Markets

Increased Sales

Current estimates suggest that impulse drying could effectively increase the production capacity of dryer-limited paper machines by up to 50%. Because machine speed is also limited by web forming and sheet handling, actual increases would probably fall in the range of 5 to 20%. Depending on the rate at which the new technology was implemented by industry (there are currently about 150 machines in Canada making newsprint or newsprint grades of paper), increased paper sales could amount to between $250 million and $1 billion annually.

Higher Quality Paper

Tests have shown that electrical impulse drying results in higher-quality paper (the impulse-dried web is denser, smoother and stronger). The lower production costs and superior quality of these papers would ensure their success in domestic and foreign markets. Current estimates suggest that additional foreign sales of high-quality Canadian papers could amount to between $100 million and $250 million annually.

Job Creation

The manufacturing of each new impulse drying press would create approximately 12.5 person-years of employment. Annual sales of the new units are forecast at 2 to 4 machines nationally, and 4 to 8 machines internationally. That translates into 75 to 150 additional jobs annually for Canadians.

Electrical impulse drying holds significant promise for Canadian paper mills that can take advantage of low-cost electricity, particularly those producing newsprint.

The Canadian pulp and paper industry produces about 30 million tonnes of market pulp and paper annually, 36% of which is newsprint, at a cost of over 12.7 GJ of energy for every tonne of paper produced. Currently, about half this energy is electrical. Clearly, the industry stands to benefit from the widespread application of electrical impulse drying. Depending on the technology's market penetration, industry-wide energy savings could total between 1 and 2 million BOE per year.

Your Invitation to Work with Us

We are interested in collaborating with you. Please contact the Business Office to discuss your particular needs.
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CETC CANMET ENERGY TECHNOLOGY CENTRE

INDUSTRY ENERGY RESEARCH AND DEVELOPMENT PROGRAM

CLEAN ENERGY TECHNOLOGIES

ELECTRICAL IMPULSE DRYING

With help from the Industry Energy Research and Development (IERD) program, the Pulp and Paper Research Institute of Canada (PAPRICAN) has developed a new approach for evaporating water from the moist web to produce a dry sheet of paper. This technology bridges the gap between conventional pressing and drying, and increases the web solids content at which conventional drying begins. PAPRICAN's electrical impulse drying technology uses 50% less energy to remove water than conventional dryers and produces paper with improved quality.

Early impulse dryer prototype

The Conventional Drying Process

Wood pulp on its way to becoming paper undergoes an extensive water removal process. Initially, water is removed mechanically by drainage, suction and pressing to form a paper web that is roughly 40% solids, 60% water. In the dryer section, more water is removed, this time through evaporation. The web passes around a series of 40 to 50 cylinders heated with low-pressure steam (usually produced by burning fossil fuel in a boiler). Paper exiting the dryer contains approximately 94% solids. It then continues on to the remaining sections of the machine for surface treatment and winding.

Removing water through evaporation in the dryer is costly and time-consuming. Conventional dryers consume up to 75% of the total energy used to make paper but remove less than 1% of the water involved in papermaking.

The New Process For Water Removal

In the early 1980s, PAPRICAN began investigating an advanced technology called impulse drying that combines heat and pressure to force water out of the paper web. In electrical impulse drying, the web is fed to a nip created by two counter-rotating rolls.

One roll is covered by a felt and the other roll is metal that is heated to temperatures in excess of 120°C by electrical induction. The unit is installed between the press and the dryer sections of the papermaking machine.

When the paper web exits the press section, it passes through the heated impulse drying nip. Water near the surface of the web contacts the heated metal roll. This surface water flashes to steam, which in turn expels water from within the web into the felt on the second roll.

Depending on the operating conditions, the solids content of the emerging web can be as high as 60%, a value that is normally achieved about halfway through a conventional dryer section. Although the remaining water must be removed conventionally, the dryer and,

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consequently, an entire dryer-limited paper machine, can be operated at a much higher speed. Alternatively, a shorter dryer section can be used. Impulse dryers can be retrofitted to existing machines or incorporated as an advanced technology into new machines.

Based on the success of a small, pilot scale impulse drying unit, PAPRICAN applied to the Industry Energy Research and Development (IERD) program for financial assistance in developing and testing a large scale pilot version of its innovation. The IERD program, which is administered by the CANMET Energy Technology Centre-Ottawa of Natural Resources Canada, helps Canadian firms develop and commercialize new, energy-saving technologies, products and processes. The program agreed to fund $4 million of the $9.5 million project cost on condition that PAPRICAN involve both paper machine users and manufacturers. A further condition was that the technology, if successful, be implemented in Canada.

Started in 1987, Phase I of the project involved the installation of a single impulse drying unit after the press section on Paprican's pilot paper machine. In Phase 2, PAPRICAN installed a second impulse drying unit in series with the first, but with the roll configuration reversed to correct any tendency to one-sidedness. In Phase 3, the final phase of the project completed in 1994, the first impulse drying unit was replaced by a Beloit Extended Nip Press. As opposed to a two-roll nip, the nip is created by the action of a shoe press against a roll. The extended nip increases the residence time of the paper web in the nip, producing a drier product.

Benefits

Energy

A survey conducted by PAPRICAN in 1985 showed that conventional dryers in Canadian paper-making machines removed 1.33 tons of water per ton of newsprint produced, using 2 tons of steam per ton of newsprint. This represents an energy cost of 4.6 GJ/ton of dry paper. If this water could be removed by evaporation at 100% thermal efficiency, the energy bill would still be 3.1 GJ/ton of dry paper. PAPRICAN's electrical impulse technology removes water much more quickly than the best conventional dryers and can use as little as 74% of the theoretical amount of energy which would be required for 100% efficient evaporation.

If the impulse dryer were used to do just half of the drying work (leaving the other half to conventional technology), the energy consumption would be 3.4 GJ/tons of dry paper. The energy saving for a typical modern newsprint machine producing 180,000 tons of paper annually would be 216,000 GJ per year – the equivalent of 35,000 barrels of oil (BOE).

Productivity

The mechanical components for impulse drying have been developed by a number of manufacturers, and will allow existing papermaking machines to be retrofitted with the new technology. As well, advanced papermaking machines based on the new technology could be constructed in Canada. In either case, capital costs would be offset by savings in equipment (since a much shorter dryer section would be needed), or by increased production as a result of higher machine speed.

Quality

Impulse-dried paper has increased in-plane strength properties, and significantly improved z-direction bond strength. This can lead to cost savings by allowing the use of cheaper furnish, and provides opportunities for conversion of older papermachines to produce value-added grades such as coating basestock.

Environmental

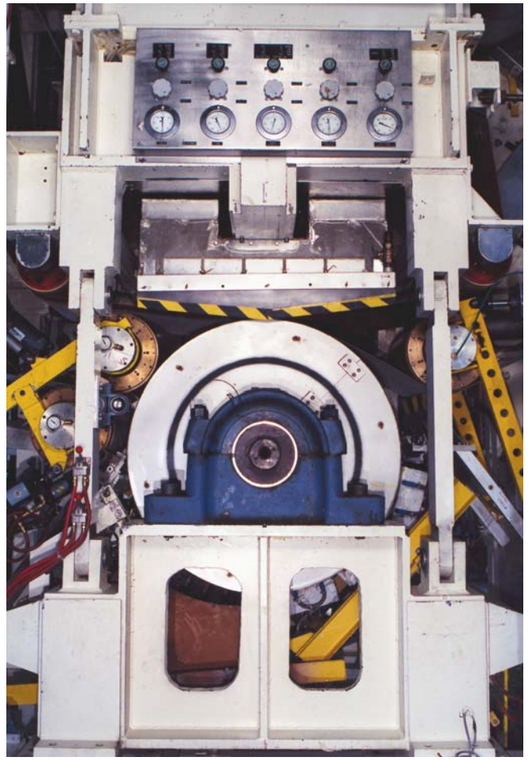
The new technology allows mills to use electricity instead of fossil fuels to create heat for the dryer sections of their papermaking machines. Where the technology is adopted and the electricity is derived from non-fossil fuel sources, the result will be reduced emissions of harmful gases, including sulphur dioxide and carbon dioxide. These benefits can be realized most readily in areas where hydroelectricity is abundant, as in British Columbia and Quebec (which together produce 50% of Canada's newsprint).

Economics

The cost of installing an impulse drying unit in a typical Canadian newsprint or groundwood specialties machine is estimated at $17.5 million: $8.5 million for the impulse drying unit, $5 million for electrical services, $2.5 million for mechanical services and $1.5 million for other costs.

The reduced energy usage, improved product quality and decrease in machine length or increase in machine speed resulting from the installation of an impulse drying unit opens up many possible options for the application of this technology. Older newsprint or groundwood specialty machines can be converted to produce high-quality offset printing paper, surface-treated paper or coated grades. Depending on the grade manufactured and the details of the rebuild, it is estimated that the payback period would range from 1 to 3 years.

The incorporation of an impulse dryer on a new newsprint machine would reduce the dryer section length by about half. In this scenario, the savings in building and dryer section costs would amount to about $20 million.



Impulse dryer on Paprican's pilot papermaking machine (1993)

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