House Calls

What the doctor ordered

A digital prescription for getting control over the wood chip pile
Chip quality measurement and analysis for pulp mills

by Alan Munro

In the impossibly complex technical and economic equation that is a modern pulp mill, finding the point where a mill's equipment, raw material supplies, and customer requirements come together to produce the right product for the right price at the right time is a major challenge; a challenge that can turn the hair of a mill manager prematurely grey.

USA industry consultant Bill Jordan calls finding that optimum balance point hitting the 'sweet spot' of a mill.

A past plant manager of both Champion International and International Paper mills in Alabama and Minnesota, Jordan, now based in Decatur, Alabama, says that every mill has its sweet spot, and it varies not only from mill to mill but within a given mill over time, sometimes day to day.

With years of hands-on experience of making mills work, Jordan is used to chasing his sweet spot. To find it, he says, mill managers need to break out of the 'volume focus' and understand the whole process.

The biggest challenge, according to Jordan, has always been "knowing what was going on." He has used everything — from matrix analysis to the classic Monday morning meeting — to find the source of the problems that beset a pulp mill.

The difficulty has always been the time it takes for information to 'trickle down' through the system, particularly when something is out of balance and the root cause itself is a constantly changing factor such as chip quality.

"It can take weeks, even months of Monday meetings to find out that you have a problem that the guy out at the chipper caused without having a clue what he was doing to the digesters," says Jordan.

Finding and hitting that balance — a dynamic, constantly changing target — is the nearly impossible job of the mill manager. To effectively manage Jordan's elusive 'sweet spot,' mill managers must know what's going on — quickly.

Jordan recently assessed a new technology, *The Virtual Chip Doctor* (TVCD), that holds the promise of turning the management of the chip quality issue from the current largely ad-hoc processes into a precise science (See sidebar *Up Close: The Virtual Chip Doctor).*

Although the TVCD system has not yet been used in an Australian mill, Joel Young, a Canadian now working as chief chemist and technical manager at Visy Pulp & Paper's PM#9 mill at Tumut, NSW, says chip quality problems here are similar, and the USA experience, where TVCD is being successfully utilised in a number of US and Canadian mills, provides a fair measure of how effective the system might be in this country.

A joint venture between New Hampshire-based Biomass Resources Inc and Fiber-M Technologies, of Bangor, Maine, The Virtual Chip Doctor's approach to solving the chip quality problem is not an entirely new paradigm. Many pulp and paper companies have developed similar tracking techniques and analytical software in-house, at considerable expense.

Joel Young observes that, "These systems, while potentially quite powerful, often ebb and flow in their use and utility owing to lack of standardisation in testing and data handling or operating platform. User familiarity and simplicity in data presentation also often compromise the utility of such in-house programs.

"TVCD brings together the knowledge base and experience of Greg True of Biomass Resources with up-to-date web-enabled software and data management. Combining the knowledge and experience of The Chip Doctor, with the user friendly attributes of TVCD provides state of the art in quality fibre processing."

Where TVCD differs from existing models is by offering a 'standardised' internet-based system that can be installed and up and running, in any mill, in a matter of weeks. Essentially, what the developers are offering might be seen as the rough

equivalent of a 'Microsoft Word' — an industry 'standard' that's easy to use yet is still able to be fully customised for a specific mill operation, no matter how large or complex.

The Microsoft analogy is not entirely appropriate. Accurate and consistent analysis of the constantly changing living material that feeds a pulp mill is a lot more complex than a word processor, and TVCD is a pretty complex system, although the system's real power remains 'under the hood' — transparent to the user — making it easy to use.

Even the smartest software is never going to replace the expertise of experienced mill operators of course, but two additional factors make the TVCD system unique, and potentially more promising than anything previously seen.

As a web-enabled information management and reporting application, the TVCD software defeats the tyranny of distance. As long as a mill has an internet connection (even a slow dial-up) it doesn't much matter if the site is in Tasmania or Timbuktu. In much the same way as an internet browser connects you to websites, the mill uses an interface to access and feed data to the main system, which is hosted on secure servers located in the USA.

With the system hosted at one point the developers can constantly 'tweak' and upgrade the software engine to incorporate new developments and solutions, while retaining complete client confidentiality. For the same reason, the system should never become obsolete in the way custom-written in-house software might.

Perhaps the greatest promise of TVCD however is that the system was developed and is implemented by people with vast experience in pulp mills and sawmills.

Greg True, who heads Biomass Resources Inc, is a fourth generation miller and industry consultant, and was able to call on decades of experience in the technical intricacies of chipping — and every other mill process, from log intake to digester feed — when the system was being developed.

Up Close

The Virtual Chip Doctor

The Virtual Chip Doctor is a web-enabled information management, trend analysis and reporting application which uses a number of unique algorithms to analyse and manipulate sample chip data.

It runs remotely on dedicated servers with continuous staffing so is available 24 hours a day. The software is remotely managed so doesn't put serious demands on a mill's internal information technology staff.

The system works by using existing in-house sampling to feed chip quality data into the TVCD analysis program. The program will accept uploads from either Gradex or Rader chip classifying machines, as well as inputs directly via a manual data-entry screen.

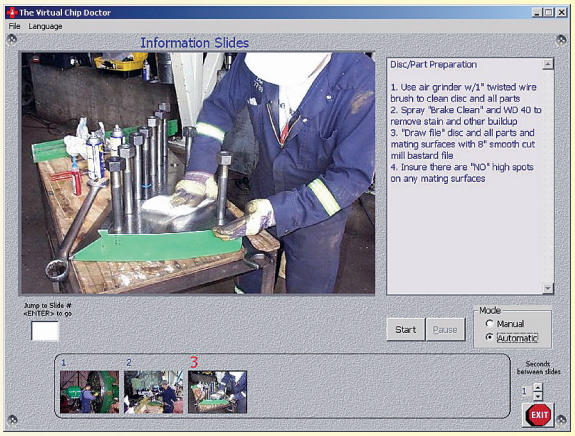
Using sophisticated trend analysis techniques, the application provides mill management, technical staff and their suppliers with chip quality information in formats custom suited to the mill's style of operation. These customisable reports enable early detection of quality problems that go well beyond the traditional 'accepts and rejects limit' yardsticks.

The integrated 'Fiber Model' module, which is species and supplier specific, measures the financial value of chip quality improvement, or the cost of leaving chip quality unchanged.

The TVCD system also has a 'Recommended Corrective Action' feature, an extensive series of image viewers and maintenance checklists designed to identify solutions to the root cause of chip problems. It includes specific 'how-to' instructions down to individual equipment set-up and maintenance.

The developers claim that in most cases the system can be accepting data within two to three weeks and will not only improve chip quality while increasing pulp yield but will lead to lower production and maintenance costs and reduced chemical and other expenses.

The TVCD system is not a one-off purchase. The developers are paid quarterly on a per tonne basis, with the first quarter paid in advance.



An example of one of the 'corrective action' screens built-in to the TVCD software.

The system is in use in number of US and Canadian mills and the developers are keen to extend their customer base to Australia and New Zealand. They can be contacted at:

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This feature has been edited and adapted for Australian audiences from material that originally appeared in US Pulp & Paper (October 2004, by Sandy Smith & Dan Derby). Portions of the original article are reproduced with permision of the authors.

"Our family has worked with the pulp and paper industry now for four generations. I've worked in and around pulp mills and sawmills for over 30 years and have seen the frustrations and problems that arise as a result of chip quality not being taken as a manageable, controllable, and correctable issue. We have also seen first hand the frustration that this causes within the mill.

"We figured there had to be a better way. After years of working with and listening to the mills, procurement groups, and suppliers, TVCD is the end result of intense development, trial and error, and the hard work of a team passionate about the industry. We think that TVCD represents the future of chip quality control."

Biomass Resources are also intimately involved in the implementation of the system at mill level. As part of the package, the company's technical staff help to physically set up and optimise the machinery both at the pulp mill and, if required, at the chip suppliers. Although they're US based, the company says that exactly the same on-the-ground service would be available to Australian and New Zealand users.

Once the system is successfully implemented, the TVCD software interface provides clear visual maintenance and solution check lists that walk the user through the process as if the Chip Doctor were on site.

The TVCD software itself was developed and is hosted by Fiber-M Technologies Inc., an independent application service provider (ASP) specialising in the pulp and paper industry. Like Biomass Resources, they too have years of experience in the analysis of mill problems.

Together, the joint venture partners appear to be able to offer mill managers and chemists a unique combination of industry expertise and powerful data acquisition, analysis and reporting software power.

After examining the TVCD system, Bill Jordan commented that, "It's remarkable that we're just now getting around to close management of the input (wood chips) of this complex, multivariable system.

"Historically, a mill might have six to eight major wood suppliers, and it would take weeks or even months to know if one supplier had a problem.

"The challenge was that the guy in the chip mill was measured on only the simplest of terms," Jordan continues. "He didn't have a clue what he might be doing to the digesters. Worse, it took days, or even weeks or months, for the plant manager to learn what was happening."

In that time, typical bottleneck processes, such as recovery boiler limits, become critical. Digester optimisation becomes impossible when the materials going into them are close to worst case.

Jordan's 'sweet spot' observation — in other words, a systems view of the whole operation — is not unique. Jordan and other mill managers have learned hands on: You have to look at the entire value chain, and particularly at the boundaries between organisations.

In his mind, the TVCD system is, "just like a plant management system, and it allows you to be not only proactive but to get everyone on the same page. The slow trickle down of information typical of a mill ceases, and the guy supplying the chip pile often will know he has a problem before you do."

Increasingly, Jordan feels such an information system will help break down the barriers between forest resources and the mill. Other experiences, in real-world mill operations, appear to confirm Jordan's views.

Steve Simmons, forester in the Forest Resources group of Smurfit-Stone Container Corp's (SSCC) West Point and Hopewell, Virginia pulp and paper mills, heads SSCC's Virginia Region Chip Quality program.

The West Point and Hopewell mills produce white top linerboard, Kraft linerboard, and corrugated medium for customers around the world. The Virginia region has had chip quality programs in the past, prior to the mills' purchase by SSCC.

When the programs were restarted under SSCC, management suggested adding additional expertise in the form of *The Virtual Chip Doctor*.

The technology turned out to make a real difference, with the outside consultant contributing both their technical expertise in chip quality technology and the software program for data acquisition, analysis, and correction. Biomass

TABLE 1: Combined Fibre Savings

Period Ending	% chips within desired fractions	Total % chips screened to fuel	% chips remaining	Pulp yield above baseline	Onsite screened out fibre $/ton	Total screened out fibre $/ton	Digester pulp yield fibre gain $/ton	Fibre value gain from chip quality	Onsite monthly screened out fibre	Mill monthly screened out fibre	Total monthly screened out fibre	Digester monthly pulp yield fibre gain	Total monthly fibre value gain	Cumulative fibre savings
Baseline	65.0%	11.7%	88.4%											
Annualized	67.8%	9.8%	90.2%	0.00%					$2,642.00	$464,302.00	$466,945.00	$445,121.00	$912,066.00	$912,066.00
Target	73.0%	4.0%	96.0%	6.65%	$1.95	$3.27	$1.09	$4.36	$934,915.00	$634,284.00	$1,569,199.00	$524,046.00	$2,093,245.00	$2,093,245.00
January	65.6%	10.1%	89.8%	3.77%	$0.11	$0.67	$0.33	$1.00	$4,510.00	$24,052.00	$28,562.00	$13,858.00	$42,420.00	$42,420.00
February	64.9%	11.7%	88.3%	3.72%	$0.69	$0.04	$0.45	$0.41	$25,019.00	$23,535.00	$1,484.00	$16,144.00	$14,660.00	$57,080.00
March	60.5%	16.2%	83.8%	3.39%	$2.95	$2.29	$0.47	$1.82	$129,163.00	$28,665.00	$100,498.00	$20,613.00	$79,886.00	$22,806.00
April	67.9%	10.0%	90.0%	4.88%	$0.13	$0.77	$0.85	$1.61	$5,156.00	$35,651.00	$30,495.00	$33,526.00	$64,021.00	$41,215.00
May	69.8%	8.5%	91.5%	5.23%	$0.51	$1.52	$1.10	$2.62	$26,050.00	$52,055.00	$78,104.00	$56,461.00	$134,565.00	$175,781.00
June	72.7%	7.3%	92.7%	5.69%	$1.08	$2.21	$1.18	$3.39	$46,321.00	$47,981.00	$94,302.00	$50,611.00	$144,913.00	$320,694.00
July	74.8%	7.0%	93.0%	5.56%	$1.13	$2.33	$1.34	$3.67	$50,182.00	$53,593.00	$103,775.00	$59,510.00	$163,285.00	$483,979.00
August	74.4%	6.7%	93.3%	5.73%	$1.09	$2.28	$1.36	$3.63	$44,446.00	$48,410.00	$92,856.00	$55,261.00	$148,117.00	$632,096.00
September	71.0%	9.2%	90.8%	5.59%	$0.02	$1.22	$1.28	$2.49	$772.00	$46,737.00	$45,966.00	$48,223.00	$94,189.00	$726,285.00
October	64.4%	10.0%	90.0%	4.28%	$0.05	$0.79	$0.76	$1.55	$2,765.00	$45,839.00	$43,075.00	$41,695.00	$84,769.00	$811,054.00
November	64.4%	9.9%	90.1%	4.03%	$0.02	$0.83	$0.64	$1.48	$767.00	$37,246.00	$38,013.00	$29,407.00	$67,420.00	$879,474.00
December	62.7%	10.5%	89.5%	3.68%	$0.22	$0.46	$0.66	$1.12	$6,759.00	$20,539.00	$13,780.00	$19,813.00	$33,592.00	$912,066.00

Resources' MACS system (Measure, Analyse, Corrective Action, and Sustainability) almost exactly paralleled SSCC's own 'CustomerOne' business philosophy of 'Measure, Analyse, and Corrective Action.'

According to Simmons, management immediately challenged the renewed chip quality program with the question, "Can we move chip quality by the way we set up chippers, particularly with the major contributors of our fibre supply?"

That raised the question: "How would we know if we have been successful in changing chip quality?" Simmons concluded, "We had to start from the very beginning, again."

Simmons said they had to re-establish a sampling program. There were basic measures in place, such as percent accepts, but more was needed. The team also needed to understand what *The Virtual Chip Doctor* program meant, and then establish complementary measurements.

Bill Jordan's view of the technology is similar. "You have to have a sampling program to get this to work," he says.

Once sampling and measures were in place, Simmons says his team "…started working with the chippers again to move chip quality in the direction we thought we wanted to go. We accomplished that, and ever since then, it's been a learning experience."

Simmons now says, "We can measure, set a goal to change, and execute change.

"When we've had a supplier who has embraced the recommended changes and maintained them, their chip quality has been steady," Simmons says. He adds that the quality measures achieved initially "just jump up and then they're steady."

Improvement of chip quality also reaches into the supplier's own operations. "The ones who are on board are getting more chips per tree with the help of the TVCD expertise," Simmons says.

Outside expertise from The Chip Doctor's staff in the technical intricacies of chipping and other mill processes was critical. Educating the mill's staff on how to succeed took more subtle technical knowledge than one might imagine. On the other hand, Simmons notes that the same problems kept showing up as he assigned The Chip Doctor's staff to visit specific suppliers. Once a problem was overcome with one supplier, it became easy to pass the knowledge to others.

The experience of other mills using the TVCD solutions has been similar, and one thing has become clear: Even if a mill has significant data available, it's hard to know just what impact it is having on a chip quality program. As everyone points out, a mill is a very complex machine fed by a living material.

So what is the overall effect of chip quality improvement?

Simmons believes, "Once you answer the question that, yes, you can sample, measure, and change chip quality, everything is open to you. Then you can start analysing what the different chip quality factors have on the pulp mill and the impact you had."

Most corporations in this very competitive environment are not typically open to sharing the data, even if they had it. That makes knowing what the potential impact is of improving chip quality quite a challenge. However, as Simmons points out, TVCD's 'Fiber Model' analysis tool was created precisely to deal with this complex problem.

Typical Mill Benefits

The TVCD developers say that, in general, the establishment of a chip management system with a fully-implemented information management system can yield the results shown below in Table 2.

Benefits are reported as:

- Real-time reporting in dollars allows the mill to account for savings (less wood purchased or more pulp produced for the same tonne of wood chips.
- Annual real-dollar savings that can be measured and tracked (Fig. 3)
- Facilitates statistical process control over the wood room and purchased wood chips
- Provides data to manage wood purchasing processes
- Supports measurement of total value chain performance
- Improves communication and problem-solving throughout the mill by a shift to fact-based decision processes using common information

Note: The data collected by TVCD on behalf of users of the system is confidential. The data below is an aggregate of a number of 'typical' results based on multiple customer experiences.

TABLE 2: Typical results from a chip management system

Item	Aggregated Results
Cost/return	$US0.02 (Cost of installation and operation of TVCD program divided by the quantified value of fibre savings)
ROI	$US49.03/dollar invested (annual ROI)
Chip quality ('accepts')	92 to 96 percent 'accepts' pre-screened
Fibre value gain: screened out chips	$US3 to $US4 per tonne
Fibre value gain: digester pulp yield (fibre only)	$US1 to $US2 per tonne
Fibre value gain: total from chip quality distribution	$US3 to $US6 per tonne
Fibre yield savings: (typical)*	$US5 per tonne

* As an example, a pulp mill with green use of one million tonnes annually should yield savings in the order of $US5 million annually on fibre only. Additional savings in chemical costs, energy etc are possible.

This built-in software module uses proprietary algorithms to predict the impact of chip profile, for example, against a mill's existing baseline. It can show the impact on mill efficiency and material usage of those adjustments via customisable graphs and tables.

In fact, says Simmons, "you can drill down by species or supplier in essentially real time."

This automated model can even indicate the monetary value of potential changes (Table 1). Analysis of baseline, current, and target chip quality allows the prediction of potential savings from chip quality optimisation. The impact of all unit managers seeing the same data at the same time in the same format is considerable.

While TVCD has confidentiality agreements with its clients that preclude publication of individual customer data, an aggregate of results from multiple installations and customers can be seen in the sidebar, *Typical Mill Benefits*. All of the financial data is expressed in US dollars.

Anyone who knows the internal operations of a paper mill is familiar with the traditional conflict between mills and chip suppliers over chip quality. There is nothing more divisive than the finger pointing of a Monday morning meeting. Simmons says that as much as anything, the TVCD program has shifted those meetings and relationships from the tradition of "just change something" to a "fact-based problem solving" session.

Perhaps the last barrier to increasing mill productivity and profitability by controlling chip quality is about to tumble.