STATUS

RELEASE 2.0
COOPERATION WITH HONEYWELL
MECHANICAL PULPING
QUALITY MODELING

RELEASE 2.0

ALL CLIENTS USING 2.0
RELEASE 1.0 NOW UNSUPPORTED
RELEASE 2.1 IN PROCESS
RELEASE 2.1

INTERRUPT KEY FOR IBM COMPATIBLE MICROCOMPUTERS

GENERALIZE PHYSICAL PROPERTY INTERFACE

RESTRUCTURED DOCUMENTATION

NEW PROCESS MODULES

KILNO2
ALKOXY
EVAP02
REFNR2

COOPERATION WITH HONEYWELL

DRIVEN BY HONEYWELL CLIENTS

USE MAPPS ON COMPUTING MODULE OF TDC 3000 SYSTEM

SUCCESSFULLY DEMONSTRATED
MECHANICAL PULPING MODULE FOR MAPPS

G. L. JONES AND M. R. DOSHI

To bleaching
OBJECTIVE

Develop useful and flexible module for the mechanical pulping process.

FIBER SIZE DISTRIBUTION

Kinetic theory (Yan)

\[ f_1(t) = \frac{1}{\sqrt{2\pi} \sigma_t} \exp\left[-\frac{(t-\tau)^2}{2 \sigma_t^2}\right] \]
The distribution function is given by:

\[ f(x) = \frac{1}{\sqrt{2\pi} \ln(\sigma_g)} \exp \left[ - \frac{(\ln x - \ln x_g)^2}{2 \left( \ln \sigma_g \right)^2} \right] \]
\[ z = \frac{1}{\sigma_t} \ln \frac{x_1 - 0.263}{x_2 - 0.263} \]
$P = 41.7 \log(z) + 76.7$

$w \ln \sigma_g = 1.1676w - 0.9737$
SURFACE AREA DEVELOPMENT (EDWARDS & STRAND)

Chip Refiner K Factor

$$K_0 = 1.54 \exp[P(0.123 - 0.0237C)]$$

Secondary Refiner K Factor

$$K = K_0 \exp\left[-0.598 + \frac{0.088P}{K_0} - 4.99K_0C\right]$$

$$S_1 = 1 - \frac{1}{K} \ln\left(\frac{L_1}{2.40}\right)$$

$$S_e = 1 - \frac{1}{K} \sum x_i \ln\left(\frac{L_i}{2.40}\right)$$
CANADIAN STANDARD FREENESS SUBMODEL
(Jensen, et al.)

CSF = 41.7 M1.375 p-0.625

CSF = 119 M1.313 p-0.823

VARIOUS ENERGY COMPONENTS IN MECHANICAL PULPING
(from Marton)

\[ E = E_d + a s^k \]
POWER CONSUMPTION AND DISTRIBUTION
(Marton)

\[ P = a + b S_t^{0.425} \]

- Functions of:
  - Wood type
  - CSF

SUMMARY

- Multiple sources required
- Substantial testing required

Specific power

Chips or fibers
Conc1

M.P.

Steam

Fiber stream
Conc0
Length and width distribution
Fibers and shives
Freeness
Surface area

Steam & chemicals

User coefficients information

- GW, RMP, TMP, CMP, CTMP
CONVERGENCE ACCELERATION OF MAPPS

- Direct substitution
  - $x_{i+1} = x_i$
  - currently used
  - very stable
  - can be slow
- Improved methods under development

- John McKibben - A190
- Wegstein
  Modified 1-D second method
  \[ \bar{x}_{i+1} = q \bar{x}_i + (1 - q) f(\bar{x}_i) \]
  \[ a = \frac{f(\bar{x}_i) - f(\bar{x}_{i-1})}{\bar{x}_i - \bar{x}_{i-1}} \]
  - $2 < a < 0$
  Implemented, undergoing testing
Broyden

Modified Newton's Method

\[ x_{i+1} = x_i + H_i f(x_i) \]

\[ H_{i+1} = H_i - \left( \frac{p_i + H_i y_i}{p_i H_i y_i} \right) \]

\[ y_i = f(x_{i+1}) - f(x_i) \]

\[ p_i = x_{i+1} - x_i \]

MULTIPLE EFFECT EVAPORATOR MODULE FOR MAPPS

- Greg Vottsmier - A190
- Current "multiple-effect" module (EVAP01) oversimplified
- Single effect module developed (EVAP02)
  - works well
  - slow to converge in some cases
- New module under development
  - simultaneous heat and material balance equations
  - implement sparse equation solving techniques
  - cocurrent, countercurrent, split feed
  - design or simulation modes
QUALITY MODELING GOALS

PROVIDE STRUCTURE FOR COMPUTING AND TRACKING QUALITY ATTRIBUTES

ALLOW USERS FLEXIBILITY IN DEFINING QUALITY ATTRIBUTES

ALLOW EXISTING DATA DECKS TO RUN WITHOUT MODIFICATION

MINIMIZE IMPACT ON EXISTING CODE

QUALITY STREAM IMPLEMENTATION

FOR EACH MATERIAL STREAM, THERE EXISTS A QUALITY STREAM

QUALITY STREAMS CAN HAVE UP TO 10 ATTRIBUTES

QUALITY STREAM DEFINITIONS RESIDE IN STREAM TABLE

TOTAL NUMBER OF QUALITY ATTRIBUTES IN A SIMULATION LIMITED TO SOME LARGE NUMBERS

STORED AS MODULE PARAMETERS

ACCESSED AS STREAM INFORMATION
QUALITY STREAM IMPLEMENTATION

DEFINE QUALITY ATTRIBUTES SAME AS ALL OTHER STREAM ATTRIBUTES

300 VISCOSITY
301 BRIGHTNESS
302 TEAR

BUILD DEFINITION FROM LIST OF ALLOWABLE ATTRIBUTES

<table>
<thead>
<tr>
<th>PAPER (MATERIAL)</th>
<th>PAPER (QUALITY)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO.</td>
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</tr>
<tr>
<td>TYPE</td>
<td>ATTRIBUTE 1</td>
</tr>
<tr>
<td>TEMP</td>
<td>ATTRIBUTE 2</td>
</tr>
</tbody>
</table>

QUALITY STREAM IMPLEMENTATION

QUALITY DEFINITIONS DEFINABLE ONLY THROUGH STREAM TABLE

USER CANNOT DYNAMICALLY REDEFINE QUALITY ATTRIBUTES
SYSTEM IMPLEMENTATION

EXECUTIVE MOVES ATTRIBUTE VALUES FROM MASTER STORAGE TO WORKING STORAGE

MODULE ACCEPTS INPUT QUALITY STREAM QUALITY ATTRIBUTES AND COMPUTES OUTPUT STREAM QUALITY ATTRIBUTES

EXECUTIVE STORES OUTPUT ATTRIBUTES FROM WORKING STORAGE TO MASTER STORAGE

EDITOR "WRITE" COMMANDS MODIFIED TO HANDLE QUALITY ATTRIBUTES

CONTROLLERS MODIFIED TO MANIPULATE QUALITY ATTRIBUTES

QUALITY MODELING IMPLEMENTATION

AS KNOWLEDGE BECOMES AVAILABLE, WE WILL DEVELOP APPROPRIATE MODELS

STRUCTURE IS FLEXIBLE TO ENCOURAGE USERS TO DEVELOP OWN MODELS

CONSIDERING IMPACT ON PHYSICAL PROPERTY DATABASE NEEDS

DISTINCTION BETWEEN PHYSICAL PROPERTIES AND QUALITY ATTRIBUTES IS UNCLEAR IN SOME AREAS