BRUEST HOT CAT

World Leader in Flameless Gas Infrared Catalytic Heaters

# Bruest Catalytic Line Heaters Ensure Supply of "Dry" Gas to Maine Pulp Mill

**A Maine pulp mill more than a century old had to close briefly in 2010 due to high energy prices and poor market conditions.**

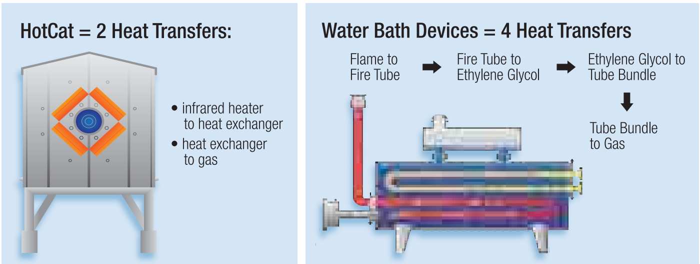
New owners and new economies prevailed, however, when the mill converted its secondary energy requirements from expensive oil to relatively inexpensive natural gas from a nearby trunkline, for which they built a 5-mile pipeline of their own.

To keep the mill's downstream equipment free of potentially damaging frozen hydrates in the natural gas supply, mill owners asked Bruest Catalytic Heaters (Independence, KS) to engineer a solution.

*Two HotCat HC2000 catalytic infrared line heaters were engineered by Bruest, allowing the Pulp mill to replace costly oil with natural gas.*

## How it Works

The catalytic process is an oxidation reduction reaction that converts natural gas into three components: infrared energy, CO2 and water. There is no open flame, and no ethylene glycol or other chemical charge. Perhaps most notably, catalytic infrared is a direct, rather than indirect, heating method, which translates into substantially higher efficiencies and lower operating costs. Specifically, in field operation, a catalytic pipeline heater generating infrared energy has an average heat transfer efficiency for higher than water bath transfer efficiency. This advantage can save thousands of dollars each year in operating expense.




Key to the HotCats' high heat transfer efficiency is the way in which they use infrared energy. By surrounding the heat exchanger with catalytic infrared energy that is absorbed directly, the system operation requires just two heat transfers: infrared to heat exchanger, and heat exchanger to gas. By contrast, water bath devices involve four separate heat transfers: from flame to the fire tube inside the solution; from the fire tube to the ethylene glycol; from the ethylene glycol to the tube bundle; and from the tubes to the gas.

Complementing the operational advantages and efficiencies of catalytic heaters are such things as a relatively small footprint and height requirement, minimal environmental impact, and the lack of a chemical charge as is required in water bath heaters. Typically, the chemical charge in a water bath heater is ethylene glycol, but concerns over its toxicity have persuaded some users of water bath systems to use propylene glycol, which is less toxic and transfers heat more efficiently. However, propylene glycol is more costly, less effective at freeze point depression, and its higher viscosity increases head loss in the system and accelerates pump wear.

## Environmental and the Environment

**Worker safety also is an issue in which water bath devices and catalytic heaters contrast sharply.** In the U.S., for example, ethylene glycol is a poisonous chemical designated a hazardous substance under Section 3(b) of the Federal Hazardous Substances Act. Excessive exposure can damage the central nervous system, heart and kidneys; damage red blood cells and bone marrow; and induce an assortment of other ailments.

Finally, there are environmental issues to consider. The transportation and use of a hazardous substance in the U.S. and other advanced economies are regulated and add a liability component to operating costs. At installations in which large quantities of ethylene glycol are used -- perhaps especially so in unmanned facilities -- there is the ongoing threat of inadvertent (or malicious) chemical release. For reasons such as this, ethylene glycol use requires permitting in the U.S.

## New Life for an Old Mill

**After more than a century of operation, the mill in Baileyville, Maine -- closed.** High petroleum prices and poor market conditions prompted its then-owner, to divest the operation.

The foresight of the new owners and their willingness to invest in the conversion was a lifeline to the plant, and the surrounding economy. The Bruest HotCat catalytic infrared heaters that condition the incoming natural gas were critical to insuring the success of the conversion, and to assuring the ongoing reliability of the natural gas supply.

Bruest Catalytic Heaters are approved for Division 1 & 2, Group D areas. They are also approved by CSA, FM, Atex and Tokyo Gas.

For more information, contact Bruest Catalytic Heaters, Division of Catalytic Industrial Group, Inc. www.bruestcatalyticheaters.com (800) 835-0557. E-Mail: sales@bruestcatalyticheaters.com

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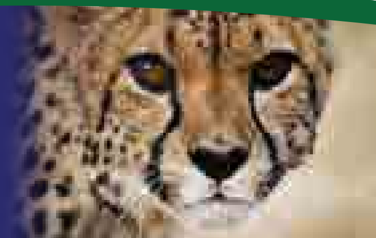



www.bruestcatalyticheaters.com

A little over a year ago, two "HotCat" catalytic infrared natural gas line heaters, manufactured by Bruest Catalytic Heaters, were installed at a pulp mill in Maine to ensure the supply of "dry" gas (free of frozen hydrates) to the mill's boilers.

The story of how this happened is an interesting one, full of lessons about new ways of doing old things, how changing market conditions can bring down an old mill, and how a willingness to invest wisely can save a mill -- and a regional economy -- from economic foreclosure.

The pulp mill is situated adjacent to the St. Croix River, an international natural boundary between Maine and New Brunswick, Canada. The mill produces Woodland St Croix Hardwood, a premium ECF (elemental chlorine-free) bleached kraft pulp manufactured using hardwood chips from Maine and New Brunswick, Canada. Its product is used all over the world in coated, machine glazed, carbonless, bond and copy papers.

The original mission of this mill was to supply newsprint to the Boston Globe. In early times, the mill preceded the town that grew around it and did, in fact, supply the community with its power since the mill was generating its own power to begin with. In 1963, Georgia-Pacific bought the mill and held it for 38 years until it sold the facility in 2001.

While the former owner owned the plant, market conditions were such that the formerly integrated (produced pulp and paper) mill's papermaking operation was shuttered because it was unprofitable. Things worsened when a combination of low pulp prices and high oil prices caused the plant to "indefinitely" close in 2010. Fortunately, that closure lasted only twenty days. With the help of the black liquor tax credit (passed by the U.S. Congress in 2005 to support the use of liquid alternative hydrocarbon fuels and expanded in 2007 to include non-mobile uses of liquid alternative fuel derived from biomass) and stabilization in pulp prices, Domtar re-opened the mill, though in short order they decided to divest it.

They found a buyer and in the Fall of 2010 the new owners took possession of the mill. The facility, previously in jeopardy of closing, was revived by its new owners, who were eager to invest in the mill's competitiveness. As an employer of about 300 people with an annual payroll of $20-$25 million, the direct and downstream economic effects of the mill's closing would have dealt an incalculable blow to the broader local economy of Eastern Maine.

## Switching from Oil to Natural Gas

**As the new owners took control of the pulp mill, they were still faced with difficult market conditions and understood they would have to find a way to secure the long term viability of their investment.**

As an energy-intensive operation, the mill would greatly improve its financial performance if it could reduce its energy costs. The primary fuel consumed by the plant was "black liquor," a derivative of the kraft pulp-making process in which lignin and cellulose are separated from the wood chips entering the plant as raw material.

Varying production and mill conditions, however, necessitate the availability of a back-up fuel. Until well into 2011, that back-up fuel was #6 fuel oil, which was used to fire the mill's production and power generation boilers. Nonetheless, oil's high price was prohibitive to the mill's continued operation. The mill's primary fuel may have been black, but without some changes its bottom line would continue to be inked in red.

Fortunately, there was a Canadian natural gas trunkline (which locally crossed over into the U.S.) from which the mill could be fueled. The mill's new owners approved a multi-million dollar investment to build a 5-mile pipeline that connected with the trunkline in the U.S. At the heart of this decision was, of course, the favorable price of natural gas versus the price of oil. As it turned out, the price differential between oil and natural gas was enormous, lowering the back-up fuel price from about $18/million BTUs with oil to about $5/million BTUs with natural gas.

In January 2011, the process of converting the mill's back-up fuel to natural gas began. Equipment conversions and modifications were made, and by May 2011 the mill started receiving trucks filled with liquid natural gas (LNG) to temporarily supply their back-up fuel needs. These trucks came from Massachusetts, and the mill was consuming 4-5 truckloads per day as its new natural gas pipeline was being built.

On December 6, 2011, the new pipeline built and all conversions made, the mill's back-up fuel officially became natural gas. It all happened in less than a year. The investment required to make this conversion was about $18 million. The project, initially thought to take three years to recover the investment, was close to break-even after only about one year of operation.

## Conditioning the Gas

**Nonetheless, the conversion to natural gas presented its own set of implications.** Those who transmit natural gas through a pipeline know well that pressure drops in the natural gas cause it to cool significantly. This, in turn, induces the Joule-Thomson effect, which causes hydrates in the gas to form ice particles that can damage equipment downstream.

Technically, natural gas hydrate is methane clathrate, also known as hydromethane, methane hydrate, methane ice or "fire ice." Extremely cold climatic conditions may induce pipeline freezing in the traditional sense. However, the dominant "freezing" problem in the mill's pipeline is the Joule-Thomson effect, which freezes hydrocarbon liquids as the pressure of incoming natural gas is reduced to feed the mill's boilers.

Natural gas comes in to the mill from the main pipeline at 1400 psi, but for use in the plant this pressure had to be reduced to 60 psi. To prevent damaging ice particles from forming, therefore, the incoming natural gas is heated before its pressure was reduced and the gas chilled as a result.

Given the parameters of incoming pressure, flow rate, inlet gas temperature of 35°F and the anticipated cooling from the pressure drop, the problem of solid hydrate formation was solved by technology developed by Bruest and proved in hundreds of installations worldwide. The technology is the Bruest HotCat catalytic infrared line heater.

Two HotCat HC2000 line heaters were installed to operate in parallel. Though either unit could accommodate the mill's nominal daily load, the mill purchased two units for redundancy. It is fortunate they did, for on a tough day in late 2012 the mill had to run both units "full-out" to keep the mill's boilers fed with natural gas.

## Benefits of Infrared Catalytic Heaters

**In most natural gas pipelines around the world, infrared catalytic heaters compete primarily with water bath heaters (or "glycol heaters") that use heated ethylene glycol to prevent the formation of hydrates.** Since 2005, however, a confluence of market drivers has increasingly favored the use of catalytic heaters. Among these favorable drivers are easy installation, low maintenance requirements, no need of hazardous chemicals, no open flame in operation, and a heat exchanger design that maximizes heat transfer.

In fact, had originally specified water bath heaters to condition their incoming natural gas. However, Bruest's short lead time of only 2 months to deliver the appropriate units dovetailed nicely into the mill's already hurried timetable. Additionally, the cost of the HotCats compared very favorably with the water bath heater. Whether the comparison is capital cost, installation cost, operational cost, or total life cycle cost, 21st century HotCat Catalytic technology is more economical than water bath devices.