Boise Mill Boosts Quality, Cuts Costs With Statistical Optimization Method

Paper machine project at Jackson, Alabama mill improves CD stiffness and formation while lowering fiber requirements—without capital investment.

— By Ken Patrick, Editorial Director

Members of J1 quality team (L-R): Jerry Yarbrough, technical services representative; Marty Parker, TQ facilitator; Joni Mazur, TQ manager; Willie McKenzie, J1 backtender; Gordon Morseth. J1 superintendent.

As part of a continuing improvement program launched several years ago, the Boise Paper Solutions mill in Jackson, Ala., recently completed an optimization project on its 37-year-old J1 paper machine, significantly improving sheet quality without investing any capital dollars. Conducted in response to customer requests for increased CD stiffness and improved formation properties, the project also reduced raw material costs by substituting a higher percentage of ash for bleached pulp fibers in the sheet.

The J1 project is the most recent in a series of optimization efforts at the mill using a statistical analysis method known as Multiple Variable Testing (MVT) developed by QualPro of Knoxville, Tenn. The mill first applied MVT to its just-started-up deinking plant in 1996, followed by a project to also boost CD stiffness and formation on its new J3 fine paper machine in 1997. The technique was subsequently applied to the mill's kraft pulp bleach plant to improve overall efficiency and reduce costs, to the converting facility to reduce waste, and then to the J1 optimization projects beginning in late 2001.

By early 2002, the J1 MVT analyses were completed and adjustments made in the furnish and filler addition. These changes improved Gurley CD stiffness by some 8% for grades produced on J1. Although in some regards contrary to common papermaking experience, increasing precipitated calcium carbonate (PCC) filler while decreasing bleached softwood fiber content proved to be the right combination. Today, the mill is running an ash content as high as 13% (or higher) with some grades produced on the J1 machine, with significant overall savings.

Still in place, the J1 optimization team then turned its attention to ways of improving formation on the machine. Increasing ash content helped improve printing properties, but the team wanted to explore other things that might improve the sheet's visual appearance and general formation properties. By spring 2002, the MVT formation improvement project was well underway, with improvements being implemented and benefits realized later that summer.

Along the eight-step path of the MVT analysis, a "gimme" surfaced that allowed some immediate improvements. The team discovered that changing the angle on wet end foil blades (scheduled to be replaced during the mill's next shutdown) would significantly improve formation characteristics and reduce visual "blotching" in the sheet.

Reducing consistency in the headbox and increasing the foil baffle angle to increase water removal produced a better overlay of fibers with a resultant dramatic increase in formation. Overall, formation was improved an average of 33% on J1, across the major grades produced on the machine.

Because optimization using MVT is an ongoing process at Jackson, a team was most recently initiated to analyze grade change efficiency on J1.While this project is currently underway, another team is examining yield and ways to reduce off-quality production in the mill's deinking plant. At the same time, a team is exploring optimization of the wet end chemistry on the J3 twin-wire paper machine.

J1 Project Background

The J1 Valley/Allis Chalmers fourdrinier paper machine was originally started up in the mid-1960s. It trims 215 in. and runs at a maximum speed of around 2,300 fpm. During the past 10 years, the press section was modified with the installation of a press suction roll, along with other upgrades (mainly by Metso) that included replacement of the headbox and conversion to a two-roll calender stack.

J1 produces 300-330 tpd of forms bond and book papers, depending on the basis weight, caliper, and other properties of the specific grade being run. The machine is highly flexible, producing 60-plus grades of paper overall, sometimes requiring as many as 10 grade changes in a 24-hr period, which is a primary reason behind the current study of ways to improve grade change efficiency.

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As Joni Mazur, TQ manager at Jackson, explains, customer input drove the project to improve CD stiffness and formation properties on J1. "This was done based on responses from our customers. Increased stiffness was needed by our converting customers to improve performance in their machines and systems, and better formation was an issue especially important to our book papers customers."

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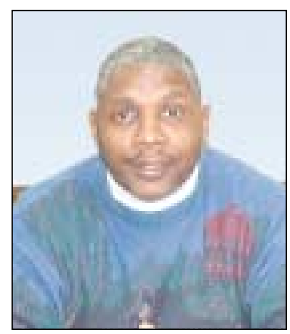
Marty Parker, TQ facilitator, adds that customers "used to pull our forms bond type of papers long-grain (machine direction) through their presses and copiers. To increase speed and through-put, they have begun pulling cross-grain (cross machine direction), which effectively shortens the length of sheets and allows more to pass through in a given period. This meant that we needed to increase our CD stiffness to improve the stability of the sheet under these conditions."

Team Structure

Willie McKenzie, backtender on J1, notes that the optimization team moved directly out of the stiffness project right into formation improvement. Adding that some 60%, or six of the eleven on the team, were hourly personnel, he points out that optimization projects at Jackson are typically driven by extensive operator expertise. "We had more than 150 years of papermaking experience on our J1 team. One of the hourly employees had clock No. 66 (mill's very first employee was given No. 1)." Hourly employees volunteer to participate on these teams, he adds. "It's not a job requirement for any of them."



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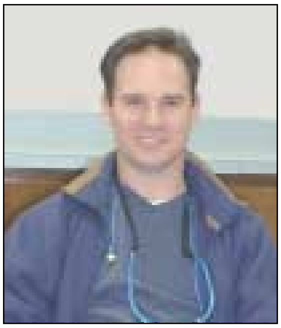
Jerry Yarbrough, technical services representative, adds that although salaried, management personnel are on these teams (five of the eleven on the J1 team, for



"That's the beauty of MVT—its consistency and replication of results—not operating by the seat of your pants."

— ***Jerry Yarbrough,*** technical services representative

example), typically only two or three meet with the team at any given time, primarily in a support capacity. "Basically, it's the experienced, hourly employees who drive the team's activities and do the work. In a way, it's a matter of ownership."

However, management support is absolutely critical, all insist. They point out that support and willingness to take risk not only at the mill level but corporate-wide is vital to the success of these continuous improvement programs. "And we've been fortunate to have this support in the Boise organization," Mazur says.

As Parker explains, prior to the CD stiffness project, the J1 team had no experience with statistical experimentation. But by the end of 2001, the team had gone through its first MVT project and was ready to move immediately into the next one "Our experience has shown that by using a very structured process and proper training, real success can be gained, regardless of a group's background or exposure to statistical methodology."

MVT Analysis

The fact that MVT is a highly structured process provides a high degree of repeatability in the mill's optimization programs. "With the old ways, before MVT, we would often make changes we could not replicate," Yarbrough says.

Gordon Morseth, J1 superintendent, adds that MVT "takes away much of the perception and gets right down to what's real—the data. With statistical analysis of multiple variables, it's possible to find out what really makes a difference, which is almost impossible when testing one thing at a time. On a paper machine, there's nothing you can do that doesn't affect something else. Any one change might affect five other things. You have to look at the whole picture and be sure you're not causing more trouble than you're solving. MVT assures that you don't do this."

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McKenzie explains that, typical of other MVT-based continuous improvement projects at the mill, the CD stiffness and formation improvement projects for J1 machine began with a team brainstorming session. The team came up with 72 suggestions for improving CD stiffness, which were then subjected to the "is it practical, feasible, and cost efficient" parameters of the MVT method. This "boiled down" the number of possibilities to five.

"In boiling down the possibilities to what is truly practical, we had to decide what would really work in our system and what would not, and what we actually could and couldn't do," McKenzie notes. "For example, we knew we couldn't go in and tear out and replace major pieces of equipment because that wouldn't be cost efficient. We knew it would not be feasible or practical to send people through extensive training because that would take too long and be difficult or impossible to assess. We also knew there were only certain things we could do with our process and furnish mix without risking extensive production loss. During these optimization projects, we wanted to continue making quality paper. It was important that we keep paper going out the doors during these times."

The five possibilities (or factors) for improving CD stiffness involved adjustments in:

- **Percent of ash**
- **Percent of softwood content in the furnish**
- **Rush/drag**
- **Hardwood freeness**
- **Wet end starch**

As Yarbrough explains, a series of "recipes" were developed using MVT statistical mathematics, that allow the interaction of multiple variables to be evaluated at one time, rather than the time-consuming one-variable-at-a-time practice normally used in most trial runs. These recipes were then given to the operating crews and results were carefully evaluated.

Yarbrough points out that although it is contrary to common papermaking experience that decreasing fiber content will increase stiffness, "it was the interaction of variables that produced the desired result. If we increased ash to 9.5% and held softwood content at 26%, (or decreased softwood content without increasing ash), there would not have been an improvement in stiffness. It was the interaction of these variables, rather than the action of either one individually."

Mazur emphasizes that by using MVT, "our operators can see just exactly what they can do with their equipment, the process, and the products they're producing. It's exciting for us to see them get excited about what they can do with the process. When they accomplish something as we did with the CD stiffness project, it isn't long before they see something else they can do even better. A comfort level comes with running MVTs, and they start pushing the envelope on what they can do with the process."

Mazur adds that the reduction in softwood fiber use not only reduced production costs, but also eased the fiber supply situation at Jackson. "We constantly walk a fine line between being a fiber-short mill and being able to deliver what our customers want, working within the cost environment. Increasing the ash content on J1 was a big help in this regard."

McKenzie explains that although rush/drag did have some impact on CD stiffness and formation, the analyses showed that the machine was already being run at the maximum ratio in this regard. Hardwood freeness, and wet end starch did not have any significant effect on these properties.

The "gimme" in the formation improvement project occurred in step six of the MVT process, and thus it was not necessary to go on to step eight and actually run the MVT mathematics and conduct runs using recipes. "As soon as the machine started up with the new foil angles, 'poof'—the formation problem was fixed. It wasn't necessary to run the MVT's on formation. Our immediate results proved that we had fixed the problem," McKenzie says.

Team Effort

Mazur points out that the success of Boise's continuous improvement program at Jackson is due, in large part, to a lot of people working together as a team. "A successful project needs input and involvement of manufacturing, marketing, and sales, among many others. We all have different sides of the story and different perspectives. Unless we work closely together, we will never make it."

Parker adds that "things are changing all the time, with new conditions and new technologies constantly coming into play. We need input and feedback from all parties, especially customers. Today the problem or challenge is CD stiffness and formation, but tomorrow it could be opacity, porosity, brightness, etc. The way we are structured, we can call our teams into action very quickly, as needed."

Morseth reports that the mill's customers "have responded very well to improvements made on J1 machine. We have had very positive feedback from our customers beginning in late 2001. Stiffness is a major runnability factor on their equipment, and it's almost a guarantee that you will hear loudly and clearly from them if any paper grade is not running well on their equipment. Our customers have also noticed and like the improved formation."

Continuous improvement is essential "if we are to survive," McKenzie notes. "We always want to improve our process to be more competitive in today's marketplaces. So these types of projects are ongoing at the mill—we have to keep the ball rolling at all times, looking for better ways to do things."

Mazur, Parker, and Yarbrough were given extensive training by QualPro and design and work with the area operators to conduct the actual MVT studies. Periodically, Mazur explains, a QualPro consultant comes to the mill and refreshes and updates the team on current and new MVT techniques. "This helps us keep a dynamic perspective. Sometimes we can develop tunnel vision with our teams and need some outside input," Mazur says. ■