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

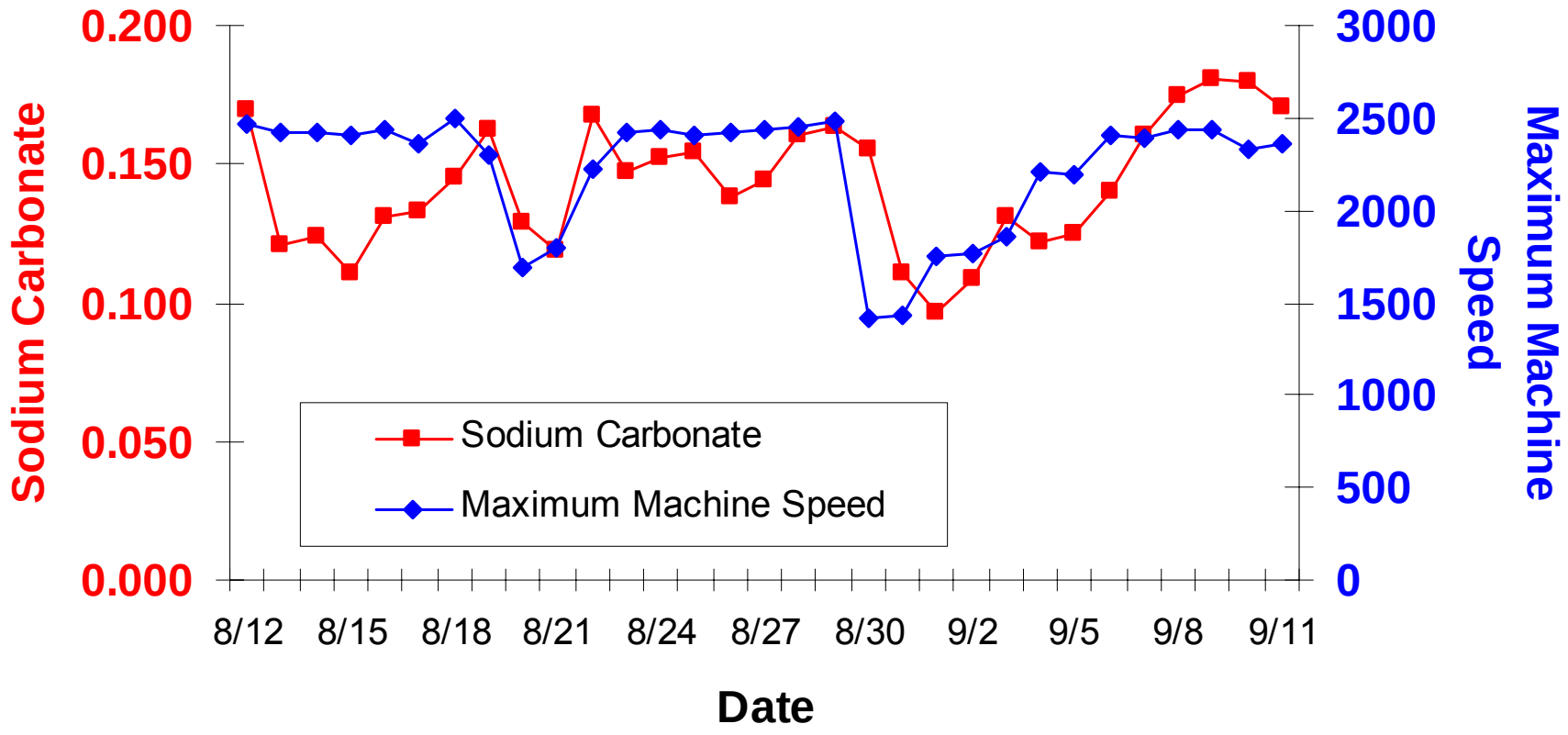
Commercialization Potential

- 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

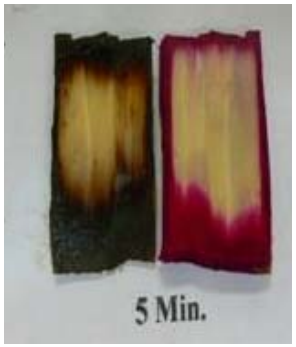
Company Support

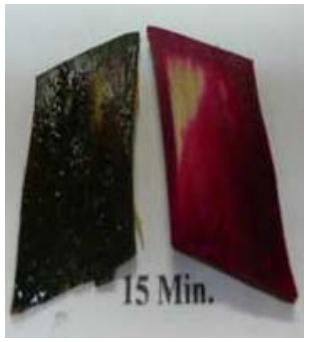
- Midst of developing batch implementation technology with Center for Technology Transfer who may provide $200K for direct implementation in Wisconsin
- An energy rebate for this technology in the amount of $200K is in the process of being awarded to Evergreen Pulp by PE&G pending successful results

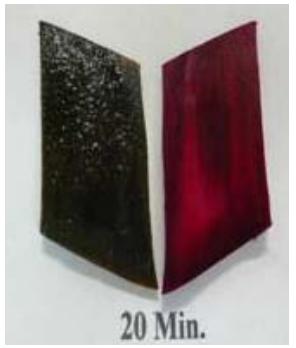
Effect of GL on Paper Machine



Chemical Penetration Profiles

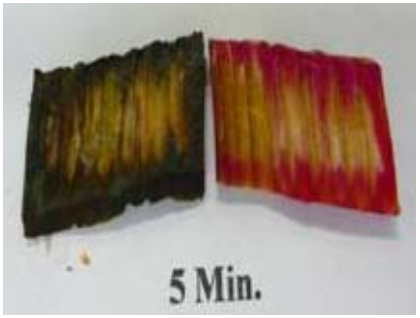


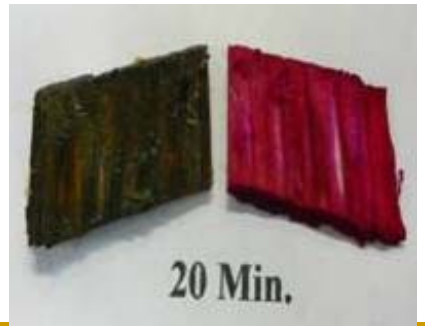


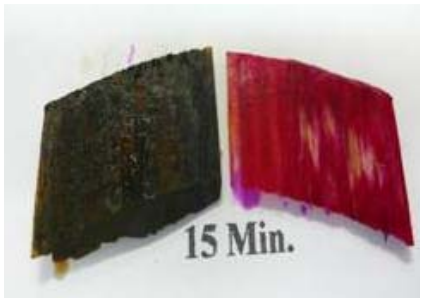


Sweetgum

Sulfide – left chip half; **Hydroxide** – right chip half







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

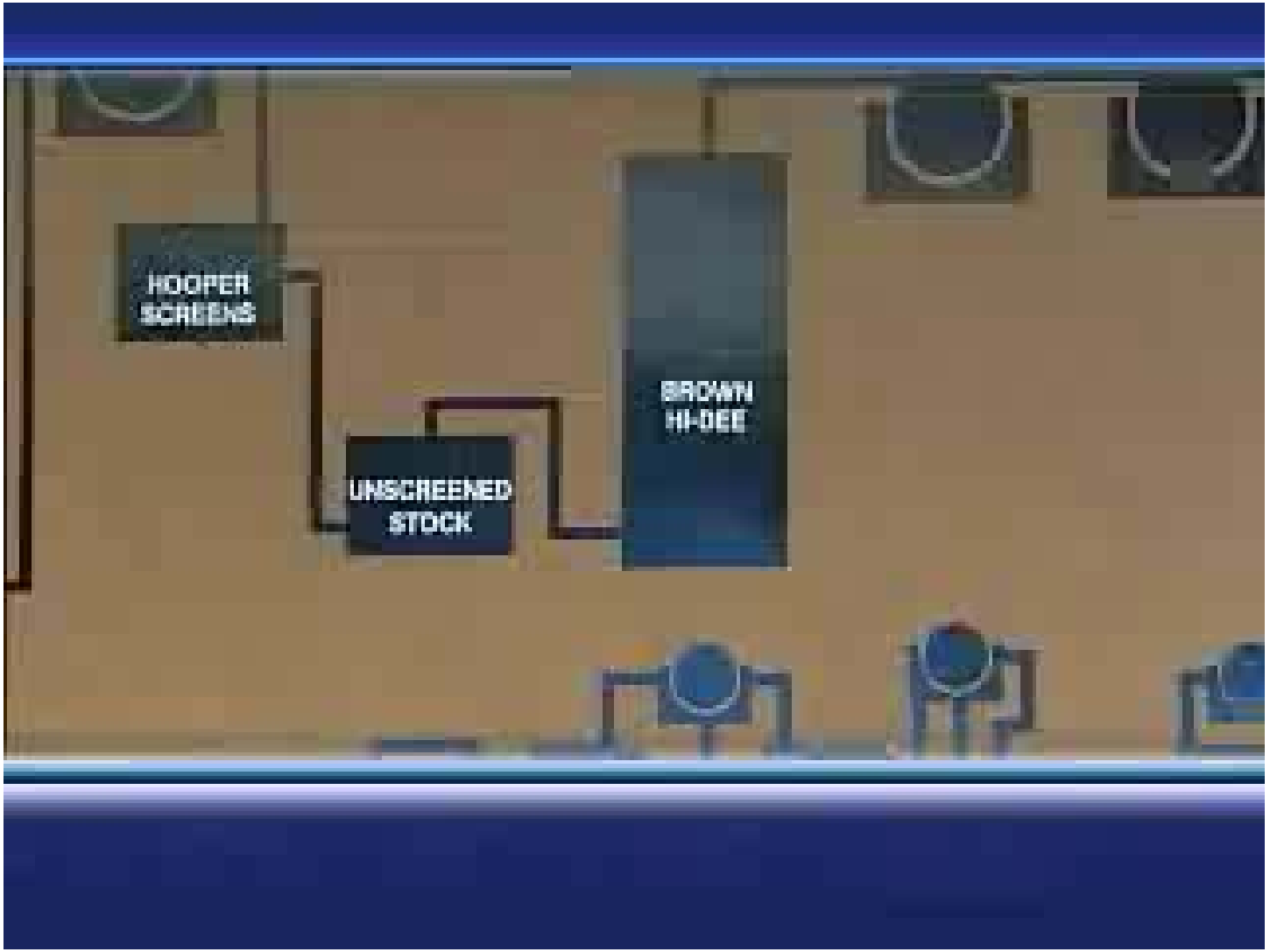
Commercialization Plan

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 → Black Liquor + Pulp
- Chemical Recovery Boiler
  - Black Liquor  → Energy + **Green Liquor**
- Causticizers
  - **Green Liquor** + Lime → White Liquor + Limestone
- Lime Kiln
  - Limestone + Natural Gas  → Lime + $CO_2\uparrow$

D-GLU Kraft Pulping and Recovery

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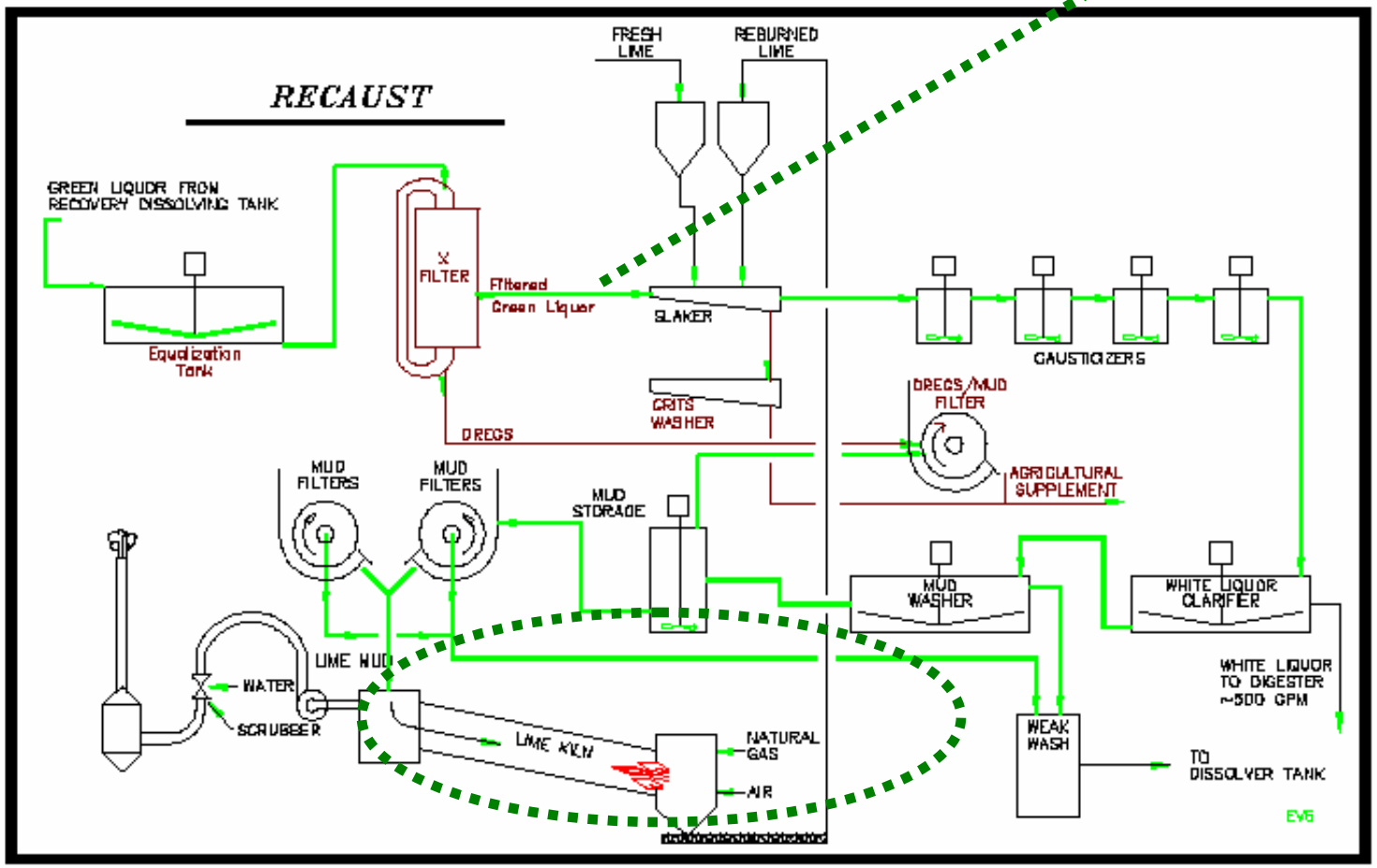
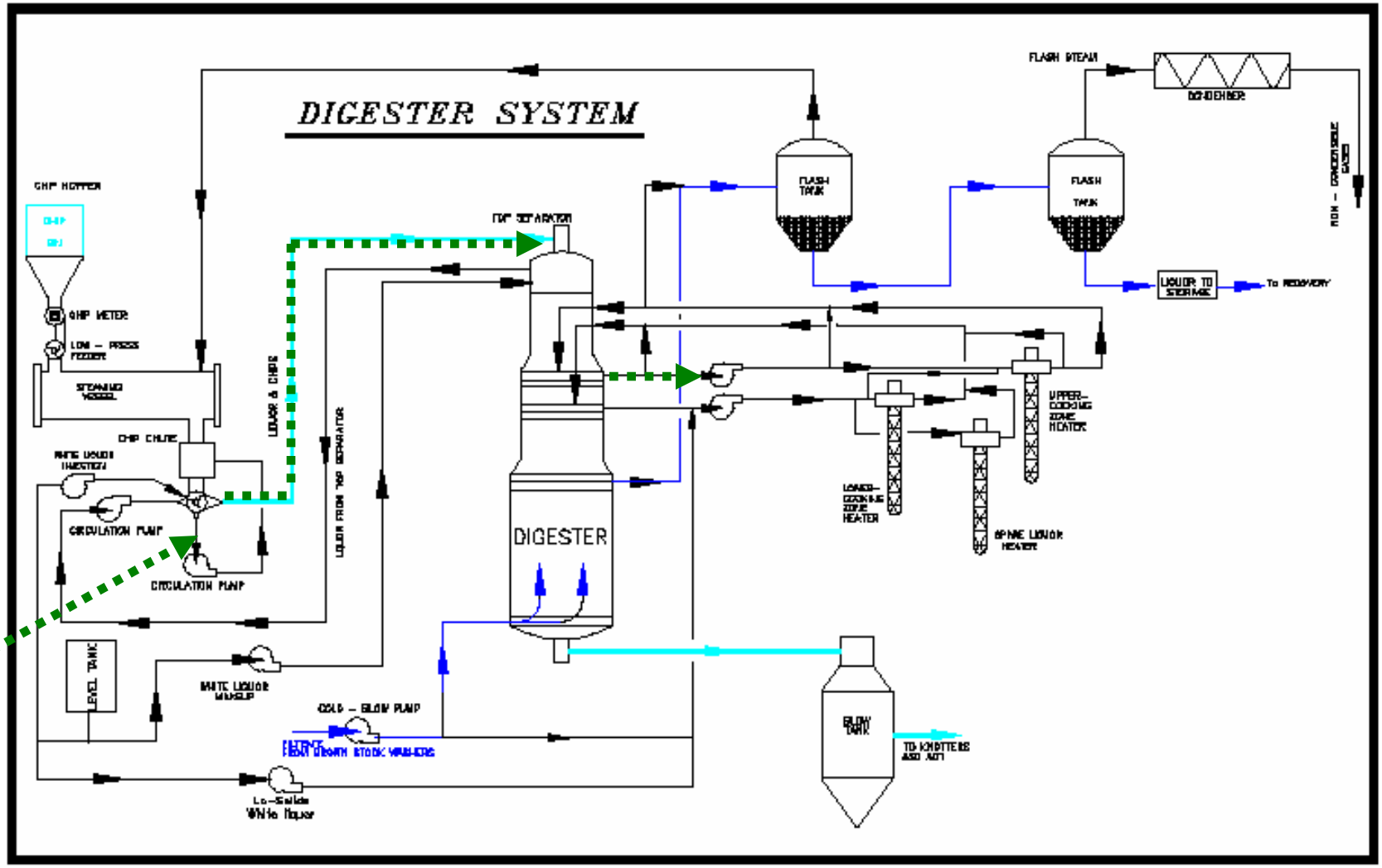
Simplified Design

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


RECAUST
FRESH LIME
REBURNED LIME
GREEN LIQUOR FROM RECOVERY DISSOLVING TANK
Equalization Tank
X FILTER
Filtered Green Liquor
SLAKER
CAUSTICIZERS
GRITS WASHER
DREGS
DREGS/MUD FILTER
AGRICULTURAL SUPPLEMENT
MUD FILTERS
MUD FILTERS
MUD STORAGE
MUD WASHER
WHITE LIQUOR CLARIFER
WHITE LIQUOR TO DIGESTER ~500 GPM
LIME MUD
WATER
SCRUBBER
LIME KILN
NATURAL GAS
AIR
WEAK WASH
TO DISSOLVER TANK
EVS


DIGESTER SYSTEM
CHIP HOPPER
CHIP METER
LOW – PRESS FEEDER
STEAMING VESSEL
CHIP CHUTE
WHITE LIQUOR IMPREGN
CIRCULATION PUMP
CIRCULATION PUMP
LEVEL TANK
WHITE LIQUOR MAKEUP
COLD – BLOW PUMP
Lo–Solids White liquor
LIQUOR & CHIPS
LIQUOR FROM TOP SEPARATOR
TOP SEPARATOR
DIGESTER
FLASH TANK
FLASH TANK
FLASH STEAM
CONDENSER
NON – CONDENSIBLE GASES
LIQUOR TO STORAGE
To RECOVERY
UPPER–COOKING ZONE HEATER
LOWER–COOKING ZONE HEATER
BYPASS LIQUOR HEATER
BLOW TANK
TO KNOTTERS AND ACC

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