TAPPI

PROCEEDINGS

1987 Polymers, Laminations and Coatings Conference

Book 1

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TAPPI's Antitrust Policy Statement

TAPPI is a professional and scientific association organized to further the application of science, engineering, and technology in the pulp and paper, packaging and converting, and allied industries. Its aim is to promote research and education, and to arrange for the collection, dissemination and interchange of technical concepts and information in fields of interest to its members. TAPPI is not intended to, and may not, play any role in the competitive decisions of its members or their employers, or in any way restrict competition among companies.

Through its seminars, short courses, technical conferences, and other activities, TAPPI brings together representatives of competitors in the pulp and paper industry. Although the subject matter of TAPPI activities is normally technical in nature, and although the purpose of these activities is principally educational and there is no intent to restrain competition in any manner, nevertheless the Board of Directors recognizes the possibility that the Association and its activities could be seen by some as an opportunity for anticompetitive conduct. For this reason, the Board has taken the opportunity, through this statement of policy, to make clear its unequivocal support for the policy of competition served by the antitrust laws and its uncompromising intent to comply strictly in all respects with those laws.

In addition to the Association's firm commitment to the principle of competition served by the antitrust laws, the penalties which may be imposed upon both the Association and its individual and corporate members involved in any violation of the antitrust laws are so severe that good business judgment demands that every effort be made to avoid any such violation. Certain violations of the Sherman Act, such as price-fixing, are felony crimes for which individuals may be imprisoned for up to three (3) years or fined up to $100,000, or both, and corporations can be fined up to $1 million for each offense. In addition, treble damage claims by private parties (including class actions) for antitrust violations are extremely expensive to litigate and can result in judgments of a magnitude which could destroy the Association and seriously affect the financial interests of its members.

It shall be the responsibility of every member of TAPPI to be guided by TAPPI's policy of strict compliance with the antitrust laws in all TAPPI activities. It shall be the special responsibility of committee chairmen, Association officers, and officers of Local Sections to ensure that this policy is known and adhered to in the course of activities pursued under their leadership.

To assist the TAPPI staff and all its officers, directors, committee chairmen, and Local Section officers in recognizing situations which may raise the appearance of an antitrust problem, the Board will as a matter of policy furnish to each of such persons the Association's General Rules of Antitrust Compliance. The Association will also make available general legal advice when questions arise as to the manner in which the antitrust laws may apply to the activities of TAPPI or any committee or Section thereof.

Antitrust compliance is the responsibility of every TAPPI member. Any violation of the TAPPI General Rules of antitrust compliance or this general policy will result in immediate suspension from membership in the Association and immediate removal from any Association office held by a member violating this policy.

General Rules of Antitrust Compliance

The following rules are applicable to all TAPPI activities and must be observed in all situations and under all circumstances without exception or qualification other than those noted below:

1. Neither TAPPI nor any committee, Section or activity of TAPPI shall be used for the purpose of bringing about or attempting to bring about any understanding or agreement, written or oral, formal or informal, express or implied, among competitors with regard to prices, terms or conditions of sale, distribution, volume of production, territories or customers.

2. No TAPPI activity or communication shall include discussion for any purpose or in any fashion of prices or pricing methods, production quotas or other limitations on either the timing or volume of production or sale, or allocation of territories or customers.

3. No TAPPI committee or Section shall undertake any activity which involves exchange or collection and dissemination among competitors of any information regarding prices or pricing methods.

4. No TAPPI committee or group should undertake the collection of individual firm cost data, or the dissemination of any compilation of such data, without prior approval of legal counsel provided by the Association.

5. No TAPPI activity should involve any discussion of costs, or any exchange of cost information, for the purpose or with the probable effect of:

a. increasing, maintaining or stabilizing prices; or,

b. reducing competition in the marketplace with respect to the range or quality of products or services offered.

6. No discussion of costs should be undertaken in connection with any TAPPI activity for the purpose or with the probable effect of promoting agreement among competing firms with respect to their selection of products for purchase, their choice of suppliers, or the prices they will pay for supplies.

7. Scientific papers published by TAPPI or presented in connection with TAPPI programs may refer to costs, provided such references are not accompanied by any suggestion, express or implied, to the effect that prices should be adjusted or maintained in order to reflect such costs. All papers containing cost information must be reviewed by the TAPPI legal counsel for possible antitrust implications prior to publication or presentation.

8. Authors of conference papers shall be informed of TAPPI's antitrust policy and the need to comply therewith in the preparation and presentation of their papers.

9. No TAPPI activity or communication shall include any discussion which might be construed as an attempt to prevent any person or business entity from gaining access to any market or customer for goods or services, or to prevent any business entity from obtaining a supply of goods or otherwise purchasing goods or services freely in the market.

10. No person shall be unreasonably excluded from participation in any TAPPI activity, committee or Section where such exclusion may impair such person's ability to compete effectively in the pulp and paper industry.

11. Neither TAPPI nor any committee or Section thereof shall make any effort to bring about the standardization of any product for the purpose or with the effect of preventing the manufacture or sale of any product not conforming to a specified standard.

12. No TAPPI activity or communication shall include any discussion which might be construed as an agreement or understanding to refrain from purchasing any raw material, equipment, services or other supplies from any supplier.

13. Committee chairmen shall prepare meeting agendas in advance and forward the agendas to TAPPI headquarters for review prior to their meetings. Minutes of such meetings shall not be distributed until they are reviewed for antitrust implications by TAPPI headquarters staff.

14. All members are expected to comply with these guidelines and TAPPI's antitrust policy in informal discussions at the site of a TAPPI meeting, but beyond the control of its chairman, as well as in formal TAPPI activities.

15. Any company which believes that it may be or has been unfairly placed at a competitive disadvantage as a result of a TAPPI activity should so notify the TAPPI member responsible for the activity, who in turn should immediately notify TAPPI headquarters. If its complaint is not resolved by the responsible TAPPI member, the company should so notify TAPPI headquarters directly. TAPPI headquarters and appropriate Section, division, or committee officers or chairpersons will then review and attempt to resolve the complaint. In time-critical situations, the company may contact TAPPI headquarters directly.

Statement of TAPPI Antitrust policy regarding submission of copies of correspondence to TAPPI headquarters

TAPPI headquarters needs to remain aware of what particular committees and sections of TAPPI are doing or planning to do in order to better assist those groups in achieving their objectives and to continue to supervise actively the antitrust compliance of TAPPI. The Board of Directors of TAPPI therefore has adopted this formal statement of TAPPI's policy which requires that persons corresponding or receiving correspondence on behalf of TAPPI provide copies of the type of correspondence outlined below to the appropriate liaison person at TAPPI headquarters.

For this policy TAPPI does not require copies of routine, written communications regarding arrangements for speakers, meetings, travel, dinner reservations and the like.

TAPPI headquarters does require that copies of correspondence of an important nature and of non-routine matters be supplied in a timely fashion to TAPPI headquarters personnel connected with the committee or section involved as shown below:

1. Plans regarding the activities of TAPPI committees or sections.

2. Communications with other TAPPI committees or sections.

3. Communications with persons or organizations outside TAPPI.

4. All written or recurring verbal complaints or criticisms of TAPPI activities.

All correspondence falling under the above-stated policy must be forwarded promptly to the appropriate TAPPI headquarters liaison person, preferably at the time of transmittal or receipt.

SHORT CONTENTS

CONTENTS

MANAGEMENT PANEL: PACKAGING AND CONVERTING -- YESTERDAY, TODAY, TOMORROW

Session Moderator:
David J. Bentley, Jr.
Manager, Product Development
and Technical Information
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ABSTRACT

The packaging and converting industry continues to grow and will be a strong market well into the next century. There are many advances where flexible packaging replaces traditional rigid containers and where new rigid container developments supercede traditional metal and glass containers. It is virtually impossible to live at the standards to which the average consumer is accustomed without encountering these packaging innovations. A panel of representatives from organizations impacting on packaging and converting will discuss how these industries arrived at their present position and where they might go in the future.

INTRODUCTION

Packaging is a very important concept in all of the areas of the world where consumers rely on modern growing and distribution systems for their food which may originate hundreds of miles from their home. Without the adhesives, primers, coatings, and inks used in combination with various flexible and rigid substrates on the latest machinery innovations under the watchful eyes of the various regulating agencies the way of life we know today would not exist.

Each of the following panel members will make a presentation with the indicated title:

Judd H. Alexander
Executive Vice President
James River Corporation
"A New Challenge: Post Use Performance"

Robert E. Hyndman
Vice Chairman
Morton Thiokol, Inc.
"A Corporate Look at the Packaging Industry"

Carl M. Landegger
President
The Black Clawson Company
Converting Machinery Division
"1994"

William S. Stavropoulos
Commercial Vice President - Basics
Dow Chemical USA
"Future Challenges - What and Who"

Robert L. Waldrop
General Manager
Reynolds Metals Company
Flexible Packaging Divison
"No Change, No Future"

Frank E. Young
Commissioner
Food and Drug Administration
"Remarks By The Commissioner"

DISCUSSION

The above representatives will address their organization's current state and how they arrived there. More importantly they will express their thoughts and concerns about the future their organization will encounter and how they will impact on it and vice versa.

The audience might use the following topics to provide discussion items for panel members:

1. Peelable Seal Applications For Convenience Items
2. Improved Barrier Materials For Extended Storage
3. Packaging Innovations For The Containment of Difficult To Package Foods
4. Expanded Microwave Cooking Applications
5. FDA Approval Of New And Unique Packaging Material Components
6. Packaging For Room Temperature Storage
7. Addressing The Increased Concerns Of Health Foods And Nutrition As It Relates To Packaging
8. Coating And Laminating Machinery For New Materials At Rapid Speeds

In addition to discussing the items noted above the panel members will answer questions posed by the audience. This will be a unique opportunity for audience members to probe key personnel from some of the most prominent organizations in the packaging industry to learn their ideas on the next significant advance in packaging, where packaging may be in 10 or 25 years, and the like.

ELECTRON BEAM CURING EQUIPMENT FOR RELEASE COATING APPLICATIONS*

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May 1987

ABSTRACT

The number of installations worldwide using the electron beam curing process for the manufacture of release liners continues to grow. The state-of-the-art of EB curing equipment systems is keeping pace with the processing requirements of release liner manufacturers. Higher processing speeds contribute to reduced product cost and can be optimized by coordinating the proper coating application equipment with an EB curing station to handle the coatings and substrates of interest.

For the most part, economic and technical advantages of the EB curing process can be realized in continuous high speed curing of EB release coatings on flexible web. This includes in-situ EB curing of 100% solids silicone and non-silicone based coatings on both paper and film. Another application of interest is the EB crosslinking of acrylic hot-melt adhesives as an in-line method for modifying adhesive modulus, plasticity, creep, and tack as well as grease and solvent resistance. In both release and PSA applications, the processing advantages of EB include instantaneous cure, room-temperature operation, elimination of pollution problems, energy and space efficiency, precision electrical control--and most importantly--a capability to develop innovative products with unique properties.

The modern electron beam curing system is a complete, in-line, curing station which can replace thermal curing processes with a totally electrical, non-thermal system. The principles of how a curtain of accelerated electrons is generated; how their energy is transferred into the product to be cured; and the specific units of measurement and processing parameters relevant to this equipment and process are defined. Radiation, as it relates to EB equipment is also discussed.

The Source of Energetic Electrons(1)

Accelerated or energetic electrons are carriers of energy. The higher the voltage gap through which they are accelerated, the higher the velocity of the electrons and the deeper they can penetrate into the product. The electron source, a series of heated filaments, becomes a continuous source of electrons when it is heated to a certain temperature by an electrical current inside a vacuum chamber.

The need for a vacuum chamber is necessary to accelerate electrons. In air, the electrons would be scattered such that no effective increase in velocity could be accomplished. A minimum velocity level must be reached to enable the electrons to carry their energy to the product.

Figure 1 is a schematic outline of an EB curing system for web. Electrons are extracted from the filament by applying a small voltage differential between the heated filament and a surrounding grid structure. This grid or extraction voltage controls the number of electrons per second extracted from the filament. The resulting electron density is known as the beam current.

These electrons are then accelerated to the outer wall of the vacuum chamber through an electrical field. This field is generated from a large negative potential on the surrounding terminal assembly, while the chamber wall is maintained at ground potential. This terminal voltage is adjustable between 150,000 - 300,000 volts. Energy is imparted to the electrons as they are accelerated through this potential gap. These accelerated electrons now have sufficient momentum to pass through a thin titanium foil "window" and deposit their energy into the moving product. The product moves through the shielded web handling assembly as in the schematic diagram, to enable the coated web to get the proper exposure to the curtain of electrons.

The accelerated electrons, moving at almost the speed of light, pass through the titanium foil "window" to reach the product. The titanium foil is fixed in an air tight, water cooled support structure. This window structure is designed to enable the use of a very thin foil (approximately 12 microns) and also to maintain a continuous vacuum in the chamber. The accelerated electrons are moving at a very high velocity and lose only a small part of their energy as they move through the window. Typical scatter angles of the electrons upon emergence from the window are in the 20-30 degree range. In a well-designed system, only 10-20% of the beam power is lost as heat in the window foil and supporting frame. The remainder of the electron beam impinges into the product as the product passes beneath the window.

Electron beam curing systems for web are designed to maintain the moving web at a distance of 1 to 2 inches from the window. The window width can range from 2 to 10 inches, depending upon the machine power rating. Window length across the web is determined by the product width. Currently there are a number of coating lines in operation with EB curing capability that can handle web widths in the 66-90 inch wide range. The major application for most of these wide web EB curing lines is the manufacture of release liner.

Figure 2 shows a typical electron beam processor for web. This view shows the in-line portion of a 66 inch wide EB curing system with the web handling assembly open for threading. All support systems such as control consoles, power supply, etc. for the EB curing station are cable connected to enable placement off line with flexibility of location.

Energy Transfer to the Product

To be effective, accelerated electrons must transfer their energy into the product being treated. The collision and scattering of the incoming electron by the electrons in the product is the main energy transfer mechanism.

The electron scattering which characterizes the particle's energy absorption in the product is the process which gives rise to free radical creation in the coatings and adhesives to be cured. These free radicals are atoms or ions of the product which possess extra energy due to their interaction with the scattered secondary electrons generated by the primary beam. After the primary electron has left its energy in the product, these free radicals initiate the crosslinking or curing of the adhesive or coating.

Is The EB Curing System a Radiation Source?

When accelerated electrons are stopped by matter, a small percentage of the electron's energy is given up as x-radiation. This radiation (bremsstrahlung) constitutes the radiation hazard with this type of equipment,High density metals such as lead are used for shielding to contain the ionizing radiation within the EB processor. There is no residual effect from this radiation. It is only present when the beam is operating and, like other electrical equipment, is inert when the beam is off.

The configuration of modern, selfshielded EB equipment enables operation of the system in an unrestricted area and in full compliance with OSHA regulations[2].

Processing Parameters and Units of Measure

There is a unique set of processing parameters and units of measure associated with electron-beam technology. An understanding of these units and parameters is essential in order to understand the capabilities of EB equipment and to properly specify EB equipment systems.

One important parameter is the <u>beam current</u>. This is the number of electrons per second (the energy density) which can be delivered by the EB processor. For a given equipment configuration, this translates directly into a specific line speed capability at a given dose level.

Another important parameter is voltage. This determines the electron velocity and therefore the subsequent penetration capability of the electrons into the product. Some typical working ranges are shown as a function of processor voltage in Figure 3.

For the purpose of simplification, accelerating voltage and beam current can be considered as independent parameters which are defined thusly:

Beam current = electron density = dose capability

Accelerating voltage = electron velocity = depth of penetration

The most efficient way to control the depth of electron penetration into a given product is by control of the accelerating voltage.

<u>Product speed</u> (line speed) is important in that it determines the dwell time of the product under the beam. Product speed combined with the dose rate (or current) determines the dose level received by the product. The beam current level can adjust itself automatically in proportion to the line speed and thereby maintain uniform dose levels regardless of line speed variations. This approach is shown in Figure 4 and is recognized as one of the most desirable features of electron beam processing for in-line application. Dynamic precision control capability is unique to EB processing equipment and provides for minimal product waste with maximum product uniformity.

The <u>megarad</u> is the unit of measurement of dose delivered by the electron beam processor. It is a measure of energy absorbed per unit mass of the product. For a given coating or adhesive, the required dose level is based upon certain physical and chemical parameters for that material. The dose requirement for curing of coatings is the dose (energy) necessary for completion of polymerization. For crosslinking of adhesives, the dose requirement is the energy necessary to achieve the desired crosslink density.

The relation of beam current, line speed and dose can now be defined. The beam current delivers energy to the product at a certain rate, that is, so many megarads/second. The dwell time of the product under the beam is usually only a fraction of a second. The mathematical product of these parameters, dose rate and dwell time, gives the <u>actual dose</u> received by the product. That dose can be changed by variation of either product speed or beam current level.

The <u>yield</u> (k) is a factor used to characterize the electron beam processor's performance capability. This constant (k) relates beam current, line speed and dose through the equation:

$$\text{Dose (megarads)} = \frac{\text{k times current (mA)}}{\text{speed (ft/min)}}$$

The units of k are megarad feet per minute/mA, and it provides a basis for calculating machine operating parameters. A performance matrix for a 66 inch wide EB processor is shown in Figure 5 and illustrates the actual realtion of current, line speed, and dose for that EB system. In practical operating situations, the automatic current control or slaving system will vary the beam current in direct proportion to line speed to achieve constant dose regardless of line speed.

Selfshielded Web Handling Assembly

The integrated web handling assembly of a selfshielded electron beam processor must meet specific requirements. These arise from the need (1) to provide a controlled atmosphere in the "process zone" where EB treatment takes place and, (2) to contain all of the x-radiation generated by the electron beam to prevent it from reaching the "outside world" around the EB processor.

The first requirement, that of a controlled atmosphere, stems from the need for an inert, or oxygen free process zone to optimize the EB curing or crosslinking process. Most EB curable coatings and adhesives do not cure well in air. During operation, the inerting system of the EB processor is capable of maintaining the environment within the process zone at levels between 50 and 500 ppm of O_2. This is done with the use of inert gas or pure nitrogen which continuously purges the process zone. Equipment design has been perfected to enable inerting of the process zone to levels below 50 PPM of O_2 at line speeds of 1000 ft./min.

The second requirement, that of total radiation containment, is met by a system design which has no direct line of sight access to the process zone from the outside of the EB processor. The requirements of "inerting" and "radiation shielding" are combined in the unique design[3] of the selfshielded web handling assembly. The product "apertures" or slots are canted between web entry and exit. This insures that radiation from the confined process zone is trapped within the assembly and cannot reach the outer surface of the unit. This effectively eliminates any radiation hazards during normal operation. To further insure personnel safety, redundant, fail safe radiation monitoring systems and mechanical safety interlocks are integrated into all modern EB systems.

Facility Requirements/Operating Costs

In general, the facility requirements for an EB curing station are 480 volt, three phase electric power, clean cooling water (usually on closed cycle), normal plant air and an inert gas source (either LN_2 or an inert gas source (either LN_2 or an inert gas generator). The volume of inert gas required will vary depending on web width, product line speed and desired O_2 concentration. Input power and cooling requirements will also vary depending on the power and energy level, width, and design of the web handling assembly of the EB system.

From an operating perspective, an EB curing system does offer significant cost and space advantages over thermal curing equipment systems. But, as mentioned earlier, the product and process advantages available with EB such as non-thermal, instantaneous cure with precision control, high throughput and unique product capability are of greater import to the manufacturer of release liners.

Safety Considerations in the Plant

The introduction of the first electron beam curing system into a plant will involve some new procedures in industrial hygiene and safety. The EB processor is a source of energetic electrons and x-rays. Therefore, regional departments of health require that the equipment be registered as "a source of ionizing radiation". This registration requires designation of a Plant Radiation Safety Officer. If an individual with pertinent experience is not available in-plant, suitable training of the responsible employee will be provided by the equipment supplier or can be derived through training seminars offered by various organizations.

The OSHA Regulations[2] governing the use of EB equipment is quite definitive. The pertinent section in OSHA is paragraph 1910.96 in FR, Vol. 37, #202, 22158-59. The following definitions have been abstrated to facilitate the interpretation of the regulation for use of EB equipment systems in unrestricted areas:

(1) "Unrestricted area" means any area access to which is not controlled by the employer for purposes of protection of individuals from exposure to radiation or radioactive materials.

(2) "Radiation area" means any area, accessible to personnel, in which there exists radiation at such levels that a major portion of the body could receive in any 1 hour a dose in excess of 5 millirem, or in any 5 consecutive days a dose in excess of 100 millirem.

(3) "Dose" means the quantity of ionizing radiation absorbed, per unit of mass, by the body or by any portion of the body.

It is most important to differentiate between a radiation area and an unrestricted area as defined by OSHA. When ambient radiation levels are kept below the levels defined above, the employer is not required to control employee access to these areas. Because no safety hazards exist, the area is designated as "unrestricted".

Modern, selfshielded EB equipment is designed for operation in unrestricted areas and can be expected to perform at a surface level of under 0.5 mrads/hour or, where limited hand access to a slot or product access opening is possible, at a level of under 5 mrads/hour. These systems use electrical interlocks to prevent accidental exposure of personnel. This primary safety system should be backed by a completely independent fail-safe monitoring system which assures that the unit continues to operate within OSHA compliance.

Equipment operators should be familiar with the radiation monitoring system. The systems utilize radiation probes, positioned around the processor, which allow system operation only within the limits of OSHA environmental requirements. These systems are "fail-safe" in that they also monitor cosmic or backround radiation which is always present, and will stop or prevent operation of the EB equipment if a probe becomes inoperative for any reason.

New EB Processing Installations

The introduction of electron processing into the plant is facilitated by the convenience of design of the selfshielded EB processor. It permits a flexible adaptation to conventional coating equipment. Sophisticated equipment and personnel safeguards assure safe and reliable performance.

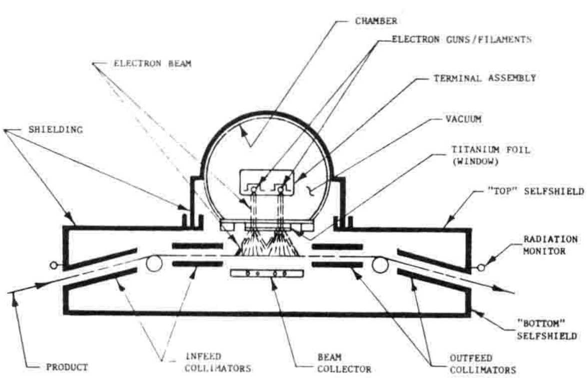


Figure 1. ELECTRON BEAM PROCESSOR WITH SHIELDED WEB HANDLING ASSEMBLY

Experience has shown that the introduction of this technology into the plant, and the association with it, carries an elitist identification for the employee. With proper training and employee/union education before installation, the transition to this new era of industrial curing should be smooth. In most cases, it also provides a source of pride and excitement to those involved.

REFERENCES

(1) Safe Handling and Use of Ultraviolet/ Electron Beam Curable Coatings, NPCA, 1500 Rhode Island Ave., N.W., Washington, D.C. 20005, Chapter III, "Curing Equipment and Radiation Safety", August 1980.

(2) OSHA Safety and Health Standards (29 CFR 1910), U.S. Dept. of Labor, Occupational Safety and Health Administration, OSHA 2206, March, 1983; U.S. Government Printing Office, Washington, D.C. 20402.

(3) Nablo, S.V., "Method of and Apparatus for Shielding Inert Zone Electron Irradiation of Moving Web Materials", U.S. Patent 4,252,413, February 24, 1982.

(4) Nablo, S.V., "Operational Maintenance Considerations with the Electrocurtain® Processor", ESI TR-86, March 1980; Proc. SME Workshop for Radiation Curing in the Graphic Arts, Rosemont, IL, March 25-27, 1980.

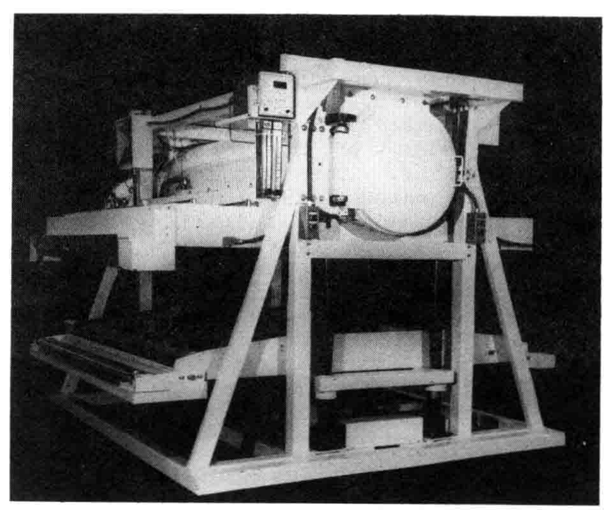


Figure 2: A 66 inch wide Electron Beam Curing Unit for Web Processing

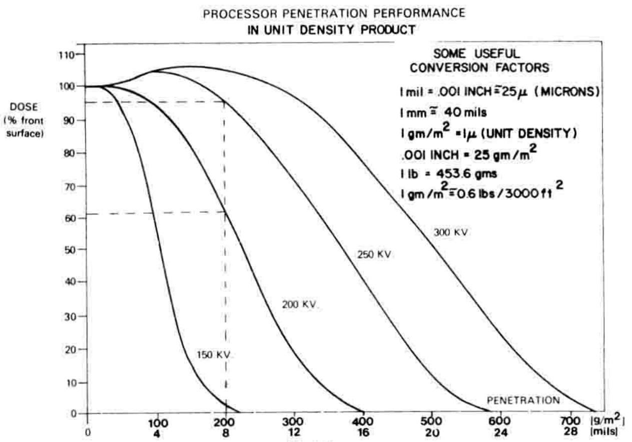
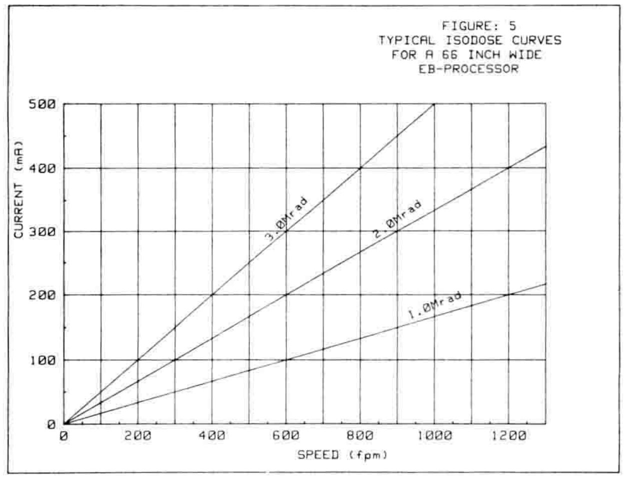


Figure 3,



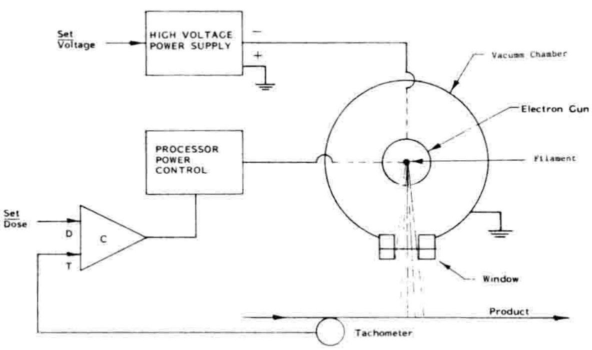


Figure 4. ELECTRON BEAM PROCESSOR SCHEMATIC FOR SLAVED OPERATION.

RECENT ADVANCES IN RADIATION CURABLE RELEASE COATING

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ABSTRACT

Application of modern radiation technology for curing silicone release coatings requires chemical modification with reactive groups. By selecting suitable reactive groups and good molecular design, short cure times and low stable release values are obtained. The material may be cured by ultraviolet or electron beam radiation. The cured coatings adhere to a variety of substrates. Release values can be adjusted by addition of additives.

INTRODUCTION

Silicone release coatings have been used for their superior release properties on paper, metal foils, and plastic films in the PSA industry. The PSA industry which uses silicone release coatings is faced with increasing energy cost, enviromental controls and dependence on rare metal catalysts such as platinum or rhodium. The purpose of this paper is to describe radiation curing DEHESIVE™ Silicone products which provide potential solutions to the above issues. These DEHESIVE™ systems were developed by Wacker Chemie, GmbH, in West Germany and are currently being marketed and supported by Wacker Silicones Corporation in Adrian, MI. The chemistry of these products, their properties and the use of controlled release additives will be discussed. Let's begin with a short discussion of conventional silicone release systems.

Curing Process Commonly Used in Silicone Paper Coating Consist of Two Types of Chemistry:

1. Condensation chemistry is completed by an elimination reaction of a volatile component.

2. Addition chemistry is completed by silicone hydride adding across an olefinic silicone side chain.

Catalysts are required for both processes. Organotin compounds are used for condensation crosslinking. Metals of the platinum group are used in addition chemistry. The curing process takes place as a result of exposure to heat which is a form of electromagnetic radiation. These types of systems attempt to balance the need for fast cure with the practical requirement of long pot life. The perfect system from a user's perspective has infinite pot life at 20°C and cures in less than a second at 30°C.

Short Wave Length Radiation Such as Ultra-Violet or Electron Beam Radiation Make These Desires a Reality.

Some advantages of short wave length curing systems over the present long wave length thermal systems are as follows:

1. Paper substrates must be continually remoistened at cure temperatures above 100°C. This adds expense and requires additional energy consumption.

2. The quality of paper substrates is reduced with thermal exposure.

3. Thermoplastic substrates such as polyethylene or polypropylene melt below 100°C.

The fastest thermal systems cure at 200°C in 2 to 3 seconds. Radiation systems can accomplish the same thing in one tenth the time at room temperature. The faster cure allows more compact design of the curing unit. For example a thermal curing unit operating at 600-700 ft./min. at 200°C with a cure time of 2 seconds requires an oven 24 to 25 feet long. The currently available Raducre DEHESIVE™ products reduce this space requirement by 50%.

Energy consumption of electron beam equipment is less than a 1/10th that of a thermal unit, a UV unit consumes 1/2 the energy. The reason that shorter wave length radiation is more efficient is that it is more selective in its interaction with the coated substrate. It activates only the crosslinking chemistry. Very little of the energy is wasted in heating the substrate or the silicone coating.

The Chemistry of the Very Selective Processes May be Divided Into Three Classes:

1. Systems which crosslink with a combination of UV and IR radiation, UV-IR systems such as DEHESIVE™1502

2. Systems which crosslink on exposure to only ultraviolet radiation or