The Future for EB Technology in Graphic Arts

By David Savastano

Radiation-curing technologies have enjoyed steady growth over the years. In particular, ultraviolet (UV) curing has received most of the attention and made strong inroads in the graphic arts industry in a wide variety of applications.

While electron beam (EB) curing has not received the same interest as UV, it too has also grown over the years. In particular, EB inks and coatings have found a niche in food packaging applications, where the instant cure and lack of extractables have made EB a strong choice for converters.

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Equipment costs and size have been the largest roadblocks for EB growth over the years. While equipment costs are coming down, the slowdown in the economy has kept many graphic arts printers from moving ahead on EB technology. Still, there are new technologies being developed, which should lead to further growth in EB.

The Growth of EB

EB technology has not had the spectacular growth of UV, due primarily to the costs associated with equipment. Still, its growth has been solid, and more printers are making the change to EB.

"Growth in EB business has been steady over the last 10 years," said Jonathan B. Graunke, director, UV/EB technical services for INX International Ink Co. "According to research from Skeist Inc., and Kusamgar, Nertfi & Gowney, the growth has maintained a 7-8% level each year.

"In 2000, the aforementioned research companies indicated EB ink sales at $17.3 million, and coatings at $31 million," Graunke said. "For 2005, they are predicting EB ink sales at $25.8 million, and coatings at $40.3 million."

"Over the last decade, the use of EB-cured printing has grown, but not at a rapid pace," said Mike McGovern, Sun Chemical Ink (GPI) director of sales and marketing, energy-curable products. "In the U.S., the total market for EB inks and coatings is in the range of $30-40 million. EB has not proven as popular in other regions of the world, where folding cartons are not as popular."

"Some years ago, due to cost limitations, EB was used on very selected applications in graphic arts as well as in the film manufacturing," said Kent Shah, Color Converting Industries' vice president of technology. "For the past few years, EB equipment, which was over-engineered for our industry needs, has been redesigned. This has greatly impacted the cost of the equipment and therefore, led to much wider acceptance. On the technology front, where UV had some limitations (cure speed, conversion rate, odor of photoinitiators and complying with some FDA regulations),

EB presented better solutions and therefore, opportunities for growth."

"Most growth that we see comes by far from the folding carton market," Graunke said. "Reasons for this growth are just in time printing, higher quality and perhaps most important is the low odor, low extractables necessary for food and pharmaceutical packaging."

"Folding carton packaging for food has been the largest growth market for EB," McGovern said. He added that this segment of the packaging market has lost share to flexible packaging in the last decade, yet EB's use continues to grow within this segment.

McGovern also said there is considerable interest in the use of EB adhesives for laminating, as well as functional EB top coats.

Capital Costs

When it comes to discussions about entering the EB segment, equipment costs remain the major drawback. It's largely believed that the price of EB equipment, combined with the economic downturn, is limiting the growth of EB.

"In general, printers are not investing a lot in new presses these days due to economic conditions. When they do, they are making careful decisions that position them for future growth through value-added products," McGovern said. "The price and size of EB-curing units have come down considerably. While more printers are taking a look at installing EB curing, they must weigh its use. Increasingly, printers are finding that EB curing can mean added profits."

"Three years ago, we noticed very high interest in the EB equipment," Shah said. "However, due to the current economic conditions, some companies have delayed investing in new equipment. We also see that some of the more technologically driven companies are exploring EB technology regardless of the economic conditions."

Still, EB equipment cost has come down, which has spurred some gains. "Capital expenditure on EB equipment has improved dramatically," Graunke said. "Where it once cost $1 million for high voltage (150+ kV) EB production units, you can now expect to spend $500,000 for the same EB equipment. With the advent of low voltage (80-150 kV) EB equipment, the capital cost is reduced even further, thus opening the doors to smaller web packaging and converting markets."

Technical Matters

A number of advancements have fueled growth in the EB sector, including the cost of equipment coming down. "The cost of the equipment has certainly increased the potential for using EB," Shah said. Shah also pointed to the improvement in chemistry.

"On the chemistry front in the past few years, a wider range of raw material availability has helped expand EB applications," Shah said. "EB formulation has provided low odor of cured product in addition to the formulation capabilities that provide FDA compliant products. All of this has promoted the industry's interest."

In addition to lower equipment costs, improved measurement techniques are also helping the industry reach out to customers.

"Lower equipment costs, more portable equipment and lower operating costs certainly are advancing growth," Graunke said. "The ability to measure the purity of a finished product at current levels by laboratories has opened doors for EB to be a favored application in packaging. This is especially true for perishable items such as orange juice, where impurities from inks and coatings can actually affect the flavor of the products on the inside of the package. Lower voltage output EB units have convenience attached to the maintenance and repair, making them user-friendly. Very short turn-around times, replacing the low voltage emitter source, are fueling less production down time."

"In addition to equipment cost reductions EB has found a niche within certain flexible packaging areas, where several new applications have been pioneered, such as replacement of conventional lamination with EB coating," said Rodney Blamer, Flint Ink's technical director. "These coatings are able to eliminate a film layer, and thus reduce material cost and processing time. These coatings can provide extremely stable levels of CoF, and, in addition, can be formulated to have excellent release characteristics to cold seal adhesives, even when stored in reel form for prolonged periods. EB-cured laminating adhesives allow for the elimination of solvent-based adhesives that may contain potentially harmful materials, such as aromatic amines. Furthermore, EB offers instantaneous cure, unlike solvent-based adhesive laminations, which may have unpredictable performance and lead to delays in delivery."

Dr. Don Duncan, Wikoff's director of research and development, noted that customers are looking for a wider operational window on press.

"Lower cost raw materials and lower cost EB-cure units, especially for coatings, have fueled growth for EB," Duncan said. "Improved performance curable resins have helped both UV and EB inks lithograph better on press."

McGovern said that educating potential customers has also paid dividends. "The industry is doing a better job of educating customers about the potential savings in applied costs over the long haul, which can overcome the near-term capital costs of installation," he said.

The Future for EB

Five or 10 years from now, where will the EB market be?

"This question really depends on equipment advances in the different energy-curable arenas, as well as other considerations such as energy prices and environmental pressures," Graunke said. "Lowering operating costs and making EB units more portable will certainly attract greater interest. FDA approval for direct food contact of EB coatings would have a large positive effect on the EB market. It would allow for the elimination of an effective barrier, and would certainly replace lamination in certain applications."

Shah believes that UV will continue to dominate the narrow web market where both press compatibility and cost of EB are the limiting factors. He sees the largest potential for EB's growth in four distinct areas.

First, Shah sees opportunities in the wide web offset and flexo for folding cartons, where EB provides physical, chemical and moisture resistance.

Shah said that EB might find opportunities on a variety of overprint applications on porous as well as non-porous substrates, where EB provides less odor, better cure consistency and, therefore, predictability for physical and chemical requirements. It is also a desirable technology where FDA compliance is required for food packaging.

Shah believes that packaging lamination adhesives is another growth opportunity for EB. "At present, in the packaging industry, there is a trend in exploring a possibility of using EB-curing adhesives for their laminated packages, which provides value for speed, instant cure and low inventories of finished products over solvent, water or solventless adhesives."

"Some companies are evaluating a possibility of replacing laminated packaging with surface printing and using EB topcoat, which can provide cost advantages," Shah added.

"I think that EB will begin to penetrate new markets, taking business away from flexo and gravure packaging printing," Duncan said. "This will require some creative resin development, some creative ink formulation and rigorous cost control in both ink and hardware."

McGovern added that EB adhesives and coatings could see significant growth in the coming years. He stated that improved EB adhesives could improve the lamination process, while functional coatings might replace lamination in some applications. Advances in both of these processes could boost the EB market.

"EB flexo is an area drawing attention now," Graunke said. "The challenge is to make EB flexo inks that can wet trap. Another area receiving attention is advancements to replace lamination with EB as it would offer significant cost savings."

Balmer sees the flexible packaging market as an opportunity for growth. "End-users continually seek improved performance in the areas of water and moisture resistance," he said. "Crinkle resistance is also considered important. In food packaging, customers continually request inks and coatings with no odor, or extractables, for purposes of secondary food packaging, transient contact and direct food contact applications. Overall, customers would like to see lower cost EB inks and coatings in order to compete with other technologies such as solvent and water-based, and to bring on board all of the associated benefits, and performance characteristics of such."

"As we are learning about new opportunities and requirements, ink suppliers and raw material suppliers will bring better solutions," Shah said.

Will there be significant technological breakthroughs in EB inks and coatings in the next five or 10 years?

"This is really dependent on equipment advances as well as changes in regulations," Graunke said. "Equipment advances will allow for EB applications in areas that do not currently use the technology. Regulatory changes may drive some to a 'green' technology such as EB, and the clarification of rules regarding food contact could offer new advances. In the end, it's all about higher quality, faster production output at lower total costs."

"I do not believe that any major technological breakthroughs are on the horizon, although as raw materials become more refined, ink and coating manufacturers will endeavor to improve properties of existing products and develop new applications and products that may be used to add value to an existing process," Balmer said. "Equipment manufacturers may be able to offer a curing system suitable for sheetfed printing." ◗

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