

Welcome to Today's Webinar





How New Inks & Surface Treatment are Revolutionizing Wire & Cable Marking

Gem Gravure

- Established in 1952, Third generation, family owned
- 6 patents on gravure wheel design
- Introduced ink jet printing into wire & cable in the early 80's
- Established in-house ink development group to develop custom inks, including inks for high temperature wire
- Exclusive representative for KBA-Metronic marking and coding products



Enercon Industries

- Established in 1974, family owned
- Global operations include facilities in USA, United Kingdom, and India
- Manufacturers of equipment for packaging, converting, extrusion, plastics, assembly, printing, coating, bonding & decorating applications
- Application expertise in improving surface adhesion properties
- Innovator of Plasma, Flame and Corona Treating Technologies
- International sales and service network



Today's Presenters



Sarah Bauer
Enercon Industries Corporation
Plasma Treatment Application Specialist



Ramona Krogman
Gem Gravure Co., Inc.
Marketing Manager



Overview

- Benefits & Challenges of Ink Jet Printing
- Ink Basics
- Material Surface Basics
- Plasma Treating enables adhesion
- Specifying Inks
- Plasma Technology Options
- Review
- Question/Answer



Benefits & Challenges of Ink Jet Printing



Benefits of Ink Jet Printing

When ink jet entered the market, it complemented contact printing and brought some advantages

- Variable data: messages can change
- Non-contact: able to print on hotter surfaces, soft surfaces
- Speed: messages can be delivered up to 1800 fpm, with logo and change over between products is rapid



Benefits of Ink Jet Printing

- Desire to move to digital printing
- Stricter measures & tolerances from customers on adhesion
- Alternatives are not cost efficient
 - i.e. hot stamping or laser marking
- Desire to use a “universal solution”



Ink Jet Printing Challenges

Adhesion issues

- Inherent Material Properties
- Surface Contamination
- Ink/Material Compatibility
- Durability of print

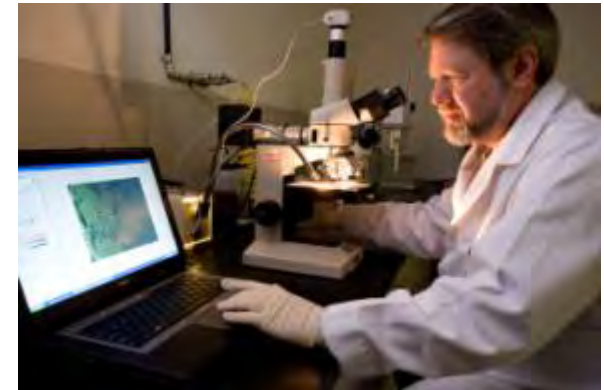


Ink Basics

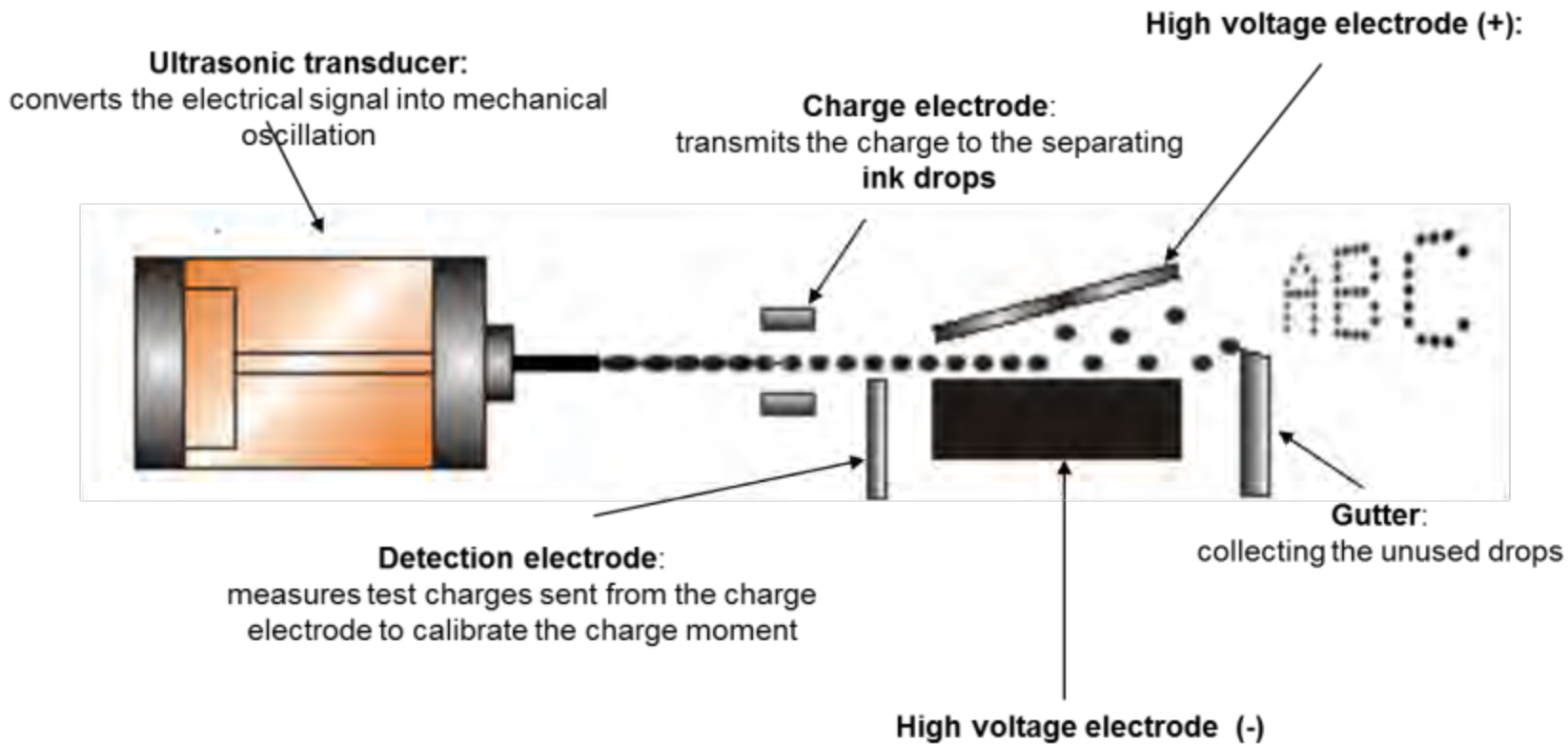


Ink Basics

- Ink jet inks vary from other inks, paints and coatings.
- Low viscosity, special stability requirements
- For wire & cable: special requirement of visibility on a wide range of colors
- Must survive operation of the printer



Ink Basics



Ink Basics

Four main components

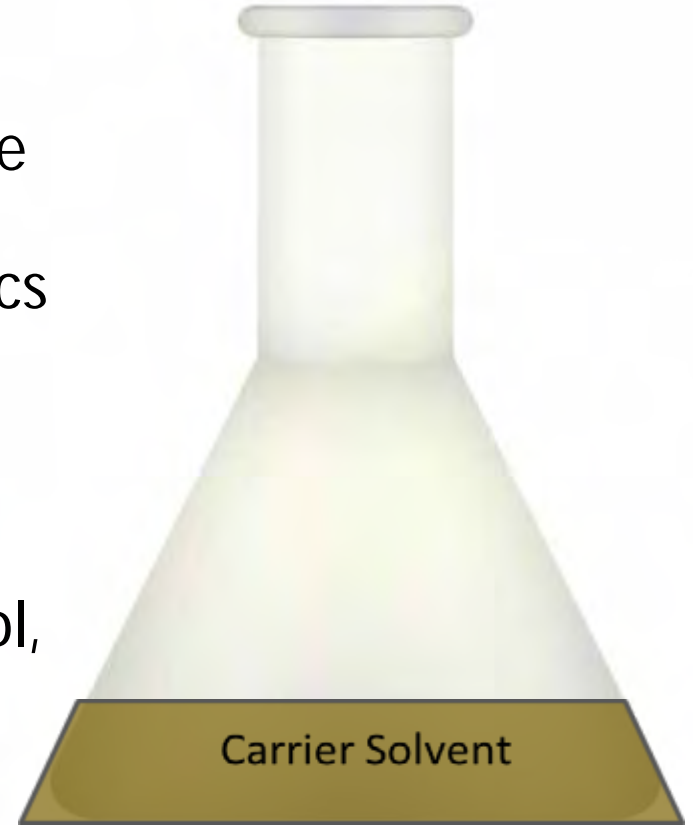
- Solvent (carrier)
- Colorant (dye or pigment)
- Resin
- Additives



Ink Basics

Carrier Solvents

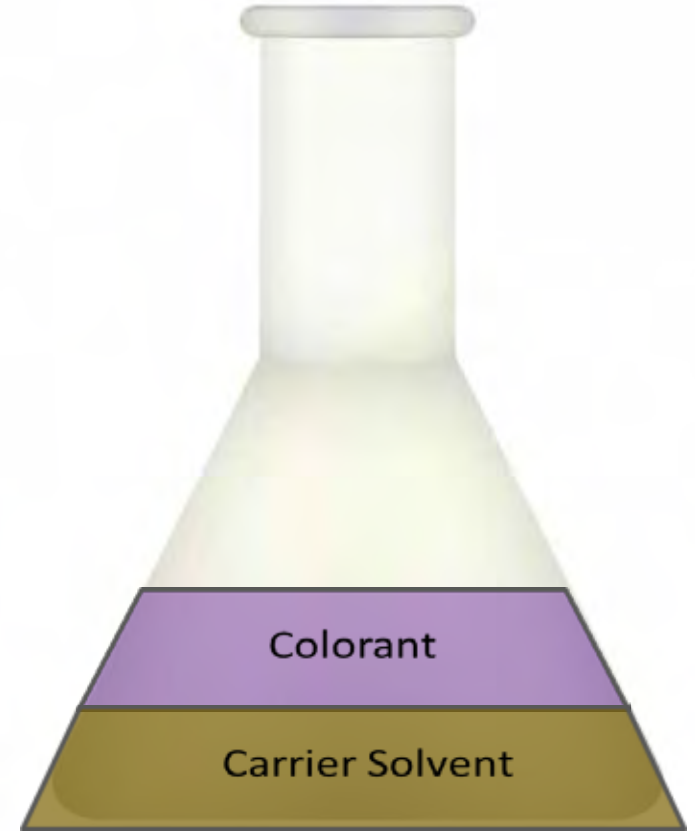
- Carry the resin and colorant to the surface
- Determine the main characteristics of dry time
- Carry the resin and colorant through the printer and keeps them in solution
- Main types: MEK, acetone, ethanol, water



Ink Basics

Colorants

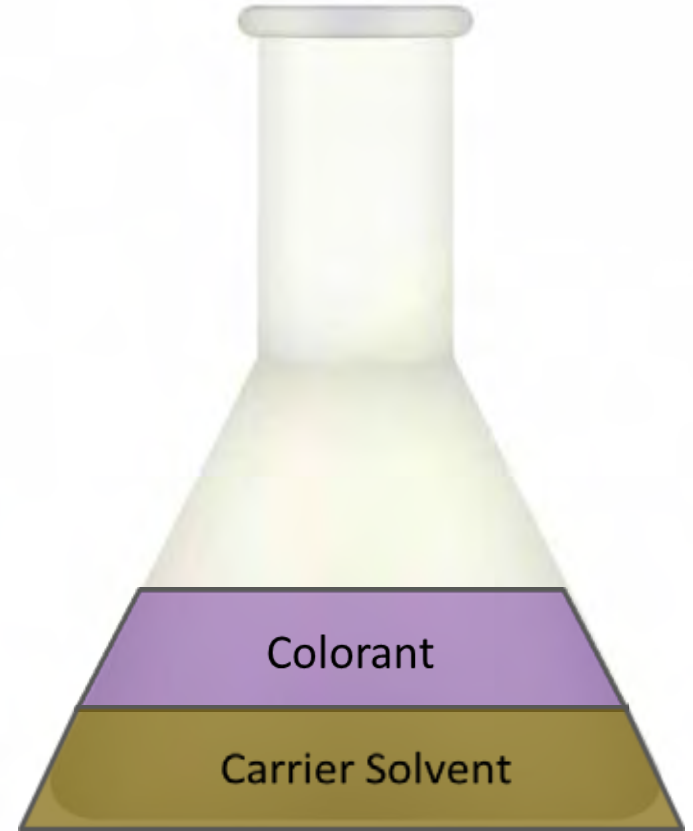
- Dye: color that is solubilized in the ink (think of sugar in hot water)
- Dye: bright colors, dark black
- Dye: can be damaged by heat, solvents, plasticizers
- Dye: used in many all purpose inks for marking packaging or paper
- Dye: easy printer operation



Ink Basics

Pigments

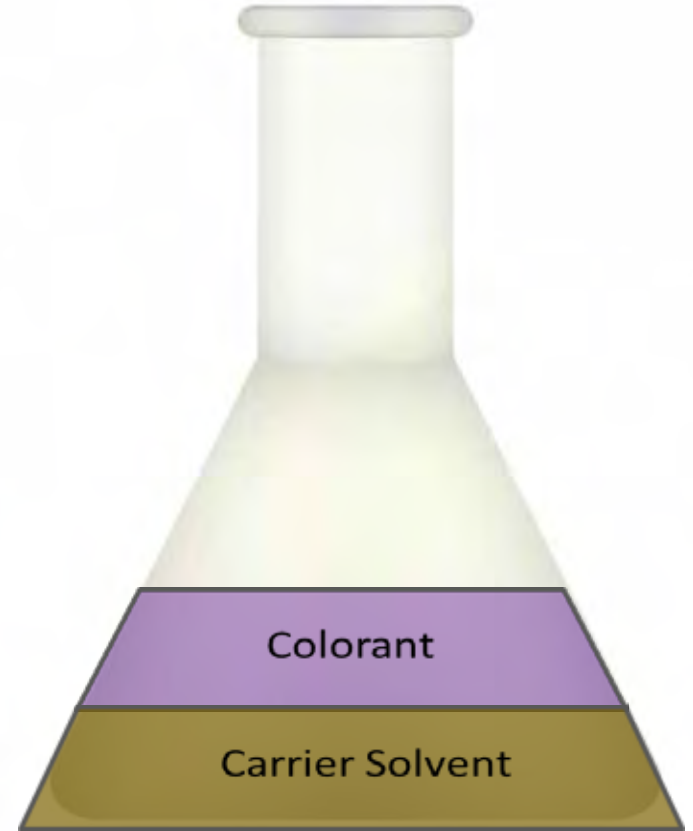
- Heavy pigmented: (think of sand in cold water)
- Heavy pigmented: opaque, can be seen on a dark surface
- Heavy pigmented: mainly white but can be a range of colors
- Heavy pigmented: requires shaking & mixing prior to use in the printer and during operation
- Heavy pigmented: printed codes withstand a higher amount of heat than other inks



Ink Basics

Pigments

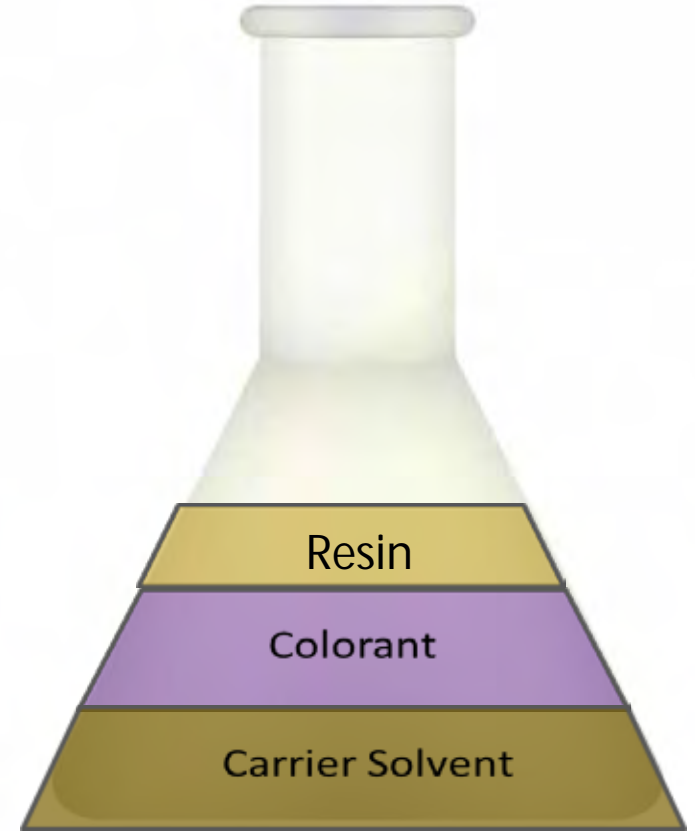
- Soft pigmented: (think of large soft particles suspended in liquid)
- Soft pigmented: less opaque than heavy pigment and can be transparent
- Soft pigmented: a range of colors available
- Soft pigmented: requires shaking prior to use in the printer and but NO mixing required during operation
- Soft pigmented: survives heat after printing but not the same level as heavy pigmented



Ink Basics

Resin

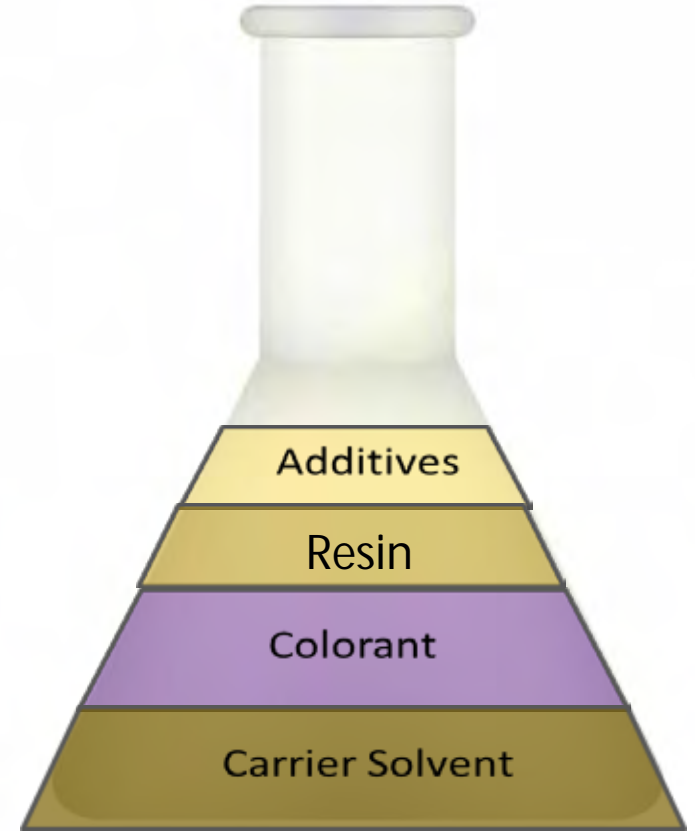
- Resin: holds colorant to the surface
- Resin: the final dried code is resin and colorant
- Resin: characteristics of the resin determine if the ink will stick to the surface
- Resin: characteristics of the resin help determine how the ink will operate in the printer



Ink Basics

Additives

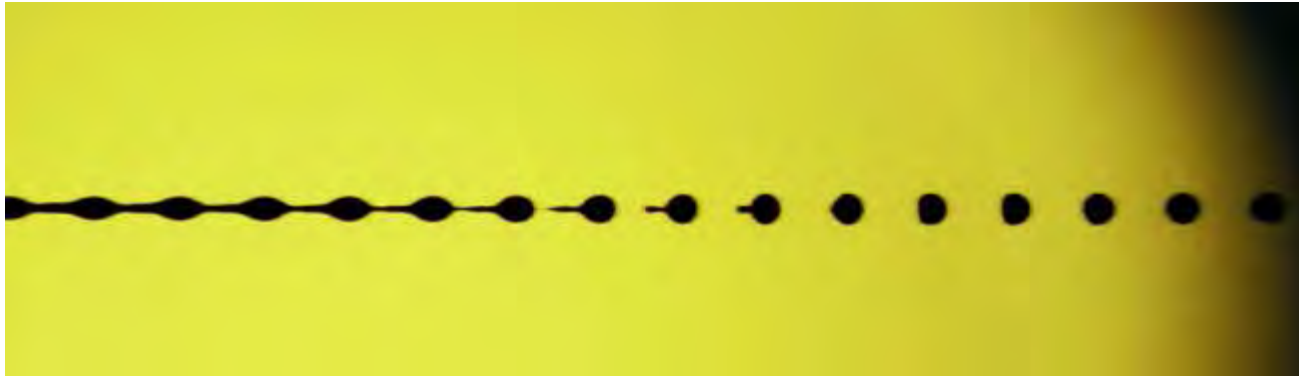
- Additives: a wide range of materials used to stabilize ink
- Additives: used to create a conductive ink, easy to jet
- Additives: small amounts with a variety of effects



The result: an Ink Jet Ink



Unused ink droplets are recycled within the printer.
Solvent is lost to evaporation.



A secondary fluid (Make Up) is designed to replace the solvents in the correct ratios.



Selecting components

- A group of soft pigmented inks were designed specifically for PVC marking
- Soft pigments do not leach into the wire surface
- Can be printed under warm or hot conditions without damage to the ink
- Pigments do not transfer or ghost when plasticizers leach out of cooling, coiled PVC



Selecting components

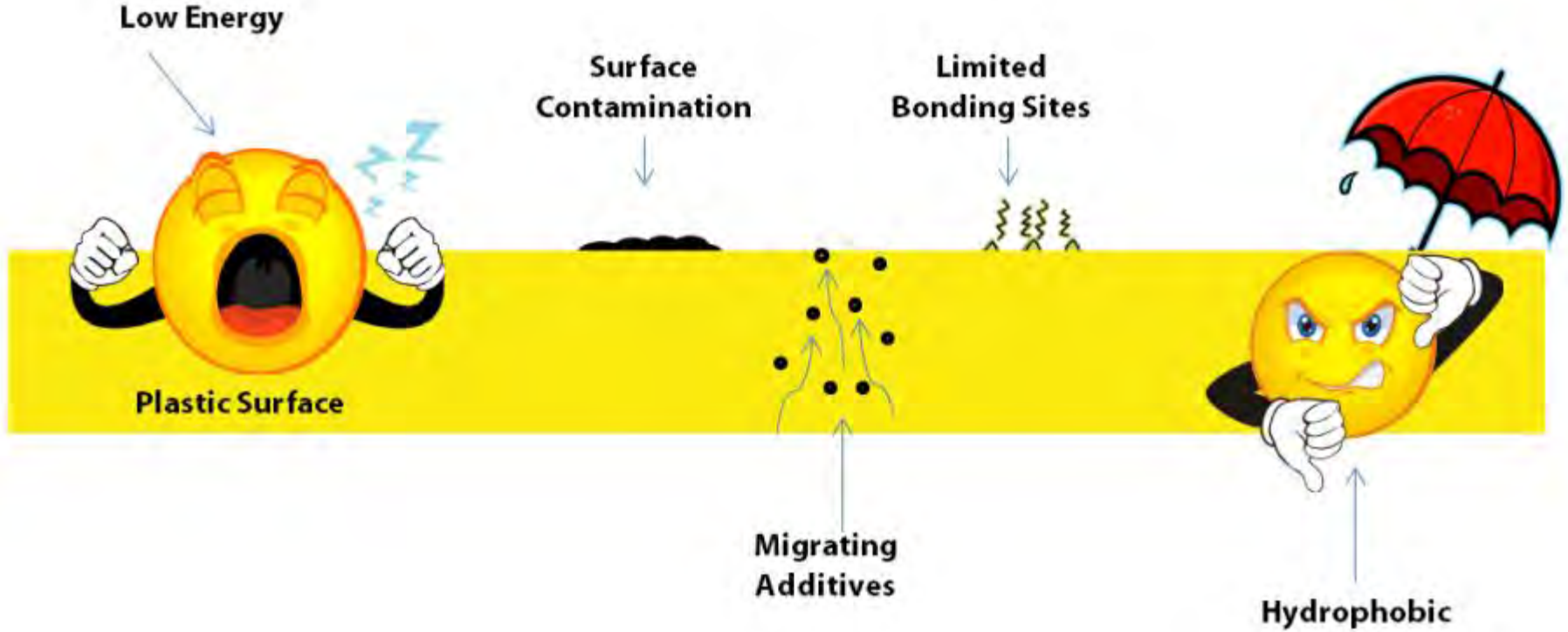
- Heavy pigmented inks resist leaching of pigment
- Can be printed under warm or hot conditions without damage to the ink
- They can be printed near the extruder head where they can lock into the matrix of the cooling jacket, particularly useful for PE surfaces



Surface Challenges

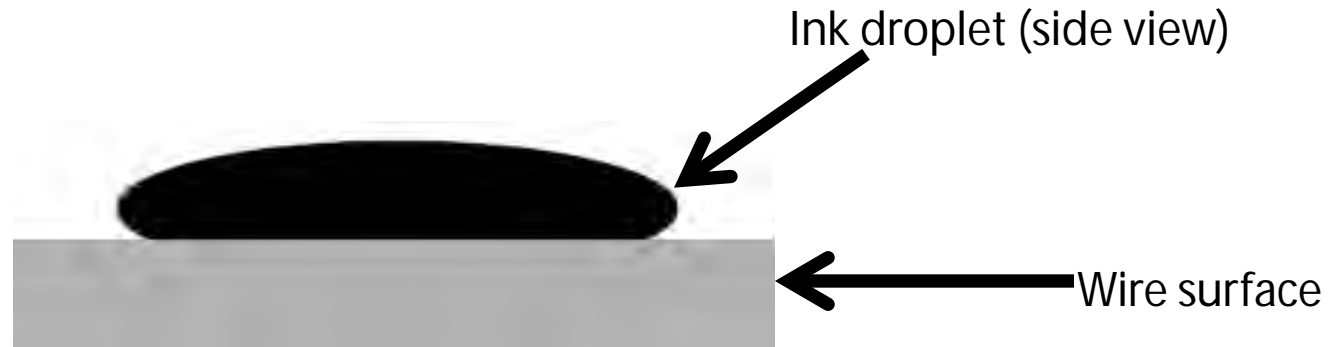


Surface Challenges

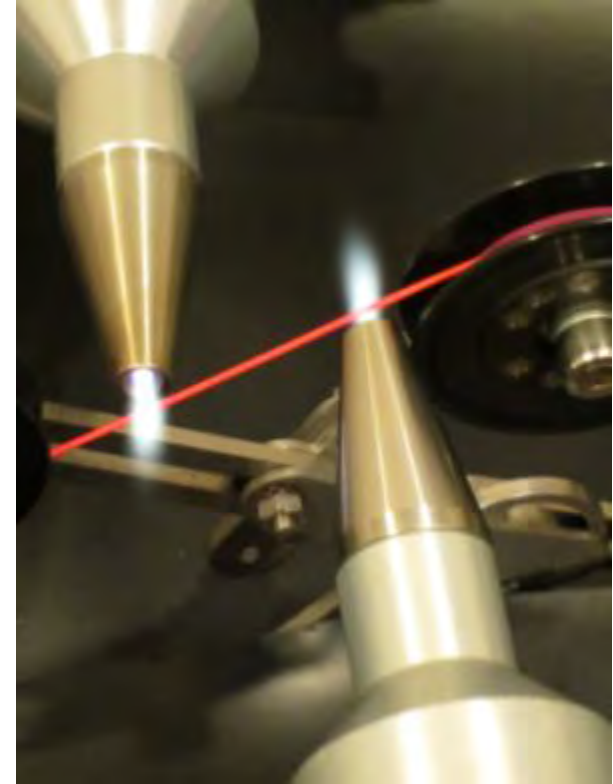


Surface Wettability and Ink Droplets

- Poor match between ink droplet and wire jacket surface energy causes beading
- Reduces interface with wire surface

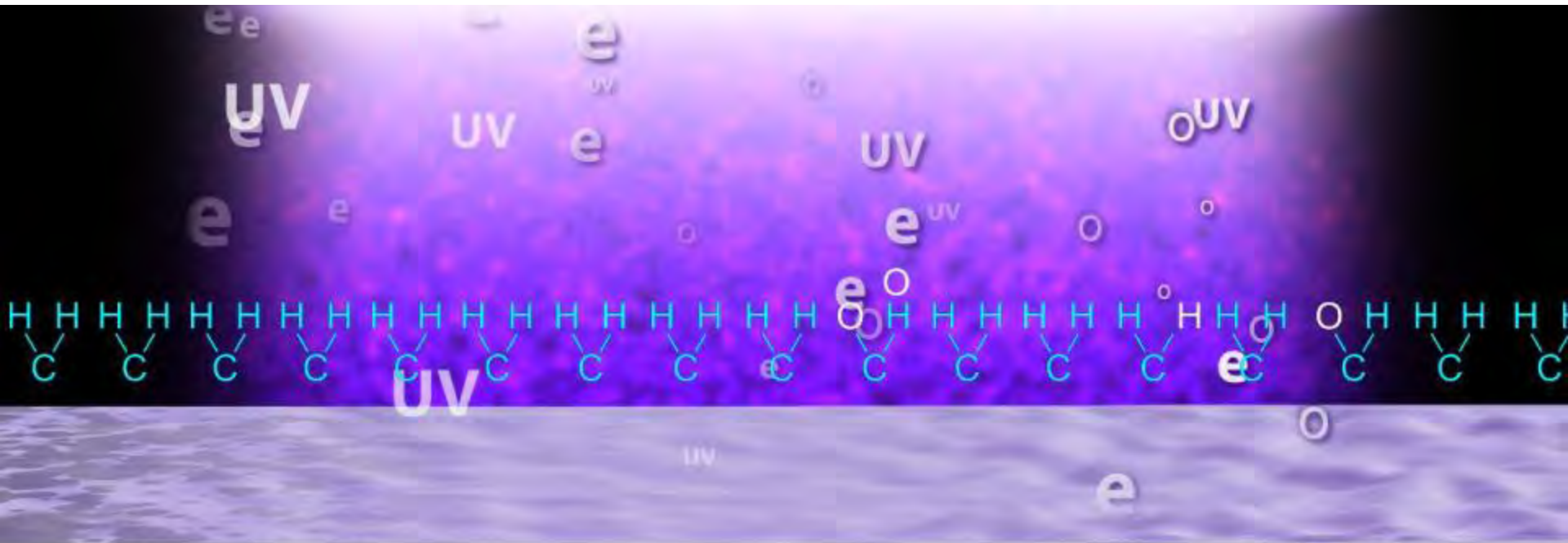


Plasma Treating



What is Plasma Treatment?

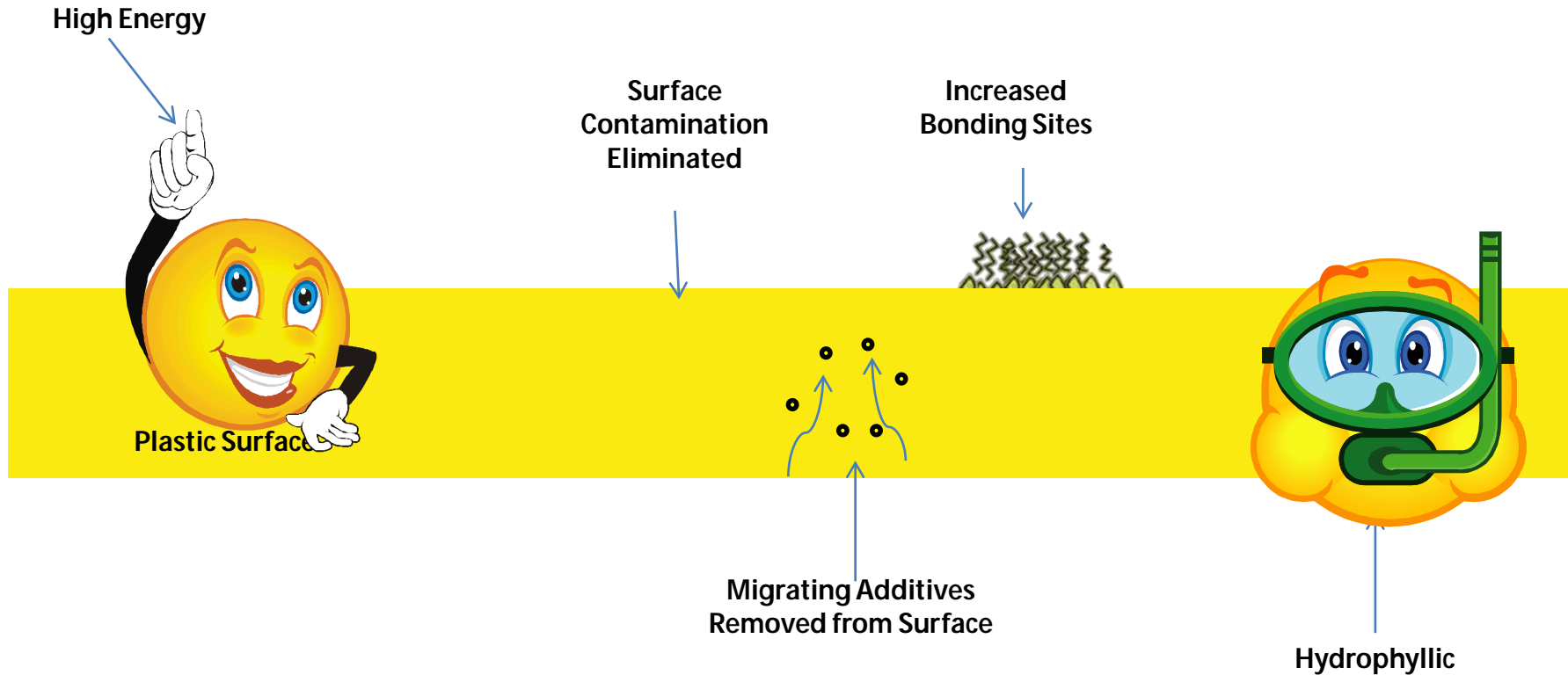
Ionized gas that bombards the surface of a substrate & create a more hydrophilic, micro etched and functionalized surface.



Contaminated Surface
Minimal Surface Area
Non-Functionalized

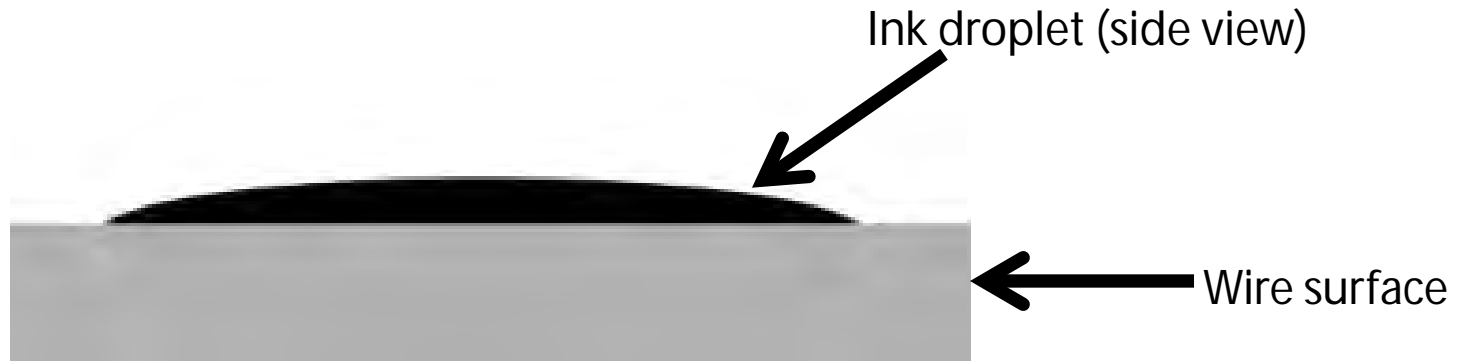
Clean Surface
Optimized Surface Area
Functionalized

What is Plasma Treatment?

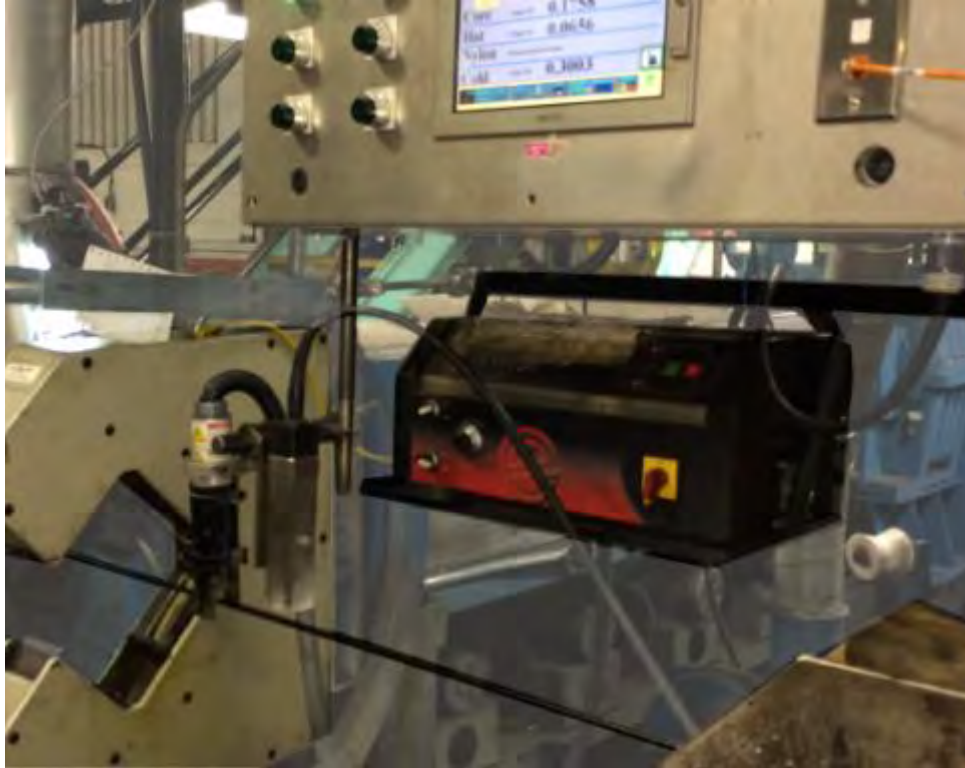


Surface Wettability and Ink droplets

- The drop must spread across the surface to form a smooth, thin film
- Maximizes interface with wire jacket



Common types of materials we treat



PE
PVC
PP
PTFE
XLPE
ETFE
FEP
EDPM
Silicone



Common types of materials we treat

Wire Jacket Material	In-Line Plasma Technology	Pre-treat Dynes/cm	Post-treat Dynes/cm
XLPE	Atmospheric Ion Plasma	32-40	46
XLPE	Flame Treatment	32-40	60+
Teflon	Atmospheric Gas-Phase Plasma	18.5	39
FEP	Atmospheric Gas-Phase Plasma	16-18	52
PVC	Flame Treatment	35	46
PVC	Atmospheric Ion Plasma	35	60+
Silicone	Atmospheric Ion Plasma	20-25	50+





Ink Formulations for Wire & Cable

BKG4861: Patented Gem wire harness black dye based ink

- Patented (US 794329316 B2) dye based ink
- Specially designed for use in wire harness marking applications
- Replaces UV cured ink on wire cutting equipment
- Codes survive exposure to automotive solvents

	Antifreeze	Motor Oil	Transmission Fluid	Gasoline	Diesel Fluid	Brake Fluid
Sample #1	Pass	Pass	Pass	Pass*	Pass	Pass
Sample #2	Pass	Pass	Pass	Pass*	Pass	Pass
Sample #3	Pass	Pass	Pass	Pass*	Pass	Pass
Sample #4	Pass	Pass	Pass	Pass*	Pass	Pass



WTG1860 White Pigmented Wire Harness Marking Ink



- White pigmented ink for use in pigmented/opaque ink jet printers (50 micron or larger nozzle sizes)
- Specially designed for use in wire harness marking Its unique
- Replaces UV cured ink on wire cutting equipment
- Maintains adhesion and visibility after exposure to automotive solvents

Results for Cross Linked Polyethylene with 72 hour Air Cure**

Wire Sample	Antifreeze	Motor Oil	Transmission Fluid	Gasoline	Diesel Fluid	Abrasion
Cross-linked PE	Pass	Pass	Pass	Pass*	Pass	Pass
Cross-linked PE	Pass	Pass	Pass	Pass*	Pass	Pass
Cross-linked PE	Pass	Pass	Pass	Pass*	Pass	Pass
Cross-linked PE	Pass	Pass	Pass	Pass*	Pass	Pass

*These samples showed faded or partial removal, but ink remains visible and writing legible on wire surface. NOTE: due to variations in materials, testing customer sample is always advised.



BLG1866 Aqua Pigmented Ink



- Light aqua heavy pigmented ink for use in opaque/pigmented ink jet printers (nozzle sizes 55 microns and larger)
- Contains a combination of white and blue pigment dispersions that prevent migration of the ink, resists transfer on PVC, light fast, resists damage by heat
- Combines properties of WTG1860 white and BLG4266 Aqua inks.



YLG1874 Yellow Pigmented Ink



- Yellow heavy pigmented ink for use in pigmented ink jet
(nozzle sizes 55 microns and larger)
- Contains a combination of white and yellow pigment dispersions which prevents migration of the ink, resists transfer on PVC, light fast, resists damage by heat
- Provides a bright yellow code on light and dark colored surfaces
- Similar performance to BLG1866



BKG7761 Black Fluoropolymer Ink

- Patented black ink for use in standard ink jet printers
(nozzle sizes 40 microns and larger)
- Provides adhesion to Fluoropolymers (see Applications) prevents migration of the ink, light fast, resists damage by heat. MEK based ink.
- Primary Use: Coding Fluoropolymer surfaces
- Must be post heated to obtain adhesion/fusion to Fluoropolymers
- FEP & ETFE generally require 300°C. PTFE generally requires 400°C. Printing on clean, dry wire highly recommended. Processing speeds, dwell times, temperatures, insulation types and size must be optimized for each specific application due to site specific variables.

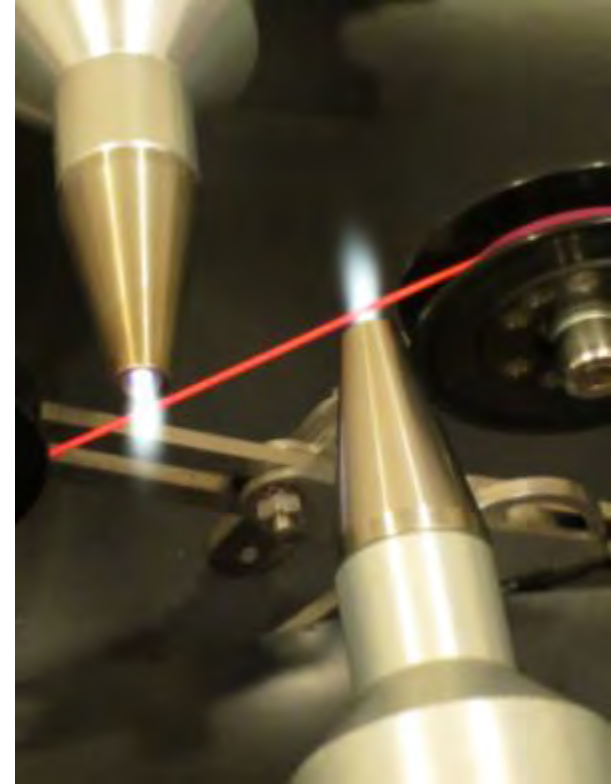


GNG7765 Green Fluoropolymer Ink

- Patented green ink for use in standard ink jet printers
(nozzle sizes 40 microns and larger)
- Provides adhesion to Fluoropolymers (see Applications) prevents migration of the ink, light fast, resists damage by heat. MEK based ink.
- Primary Use: Coding Fluoropolymer surfaces
- must be post heated to obtain adhesion/fusion to Fluoropolymers
- FEP & ETFE generally require 300°C. PTFE generally requires 400°C. Printing on clean, dry wire highly recommended. Processing speeds, dwell times, temperatures, insulation types and size must be optimized for each specific application due to site specific variables.



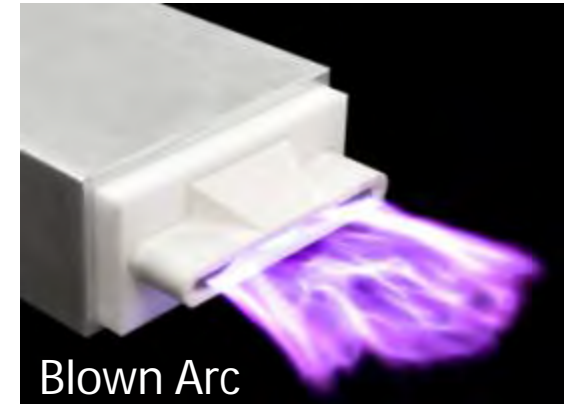
Plasma Treatment Options



Surface Treatment Options

Blown Ion & Blown Arc Plasma

- Used on most jacketed cables with an initial dyne level of 30+
- Examples include: PE, XLPE, PVC, PP, EDPM, Silicone
- Utilizes compressed air and electricity to create a ionized air
- Concentrated head discharge allows for easy adjustment and maneuverability



Surface Treatment Options

- New Technology
- Intuitive Touch Screen Control
- Plasma Integrity Monitoring



Surface Treatment Options

Variable Chemistry Plasma

- Used for fluoropolymers such as PTFE, FEP & ETFE
- Also used on materials that have tight tolerances for adhesion (i.e. acid bath)
- Utilizes gas chemistries with or without the introduction of air
- Multiple/custom designs available to meet width and speed requirements



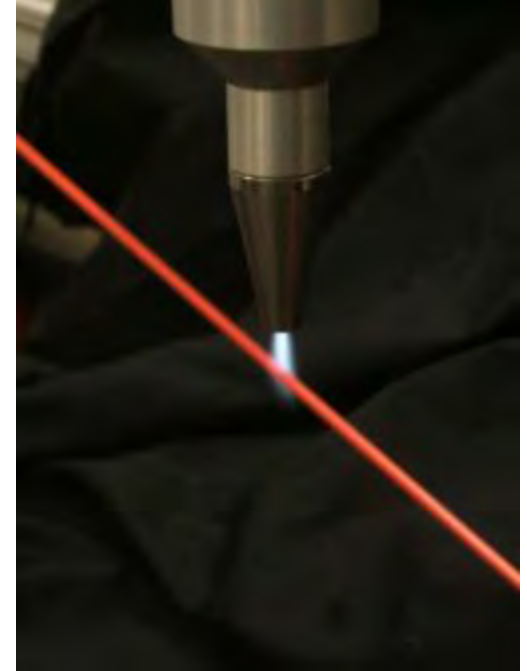
How to qualify?

- Set up a proper DOE
- Run on-site printing/plasma trial
- Narrow down testing parameters
 - i.e. Scratch Test, Acid Test, etc?
 - Do we have to meet Military/Aviation requirements?



What else can plasma do?

- Addition of a plasma system can ensure your surface energy is at an optimal level for all applications
- Can be used to clean/prep the conductor
- Sometimes allows for a less expensive ink/jacket to be used
- Peace of mind



Summary

- Ink jet offers digital printing, higher quality, faster throughput
- Ink formulations can be developed for specific applications
- Plasma treating aids adhesion by modifying surface properties



Questions



Sarah Bauer
Enercon Industries Corporation
Plasma Treatment Application Specialist
262.250.3177
sbauer@enerconmail.com



Ramona Krogman
Gem Gravure Co., Inc.
Marketing Manager
781.878.0456
rkrogman@gemgravure.com



Thank you

