Managing Corona & Atmospheric Plasma Systems 101

presented by
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What it's all about...

**The Air Plasma (Corona Discharge) Effect**
How Corona chemically affects a surface...

A corona-processed PP film contains hydrophilic surface functional groups such as:

- Carbonyl (-C=O)
- Alcohols (C-OH)
- Peroxyl (-C-O-O)
- Acids ((OH)C=O)

How Corona physically affects a surface...

- Forms low-molecular weight (LMWOM) on the film surface
- Oxidizes film surface
- Forms positive and negative sites by adding and deleting electrons
Using Watt Density...

\[ W_d = \frac{P_S}{W_W \times L_S \times N_ST} \]

Where:
- \( W_d \) = Watt Density (watts/m²/minute)
- \( P_S \) = Power Supply (watts)
- \( W_W \) = Web Width (meters)
- \( L_S \) = Line Speed (m/minute)
- \( N_ST \) = Number of Sides Treated

Typical Watt Densities for Printing, Coating & Laminating...

<table>
<thead>
<tr>
<th>Material Type</th>
<th>Solvent</th>
<th>Water</th>
<th>UV</th>
<th>Solventless</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretreated LDPE</td>
<td>1.5-2.0</td>
<td>2.2.5</td>
<td>2.2.5</td>
<td>1.0-1.3</td>
</tr>
<tr>
<td>Pretreated LLDPE</td>
<td>1.5-2.0</td>
<td>2.2.5</td>
<td>2.2.5</td>
<td>1.0-1.3</td>
</tr>
<tr>
<td>PET</td>
<td>1-1.5</td>
<td>1-1.5</td>
<td>1-1.5</td>
<td>1.0-1.3</td>
</tr>
<tr>
<td>Pretreated BOPP</td>
<td>2-2.5</td>
<td>2.5-3.0</td>
<td>2.5-3.0</td>
<td>1.0-1.3</td>
</tr>
</tbody>
</table>
Treatment Longevity...

- Treatment level longevity depends on material, material thickness, surface contamination, processing additives, storage conditions, and pre-treatment process.

A Typical Corona Treatment System...
Bare Roll with ceramic electrodes  
(conductive & non-conductive)

Covered Roll with metal (segmented) electrodes  
(non-conductive)

Universal Roll with ceramic electrodes  
(conductive & non-conductive)

Covered Roll with metal (fin) electrodes  
(non-conductive)
Corona Roll Coatings & Electrode Power Density Chart

- Stainless Steel Tubes
- Stainless Steel 1/4" Segments
- Stainless Steel 1/2" Segments
- Stainless Steel Fins
- Enhanced Discharge

Maximum Electrode Watts/Inch

Proper web direction...
Proper Electrode Gapping...

- Air gap between each electrode and ground roll is equal
- Recommended air gap is .060”/1.5mm
- Equal discharge from full electrode face
**System Exhaust Guidelines...**

- Removes ozone, cools electrodes
- Verify the Proper Duct Size & Materials
  - PVC
  - Stainless Steel
- Minimize Duct Run & Bends
- Verify Blower Rotation

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**Universal Roll Exhaust Path**

[Diagram of Universal Roll Exhaust Path]
Exhaust Air Flow Switch...

Direct Mount Blower...
Blower Mounted To Station...

Drive Addition w/ Air Fittings...
High Voltage Wiring...

Corona System Market Applications...

<table>
<thead>
<tr>
<th>System Types</th>
<th>Bare Roll</th>
<th>Covered Roll</th>
<th>Universal Roll</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process Application Markets</td>
<td>Flexo/Solvent Printing Coating</td>
<td>Blown Film Ext. Cast Film Ext. In-Line Bag Production</td>
<td>Flexo/Solvent Printing Coating Lamination</td>
</tr>
<tr>
<td>High-Growth Markets</td>
<td>Flexible Packaging Poly Banners Skin Packaging</td>
<td>Food Barrier Film UV/Digital Printing Solventless Lam.</td>
<td>Shrink Film Low Sealing Temp. Film Solventless Lam.</td>
</tr>
</tbody>
</table>
Atmospheric Plasma System Discharge...

How Atmospheric Plasma chemically enhances a surface bond...
How Atmospheric Plasma physically enhances a surface bond...

**PlasmaTreat™**

- **reactive gas molecules**
- **specific gas molecules**
- **adsorbed water vapor**
- **adsorbed oxygen**
- **surface particles**

**WEB SURFACE**

How plasma functionalizes a surface:

Reactive gas molecules are accelerated or diffused towards the target surface under the influence of electric and/or magnetic fields. Low molecular weight materials, such as water, adsorbed gases and polymer fragments, are knocked off the surface of the film to expose a clean, clean substrate. At the same time, a portion of the reactive components of the plasma gas impinge with sufficient energy to bond to the locally exposed bulk substrate, thus changing the chemistry of the substrate surface to impart the desired functionality.
Polyethylene (30,000 SEM magnification)

Atmospheric Plasma Longevity vs. Other Processes...

Surface Treatment Longevity Chart
Thank you for your attention to .......

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