

A background image of a paper mill showing large rolls of paper being processed on machinery.

High Filler Content Paper and Board Products

TIP3 2004-2005

Mid-Year Report

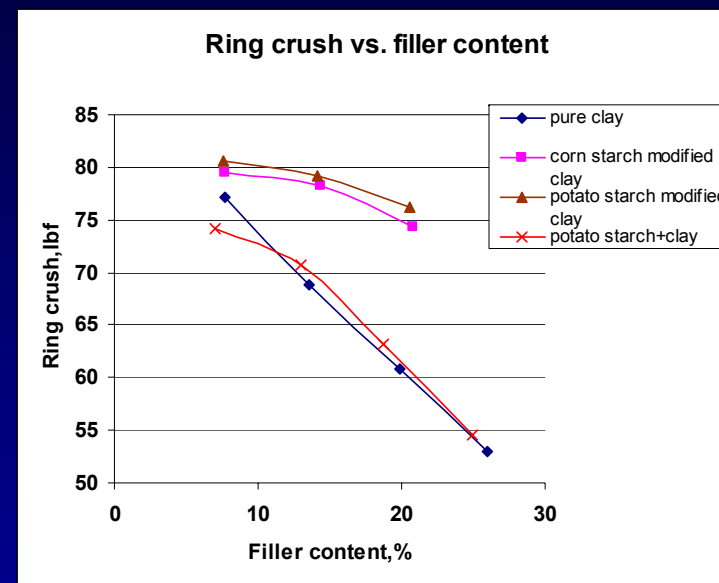
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Objectives and Key Questions

- Develop new bonding fillers to improve existing sheet properties while decreasing fiber costs
 - Projected filler loading targets: 100% increase in current filler loading-levels (35% for copy paper, 15% for newsprint, 15% tissue and 15% for container board)
- Leverage Georgia's unique manufacturing capabilities in kaolin and SW kraft pulp to develop a unique economic advantage for these two industries
 - 50-100% increase in the use of GA kaolin fillers in GA paper industry
- Key Questions: Modified filler detailed approach and cost, pilot trial on filler modification (feasibility, runnability, sheet properties), paper mill trial

Prior Results

- Starch coated and dried on clay surface can increase paper strength significantly (10-15%) vs. use of unmodified clay
 - Ring crush
- Different starches (corn, potato, cationic starch) gave similar effects
- Starch amount as little as 2.5% of the filler to give significant positive effect
- Potential to use low cost clay and low grade starch to produce high strength paper/board with high filler content



Milestones, 7-12/04

- Confirmed benefits of modified clay
- Identified and conducted approach to produce modified clay (pilot spray drying)
- Scheduled to measure properties of sheets containing spray dried modified filler
- Planning scaled up spray drying and pilot trial

Key Findings

- Confirmed that clay with coated starch increased the paper strength significantly, vs. unmodified clay
 - Ring crush improved significantly with modified filler at high filler content compared with uncoated fillers
- Optical properties (paper brightness, smoothness) of calendered handsheets improved with modified clay vs. no clay
- Different starches (corn, potato) continue to give similar effects
- Possible to use spray drying to produce the modified clay
 - Other methods, such as apron drying, are additional possibilities

Modified Clay Initial Preparation Procedure

- Clay slurry mixed with required amount of starch (e.g., 2.5% based on clay)
- Clay slurry – starch mixture cooked at 50% solids, 95 °C for 30 minutes
- Dried at 50 °C under vacuum
- Dried mixture ground for 2 minutes

Clay Characterization

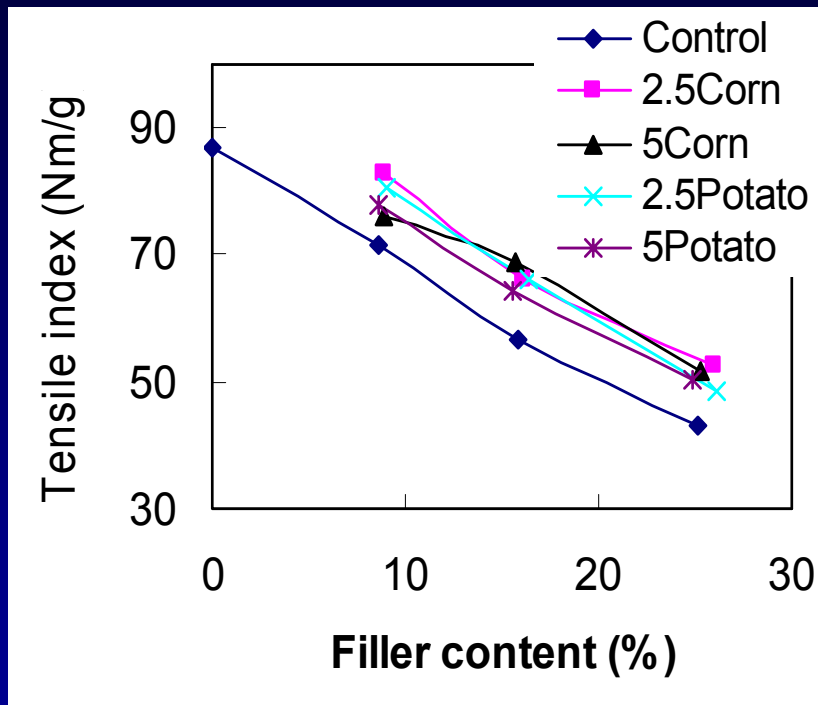
Clay surface area and particle size

	Clay	2.5% Corn	5% Corn	2.5% Potato	7.5% Potato
Surface area (m ² /g)	10.7	7.9	7.0	8.2	8.3
Particle size (micron)	Percentage less than given particle size				
10	98	95	91	97	96
5	88	88	70	82	84
2	56	43	33	46	52
1	35	22	16	24	31
.5	19	9	6	10	14
.25	8	3	2	3	5
.2	6	2	1	2	3

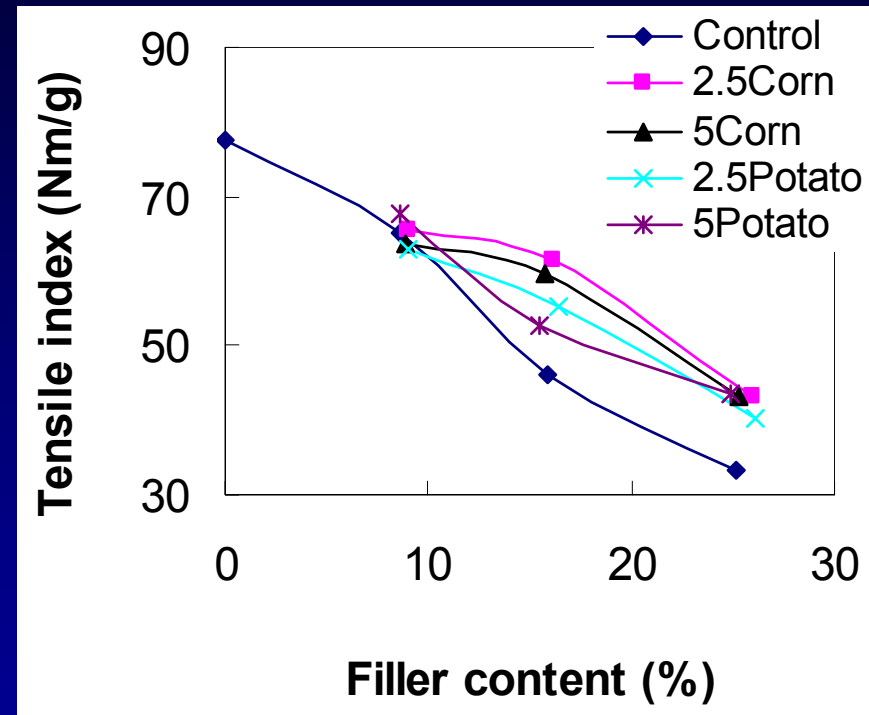
Modified clays: lower surface area, larger particle size

Recent Research Results

Handsheet Tensile Strength



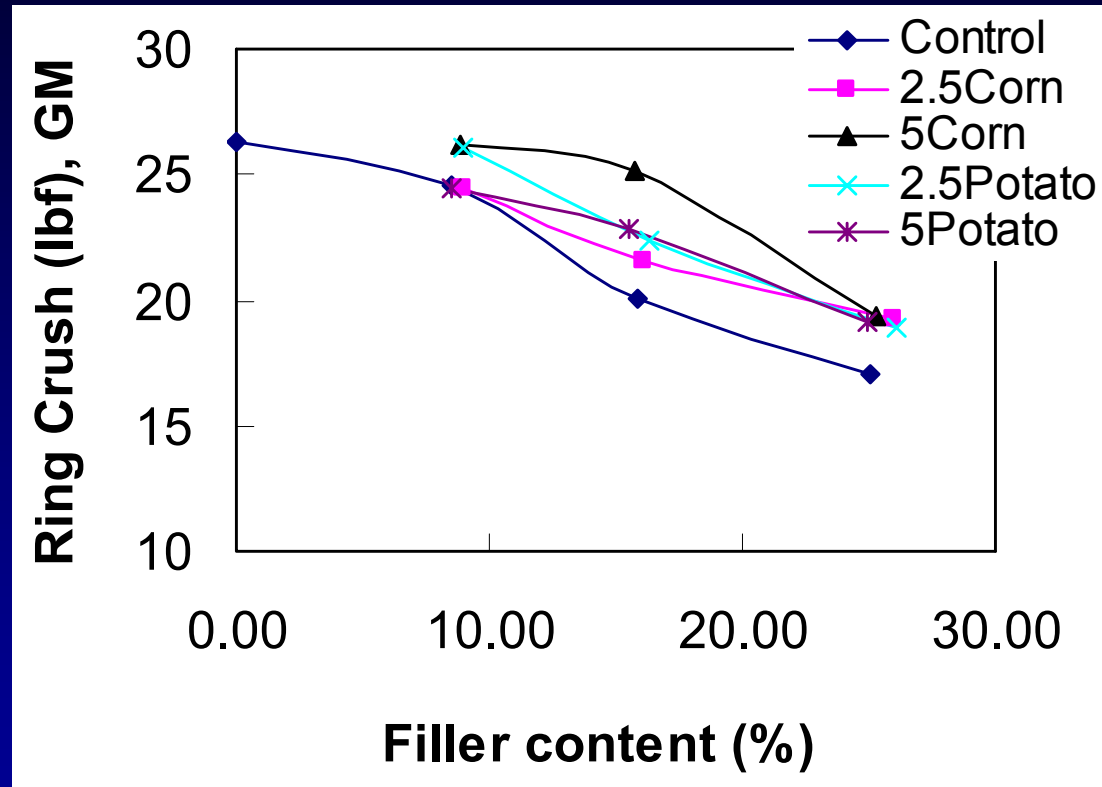
Before Calendering



Calendered

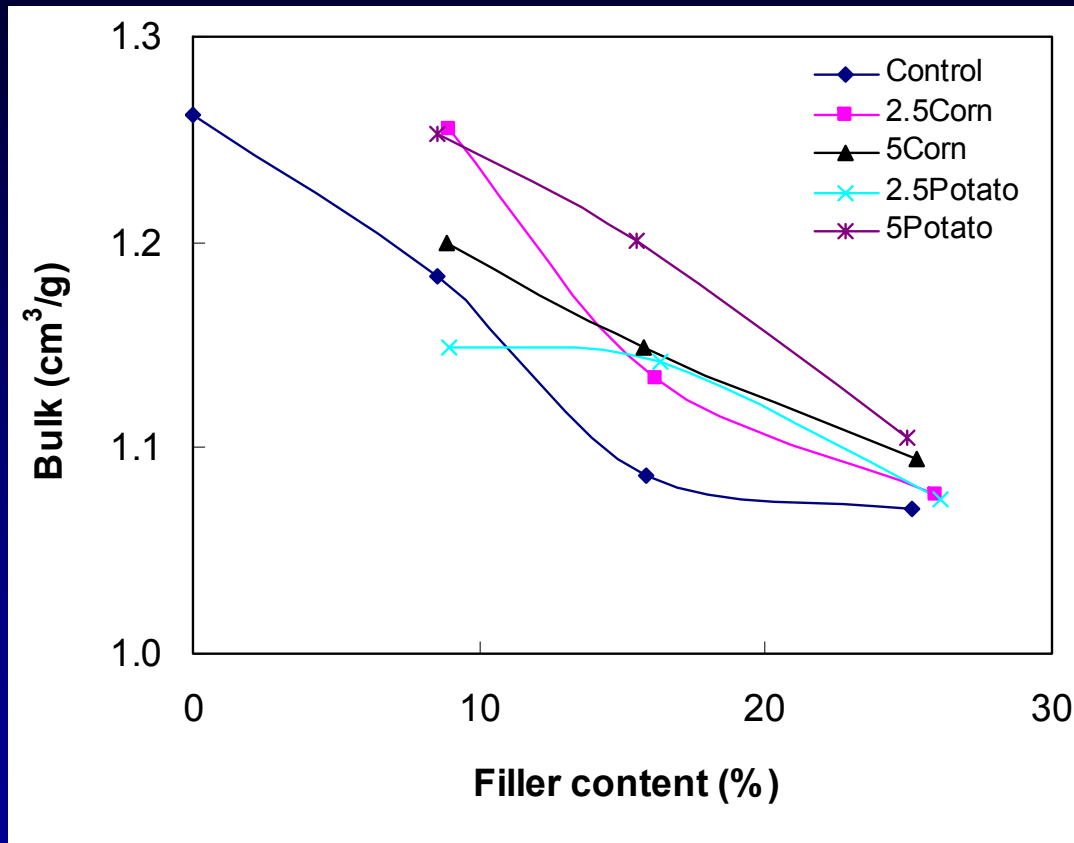
Control: 5% starch based on unmodified clay;
i.e., at 10% clay in sheet: 0.5% starch in sheet (10 lb/t)

Ring Crush, Calendered Handsheets



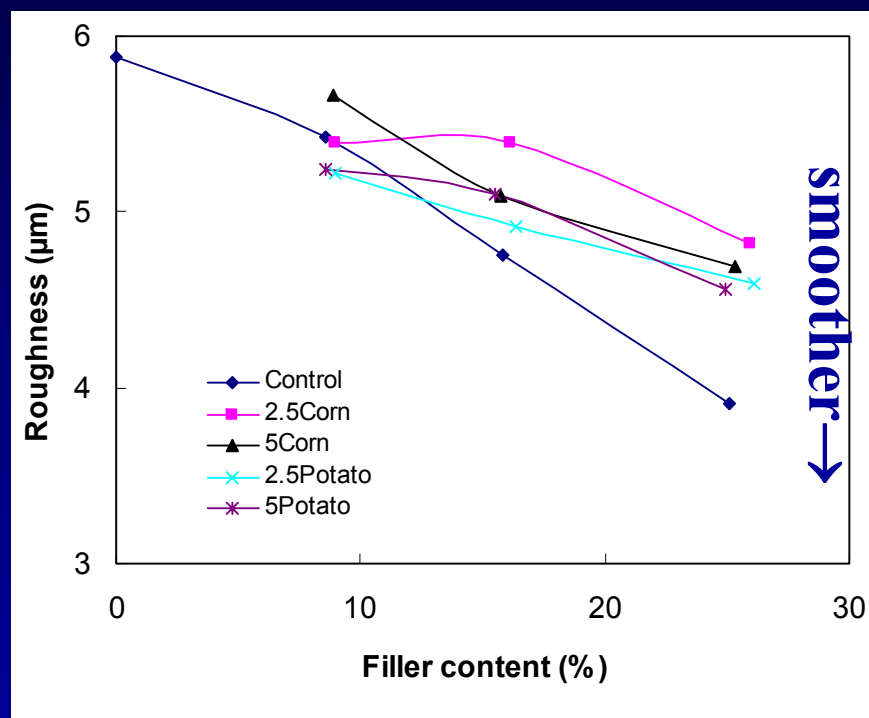
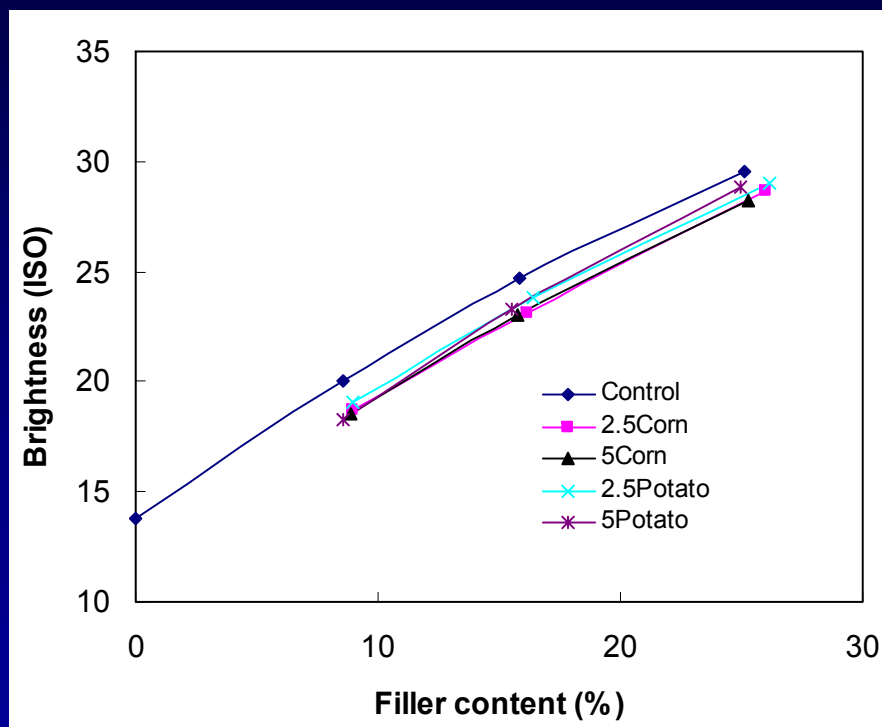
Can add at least 10-15% modified clay and get same ring crush

Bulk of Calendered Handsheets



Potential for at least 10% filler increase without affecting bulk

Brightness and Smoothness Calendered Handsheets



Improvement in brightness and smoothness with higher clay levels
Modified clay has somewhat less impact due to larger particle size

Improved Modified Clay Preparation Procedure Prior to Spray Drying

- Starch cooked separately
- Cooked starch mixed under high shear with dry clay and water to desired solids and starch content
 - Range of 20-50% solids investigated
 - 2.5 or 5% starch based on clay

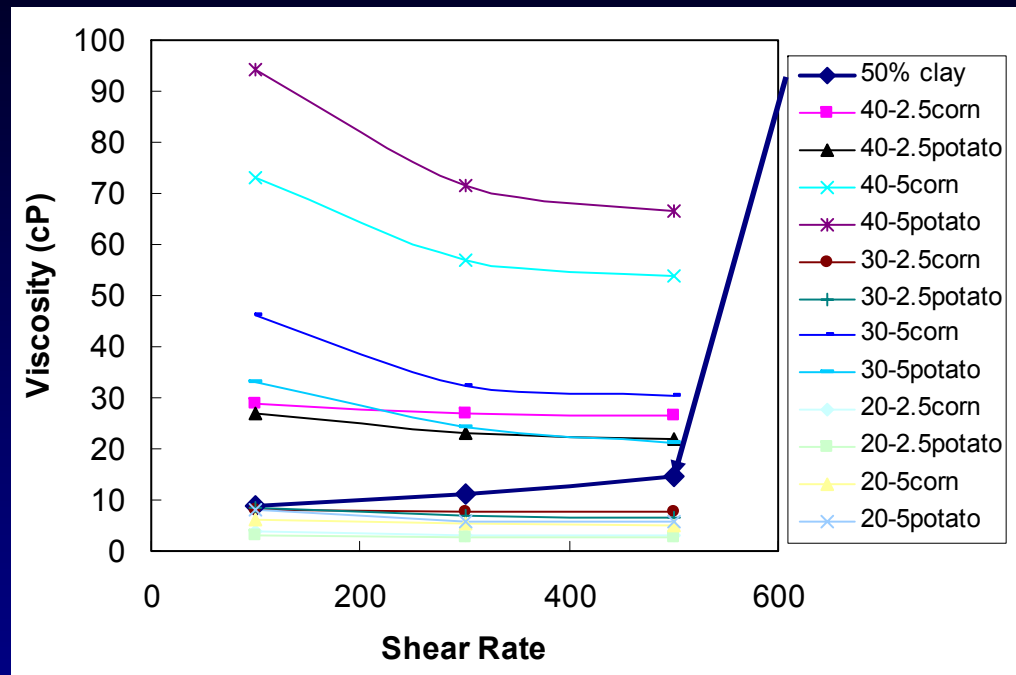
IPST Spray Dryer



Lab S1 Spray Dryer
Andydro
Copenhagen, Denmark

Spray Dryer Evaluation

- Shear viscosity measured for control clay and modified clay to screen slurries prior to spray drying
 - Control: 50% solids unmodified clay
 - Modified clay: 20-50% solids investigated
- Results: modified clay can be spray dried up to 40-45% clay (with 2.5% starch)



Sample	Feed rate (ml/min)	Gas Temp (oC)		Mass yield (%)
		Inlet	Outlet	
20% Clay	24.5	210	120	72.0
20-2.5Corn	22.3	210	120	99.0
20-5Corn	25.3	210	120	88.1
20-2.5Potato	35.6	210	120	74.0
20-5Potato	24.6	210	120	82.1
50% Clay	27.5	210	120	79.7
30-2.5Corn	25.3	210	120	96.9
35-2.5Corn	17.3	210	120	95.1
40-2.5Corn	20.8	210	120	97.8
45-2.5Corn	7.5	210	120	92.6

Technology Transfer Issues

- Complete characterization of spray-dried modified clay
 - Particle size (IMERYS)
- Assess handsheet properties for spray-dried modified clay
 - Strength, optical properties (IPST)
 - Printing properties (IMERYS)
- Scale-up spray drying at IMERYS to produce large quantities for pilot trial
- Conduct pilot trial
- Calculate economics for clay production, for use of modified clay in mill
- Meet with paper producers

Industrial Partner's Evaluation

- Feasibility of producing the modified clay economically
- Characterization of spray-dried clay and calendered handsheets
- Production of large quantities of spray-dried modified clay

Relevance to Industry Needs

Potential Economic Benefits

- Leverage Georgia's unique manufacturing capabilities in kaolin and SW pulp to develop a unique economic advantage for these two industries.
- Given pulp cost of \$400/ton and new bonding filler cost of \$150/ton, filler increase of 10% will save \$22/ton fiber
- Reduced papermaking chemicals will save \$10/ton
- Projected average saving of \$32/ton
- 50-100% increase in the use of GA kaolin fillers in GA paper industry
- These benefits will allow Georgia's paper industry to utilize GA kaolin with reduce transportation costs and increase paper products quality.