Oxygen Delignification Process Chemistry for Acacia

RESEARCH INVESTIGATORS

Arthur J. Ragauskas
Professor, Wood Chemistry
Institute of Paper Science & Technology, Atlanta GA
Jeffery S. Hsieh
Professor, Chemical Engineering
Institute of Paper Science & Technology, Atlanta GA
Widiatmoko
Graduate Student, Chemical Engineering
Institute of Paper Science and Technology, Atlanta GA

PROJECT OBJECTIVE

Determine the fundamental principles contributing to strength loss in kraft *Acacia* brownstock during oxygen delignification

RESEARCH OBJECTIVES

•Determine fiber chemistry changes during oxygen delignification including cellulose crystallinity, hemicellulose composition, fiber charge and fiber structure

•Model the physical strength parameters employ principal components analysis and partial least square regression analysis

PROJECT BACKGROUND

- Strength loss on *Acacia* fiber at oxygen delignification stage is a lot more than others
- Mill is currently operating the oxygen delignification stage at similar condition between *Acacia* and MHW
- *Acacia* has a significant different in their morphology and chemistry
- This research is to study the response of *Acacia* on different oxygen delignification conditions, include reaction time, temperature, soda addition and mechanical pretreatment

Zero Span Strength Loss across Mill Fiberlines

	Mill C	Mill D	Mill E	Mill F	Mill F
Brownstock	7%	13%	5%	4%	9%
O_2 Stage	13%		8%	25%	21%
D_1 Stage	16%	14%	10%		
D_2 Stage				31%	21%
Mill Refiner			15%		

Fiber Modification, IPST 2005

Current Mill Operating Conditions

	Acacia	MHW
Soda loss, kg as saltcake/ADT	<10	<10
Temperature, C	87-90	87-90
O2 charge, kg/ADT	14-17	14-17
NaOH charge, kg/ADT	14-16	16-18
pH	10.8-11.0	10.8-11.0
Reaction time, minutes	120	120

APRIL Fine Paper, Indonesia 2005

Hardwood Morphology

	Fiber length	Fiber width	Shape factor	Fiber perimeter	Fiber wall thickness
	mm	µm		µm	µm
Acacia 1	0,678	14,5	93,1	38,5	2,01
Acacia 2	0,661	14,8	91,7	41,3	1,96
Eucalyptus H	0,688	15,5	91,3	39,4	2,55
Eucalyptus A	0,740	15,4	90,1	38,9	2,70
Pontiac	0,750	19,6	90,7	48,6	2,44
Birch	0,875	18,8	90,1	n.a.	n.a.

Ulla-Britt Mohlin, Joanna Hornatowska, STFI 2002

EXPERIMENTAL O-DELIGNIFICATION CONDITIONS

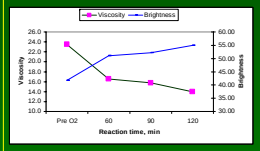
- The pre O2 *Acacia* kraft pulp was acquired from April's pulp mill in Sumatra, Indonesia, and was fully characterized according to its hardwood chemistry and physical properties
- The response of this pulp to oxygen delignification is under study employing a laboratory Parr reactor under constant oxygen pressure (150 psi) and consistency (12%)
- The reaction parameter under study includes:
  - Reaction time 60, 90 and 120 minutes
  - Reaction temperature 85, 90 and 95 C
  - Soda addition 16.6, 20 and 23.3 g/kg pulp
  - Quantum pretreatment mixing time 5, 10 and 15 seconds
- The pulp was characterized according to brightness, kappa#, viscosity, HexA, carbohydrate, FQA and physical properties

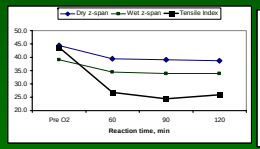
PROJECT BENEFITS

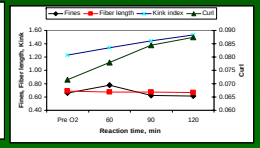
- Better understanding on what impacts most on strength loss and fiber chemistry changes during oxygen delignification process
- Extend practical mill process improvement

RESULTS

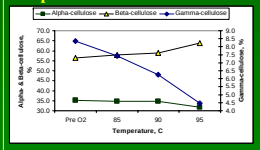
Reaction time

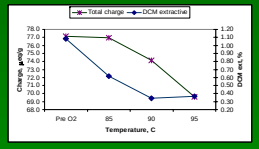


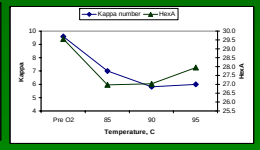




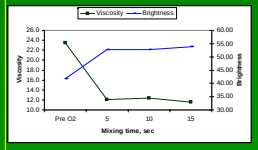
Temperature

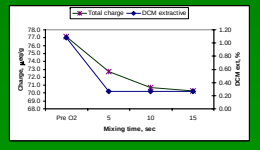


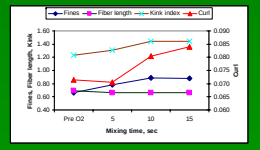




Mixing time







CONCLUSIONS

- Pulp brightness was obtained relatively better while viscosity could be maintained high and kappa# was low at reaction time 120 minutes
- The dry and wet z-span tensile strengths were decreasing relatively small at the reaction time 60, 90 and 120 minutes
- The total charge and DCM extractive were decreasing a lot at the reaction temperature 95 C
- Pulp viscosity decreased a lot at pretreatment with Quantum mixer while brightness was not gained