Elongation ϵ



Results

	Stirred reactor	Twin screw extruder
Extraction yield	58	28
Sugar (%)	76	53
Proteins (%)	10	26
Lignins (%)	3	10
Ash (%)	10	10



Results

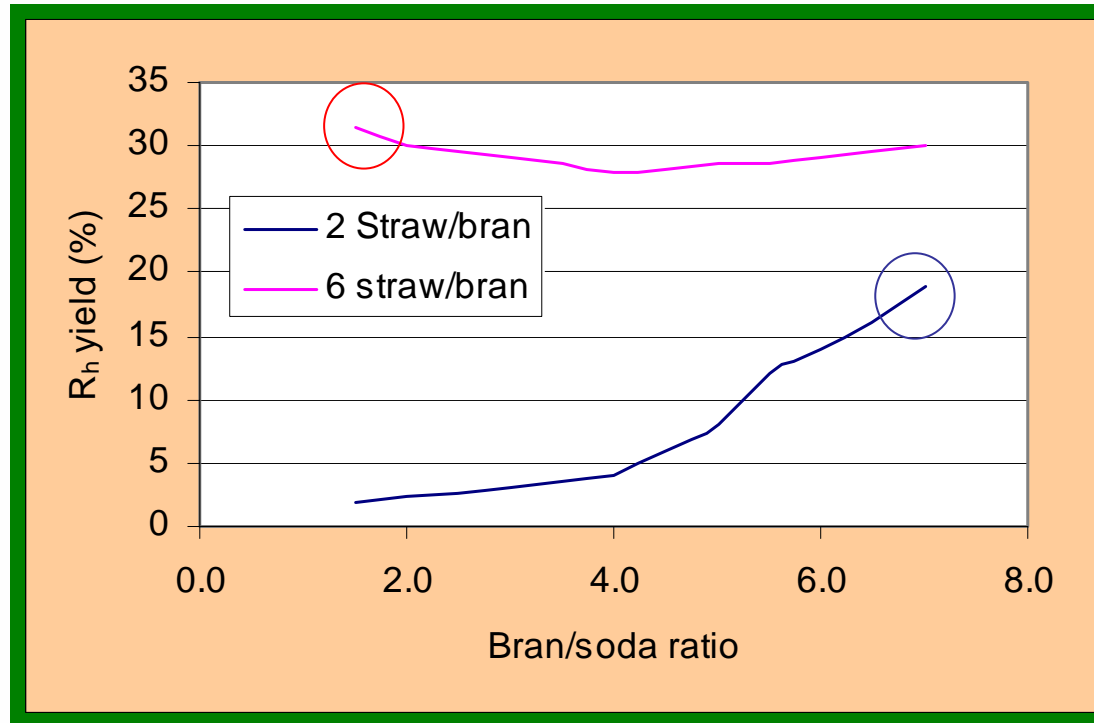
Stirred reactor Twin screw extruder

Viscosity (Pa.s)	$70 \cdot 10^{-3}$	$450 \cdot 10^{-3}$
Elasticity (%)	2.4	1.3
Tensile strength (MPa)	31.3	31.4
Young's modulus (GPa)	1790	2760



Results

Extraction yield



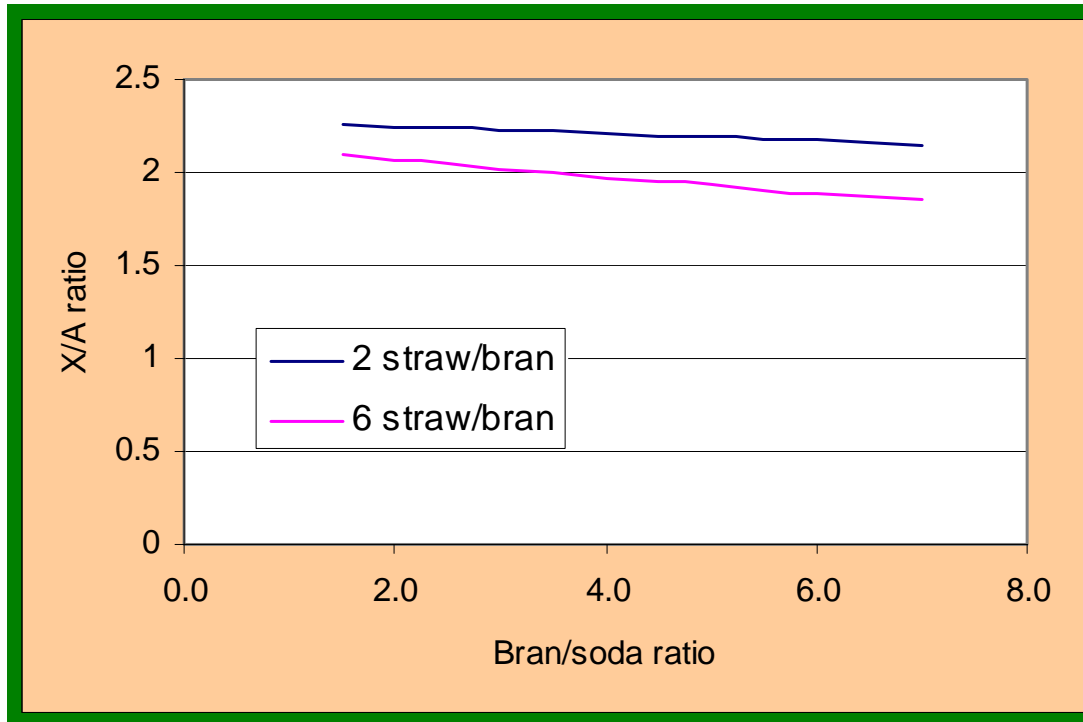
$$Rh = \frac{\text{Dry matter recovered mass}}{\text{Dry matter from bran}}$$

Straw flow rate 10kg/h
Water flow rate 90kg/h
Screw rotation 150 rpm



Results

Xylose/arabinose ratio

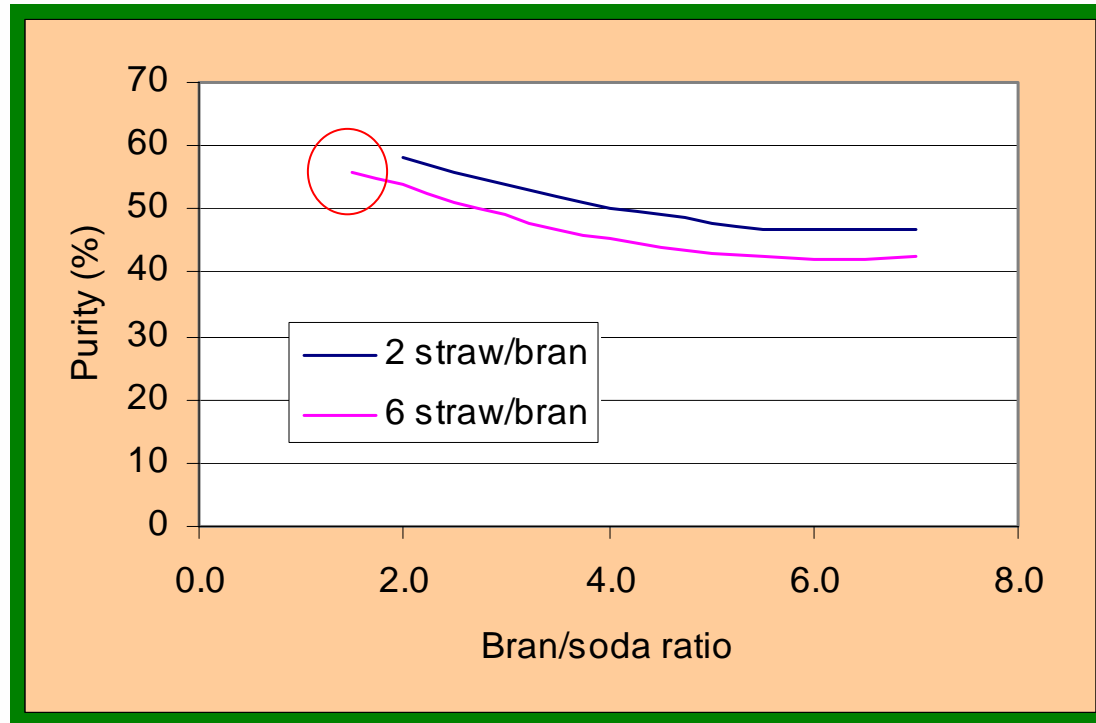


Straw flow rate 10kg/h
Water flow rate 90kg/h
Screw rotation 150 rpm



Results

Purity

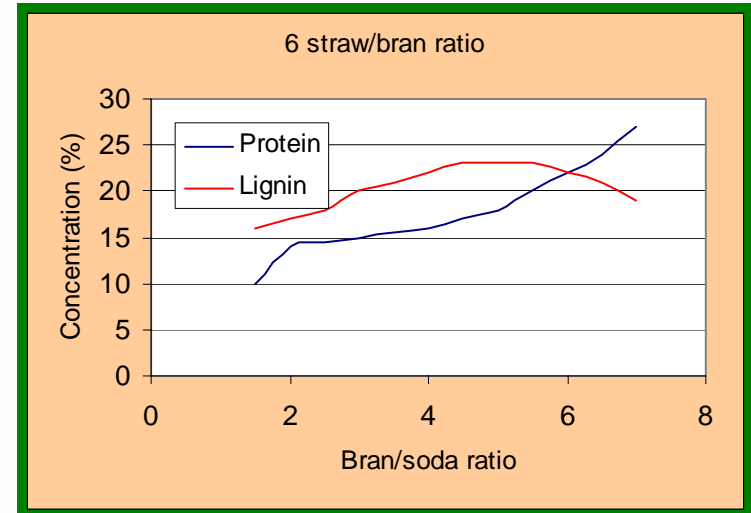
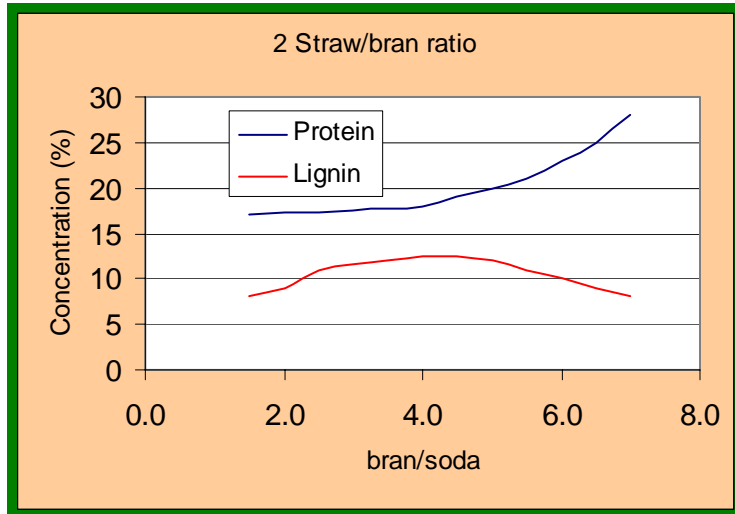


Straw flow rate 10kg/h
Water flow rate 90kg/h
Screw rotation 150 rpm



Results

Protein and lignin concentration



Straw flow rate 10kg/h
Water flow rate 90kg/h
Screw rotation 150 rpm



Results

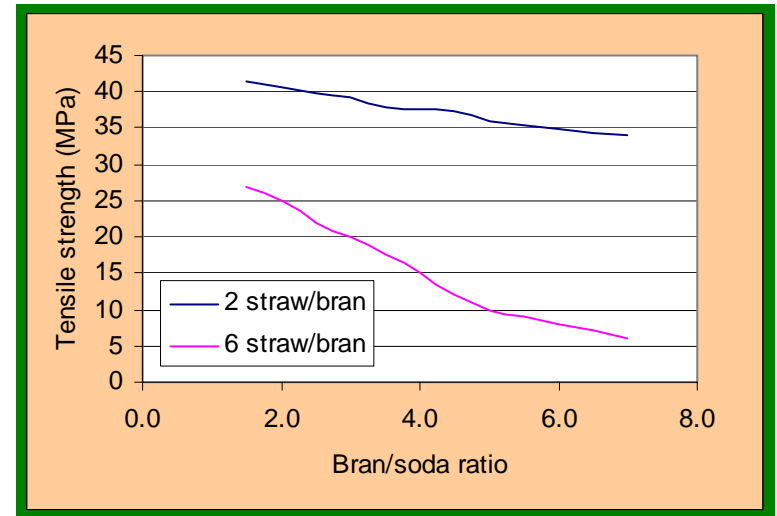
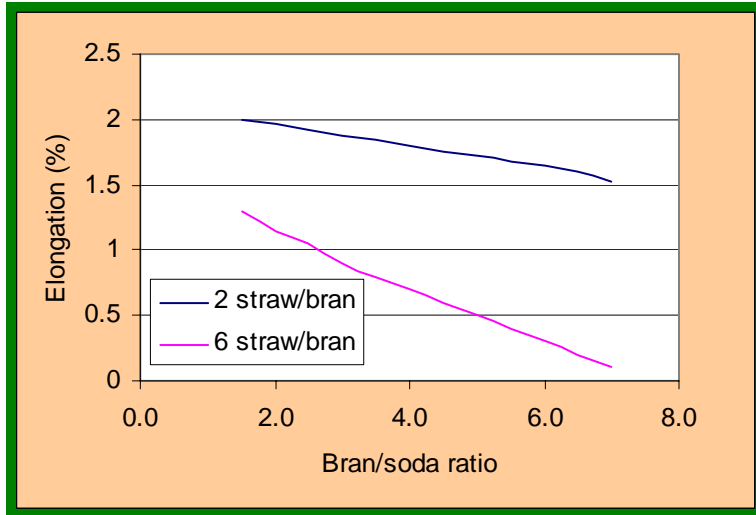
Best extraction

Conditions		Composition	
Straw/bran	6	R _h	16 %
Bran/soda	2	Purity	56 %
Straw flow rate	10 kg/h	Protein	25 %
Water flow rate	90 kg/h	Lignin	8 %
Screw speed	150 rpm	Ash	10 %

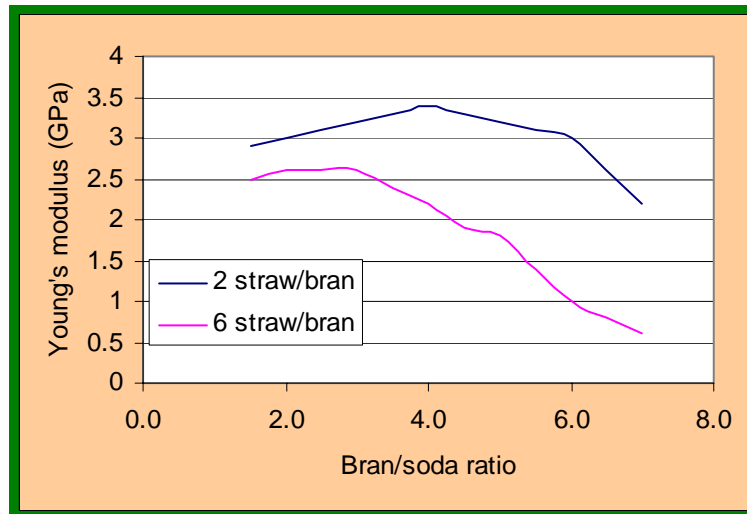


Results

Film properties



Straw flow rate 10kg/h
Water flow rate 90kg/h
Screw rotation 150 rpm



Results

Optimal performance

Composition		Film properties	
R _h	16 %		
Purity	56 %	Elongation	2 %
Protein	25 %	Tensile strength	40 MPa
Lignin	8 %	Young's modulus	3 GPa
Ash	10 %		



Conclusion - extraction

Is twin screw extrusion efficient?

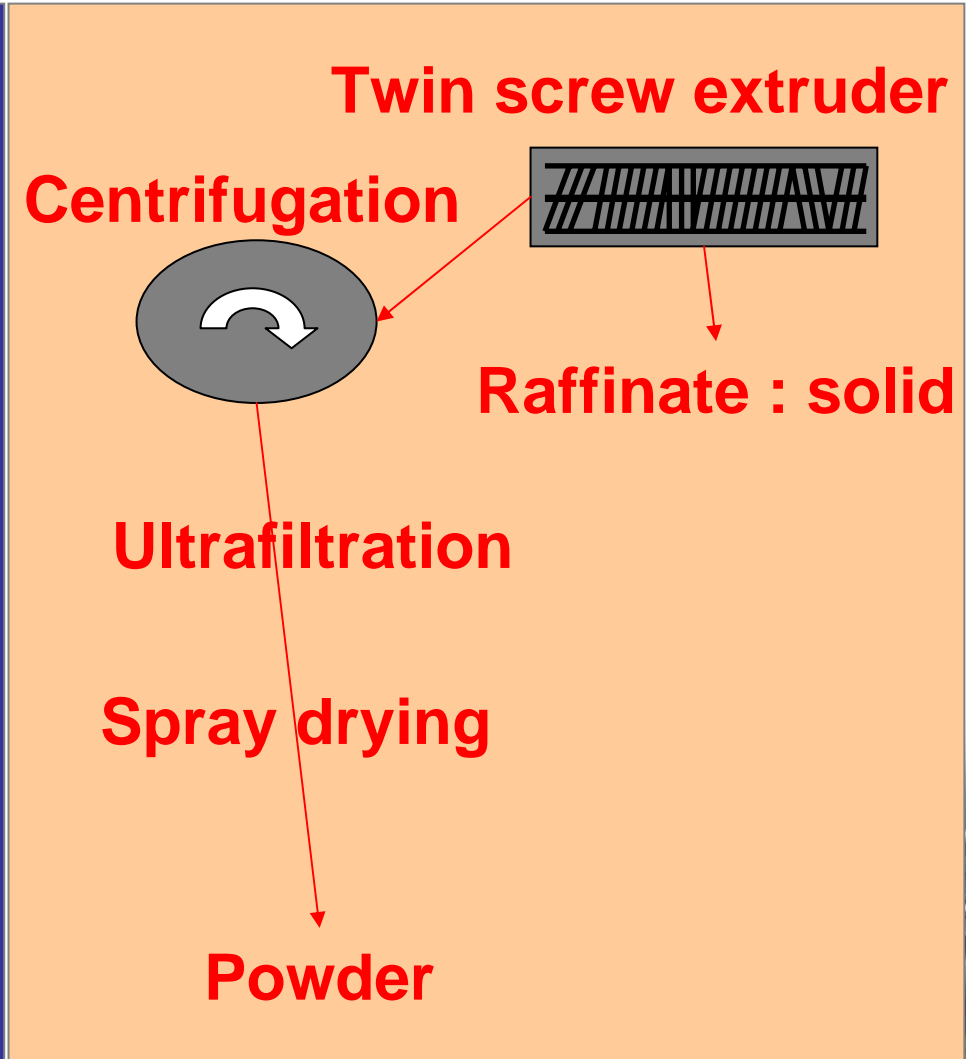
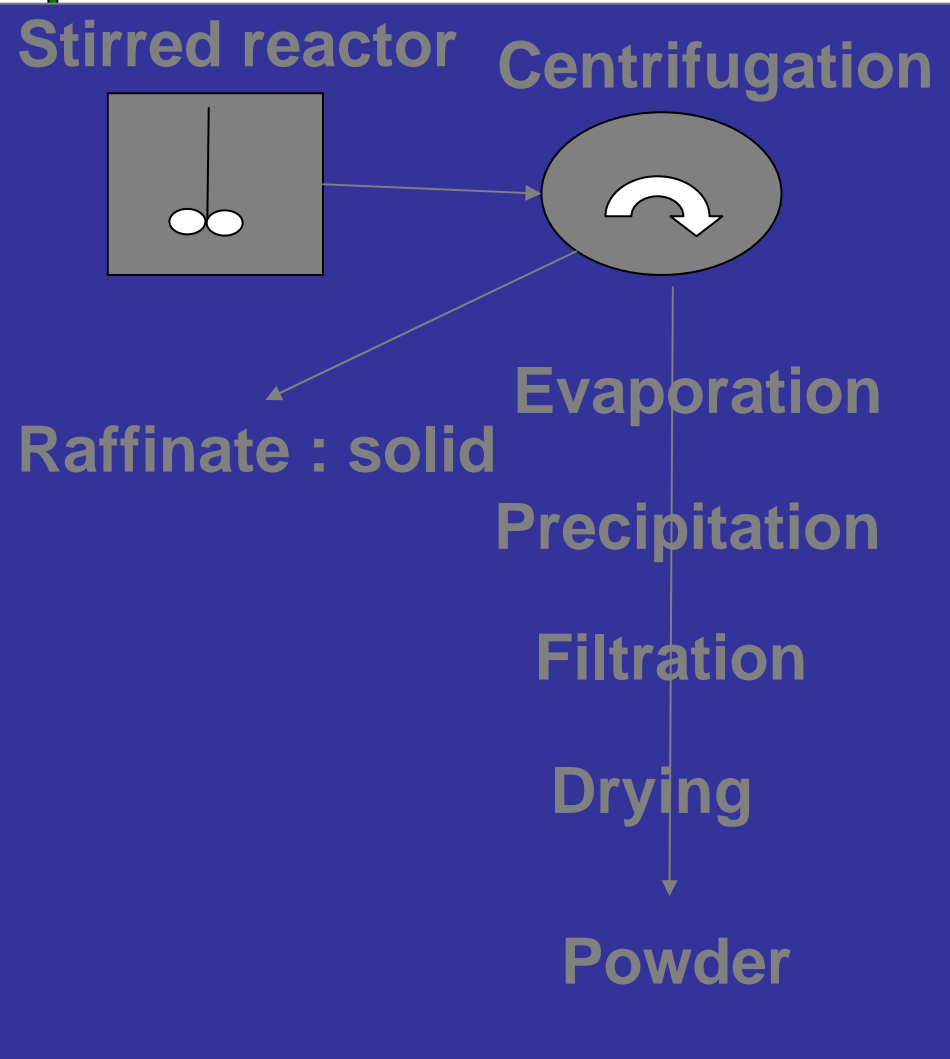
low yield and purity

best extraction conditions opposite to best purity

Needs for further refining or new ways, with lower cost



Processes for xylan production

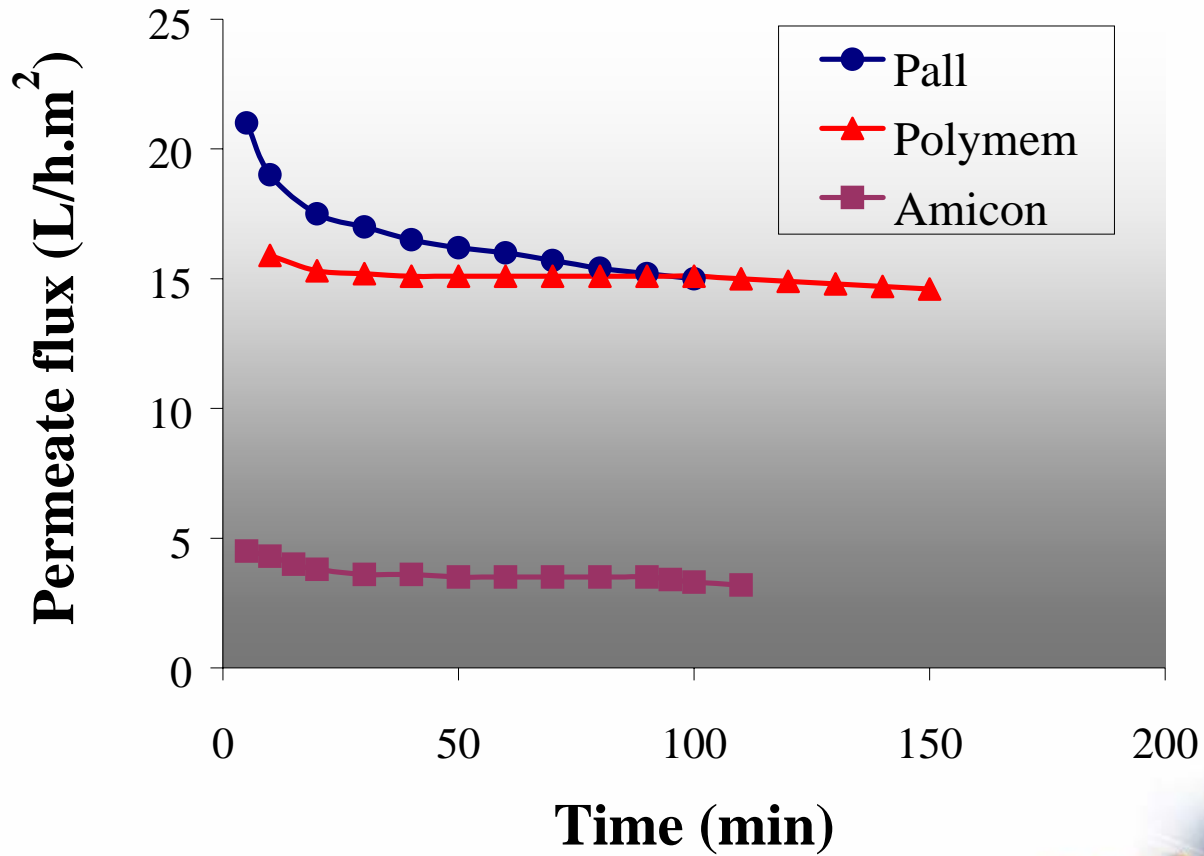


Ultrafiltration membranes

	Type	Composition	Area (m ²)	MWCO (kDa)
Amicon	Hollow fiber	CA	0.9	10
Polymem	Hollow fiber	Polysulfone	0.06	6
Pall	cassette	PES	0.09	1, 5, 10, 30, 50

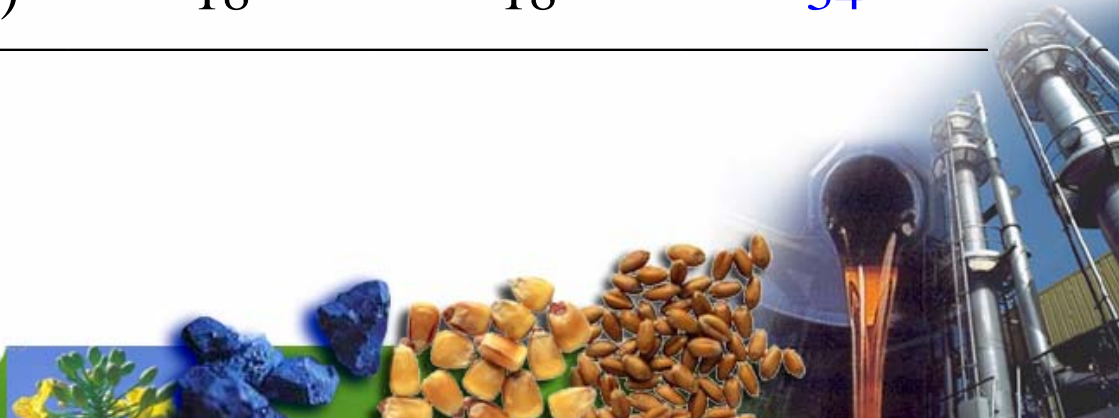


Flux evolution



Influence of membrane type

	Pall	Amicon	Polymem
Final VCR	1.3	1.5	2.4
Final volume flux (L/h.m ²)	15	3	14
DM Yield in retentate (%)	90	63	56
DM loss in permeate (%)	10	10	16
Demineralization rate (%)	18	18	34



Conclusion - purification

- ◆ **Ultrafiltration can be used for concentration and for demineralization as well**
- ◆ **Direct spray drying can be realized after ultrafiltration**



Prospective

Decoloration by ion exchange chromatography

