New Developments in Low Energy EB Equipment

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Electron beam (EB) technology has been used in industrial applications for more than 30 years. The use of EB is driven by a number of factors including: improved product performance, product consistency, high throughput, energy savings, and environmental advantages. The nature of EB technology can also enable unique applications that are not possible by other means.

Recent developments in EB equipment have focused on "low energy" systems. These systems typically operate in the range of 70 to 150 kV. This equipment is well suited for curing of inks and coatings used in package printing applications and can also address a variety of non-printing converting applications.

Users and potential users of EB technology continue to ask more from the suppliers of this equipment. They are requesting:

- Lower capital costs
- Improved reliability
- Lower cost of operation
- Easy and inexpensive maintenance
- Customization for new applications
- Environmental compliance

Equipment providers are responding to these requests and are introducing innovative new designs that leverage advances in technology and years of experience with industrial EB systems. A summary of these developments is presented and these advances are compared against the needs of the market.

Integrated Chill Roll

All EB systems require shielding to protect personnel from the x-rays that are generated by the interaction of the electrons with materials in the equipment. Low energy EB systems can be self-shielded such that all of the required shielding is integral to the system. The amount of shielding material required varies with the energy level of the machine.

Chill rolls have been utilized in EB systems for many years. When a chilled roll is used to support the material as it is exposed to the electrons the distance between the material and the window where the electrons are emitted is precisely fixed. This ensures that any variations in the amount of energy delivered to the material are minimized. Even small changes in this distance will have an effect on the amount of energy when operating at low voltage levels. Supporting the material with a chill roll is also beneficial when processing plastic films. This design minimizes the potential for temperature rise in the material which facilitates the processing of heat sensitive films such as those used in the production of shrink sleeve labels.

An innovative new design has been introduced that uses an integral chill roll. This patent-pending design uses a chilled roll to support the material while the roll simultaneously serves as a functional portion of the required shielding. The roll is precisely fit to the mating surfaces. The results are reduced size and materials, minimization of the volume that must be inerted with nitrogen, and easy access for threading and cleaning.

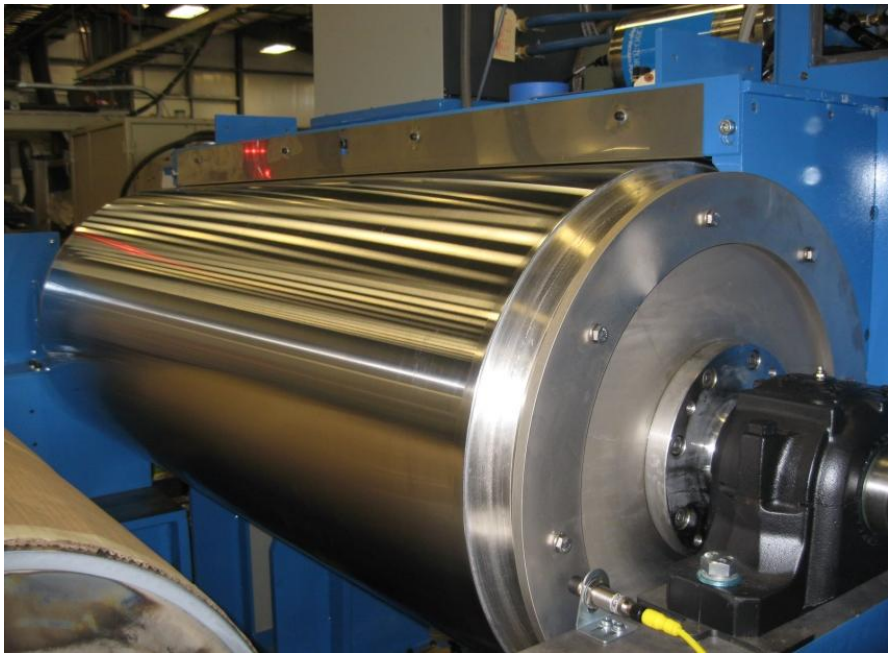

Figure 1. Integrated Chill Roll

Low Profile

Advances in printing press technology targeted at the flexible package printing market have opened more market opportunities for EB systems. An important press technology is the use of variable sleeves on web offset presses. This style of press requires the EB system to accept a low web entry height. The web height will also vary as the sleeve diameters change. The latest EB system designs accommodate these web handling requirements and maintain a "side fire" orientation. The "side fire" orientation is preferred for the maintenance access that is required to perform a window foil change. The small size of this design also facilitates easier retrofits onto existing production lines.

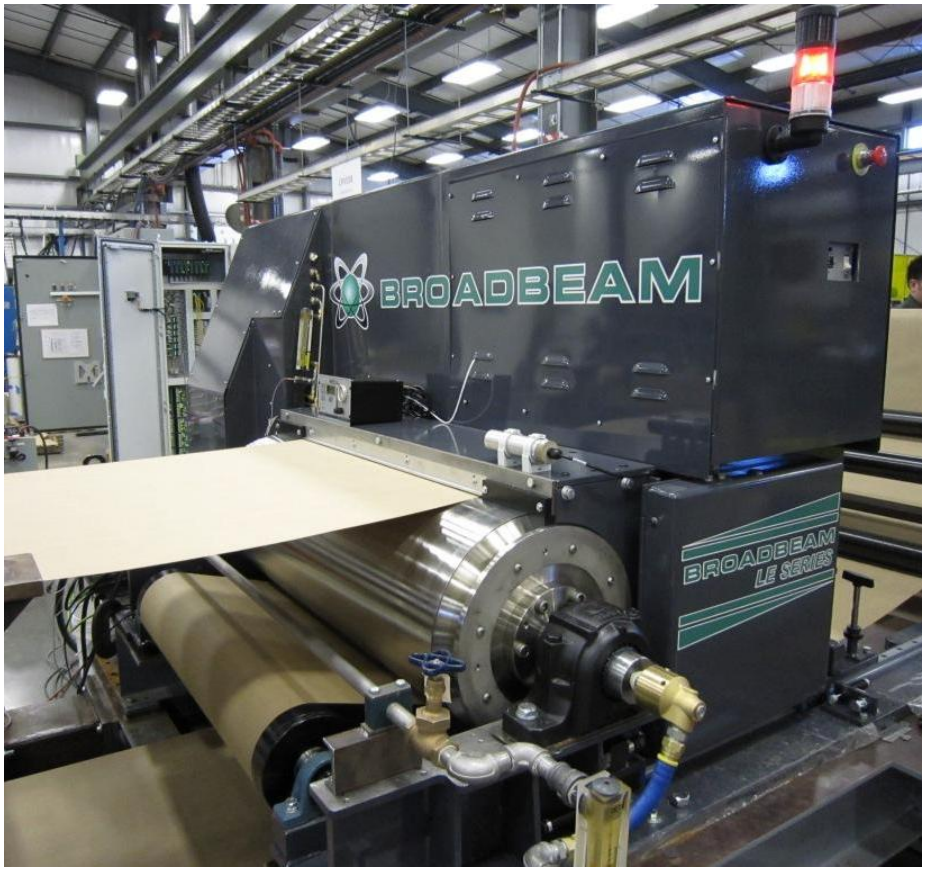

Figure 2. Low Profile EB System

High Voltage Power Supply

The high voltage power supply is a significant component in an EB system. The power supply technology used impacts the equipment's reliability, controllability and energy consumption. EB systems have been introduced that now use high frequency switch-mode power supplies. The high frequency switching of the power transistors minimizes the voltage ripple to give a power factor above .90. This contributes to a reduction in the electrical power consumption.

These latest power supply designs are controlled by integrated digital signal processors. Operating parameters are programmed through a standard web browser and an Ethernet connection. An Ethernet connection is also used for integration with the EB system controls. This connectivity allows direct diagnostic checks to be performed remotely over the internet.

A power supply rated for outputs above 30 kV will use an insulating material in the transformer section. Some power supply designs use sulfur hexafluoride (SF_6) gas for this purpose. SF_6 has been identified as a greenhouse gas air pollutant by the U.S. EPA. It has a global warming potential 23,900 times greater than CO_2. This latest generation of power supplies uses silicone fluid for electrical insulation. The silicone fluid is a more environmentally friendly solution that also results in a cost savings compared to the higher cost SF_6 gas.

Figure 3. High Voltage Power Supply

Summary

There are a number of recent developments in low energy EB system design. As shown in the Table below, these developments are very effective in addressing many of the market requests associated with low energy EB applications. These developments are expected to facilitate the continued growth of EB technology.

Table. Market requests addressed by new EB equipment developments.

	Market Request					
Development	Capital Cost	Reliability	Operating Cost	Maintenance	New Applications	Environmental Compliance
Low Profile				XX	X	
Integral Chill Roll	X	X	XX	XX	X	
High Voltage Power Supply		X	XX	X		X