Challenge
In addition to being a major consumer of energy, the Kraft Mill kiln at Abitibi Bowater – Fort Frances presents a variety of operational challenges. Large temperature swings cause lime quality variability and degrade performance, wasting energy and creating a significant bottleneck in the mill process.

Solution
Fort Frances chose Honeywell’s Model-based Predictive Control (MPC) system to provide an overall balanced and optimized control of their Kraft mill lime kiln, one of their most energy-intensive process areas.

Advantage
- Reduced process variability
- Improved in product quality stability
- Increased production throughput

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Lime Kiln Creates a Major Bottleneck
Abitibi Bowater – Fort Frances Division produces 800 tons per day of commercial printing paper requiring 450 to 550 tons per day of 80% ISO brightness groundwood pulp and 150 to 250 tons per day of Kraft pulp.

The Kraft mill lime kiln is one of the major bottlenecks of the mill’s production throughput, and also a major consumer of energy; in 2005, kiln operation alone consumed upwards of $3 million in natural gas.

In addition to being a major consumer of energy, the kiln presents a variety of operational challenges. Large temperature swings cause lime quality variability and degrade performance, wasting energy and creating a significant bottleneck in the mill process.

Variability in the kiln’s performance also has a negative impact on the scrubber performance, as process upsets result in increased emissions of carbon monoxide and lime particulate.

Poor kiln performance was limiting the amount of lime available for cooking wood chips in producing pulp.

Management of these factors is complicated by the fact the lime kiln is a very slow process, often creating delays up to hours at a time between process input and output, making it difficult to manually maintain process stability.

Any initiative aimed at reducing energy consumption and emission, and increasing materials inputs, would have to gain control of these critical sources of process variation.

Development of MPC
To achieve their objectives, Fort Frances decided to use a Model-based Predictive Control system that would automatically adjust key control parameters and allow the Kiln to operate in automatic.

Having had success with Honeywell’s process and control monitoring technologies in other areas of their operation, Fort Frances again partnered with Honeywell to implement an advanced process control solution at their lime kiln.

Prior to this project, the lime kiln had never operated under automatic control. As implementation of an MPC controller requires all control loops operating in automatic mode, the first phase of the project was to improve controls to allow control loops at the DCS level to run in automatic.

Figure 1: Lime Kiln Process
Honeywell engineers then developed a control matrix, a set of process models describing the relationship among the kiln operating variables, which the MPC controller uses to calculate control actions.

The MPC system was then tested and evaluated, partly through computer simulation, before being fully implemented on the Lime Kiln. The Lime Kiln MPC system was proven to be fully functional.

Utilization and Reduction in Variability and Energy Use

The benefits of an MPC system are dependent on system utilization. Performance data gathered at the lime kiln in 2007 shows that the average MPC utilization rate was about 85%. The low utilization was mainly due to the learning curve of the new technology, the initial plant shutdown, and onsite construction of new infrastructure. It is very clear that all mill staff, from the operators and engineers to the mill managers, have become confident and comfortable with the technology and were seeing benefits to lime kiln operation.

Take the Fire End Temperature of the kiln as an example. The variation of Fire End Temperature in year 2007 is about 66% of that in year 2005 and only 36% of year 2006. This is a critical KPI, as the stability of Fire End Temperature is directly related to the stability of lime quality, which in turn directly affects the productivity and profitability of the operation as a whole. With the kiln providing a dependable throughput of reliably high-quality lime, costs associated with raw materials inputs decrease significantly. Furthermore, only when this low variability is achieved, the kiln can be run at a lower Fire End Temperature to save the gas consumption, without sacrificing the lime quality.

Since the implementation of MPC control on the lime kiln, the energy efficiency has been improved, burning the gas in a more efficient way. Take the average gas usage per digest cook as an example. The following graphs compare the average gas consumption and its standard deviation for the years of 2005-2007.

Even though year 2007 has a significantly higher production than 2005 and 2006, its average gas consumption per digest cook is significantly lower.

Figure 2: Lime Kiln Feed End Temperature during mud filter wash

The reduction in process variability and the improvement in product quality stability, which further leads to increased production throughput and removing lime production as a bottleneck, are the most significant achievements of this Lime Kiln APC project.
Model Based Predictive Control (MPC) System Helps Reduce Lime Kiln Process Variability Yielding Significant Results for Abitibi Bowater

Moving Forward

With the MPC control system in place, Abitibi Bowater – Fort Frances has already seen the benefit of reduced process variability and increased lime production. It is now able to move forward to make further gains in energy and materials efficiency, increasing MPC uptime and using the newly stable process as a basis for ongoing process optimization.

The energy efficiency improvement being seen since the MPC commissioning is mainly due to the stability gained in the kiln operation. With a stable operation, it is now possible to push the operational parameters towards their constraints.

Further energy efficiency improvement can be achieved by decreasing the overall kiln operation temperature, mostly the Feed End Temperature but also the Fire End Temperature as well.

To make this happen, the technology is already in place, leaving the remaining major barrier of practice and culture change in the operational environment that staff develop.
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Figure 5: Kiln performance under mud flow changes

About Abitibi-Consolidated
Abitibi-Consolidated is a global leader in newsprint and commercial printing papers as well as a major producer of wood products, serving clients in some 70 countries from its 45 operating facilities. Abitibi-Consolidated is the largest recycler of newspapers and magazines in North America, diverting annually approximately 1.9 million tons of waste paper from landfills. It also ranks first in Canada in terms of total certified woodlands.

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