“Electron Beam Powered Process and Product Improvement Opportunities in Three-Piece and Sheet-fed Metal Decoration”

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Beam *power*

Carl Carlson, business development account manager of Advanced Electron Beam (AEB), discusses the opportunities that electron beam powered product and process can offer can makers.

When *CanTech International* asked me to give a quick preview of the electron beam powered process and product improvement workshops at the upcoming IMDA annual conference, they joked that writing this preview would be harder than presenting the workshops themselves.

They were not kidding; the biggest challenge is where to start. Perhaps the best place is by looking at electron beam technology from lean and Six Sigma perspectives.

From the lean perspective let us compare the value streams of an energy curable coating with one for a thermal (solvent or 'solventless waterborne') coating. The value delivered to the customer at the end of both value chains is the same, cured polymers on a substrate of choice; this is all the customer is willing to pay for.

Any process or material in either value stream that does not directly contribute to the customer's requirement is pure waste. Where the value streams differ radically is in the inclusion of an entire supply chain devoted exclusively to transport and storage solvents for use in thermal coating suspensions. The non-value adding solvent and water content in thermal systems must be boiled off and burned as part of the value adding and profit producing manufacturing process.

With the advent of energy curable technologies that eliminate or radically reduce the solvent content in ink and coating formulations, factors such as the exploration, recovery, refining and taxes associated with solvents become purely avoidable waste, which add nothing but cost to the value stream. So from the lean perspective it makes fundamental sense to pursue the far simpler energy curable value stream.

Six Sigma

Now that we've focused on energy curables through our lean goggles, let's take a look at the energy curable front-runners, electron beam (EB) and ultra violet (UV), with a Six Sigma perspective.

A ten inch emitter and 125kV power supply

The goal in Six Sigma is to bring a process under control and one of the first steps is to identify the process quanta and their respective control tolerances to establish constraints that will maintain a robust process.

With an electron beam the process quanta are relatively easy to identify, constrain, and control. If we look at cationic formulation our primary process quanta are line speed, coating thickness, beam current, and beam voltage. Because electrons are high energy particles with mass and not wavelength, we can ignore colour related concerns of bounce, reflectivity, or over absorption because electrons are completely colorblind and 'see' only density.

For example, a reflective coating deposited on an opaque web or thin foil can be completely cured from the back side with an electron beam.

In UV there are not only many more quanta to manage, the quanta themselves have much looser control tolerances than EB – for example, how much has the lamp and ballast output degraded? How do you determine if a reflector is correctly focused? So from a Six Sigma perspective the more obvious choice is to pursue the EB process with 75 per cent less process quanta to manage with far tighter control tolerances as the resulting likelihood of successfully running a controlled, scrap-free process improves by several orders of magnitude over UV.

Ultra violet

Moving on to ultra violet, the goal here is to deliver enough high energy photons to the randomly scattered photo initiators to make the photo initiator excite and release free radicals which will deliver the energy required for polymerization.

Why would you choose a system that generates high energy photons inefficiently, directs and targets them inefficiently, converts them to free radicals inefficiently and is color sensitive in a decorative application, when you could simply use high energy electrons to produce free radicals directly, unless your application was EB intolerant?

This brings us brings us back to electron beam which delivers polymerization energy in the form of an abundant number of free radicals simply by striking the molecules of the chemistry and substrate itself. Because the polymerization energy supply is so direct and simple, product and process improvements like 99 per cent or more polymerization (which yields improved scratch and abrasion resistance, higher colour saturation, and far lower levels of extractables), and the elimination of solvents and all of their associated wastes, are delivered.

Additional product and process improvement opportunities include an unlimited colour pallet, the ability to cure metallics and through opaque materials, and the ability to sterilize or pasteurize formed containers prior to aseptic filling.

I am going to save an introduction to AEB's remarkable and industry-enabling EB equipment for the IMDA workshops – see you at the conference.

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Beam Power Workshop Overview

- Introduce Presenter
- Why EB
- Why AEB EB
- 2 & 3 Piece Industrial EB Applications
- Application Development Example
- Questions

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Your Presenter, Carl Carlson

- UVM- B.S. Industrial Technology & Management
- Boulder Bicycles- Machinist
- Yeti Cycles- Warranty Service Manager
- Burton Snowboards- Tool & Die Maker
- Vermont Castings- Assembly & Enamel Mfg. Engineer
- U.S. Dept. of Commerce, NIST/MEP Mfg. Business Advisor
- Lean Enterprise Institute- Certified LEI Instructor
- Lean Enterprise Advisors- Lean Implementation Consultant
- Moscow Mills- Director of Operations & Client Services
- AEB 2002 to Present

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Why EB?

- 99.95%+ Instant Polymerization
  - Higher Gloss & Abrasion resistance
  - Low or no extractables
- Color Blind
- Solvent Free
- Eliminate or Radically Reduce Photo Initiator Content, Complexity, and Cost
- Fewer Process Quanta with Tighter Control Tolerances
- 1-5°F Temperature Gradient
- 1% of the Direct Energy Cost of Waterborne Thermal Cure

ENERGY CONSERVATION

Energy Needed to Dry/Cure Coatings

(calories per gram)

Solvent	Water	EB Curable
177	810	7

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What do these EB advantages mean to me?

EB technology enables product improvements while reducing or eliminating non-value added processes and process equipment like;

- Non-Value Added Material Handling, Transport, and Storage (pin chains, wicket lines, belt conveyors, etc.)
- Thermal Ovens (pin oven, ibo, wicket oven, flotation dryer, etc.)
- Fume Collection & Incineration Systems
- Cooling Tunnels

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Again, Please?

- EB technology allows for the “direct connect” of value-adding process equipment and machinery.

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What does "direct connect" of value adding processes mean to me?

"The less time anything spends inside my factories, the less it costs me."

-H. Ford

(At 3,200 CPM, relatively speaking 20 seconds is a lot of time. Restated, any percentage of 280B cans is going to be a huge number!)

"Any activity that does not add value is pure waste, and can only add cost and (lead) time."

-J. Womack, Founder and President LEI

2-Piece EB Process Opportunities

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Thermal System

1. Uncoiler
2. Lubricator
3. Cupper
4. Bodymaker
5. Trimmers
6. Washers/Ovens
7. Base Coater
8. Base Coater Pin Oven
9. Decorator
10. Bottom Coater*
11. Decorator Pin Oven
12. Internal Coaters
13. IBO
14. Waxer
15. Die Necker
16. Flanger
17. Reprofiler/Reformer
18. Tester
19. Camera Inspection
20. Fume Collection
21. TO/RTO
22. Palletizer

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*Yellow text & boxes for value adding processes & equipment. Don't shoot me if the bottom coater is misplaced.

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Coil Coating EB Process Opportunities

- Start/Stop Compatibility
- Elimination of Accumulator Towers
- Elimination of Twin Unwinders/Rewinders
- Elimination of twin 300'+ Ovens
- Elimination of Fume Collection Systems
- Elimination of TO/RTO
- Line Speed Governed by Coater, not Oven
- Elimination of Quenching

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Sheet Fed EB Process Opportunities

- Elimination of Wickets & Wicket Ovens
- Elimination of Cooling Tunnels
- Full and Instantaneous Cure of Any Color, Color Combination, or Metallics
- Perfect for Final Cure of Deco & OPV/L

  (EB will cure UV Product)
- Elimination of Fume Collection Systems
- Elimination of R/TO Systems
- Elimination of Photo Initiator Health & Safety Concerns
- Elimination of Photo Initiator Cost and Complexity

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OK, EB is Good. Why AEB?

- Repetitively Manufactured Modular Emitter and Power Supply Technology (Remember Samuel Colt? Serial Numbers, Not Project Numbers)
- 19” DIN Standard Solid State Power Supplies
- No End User Internal EB Maintenance
- No Vacuum Pumping Train (Scavenger, Turbo, Molecular, & Ion Pumps)
- No SF6 Gas
- Passive Electron Extraction
- Passive Electron Optics
- Area Beam

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Area Beam?

"Your (AEB's) technology is an event probability cluster bomb!"

-Teddy Van Kessell, Ph.D. IBM Senior Research Scientist, T.J. Watson Research Center

Translation:

EB energy cure is based on the formation of free radicals generated by high energy electrons colliding with the compound and substrate. Since 'Area' beams do not raster or scan like a TV or monitor, they bath the entire target area with an abundant and consistent shower of electrons at all times.

-Think light bulbs…

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10” AEB Emitter

The 10” Emitter can be ganged to cover any line width. 16” emitters are also available. 2” and 24” models coming soon.

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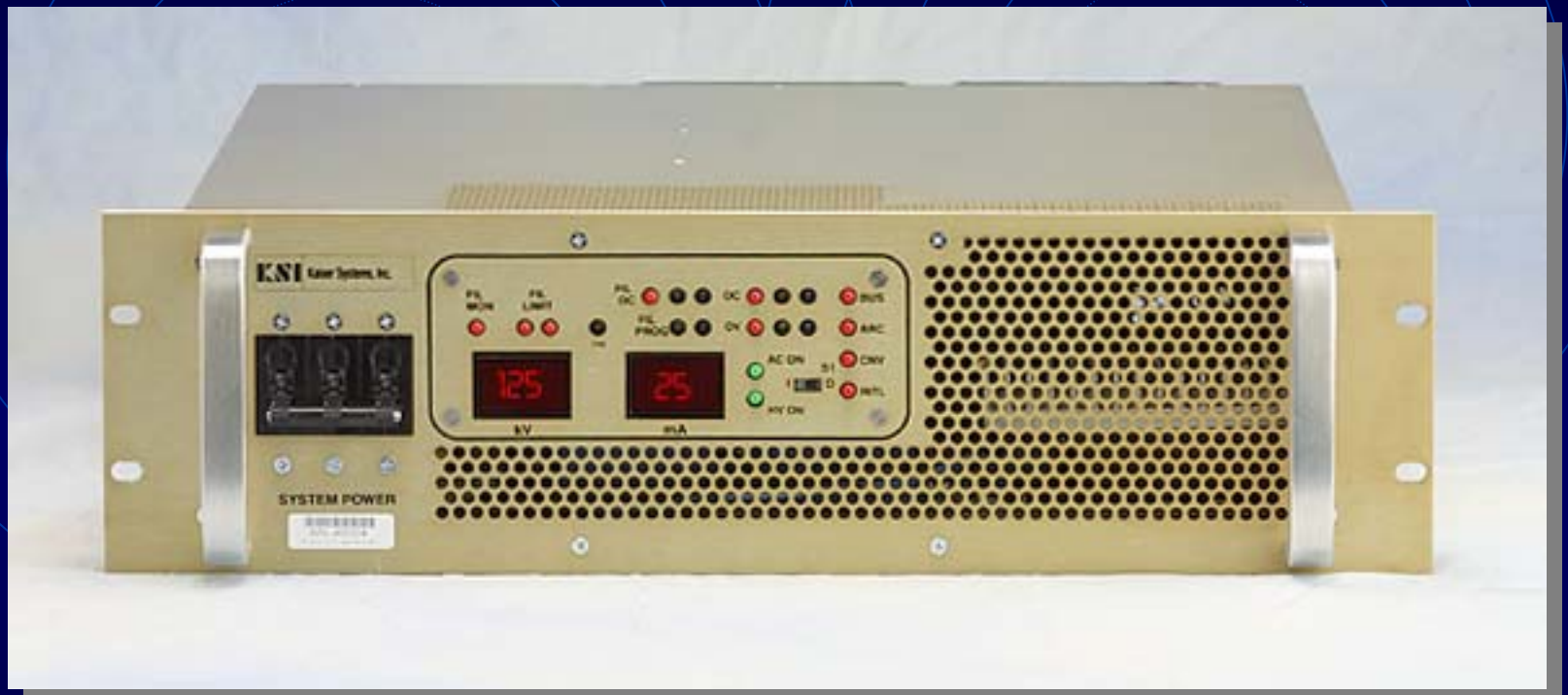
AEB/KSI 125 kV Modular Power Supply



Power Supplies are available in 100 kV, 125 kV, and 150 kV. Any AEB Power Supply will power any AEB emitter.

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A Word on EB Power

- kV = Penetration
- mA= Dose

E.g. At 125 kV penetration to 4.5-5.5 mils is achieved (density dependent).

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Ok, I’m interested. What’s next?

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2 Piece Deco/OPV EB Adoption Model

(It takes 4 to Tango)

- End User
- Sequa Can Machinery (EB integration)
- INX International (EB Deco & OPV)
- AEB (EB supply)

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Is it Real?

INX International Ink Co.

Research and Development Bulletin

INXCure EXP EB Inks for 2-Piece Metal Decorating

For more information or for the INX location in your area, contact our Research and Development Facility at:

INX International Ink Co.

1760 Western Drive
West Chicago, IL 60185
Phone: 630/681-7100
Fax: 630/681-7199

Visit our Website:
http://www.inxinternational.com

Product Name:
INXCure EXP EB Inks for 2-Piece Metal Decorating

Product Type:
Electron Beam Curable Metal Decorating Inks

The INXCure EXP EB inks are intended to replace conventional thermally cured ink and Varnish systems in locations where VOC emission or Natural Gas usage reduction is a driving force.

Goal Attributes :
(Compared to AP LoVOC)

- Equal Gloss
- Equal Misting
- Good Transfer
- Equal Abrasion resistance
- Zero VOC
- HAP's Free
- Print well at the highest line speeds on:
  - Aluminum.
  - Coated Steel
- Good press performance.
- Equal Pasteurization performance

Physical Properties (Goal):

Tack, 1 min. @ 90 °F:
- 16 +/- 2 @ 1200 rpm

Weight/gallon:
- 15.0 +/- 4 lb. for white
- 11.5 +/- 3.5 lb. for colors

Total Solids:
- 98 - 100% by weight for whites
- 95 - 100% by weight for colors

Grind (NPIRI):
- 3 or less

Viscosity, 25 °C:
- 100 +/- 50 poise

VOC (less H2O):
- Less than 20 g/L (all colors)

Internal Lubricant:
- No

Handling Characteristics:

Flash Point:
- >200 °F (PMCC)

Freeze Protection Required:
- No

Shelf Life:
- 6 months @ 77 °F

Shelf Life:
- 3 months @ 100 °F

Anticipated Use and Cure Schedules:

Substrate:
- Plain, Clear and White basecoated D&I aluminumcans.

Recommended Fountain Temp:
- 95 – 105 °F

Varnish:
- EB Curable 2-Pc Over Print Varnish

Cure Requirements:
- <20 MegaRad

IBO Schedule:
- 60 sec. @ 400 °F PMT

Thinners:
- Not recommended.

Cleaning Solvent:
- Isopropanol or glycols.

*Results may vary according to your process conditions.

5/12/04 H. Yoshizawa

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What's (or Who's) Next?

- Coil
- Three Piece
- Aerosol
- Sheet Fed
- IS (EB is 3D Compatible)
- Food Grade
- DFC

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