Printing Ink Technologies for Shrink Sleeves

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Agenda

- Introduction
- Different ink types and printing technologies
- Typical ink ingredients
- Requirements for the inks for shrink sleeves
- Tips for water based and solvent based printing
- Deep dive into UV curable inks
- Summary
Role of packaging

- protection - increase of shelf life

Brand Recognition

Eye Catching Packaging
Attractiveness of shrink sleeves

Eye catching
Possibility to differentiate (360° info)
High quality printing
High resistance (scratch & chemical) properties
Food safety
Different ink types and printing technologies

- **Oil based**
  - Diluent
  - Resin
  - Additives
  - Pigments

- **Conventional**
  - Solvent or Water
  - Resin
  - Additives
  - Pigments

- **Radiation (UV)**
  - Diluent (monomers)
  - Oligomer “resin”
  - Additives
  - Pigments
  - Photo-initiators
Different ink types and printing technologies

<table>
<thead>
<tr>
<th>Print method</th>
<th>Ink type</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Solvent-based</td>
</tr>
<tr>
<td>Flexo</td>
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<tr>
<td>Letterpress</td>
<td></td>
</tr>
<tr>
<td>Offset</td>
<td></td>
</tr>
<tr>
<td>Screen</td>
<td>X</td>
</tr>
<tr>
<td>Gravure</td>
<td>X</td>
</tr>
<tr>
<td>&quot;Digital&quot;</td>
<td>X</td>
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## Typical ink ingredients

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Ink types</th>
<th>Solvent-based</th>
<th>Water-based</th>
<th>Oil-based</th>
<th>UV curing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pigments</td>
<td></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Resins</td>
<td></td>
<td>Nitrocellulose</td>
<td>Acrylic</td>
<td>Phenolic</td>
<td>Alkyd</td>
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<tr>
<td>Diluents</td>
<td></td>
<td>Solvents</td>
<td>Water/amine</td>
<td>Mineral / Vegetable Oil</td>
<td>Monomers</td>
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<tr>
<td>Solvents</td>
<td></td>
<td>&gt; 30%</td>
<td>&lt; 5%</td>
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<tr>
<td>Additives</td>
<td>Wax</td>
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<tr>
<td></td>
<td>Antifoam</td>
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<td>Stabilizers</td>
<td>Stabilizers</td>
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<tr>
<td></td>
<td>Silicones</td>
<td></td>
<td>Fillers</td>
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</tr>
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<td></td>
<td>Plasticizers</td>
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<td>Stabilizers</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Photo initiator</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Stabilizers</td>
<td></td>
</tr>
</tbody>
</table>
Pigments

- Pigments
  - physically & chemically stable
  - non-soluble

- Denoted by Color Index Number (CI#)
  - Red 57.1, Red 184, Red 177

- CI# indicates properties
  - hue, fastness, cost....
  - important to know CI#!

- Organic nature
  - Pyrazolene, Disazo, Naphthol, Pthalocyanine, Quinacridone

- Inorganic
  - Titanium Dioxide
  - Iron Oxides
  - Metallic
Resins

• Typical resins used
  • Nitrocellulose
  • Polyamide
  • Acrylic (styrene and acrylic acid)
  • Phenolic
  • Epoxy Acrylates, polyester acrylates, etc...: used in UV/EB inks & coatings
  • Urethanes, Polyesters: used in solvent based inks & coatings

• This is the backbone of the ink!
• Will affect adhesion, flexibility, resistance properties, speed of drying/curing, and overall end performance of printed material
Diluents

- Used to reduce viscosity, to “thin” the ink
- Most common is \(H_2O\) for waterbased inks
- UV inks use monomers
- Diluents will affect dry/cure speeds also
Additives

- Defoamers
- Waxes/Silicones (Coefficient Of Friction=COF)
- Matting agents
- Photoinitiators for UV inks
- Adhesion promoters
- Surfactants
- Optical Brighteners
Requirements for inks for shrink sleeves

- Very high color strength
- High cure speed
- Excellent press & print performance
- Ability to shrink (so flexibility!)
- Adhesion to wide range of substrates (PET-G, PVC, OPS, PLA,....)
- Good surface slip properties, especially for ink on the last printing station (usually white)
Why is white ink so important?

- Usually last down so COF is very important
- Scratch resistance, adhesion and flexibility
- Opacity, adhesion and flexibility
- Low COF (high slip) – last down
- High COF (low slip) – first down
- Some people will print single bump of white and up to 3 bumps to get opacity and performance
Tips for printing water based inks

• Proper anilox roller selection and press speed

• Ensure proper drying in order to reach the desired properties (adhesion and scuff resistance) as well as to prevent blocking in the rewind

• Catalyze the inks (whites/last down) if steam tunnel is used for shrinkage

• pH maintenance is critical!
Tips for printing solvent based inks

• Correct solvent selection is important as some solvents like e.g. acetates damage the film, leading to e.g. whitening

• No retained solvent in inks after drying as this can affect shrink performance, so a combination of proper air drying with right viscosity is important
Deep dive into UV inks: designing a Low Migration UV flexo ink

**Flexibility**
- Oligomers
- Monomers
- Photoinitiators
- Pigments
- Additives

**Properties**
- Adhesion
- Viscosity
- Cure speed
- Shade/Strength
- Lightfastness
- Scratch resistance
- Chemical resistance
- Pigment wetting

**Production**
- Price
- Migration evaluation

**Food packaging**
- Compliant ink
- No taste transfer
- Low odour

Food packaging:
- Compliant ink
- No taste transfer
- Low odour
Designing Low Migration UV flexo inks

- Less building blocks available
- Excluding low molecular weight monomers prone to migrate
- Legislations and regulatory environment continuously moving
- Increased awareness among local brand owners

Targeting a design window that gets smaller every year
Challenges with UV curable inks

• Heat generation from UV lamps will distort films, especially thin films
• If you don’t have the proper ink formulated for “cool UV” systems, then your UV inks may not cure as fast
• Often the chill roller is too cool
• All of these challenges can be addressed with UV LED curing
What is UV LED?

- UV LED means UltraViolett Ligth Emitting Diode
- UV LED is an alternative for the tradioitional UV Hg lamp systems (different wavelengh and intensity compared to conventional UV)
- Different ink chemistries are needed
## Advantages of UV LED curing

### Performance
- High color strength with excellent cure
- Reliable and consistent adhesion and printability
- Dual cure

### Advanced Capabilities
- Useful with heat sensitive films, thin substrates
- Controlled and consistent curing intensity - Consistent curing

### Operating Economics
- Higher Productivity
  - Press UPTIME – less equipment faults
  - Faster cure
- Energy Efficient
- Long Lifetime & Low Maintenance
- Solid State: Instant on/off

### Health and Environmental
- Mercury & Ozone Free
- Less Heat and Operating Noise

IDEAL for Shrink Sleeves
Summary

• Shrink sleeves allow to make eye catching packaging and labels

• Inks are an important part of the shrink sleeves

• Requirements for the inks for shrink sleeves are quite stringent

• Not all inks will fit...........they must be specially designed and tested to achieve those performance requirements