Cork Tech Talk News

Manufacturers of Waterbase, UV+EB Curable Coatings, Varnishes and Adhesives

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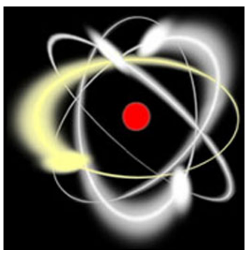
ELECTRON BEAM (EB), EXPLAINING THE PROCESS

Electron Beam technology has been effectively adopted by the graphic arts industry as a means of curing energy curable inks, coatings and adhesives.



EB along with UV, the other energy curing process, has enjoyed notably steady usage growth since early adopters pioneered and advanced a variety of applications.

Some would say that EB is the more exciting and potentially more rewarding technology of the two, since UV limitations in terms of cure speed, conversion, photo initiator odor and FDA compliance issues are a factor.

Initially, in spite of an improved product potential, the cost of EB entry was prohibitive to many. While the first EB equipment for the graphic arts industry easily cost $1 million for a 150+ kV unit, today equipment cost has been cut in half and even less. Recently, advances in equipment design have lead to reductions in cost and size such that much wider acceptance is now expected. This should lead to new smaller web installations and other unique converting applications.

EB has found a home in food packaging applications where instant cure has produced productivity and product advantages, essentially zero VOC emissions and low ink/coating extractable levels. Most all of these food packaging applications have been wide web applications where the scale of the process equipment has provided a good fit.

Newer applications are being demonstrated in multiple film laminating using EB laminating adhesives, and the use of top coatings on film to replace some film lamination products.

Commercial EB applications now include, flexible packaging, aseptic packaging, folding carton, narrow web label, milk and juice carton, multi-wall bags, pet food bags, laminated flexible packaging, bottle wraps, and direct food contact packaging. EB energy curing products include inks, overprint varnishes, coatings, adhesives and release coatings, with other product types continuously in the pipe line.

The largest UV/EB graphic arts printing process is lithographic printing, utilizing UV and EB energy curing inks and coatings. EB web litho represents greater than 33% of this market and is over 80% directed to food packaging. Most of the substrate material involved is SBS, CCN or poly-board. Newer applications are using film materials for flexible packaging and the exploding shrink sleeve market.

Electron beam energy curing systems are simple in concept. An EB processor consists of four major items, power supply, acceleration chamber, beam window, and protective x-ray shielding.

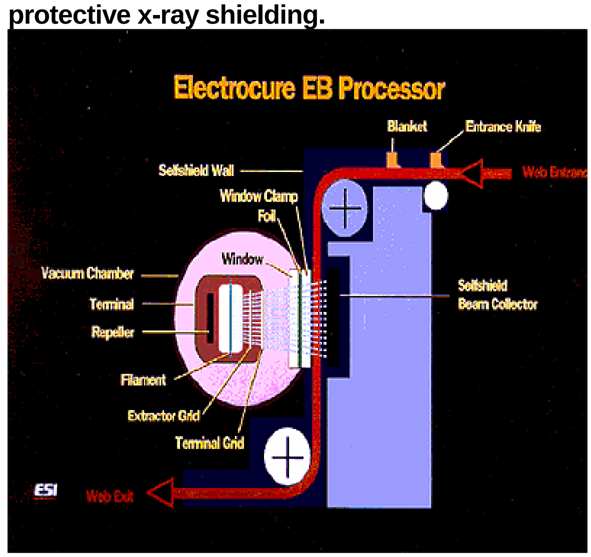


Photo Courtesy ESI

Cork Industries, Inc., 500 Kaiser Drive, Folcroft, PA 19032 610.522.9550 F 610.522.9659
Elmer W. Griese, Jr. 440.748.0980 ewgriesecork@oh.rr.com
Website http://www.corkindustries.com

Basically in the EB curing process high energy electrons impact liquid formulated inks, coatings, varnishes and adhesives to impart their energy. This action starts the curing process without the requirement of a photo initiator, as is required in UV curing formulations. The difference is the low energy, extremely low mass, photons of light that characterize the UV process vs. the high energy, higher mass, accelerated electrons of the EB process. Thick and opaque films can be cured with EB, whereas UV photons are easily stopped at a curable materials surface.

In the EB process, electrons are formed by creating a high voltage potential between negatively charged filaments inside a positively charged metal chamber located in a vacuum acceleration chamber. The acceleration chamber, in the form of a cylinder, stretches the entire width of the substrate web. The acceleration chamber is maintained at a vacuum of 1.0 x 10-6mBar so that there is no loss of energy as electrons are being accelerated. The vacuum also works to prevent oxidation which shortens the life span of the filaments themselves.

Filaments are super heated electrically to generate electrons, which are accelerated to very high speeds by a high voltage potential. In this vacuum, electrons will flow between the negative and positive electrodes. The electrons are targeted to a window in the chamber, which is covered with a thin titanium foil. The role of the foil is to maintain the vacuum in the chamber, while allowing the electrons to exit to reach a cure zone, and printed/coated curables in the cure zone. As soon as electrons hit the curables, the curing process begins, and is completed almost instantaneously. The curing process is dependent on taking place in an oxygen free cure zone, typically flooded with nitrogen or CO_2. Oxygen inhibits the EB curing process such that the top most layer of ink/coating will not cure and stay wet.

Well designed curing systems have oxygen sensors that effectively shut down the print /coat cure process to minimize the generation of scrap. Proper safeguards will cause an EB system to shut down, whenever conditions that would cause a partial cure are present.

Compact EB accelerators, in the 90keV to 300keV low voltage range use linear filaments. This means that electrons don't have to be scanned, as would be the case with a cathode ray tube (CRT) source such as is used in computer displays and television.

Coil wound transformers, using standard factory power, supply the high voltages required by linear electron beam accelerators.

The cure zone is an area designed to present the substrate with EB materials to be cured to the curing electron stream.

An EB processor is operated by controlling the beam accelerating voltage, the beam current, and line speed. The line speed of the moving substrate web and the beam current form a relationship that establishes dose.

Dose is the total absorption of the electron beam by the target curables. Dose is usually expressed in Megarads with one rad equal to 100 ergs per gram of absorbed energy. As a rule of thumb, most EB curing of inks, coatings, and adhesives require in the range of from 1-3 Megarads to produce full cure.

In EB processing of web printing/coating, it is easy to coordinate line speed with accelerator output, because it can be interlocked with the equipment drive system. Dose can always be coordinated with the speed of the press assuring optimum cure, and electron penetration of EB inks/coatings/adhesives.

Electrons emitted by an EB processor flow in a straight line from the beam window to the cure zone, and the substrate with its curables. High energy accelerated electrons hitting a substrate or other materials in its path will generate long penetration x-rays. These secondary x-rays are blocked from becoming harmful to workers by a lead shield encasement.