CADSIM*ulator*

CADSIM Plus Process Simulation News

Advanced Product Tracking Can Improve Your Bottom Line

Tembec's Specialty Cellulose mill in Temiscaming,

QC is a world leader in specialty cellulose, which is used in a large range of applications across many industries, such as cosmetics, pharmaceuticals, personal care, food, coatings, electronics and energy.

Specialty cellulose is a component of the liquid crystal displays on computer screens. And it can be used to heighten the glossiness of inks, lacquers, nail polishes and varnishes. It is used as a texturizer in dairy products and a thickening and binding agent in cosmetics. It is also used as a binding agent in pharmaceuticals, a strengthening agent in plastics and for splatter control in paint, mortar and plaster.

To meet the specifications required for these different products the Temiscaming mill produces several different grades of pulp. These vary in both chemical and physical properties. Typically there will be up to 10 different grade changes per month.

The Problem

The mill has an annual capacity of 160,000 tonnes. Cooking is done in 11 batch digesters which are emptied into a blow tank. The process is continuous from the blow tank through to the pulp machine. The grade transitions can start in the digesters or at specific points after the blow tank. It is difficult to accurately track the transitions due to mixing in the tanks and the normal error in instrumentation.

It is challenging for operators to know when to make process changes for the next pulp grade at transitions. In situ sample testing to determine grade mix in real time is not feasible. Incorrect timing of the changes can increase chemical costs, transition (off-grade) pulp produced and environmental loading.

The Objective

The objective is to produce a reliable tool that will help Tembec visualize grade transitions, enabling proactive decision-making in operational strategy based on the actual grade transition in each stage of the pulping process. This tool must allow operators to track the transition through the process in real time. It must also be robust enough so that it is not affected by instrument error and it needs to have a high up time.
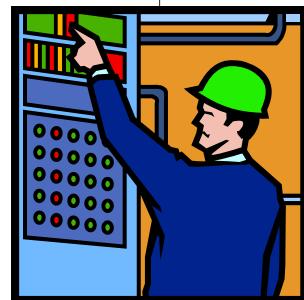
Online monitoring of grade transitions will make it possible for operators to make process changes at the correct time, which will reduce the chemical consumption and the amount of off-grade product that is produced. In addition, this will provide a means to accurately track grade costs and be a useful tool for process analysis and customer quality control.

Beneficiaries of this tool would include mill operators, process managers and others who work in production, maintenance, process analysis, planning and accounting departments.

The Solution

Tembec's Sr Process Engineer Joe Rankin says that the selection of Aurel's CADSIM Plus simulation software with Aurel's proprietary Dynamic Data Reconciliation was based on several factors. Tembec's Specialty Cellulose mill has previously had success with Aurel's CADSIM Plus simulation software using Aurel's Dynamic Data Reconciliation to model from the digesters through the screen room. The original model has proven itself to be accurate and has an uptime of over 99%. Additionally, using data reconcilation gives a more robust model which can handle poor data and has been used to identify instrumentation problems. Based on this experience, it was decided to extend this technology to model the entire process.

Every minute, an automated system pulls selected data from the mill historian via OPC, pokes it into the CADSIM Plus (CP) model and then runs the Dynamic Data Reconciliation (DDR) reconciliation process, which runs thousands of trials to reconcile and fill in missing and inaccurate data. It then writes the reconciled data back to the mill historian.

CADSIM Plus also writes out a Startup Dynamic Profile (SDP) that captures the current state of the process, which can be used to launch other copies of CP for further analysis. The automated system then starts the DDR again with fresh data from the historian.

Parallel simulation sessions are launched for specific purposes, using the CADSIM Plus model and the current SDP profile. One CP model will produce real-time tracking data for production planners and operators. Another CP model will be used to predict future operating conditions in faster than real time or perform what-if scenario analysis.

The tracking data is subsequently summarized in a real-time viewer, which is made available to operators and process managers and others. Tracking data and other KPIs will re-main stored in dated SDP form for off-line analysis.

Aurel's Advanced Product Tracking (APT) will enable Tembec to improve productivity, reduce off-spec

> *"The original model has proven itself to be accurate and has an uptime of over 99%"*

pulp, facilitate process optimization, analyze customer complaints and reduce costs.

The APT system offers the following benefits and opportunities:

- Real-time visualization of quality and grade tracking and time to next transition for improved on-line decision-making
- Off-line analysis to investigate upset condition tracking and customer product quality complaints
- On-line reconciliation of production data (flows, production rates, levels, etc.) to correct inaccurate measurements and fill in unmeasured data
- Overall and stage-specific online production costing and other KPI calculations
- Improved profitability and reduced environmental loading by optimizing water, steam, and chemical dosage, based on the knowledge of the actual grade transition through each processing stage
- Continuous calculation of key process parameters, such as retention times, pulp process age and individual grade inventories in storage units
- Stabilization of the process for improved quality by reducing shift-to-shift operator variability
- Automated e-mail alerts can be sent out based on the results of data reconciliation and other process conditions, such as consistently erroneous measurements
- Coordinated visualization and mill-wide, multi-stage optimization

Chemical dosage control in process industries is typically associated with applying the correct balance of chemicals to satisfy the end product requirements, while minimizing the effluent flow and concentration. As production rate and grade changes inevitably lead to some process upset, it is crucial to be able to visualize the transition and change the control and operational strategy based on actual grade transition.

Online monitoring of the grade transition will enable Tembec to apply the correct dosage of bleaching chemicals, which will not only reduce the chemical consumption but also the transition pulp. Other potential benefits include reduced steam usage and environmental loading by better monitoring and control of grade-dependant operating parameters such as chemical dosage.

APT also keeps track of the amount of pulp for each recipe currently in process and facilitates production scheduling and accurate residence time calculations. Cost calculation is intended to give stage-wise and overall view of the bleaching costs, which can be used for production cost related KPI monitoring and reporting.

Aurel's solution will include a lookup table of different grade-dependant setpoints at each stage. At a later stage, Tembec can utilize this functionality to implement advanced control strategies including multivariable, retention-based and model-based bleaching control strategies.

Rankin also mentioned that the model will solve a problem with developing and running soft-sensors to predict pulp properties. These take inputs from various points in the process. Therefore, time lags must be taken into account. Further, the soft-sensor can be put directly into the CADSIM Plus model, which can then be used to improve control.

The first phase of this development has been completed, and the DDR system is currently running live. The complete plant-wide Tembec Specialty Cellulose APT solution is expected to be fully commissioned in 2014.

✎ Tech Corner: New CADSIM Plus Multi-Document Interface

A new CADSIM Plus multi-document interface will be introduced with version 3.0. The purpose of the new interface is to allow two or more CADSIM Plus drawings to be developed as separate simulations, and then linked together to run as a single simulation model.
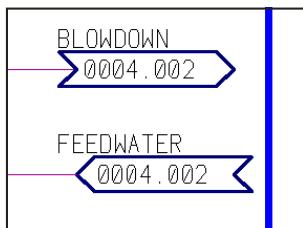
The new multi-document interface features tabbed windows, one for each drawing, that are available in both drawing and simulation modes.

One of the advantages of this approach to modelling, is that it allows you to run each drawing to a steady-state and save a startup file, prior to running them as a group. If done properly, this can save a lot of time in getting a large simulation to run in a stable condition.

Another advantage, is that more than one engineer can collaborate by working on their part of the simulation, and then combine their work together. It also makes it easier to make followup changes, avoiding the necessity of passing the entire simulation from person to person. It makes it easier to plot individual drawings and to debug specification problems.
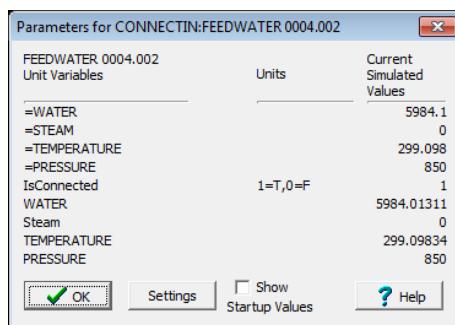
Connections between drawings are made using new ConnectIn and ConnectOut units. The Connect units bridge the gap between drawings.

Connections can be drawn in a form which is similar to P&C or P&ID style stream continuity symbols. CADSIM Plus v3.0 will include a set of drawing parts configured for visible and invisible connections in several orientations.
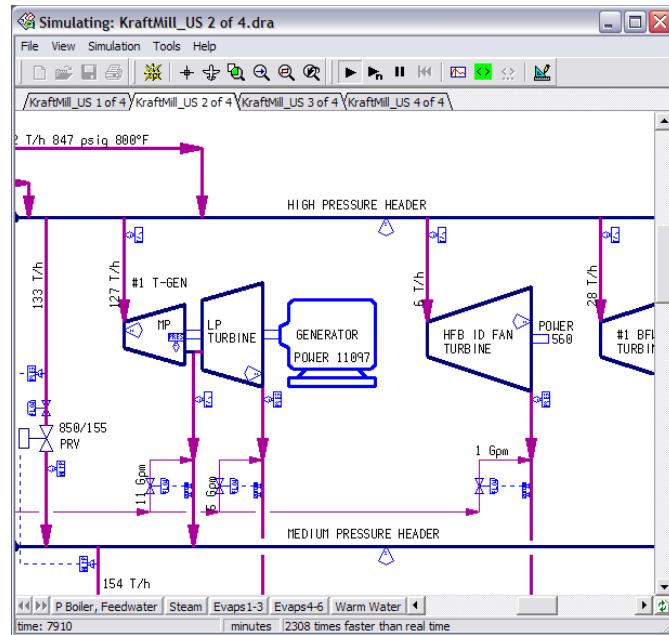
Each drawing is assigned a unique drawing name identifier that is stored as part of the drawing options. Connect units use the drawing name, along with unique polygon names in the form of stream identifiers, to establish connections.

If a drawing is run by itself, its ConnectIn units act as stream sources and use special unit specifications to supply a set values to initialize the simuation to run. These initial values are supplied by the user. Later, these values can be replaced by better calculated values when the drawings are run as a set and startup files are created. These values are given a '=' prefix.

Connect units can also be used as interchanges between drawings that have different process chemistries and units of measure. This allows a set of drawings to use up to nine process stream definitions per drawing.

Connect units will also automatically convert units of measure between streams on different drawings. Connect units can also be used to extend flow and pressure flow networks between drawings.

A typical workflow involves creating one or more process drawings of specific areas of the process. The internal drawing number is set for each and connect units are placed on each stream that is continued to or from another drawing. ConnectIn units are then specified with set values by the user.

When two or more drawings are completed, their names are entered into a text file which is given a **.draproj** file name extension. This project configuration may also include other information about each drawing, such as its time step.

When CADSIM Plus opens a [filename].draproj, it automatically reads each of the drawing files that it contains and then loads each of the drawings into a separate, tabbed window. You can then run the drawings as a set, tune controllers and save a set of startup files, one for each drawing, as well as update the saved values for ConnectIn units.

CADSIM Plus v3.0 will ship with sample drawings set up as a multi-document project. The drawings contain examples of visible and invisible Connect units on minor and major process streams. Each of these sample drawings can also be run by itself with no modification. ✎

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CADSIM PLUS

Did you know...?

There are a number of mouse wheel plus key combinations for easier viewing and zooming around your drawing:

- Use the **scroll wheel** on the mouse to scroll the drawing up or down
- **Shift key + scroll wheel** to scroll the drawing left or right
- **Ctrl key + scroll wheel** to zoom in or out, centered on the current location of the mouse cursor
- **Ctrl + shift + scroll wheel** to zoom in or out, centered in the middle of the current drawing window

Announcing CADSIM Plus v3.0

- New Multi-Document Interface
  - Run a set of drawings individually, or as one large simulation, without making any changes to the drawings
- New Units:
  - ConnectIn, ConnectOut (for multi-document interface)
  - Queue (for data interpolation)
- Improved Units:
  - Pump (added affinity laws)
  - Pipe, Pump and Valve (calculate outlet pressure when PRESSURE is not a stream variable)
  - Euler (added reset option)
  - Storage and Tower (added Age = VariableName for stock tracking)
- Dynamic Data Reconciliation:
  - New filter types: Integral and Savitzky Golay (cubic polynomial)
  - Support for multiple filters: allows up to 5 filter types per measurement
  - New objective functions: Gaussian, Fair, Lorentzian and Contaminated Gaussian
  - Real-time catch-up: runs DDR faster than real time
  - Improved measurement reports in .rec files
- Specifications:
  - Right-click to toggle between single spec and multi-spec icons
- Error Messages:
  - Added locate button to many error messages to help find the source of the problem
- Runtime Factors:
  - Added runtime access to some specified factors, such as linear, ratio etc. which can now be changed on the fly without returning to drawing mode.
- Control Lines:
  - Specification control lines can be globally set invisible. And when you click to select a specification, its control lines will appear temporarily while it is selected.
- Reactions Editor:
  - Added a tool to estimate heat of reaction based on the reacting compounds
- Simulation Time Units:
  - Extended options for specifying the units of measure for simulated time, to include milliseconds, seconds, minutes, hours and days