CADSIMulator

CADSIM PLUS PROCESS SIMULATION NEWS

VOLUME 2, ISSUE 1

SPRING, 2003

1

Duncan Industrial Wins Professional Engineering Award

Duncan Industrial Engineering (DIE) recently won the 2002 Design, Construction and Monitoring Award, presented at the Association of Professional Engineers and Geoscientists of British Columbia (APEGBC) annual conference, for their work developing several technological improvements at the Quesnel River Pulp (QRP) mill, in BC, Canada.

The QRP projects were initiated because the amount of clean steam generated from the reboiler had decreased over a period of years, along with the amount of energy recovered from various heat exchangers. This resulted in the need for more steam from the gas-fired package boiler and increased greenhouse gas emissions. Effluent discharge temperatures had also risen, necessitating the addition of cold fresh water from wells, in order to meet environmental regulations.

DIE conducted a study for QRP that combined computer simulation modeling with extensive onsite verification and Pinch analysis (subcontracted to SodeXpro/Pragmathic).

The QRP mill is a large and complex pulp mill that has three production lines and many interconnected systems. A change in heat recovery in any one of these systems will affect operations throughout the mill. Historically, it has been very difficult to analyze large systems to precisely define energy problems such as these, and to find optimum solutions.

DIE used CADSIM Plus to model all of the systems in the mill. Aurel's simulation software allowed DIE to generate heat and material balance drawings similar to the mill process and control diagrams.

> *"Our new CADSIM Plus corporate lease gives us unlimited use to better serve our customers..."*

The model included all three production lines and all major equipment as well as stock flows, steam loads and natural gas fuel requirements. Freshwater supply and effluent treatment systems were included.

When the computer model was completed, it was extensively verified during a two month onsite visit. The model was then coupled with Pinch analysis, which uses a relatively new thermodynamic concept to identify all process cold streams in a mill that require heating, and all hot effluent streams that can supply the heat. Pinch analysis is used to find the theoretical optimum energy performance.

As a result, over a dozen energy conservation opportunities were identified. Selected projects include effluent heat exchanger cleaning, boiler feedwater preheating, glycol heat exchanger utilization, waste steam utilization and reboiler retubing and modification.

When all projects are completed, the mill expects to save 430,000 GJ of gas annually and costs savings are predicted to be in the range C $2.1 million. Total capital expense costs to achieve these savings will be approximately C $1.3 million. In addition, freshwater usage will be reduced by 9% and greenhouse gas emissions will be reduced by 21,500 tonnes annually.

"Our new CADSIM Plus corporate lease gives us unlimited use to better serve our customers with this advanced simulation technology", said Mr. Connaghan.

For more information, contact:
Chris Connaghan
cconnaghan@diei.com

Inside this issue:

This Issue:

- **A focus on consultant's use of CADSIM Plus**

Next Issue:

- **Find out how universities and other learning institutions are using CADSIM Plus in their research activities**
- **Operator training is made practical and cost effective using new CADSIM Plus features**

Beca Pty offers CADSIM Plus Process & Control (P&C) Diagrams

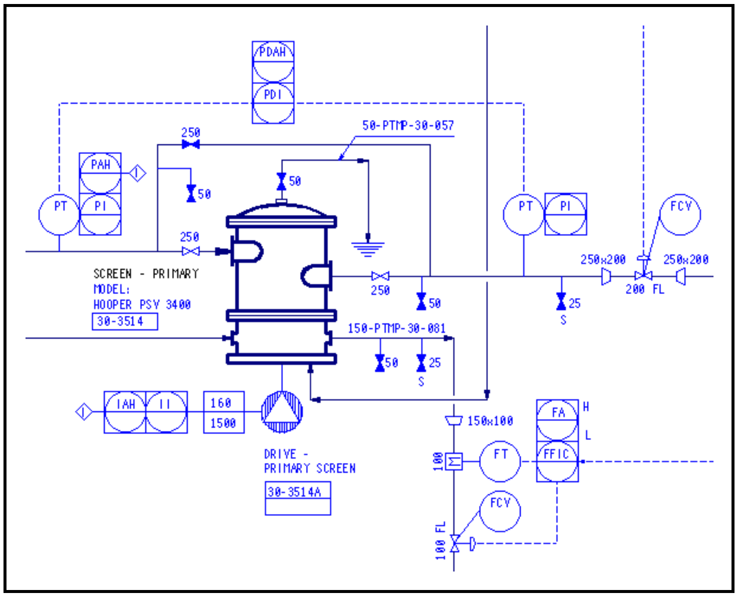
by Roberto Miotti, Beca Pty

Process & Control Diagrams (P&Cs) are standard engineering drawings that show all the details of an engineered process. They depict equipment, piping, valves, electricals, process controls, alarms, safety and equipment interlocks. Sometimes they also include the plant operating logic.

P&Cs are usually prepared with CAD software, such as AutoCAD® or MicroStation®. However, CAD diagrams lack an easy way to include mass & energy balance information. This information is prepared using process simulation software. Simulation results can then be added to the P&C diagrams.

Process simulation provides data for desired sets of operating conditions. This data can include minimum tonnage, maximum tonnage, special or upset conditions, and many other variables.

Most process simulators require some kind of diagram to be built as part of the modelling process. It is therefore necessary for the consultant to create two sets of similar visualizations: the actual P&C drawings and the process simulation diagrams.



CADSIM Plus P&C (P&ID) Intelligent Drawing / Simulation

In addition, modifications carried out in a plant after it is built are seldom transferred to the original P&Cs, which are used primarily during plant construction. The result is that P&Cs rapidly become out of date and don't reflect the current operating state of the plant.

An alternative method of preparing standard P&Cs is to use CADSIM Plus directly to build a "CAD like" drawing that combines all the information in a single source. Engineering is faster this way because the originator of the P&Cs (the process engineer) can prepare the drawings directly in the simulation platform, thus reducing the steps of manual preparation, drafting, and checking of separate CAD drawings.

It is also more likely that plant modifications will be transferred to these P&Cs over time, because equipment, piping and mass & energy balance information can be updated in one step.

Beca's staff has prepared CADSIM P&Cs for Abitibi-Consolidated in Mackenzie, BC, Canada and Norske Skog Boyer in Tasmania, Australia. Beca is currently investigating with its other clients, the possibility of converting their out of date P&Cs into intelligent CADSIM Plus "Living Drawings."

For more information, contact:
Roberto Miotti
rmiotti@beca.com.au

Neill and Gunter finds Silica Solution using CADSIM Plus

by Leon Livingstone, Neill and Gunter

Recently, Neill and Gunter used Aurel's CADSIM Plus simulation software to do an equipment evaluation in the selection of stock cleaners for a pulp and paper mill client.

The mill was receiving complaints from its customers about silica contamination of its pulp. Silica particles ranging from 40 to 50 microns in diameter were causing excessive wear of spinnerets used for making Rayon fibers. Existing hydrocyclone cleaners were not removing this silica particle contamination effectively.

The mill evaluated a chip washer facility, but the cost proved to be prohibitive. An alternative was to install a second cleaner system in series with the existing stock cleaner system that would lower the silica content to meet customer specifications.

Neill and Gunter built a dynamic process model of the mill's stock preparation system ahead of its pulp dryer to show removal of process contaminants. Since the supplier had no data for this contaminant, a number of trials on different cleaner models were conducted at the mill to confirm modelled performance.

Test unit performance data was then inserted into the process model and "What If" scenarios were run until the optimum system and overall performance was identified. With process conditions established, the system was designed, procured and installed.

On start up, the system met expected performance on silica removal, and it continues to do so. The project was successful, in part, due to the modeling, which demonstrated that hydrocyclone cleaning was a sound alternative to chip washing, at a much lower capital and operating cost.

For more information, contact:
Leon Livingstone
rmiotti@beca.com.au

Tech Corner: Pipe Friction of Flowing Pulp Suspensions

Friction loss for pipes with pulp slurries can be very difficult for dynamic simulators to calculate because of certain anomalies. For example, friction loss can actually decrease with increased velocity or it can exhibit unexpected behaviour with a change in consistency.

CADSIM Plus uses a novel empirical method which normalizes each curve fitted through the friction loss maximum, minimum and point of crossing of the water curve. This method calculates the friction loss through the difficult region where the friction loss dips as the velocity increases. The results shown in *Figure 1* demonstrate a good fit of the various methods that CADSIM Plus uses, when compared to measured data.

Many friction loss calculations have been based on the TAPPI method *TIS 0410-14*. This method uses a formula, given below, to calculate friction loss up to the velocity at which the maximum friction loss is observed. Beyond this point the TAPPI method suggests a straight line be drawn to where it crosses the friction loss curve for water.

The TAPPI method may be fine for design because it is very conservative (it overstates the friction loss in the region where it dips) but it is not acceptable for dynamic simulation. A more realistic response to changing flows is required by dynamic simulation to more accurately predict pressure flow networks and control responses.

In the region of consistency depicted in *Figure 1*, the first section of pulp slurry friction loss is calculated using the TAPPI method, given by the following formula:

$$frictionLoss = F \times K \times V^{\alpha} \times C^{\beta} \times D^{\gamma} \times L$$

where,

frictionLoss = ΔH/L = m water / 100 m pipe

F = correction factor for temperature, pipe roughness, etc.

K, α, β, γ are CADSIM Plus fibre type constants

V = velocity

C = consistency

D = internal diameter

L = equivalent length

Figure 1 shows the results of these calculations for the lower velocities which are linear on the log – log plot. The lines shown are CADSIM Plus calculations for one to five percent consistencies. The points shown on Figure 1 are taken from *Tappi Vol 33 No 9, Fig 6, p22A* to show proximity to measured data.

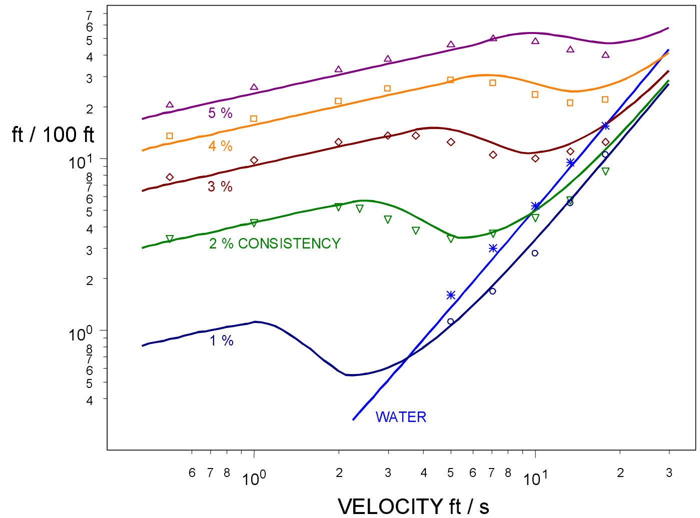


Figure 1: Pulp Slurry Friction Loss in Pipes

The challenge is to calculate the dip in friction loss as the velocities increase, and the ultimate convergence back towards the curve for friction loss with just water. Water friction loss in CADSIM Plus is calculated by:

$$frictionLoss = \frac{f \times V^2 \times L \times \rho}{2D}$$

where,

ρ = fluid density

f = Fanning friction factor given by:

$$\frac{1}{\sqrt{f}} = -4 \times \log\left(\frac{\varepsilon}{3.7 \times D} + \frac{1.256}{N_{Re} \times \sqrt{f}}\right)$$

where,

ε = surface roughness

N_{Re} = Reynolds number

This method allows CADSIM Plus to deliver reasonable dynamic simulation results, while adhering to the TAPPI method at the lower velocities, observing the dip at medium velocities and approaching the more rigorous water friction loss calculations at higher velocities.

Aurel Systems Inc.
7197 Ridgeview Drive
Burnaby BC Canada V5A 4S1

Phone: +1.604.299.7707
Fax: +1.604.299.8178
Email: mail@aurelsystems.com
Web: www.aurelsystems.com

Your practical solution to process improvement and

Visit us on the web at www.aurelsystems.com

Did you know…

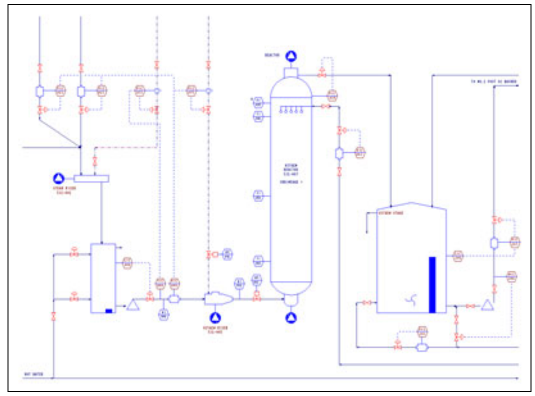
Rather than slow a speedy simulation down to closely observe a transient behavior, use the CADSIM Plus feature **Run *n* Passes** to fast-forward to the time just before the transient by entering a number in the dialog box. Then use **Run *n* Passes** to advance one iteration at a time to watch detailed changes.

Similarly, a run until condition can easily be set up by using an **Alarm** or **Warning unit-**modules.

NLK Links CADSIM Plus to DCS

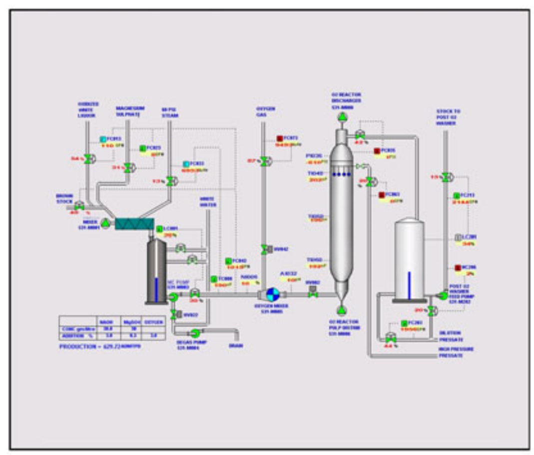
By John Ngai, NLK Consultants

True Dynamic Simulation (TDS) has been developed by NLK to use "off-the-shelf" software packages to integrate process modeling, operation and control. This method provides a simulation system that is easy to keep up to date. The approach amalgamates existing in-plant control systems with CADSIM Plus process modeling software, to create a simulation system that has the look and feel of the real process.



CADSIM Plus Simulation Drawing

The interface package permits cross communication between CADSIM Plus and a typical Distributed Control System (DCS) package such as Fisher Delta V. The simulation system lends itself to operator training in process operation and control, using the actual DCS operating graphics. The system could also be used for process prediction, startup, loop tuning and optimization of the process design.



DCS Operator Graphics

In addition, CADSIM Plus, which is typically used for process design, is expanded to its fullest potential for process simulation, by utilizing the DCS as the front-end. NLK's modeling process incorporates mass balance, material properties, and equipment characteristics and will also account for system dynamics and losses.

Form more information, contact:
John Ngai
john.ngai@nlkconsutants.com

New Features Planned for CADSIM Plus v2.3:

- Use OLE for Process Control (**OPC**) to connect CADSIM Plus to process control systems—now in Beta test.
- Save energy with the new integrated **Pinch module** that allows Pinch Analysis to be done interactively within a running CADSIM Plus simulation—now in Beta test.