

REACTOR EC

Electrosatic Web Cooling

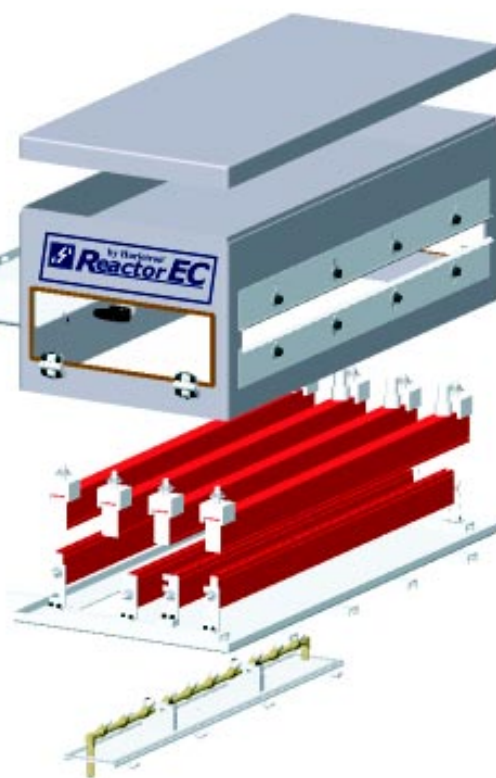
Reduce Web Temperature and Control Chill Roll Condensation Streaking in one easy operation.

Hurletron's new Reactor EC relies on the latent heat of vaporization to reduce the temperature of a moving web by efficiently removing thermal energy from the web. The Electrostatic charge bars mounted above the web create an electrostatic field into which a water cloud is sprayed. The field director bars, mounted below the web, concentrate the electrostatic field in the area of the water cloud.

Electrostatic Cooling

Mounted between the exit of the hot air dryer and the first chill roll, a Reactor EC can reduce the web temperature as much as 100°F, depending on the basis weight and press running speed.

The electrostatic charge deposited on the water droplets that comprise the water cloud, explodes the droplets into microdroplets that are charged by the electrostatic field and driven into the web.



The efficiency of electrostatic cooling is dramatically greater than conventional water nozzle systems in which there is significant over spray. Without electrostatics a significant portion of the relatively low percentage

(continued on page 2)

Using ESA with Water-Based Inks

By Steven J. Siler

Electrostatic Assist (ESA) has been effective in reducing the number of missing dots or "snowflakes" that are a common print quality problem in gravure printing. For the past thirty years, rotogravure printers have commonly used ESA to improve the quality of gravure printing, following demonstration of the primary ESA effect in experimental work by the Gravure Research Institute. However, the trend toward increased use of water-based inks has created several questions regarding the applicability of ESA. A poll of the results among printers using ESA with water-based inks would probably produce very mixed results.

While this may not initially sound encouraging, using ESA with water-based inks can produce significant improvements to print quality.

(continued on page 2)

*Reactor EC**Continued from Page 1*

of the water reaching the web remains resident on the surface.

The process of electrostatic cooling ensures that water droplets directed to the web are small enough to reach the web and penetrate the surface.

Condensation Streaking

The solvent in heat set ink that remains in the ink after the web leaves the dryer continues to evaporate.

As the web travels over the first chill roll enough air is pulled between the web and the chill roll surface to lift the web off the chill roll— The amount of web lift depends on the press speed, web weight, web tension and chill roll diameter.

The condensation that occurs when the air comes in contact with the solvent vapors is deposited on the chill roll and is then transferred to the web. A number of methods have been developed to prevent the streaking that occurs when the condensation is transferred to the web.

Because the Reactor EC cools the web before it reaches the first chill roll, the amount of condensation is greatly reduced, and the system can eliminate the need for additional equipment to control condensation streaking.

For Electrostatic Web Cooling, Reactor EC technology is also available from Megtec Systems in their Triton ES system.

*ESA With Water-Based Inks**Continued from Page 1*

Achieving consistently good results with water-based inks requires an understanding of how ESA works, as well as an understanding of the differences between solvent-based inks and water-based inks

Physics of the ESA Process

Gravure printing relies on the transfer of a small amount of ink from a cell in the gravure cylinder (a depression in the cylinder surface) to a substrate (the surface to be printed upon). Transfer takes place whenever the substrate, pressed against the gravure cylinder by an impression roll, contacts the ink, wets, and draws the ink to the substrate surface by capillary action. The transferred ink produces a printed dot on the substrate. Under ideal conditions, each gravure cell produces a single printed dot with uniform ink density. Ink transfer (dot transfer) requires a gravure cell full of ink, contact between the substrate and the ink in the gravure cell, and enough adhesion to produce the capillary action to pull the ink out of the cell.

When a dot fails to transfer, it leaves a print void surrounded by typically six printed dots that we perceive as a snowflake-shaped region (all snowflakes are six-sided). Assuming there is ink in the gravure cell, a missing dot or

snowflake occurs when the substrate fails to contact the ink or the adhesive forces are insufficient to cause the necessary capillary action.

The strength of the adhesive force producing the capillary action depends on the difference between the surface tension of the ink (a fluid) and the surface energy of the substrate (a solid). The greater the difference, the stronger the capillary action. The significance of this will be discussed later. At this point, we will assume sufficient adhesive forces to draw the ink out of the cell if the ink makes contact with the substrate.

Electrostatic Assist helps to overcome less than ideal conditions that prevent the ink from making contact with the substrate. *Figure 1* shows a full gravure cell and the more typical ink surface resulting from removing the excess ink on the cylinder surface. Absent increased impression roll pressure, it is difficult for the substrate to make contact with the ink surface when it is below the cylinder surface.

Electrostatic Assist develops an electric field in the impression zone that exerts a force pulling on the ink surface causing it to deform slightly. *Figure 2* shows the



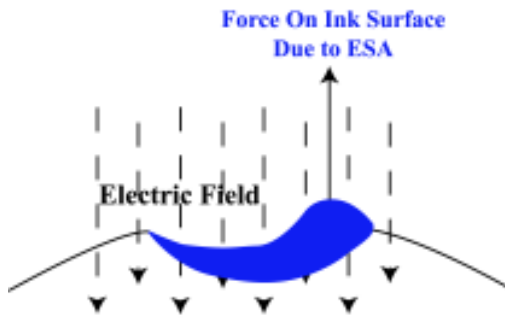


Figure 2
Ink in the Gravure Cell Under the Influence of the Electric Field

ink in a gravure cell under the influence of an electric field. The change in shape of the ink surface causes part of the ink to rise above the cylinder surface and increases the likelihood of contact with the substrate. Once contact occurs, capillary action causes the ink dot to transfer.

One common misperception is that ESA causes the otherwise missing dots to transfer. Clearly, the capillary action created by adhesion causes the ink transfer, not Electrostatic Assist. However, without contact transfer cannot occur. ESA facilitates contact between the ink in the cell and the substrate. In this way the electrostatics “assist” in the transfer.

Theory suggests the effectiveness of ESA should be proportional to the force exerted by the electric field on the ink surface. The force is determined by the following force equation.

$$F = 1/2 \epsilon E^2$$

The amount of ink surface deflection can be determined by balancing the

force produced by the electric field with the hydrodynamic forces acting on the fluid ink. The electric field is developed by an electric charge density, σ , on the substrate at the point opposite the gravure cell.

$$E = \sigma / \epsilon$$

Substituting for the electric field, E , produces the following equation that predicts the force is proportional to the square of the electric charge density on the substrate at that point.

$$F = 1/2 \sigma^2 / \epsilon$$

While interesting, why is this important? Since the charge is supplied through a resistive impression roll to the moving web, the magnitude of charge density is proportional to the flow of charge, or current, from the ESA power supply. Therefore, the force created at the surface of the ink in the gravure cell is proportional to the flow of ESA current.

$$F = K * I^2$$

The physics predict the effectiveness of ESA should therefore be proportional to the square of the ESA current. Power supply polarity should not be a factor because the effect is proportional to the square of the current. Furthermore, ESA should be effective for both water- and solvent-based inks.

Experimental Results

There is strong allegorical evidence among printers that ESA is effective with water-based inks, and that the effectiveness is dependent on ESA current. The following results are represen-

tative of data collected at several printers using water-based inks on a variety of products. They illustrate results observed when properly using ESA with water-based inks. The missing dots were counted on 20 samples at several levels of ESA current. The sample area counted was approximately 0,25 cm². The graphs plot the average number of missing

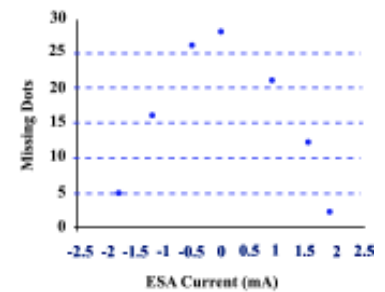


Figure 3
Results for Wide-Web Packaging Press

dots in 20 samples for several ESA currents. **Figure 3** shows results for a wide-web packaging press.

Figure 4 shows results for a narrow-web press printing on lightweight substrates.

Both figures clearly suggest a predictable relationship between the average number of missing dots and ESA current. It should be noted that these examples show the relationship most clearly. More commonly, the data, though illustrating the same effect, is less ordered. The symmetry observed in the graphs appears to suggest a relationship independent of polarity. While not shown here, the same data, plotted as a function of ESA power supply voltage, produces

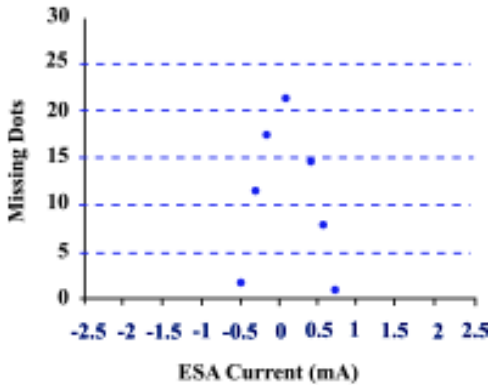


Figure 4
Results for Narrow-Web Press

a graph that is clearly asymmetrical. Why, when viewed as a function of ESA current, does the effect appear polarity independent, but when viewed as a function of voltage is dependent on polarity?

To answer this question, consider Ohm’s Law which states that the current in a circuit is proportional to the voltage and inversely proportional to the resistance.

$$I \text{ (Current)} = E \text{ (Voltage)} / R \text{ (Resistance)}$$

The primary resistance in an ESA application is the semiconductive surface of the impression roll. Unfortunately, this resistance has a different magnitude for positive ESA voltages than it does for negative ESA voltages. While this can be a very difficult issue to understand, it leads to an interesting result. The current flowing in an ESA system is typically (but not always) larger for negative voltages than it is for positive voltages. It naturally follows that one would expect better ESA results with negative power supplies than with positive power supplies.

Fortunately, this is true only for voltage-regulated power supplies. On the basis of early printer experience, suppliers started to change from voltage-regulated supplies to current-regulated supplies. The physics predict, and experience shows, that the results with current-regulated supplies are no longer dependent on supply polarity.

To confirm the effect of polarity, the data from Figure 3 is shown plotted as a function of the absolute value of current in *Figure 5*. A casual observation of the data clearly leads to

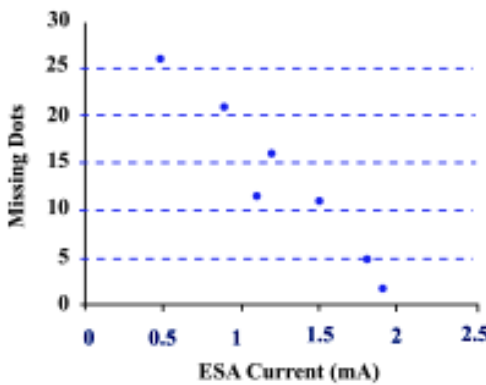


Figure 5
Data Plotted Versus Absolute Value of Current

the conclusion that the effectiveness of ESA is dependent only on current magnitude and not polarity.

The same data plotted as a function of the square of the current in *Figure 6* illustrates that the effectiveness of ESA is proportional to the square of the current.

This data, coupled with water-based ink, supports the assertion that ESA is effective when used with wa-

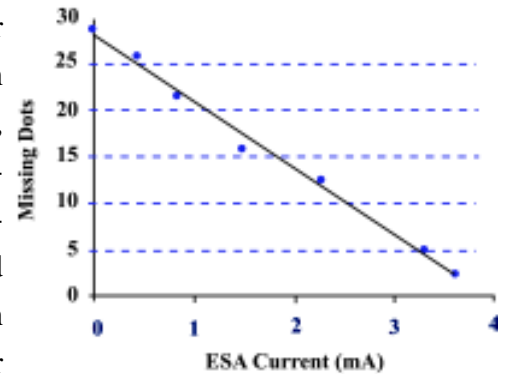


Figure 6
Effectiveness of ESA Dependent on the Square of the Current

ter-based inks. Why, then, don’t all printers using water-based inks have equally successful results?

Special Considerations for Water-Based Inks

There are a few critical issues that make the use of ESA with water-based ink somewhat more complex than with solvent ink systems.

The impression zone must be somewhat resistant to current flow in order to build up the electric field necessary to allow ESA to be effective. Solvent-based inks are relatively non-conductive and readily facilitate the creation of this electric field. Water, being a better electrical conductor than most solvents, works against building the electric field. Viewed differently, water-based inks leave a slightly “damp” substrate. It is commonly understood that damp webs do not readily hold electrostatic charges. Intuitively, one would expect the surface charge density, σ , for wet substrates to be somewhat smaller than typical with

solvents. The result is a smaller electric field in the impression zone when using water-based inks.

The surface tension of water (typically larger than that for the solvents used with inks) requires a greater force to produce the same surface deflection. In the previous discussion, I attempted to substantiate the conclusion that the ESA effect is dependent on the magnitude of the force created at the ink surface in the gravure cell. For a given force (in other words, a given ESA current), solvent-based inks deflect more than water-based inks.

Both of these issues lead to the conclusion that water-based inks require larger electric fields in the impression zone than solvent-based inks. Experience confirms that for ESA to be effective with water-based inks, power supply current must be increased to levels not commonly used with solvent-based inks. This will often require power supplies with greater current capability.

Assuming that it is possible to develop the higher ESA power supply current, will ESA always be effective with water-based inks? Unfortunately, some water-based ink formulations are too conductive to support creating the necessary electric field. Generally, ESA will be effective in providing some level of assist for most water-based inks.

Previously, I stated that the strength of the capillary action drawing the ink from the cell to the substrate depends on the physical properties of the ink and the substrate. The adhe-

sive forces holding the ink molecules together create surface tension in the fluid ink. Greater surface tension makes the ink less likely to wet or be drawn to the substrate surface. Lower surface tension makes the ink molecules more likely to adhere to the substrate. Similarly, the surface energy of the substrate must be sufficiently large to overcome the surface tension of the ink. When it is, adhesion will produce sufficient capillary action to transfer the ink dot. With solvent-based inks, any contact between the ink in the gravure cell and the substrate is normally sufficient to cause ink transfer. The capillary action with solvent-based ink is quite strong. With water-based ink, contact is necessary but not always sufficient to cause ink transfer.

Steps must be taken to ensure that the difference between the surface energy of the substrate and the surface tension of the ink is large enough to create the capillary action needed to transfer the ink. Experience suggests the addition of small amounts of solvent, typically alcohol, to water-based inks often lowers the surface tension sufficiently to allow ESA.

Summing It Up

In summary, more ESA current than is common with solvent-based inks is required for ESA to be effective with water-based inks. The increased current may require power supplies with greater capability. The common rule of thumb for solvent-based ink is 1 mA of current per 30 inches of web width. Water-based inks will typically require three

times this or at least 3 mA of ESA current per 30 inches of web width. However, a careful review of the complete ESA process is required to ensure the higher current levels can be attained. For optimal results this must include the ink formulation, the electrical properties of the impression roll and the physical properties of the substrate.

LabelExpo 2002

Customers from the United States, Canada, Mexico, Central and South America were welcomed to Hurlertron's booth at LabelExpo, in the Rosemont Convention Center,



September 10-12, 2002. Attendance was much better than recent exhibitions.

Hurlertron featured its entire range of register control systems including the Aquila and Halcon spot-scanner register control systems, Halcon inseting and the newly introduced MicroDot digital camera system that uses very small (0.008") marks and that does not require a large clear path in order to read the marks. The system accommodates up to twelve colors, normal out-board stations and speeds up to 3,600 feet per minute.

Solvent Condensation and Streaking

By Ralph W. Creapo

Solvent condensation is the formation and accumulation of ink solvent on the first contact chill roll of a printing press.

Heat set ink dryers do not remove 100% of the solvent from the ink that has been applied to the moving web. In the final print product, there is a residual solvent level of about 15%.

As the web leaves the dryer, the ink solvent continues to evaporate until web temperature drops below the dew point of the ink solvent (about 170°F). As the web travels over the first chill roll, air is pulled into the area between the moving web and rotating chill roll causing "web lift off". The amount of web lift depends on the press speed, web weight, web tension and chill roll diameter.

The air being pulled between the chill roll surface and the moving web, is cooled by the surface of the chill roll. As this cooled air comes in contact with the ink solvent vapors rising from the web, the vapor will cool and will turn to a liquid (condensation).

The solvent condensation that was formed on the first chill roll is then transferred to the printed surface; re-softening the ink and smearing the printed area and, in some cases, caus-

ing blocking problems between signature.

Controlling solvent condensation

There are two methods of controlling the chill roll solvent condensation.

1. Allow the solvent to form on the chill roll and then remove the solvent before it can be transferred to the moving web.
2. Do not allow the solvent condensation to be formed on the chill roll.

Remove the solvent from the chill roll:

Scavenger Blade

This doctor blade is designed to remove the solvent from the chill roll using a blade to scrape the solvent from the surface. The blade is made from a special material that will wear out before there is any damage to the surface of the chill roll. In most cases, the doctor blade will oscillate from side to side on the chill roll.

Scavenger blade operating cost is very low. The doctor blade is the only item that should need to be replaced. The cost of a new doctor blade is currently between \$75.00 and \$100.00.

The main operating problem when using a scavenger blade is to keep the blade clean. If the blade is not kept clean, the build-up solvent and ink resin on the blade will harden and can cause damage to the surface

of the chill roll. Absorption Roll Cleaning System

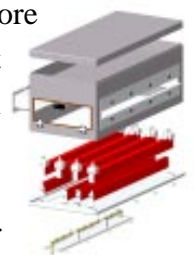
Absorption roll cleaning systems will automatically and periodically remove the solvent condensation from the surface of a chill roll by absorbing it into a cloth roll. This unit can be manually adjusted to allow for light coverage to heavy coverage.

Absorption roll cleaning operating costs can be very high because of the cost of replacement rolls and the labor involved in installing the new roll.

The main problems in using absorption roll cleaning systems are 1) press crews will often shut off the unit once the cloth roll has run out rather than take the time to replace it; and 2) the used cloth can be considered hazardous in many states.

Prevent Condensation From Forming On The Chill Roll Electrostatic Cooling

Electrostatic Cooling, such as Hurtletron's Reactor EC, is the optimum method available to cool the web before it reaches the first chill roll. The system is designed to set up an electrostatic field between a set of charging bars and field director bars. As the moving web passes through the electrostatic field, a spray of micro-droplets of wa-



ter is directed toward the moving web. The mist resulting when the micro-droplets explode in the electrostatic field, cools the web.

The operating costs of electrostatic cooling are very low. Based on operating a press and the electrostatic cooling unit for 19 hours per day, 7 days per week, 50 weeks per year, and a cost of .08 per kW hour, the total operating cost is \$638.40 per year.

The two main operating problems in electrostatic cooling are 1) keeping the charging bars clean, and 2) keeping the spray nozzles clean.

Chill Jet

The chill jet system uses high pressure, low volume air to force the moving web to the surface of the chill roll. The pressure from the chill jet slot must be greater than the pressure of the air being forced between the moving web and the chill roll surface. Once the moving web has been forced onto the chill roll, it will remain against the roll as long as the chill jet is on. The maximum outlet pressure of the chill jet blower will limit the weight of the substrate and the maximum speed of the press. The air leaving the slot of the chill jet will not remain in the area of the chill roll stand and will be forced into the pressroom.

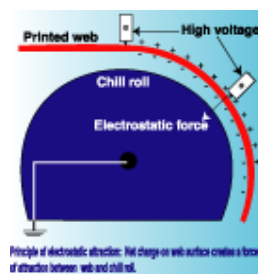
Chill jet operating costs are very high due to the large motor used on the pressure blower. In most cases the blower has a 40 HP motor. Based

on operating the press and the chill jet unit for 19 hours per day, 7 days per week, 50 weeks per year and a cost of \$.08 per kW, the total operating cost is \$15,850.00 per year.

Chill jet operating problems include keeping the chill jet slot in the correct alignment to the web, keeping the slot clean and open, and the noise level of the pressure blower which may cause complaints from the press crews.

Chill Roll Tacking

Electrostatic Tacking systems, such as Hurletron's VersaTack Chill Roll Tacking, apply a static charge to the web at the first chill roll. The applied charge causes the web to be attracted to the chill roll surface greatly reducing or eliminating web lift off. The standard Hurletron chill tacking system comes with two tacking bars that should be installed on the first chill roll. Depending on the web weight and press speed it is sometimes possible to operate a system effectively with only one charge bar.



Chill roll tacking operating costs are very low. Based on operating a press and the chill roll tacking system 19 hours per day, 7 days per week, 50 weeks per year and a cost of .08 kW, the total operating cost would come to \$80.00 per year.

The main operating problem in using chill roll tacking systems is keeping the charging bars clean. A copper wire brush and swivel mounting plates are provided with every system for this purpose.

Web Stabilization is another benefit of the Hurletron tacking system. The systems can be used to act as a non-contact nip roll on a moving web. The force between the charging bar and the chill roll is so great that sideways movement of the web can be reduced or stopped.

Meet the Staff



Jeffrey C. Petrin

Jeff Petrin became Director of Engineering at Hurletron in January 2002. Jeff joined the company as a project engineer in the Spring of 1995, and in 1996, after successfully completing new development of the ElectroCard machine and Hurletron's Aquila Advanced Color Registration system, was promoted to Project Engineering Manager.

Jeff is a graduate of the Milwaukee School of Engineering, where he received a BS in Electrical Engineering in 1991. He is now working toward an Executive MBA at the Lake Forest Graduate School of Management in Lake Forest, Illinois.

Product Line

Promotional Product Applicators

- ElectroCard®
- ElectroSplice®
- LabelJet

Registration Controls

- Aquila®
- Halcon®
- Halcon® Insetting
- MicroDot

Electrostatic Web Cooling

- Reactor EC

Electrostatic Web Remoistening

- ElectroMist ES

VersaTack

Electrostatic Tacking

- Chill Roll Tacking
- Ribbon Tacking
- Card Tacking
- Stack Tacking
- Bundle Tacking

Video Web Inspection

- Visus® 100
- Visus® 200

Active Antistatics

- Hurlatron/Spengler

Planatol-Hurlatron

- Longitudinal Fold Gluing
- Fold Softening
- Ink Supply Systems
- Adhesives
- Softening Concentrates

Authorized Agents

Let us put you in touch with the authorized agent nearest you, or you can visit our web site.

Canada

Tech Sales Co.

Les F. Rapchak - 416-410-1313

Ontario

Honey Felske - 905-857-3331

Ontario

Daniel Marcoux - 450-920-1933

Quebec

Lyle Faulks - 604-859-5393

British Columbia

China

China Engineering & Mercantile Co., Ltd.

James C.H. Lee - +886-2-2541-5935

Taipei, Taiwan

Charlie Chai - +86-21-6486-0425

Shanghai, P.R. China

Leonard Chen - +86-10-6711-7042

Beijing, P.R. China

Europe

Hurlatron®-Planatol®

Ulrich Brünis - +49 80 31 720-0

Rohrdorf, Germany

Japan

Tron Systems

Hugh Takase - 847-559-1747

Northbrook, Illinois

Mexico

Resie S.A.

Jose Macias - 52-818-371-3700

Monterrey, Mexico

South America - Argentina, Brazil, Chile, Ecuador, Paraguay

Dieter Stanior - +54 11 47 32 05 28

San Isidro, Argentina

Ivo de Rizzo - +55 11 3846 6877

Sao Paulo, Brazil

South America - Venezuela, Columbia, Trinidad, El Salvador

Digimex Sistemas

Elias Cardenas - +58 243-551-1634

Maracay, Venezuela

United States

Nortech Web Converting Systems

Jack & Nancy Salerno - 203-758-1740

Middlebury, Connecticut

Southwood Technology

Mas Southwood - 502-905-5490

Prospect, Kentucky

Herbert L. Gibson - 704-523-0710

Charlotte, North Carolina

Magnum Graphix Industrial LLC

Marc Masey - 972-712-2289

Frisco, Texas

Show Schedule

Stop and see us at any of these shows or conferences:

CMM International 2003

April 14-17, 2003

Chicago, IL

Booth 1960

GAA Pressroom Conferene

February 2-5, 2003

Memphis, TN

PLGA Annual Meeting

February 26-27, 2003

Clearwater Beach, FL

Infoflex 2003

May 4-5, 2003

Salt Lake City, UT

Booth 728

GAA Annual Conference

May 6-8, 2003

Operlyland

Nashville, TN

Nexpo 2003

June 16-19, 2003

Las Vegas, NV

Booth 684

PLGA Conference

October 16-17, 2003

San Antonio, TX



HURLETRON®

Page 8

1820 Tempel Drive, Libertyville, IL 60048

847.680.7022 • Fax: 847.680.7338 • US & Canda: 888.371.0761

sales@hurlatron.com • www.hurlatron.com • service@hurlatron.com

