Highly Energy Efficient Directed Green Liquor Utilization (D-GLU) Pulping

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R&D Partners: North Carolina State University & Georgia Institute of Technology
Industry Partners: Evergreen Pulp
Technology Description

- Enhance energy savings for the pulp and paper industry by strategic control of the front end of their operations

Project Goal: complement existing kraft pulping facilities by incorporating low cost capital modifications through rational use of green liquor to boost energy savings and improve pulp qualities
Energy Savings

- The approximate number of kraft pulp mills in the US that are using Kamyr cooking are 121.
- Commercialization should begin this year (2006).
- We estimate this technology will provide an overall savings of 20-30% versus current technology.
- We estimate a total energy consumption decrease of 2.1 MM BBL/year.
Other Benefits

- Less material losses (rejects)
- Higher cellulose retention – higher yield
- Potential to recover hemicelluloses
- Compatible with borate autocausticization
- Greater pulp bleachability
- Faster machine speeds
Project Strategy

- Key technical barrier: carbonate deadload
- Currently working on a technical strategy that provides us with a graduated GL delivery
  - Milestones: lab work/modeling work support project continuation; expect mill implementation by middle of this year
  - Current go/no-go point for implementation passed
  - All lab data, mill data support implementation – no outstanding show stoppers
  - Part of our new focus involves examining mill liquor penetration into chips
Commercialization Potential

- Technology is not a major capital investment, straightforward to implement, and offloads kiln
- Currently, energy savings are a huge driver for implementation of this technology
- This technology is seeing interest by Evergreen Pulp, Inland, Potlatch, IP, Center for Technology Transfer (WI), and Lincoln
- No restrictions other than mill specific exist to implementing it
Company Support

- Midst of developing batch implementation technology with Center for Technology Transfer who may provide $200K for direct implementation in Wisconsin

- An energy rebate for this technology in the amount of $200K is in the process of being awarded to Evergreen Pulp by PE&G pending successful results
Effect of GL on Paper Machine

![Graph showing the effect of sodium carbonate on maximum machine speed over time.]
Chemical Penetration Profiles

Sulfide – left chip half; Hydroxide – right chip half

Sweetgum

Southern softwood
Project Partners

- **Evergreen Pulp**
  - Currently implementing technology
  - Energy savings

- **Potlatch**
  - Currently evaluating batch implementation
  - Energy savings

- **Inland**
  - Evaluating pulp property changes
  - Refinability of pulp
Commercialization Plan

Direct Green Liquor Utilization at

Evergreen Pulp, Inc.
Samoa, California
D-GLU at Evergreen Pulp

- Mill Background and CNN Video
- Project History & Progress
- Mill Objectives
- Technology Summary
- Implementation Plans
Evergreen Pulp in Samoa, California
Evergreen Pulp ~95% Energy Self Sufficient
Project History

- Samoa Pacific, Stockton Pacific, Evergreen & DOE
- Found Samoa Mill to be particularly good fit
  - Diminishing Pulp Strength
  - White Liquor Limited
  - California Gas Prices
  - Extra Clean Green Liquor
  - No Impregnation Vessel but running LoSolids
Project Progress at Evergreen Pulp

- Conceptual Design Completed
- Engineering Estimate Completed
- Engineering Design/Re-design 85% Completed
  - New supervisor revisions in November 2005
  - Funding delay November 2005– March 2006
  - Specs, interlocks and schematics in April 2006
- Maintenance Shutdown in April 2006
- Installation to begin by June 2006
Direct Green Liquor Utilization for Lower Chemical and Energy Use in Kraft Pulp Production

- Chemical Efficiency → Gas Efficiency Less ~Lime/ADMT → Less Lime Kiln Gas/ADMT
  - Reduce Natural Gas Use at Current Production
  - Increase Production Beyond Lime Bottleneck

**Project Goal:** Reduce Lime Kiln Natural Gas by 690,000 Therms/Year (~$690,000) or 10%/ADMT
Desirable Secondary Effects

- Pulp Strength Increase
- Digester Production Increase
- Pulp Yield Gain
- Pulp Dryer Uptime Increase
- 690,000 Therms /yr = ~ 4,000 tons CO2/yr
Potential Undesirable Effects

- Digester production loss via
  - Liquor Balance
  - Scaling
  - Corrosion
- Black liquor heat value reduction
- Black liquor dead load increase
Kraft Pulping and Recovery

- **Digester**
  - White Liquor + Chips $\rightarrow$ Black Liquor + Pulp

- **Chemical Recovery Boiler**
  - Black Liquor $\rightarrow$ Energy + Green Liquor

- **Causticizers**
  - Green Liquor + Lime $\rightarrow$ White Liquor + Limestone

- **Lime Kiln**
  - Limestone + Natural Gas $\rightarrow$ Lime + CO2↑
D-GLU Kraft Pulping and Recovery

- **Digester**
  - **Green Liquor** + White Liquor + Chips → Black Liquor + Pulp

- **Chemical Recovery Boiler**
  - Black Liquor 🔥 → Energy + **Green Liquor**

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Simplified Design

- Mostly Piping and Controls
- No Tanks or Specialized Equipment
- Single Pump System
- Re-use GL Piping
- Lo-pressure Injection into Upper Digester
Trial Start-up: Digester Side

- Minimize Risk of Digester and Quality Upsets
- Slow and Step-wise
- Set WL, +50 gpm/wk GL
- Greater Risk of Production Loss ~ $20,000/Day
Trial Start-up: Recaust Side

- Minimize Risk of Production Loss
- Full Liquor Tanks
- Make stronger white liquor
D-GLU Trials and Optimizations

- Digester hydraulics and operability
- Minimum white liquor use
- Liquor recovery balance
- Recovery dead load vs. production
- Recovery dead load vs. natural gas
- Snake oils
CNN’s Terry Bradshaw says...
Questions?
Appendix

- Short Video Clip: Recaust to Digester
- Long Video Clip: GL heater to Chip Chute
Piping Run: Recaust to Digester
Piping Run: GL Heater to Chip Chute