OVERVIEW
Coatings are applied onto a metal surface to improve the appearance and provide corrosion resistance from elements that would compromise it. Without a protective coating, the metal surface would form rust and potentially reduce its service life. In the Tube & Pipe industry, coatings are designed for heavy duty applications requiring a high degree of protection since these objects are stored in an outdoor setting. The coating needs to endure challenging environments such as marine atmospheres, ultraviolet (UV) sunlight exposure, moisture, solvents, etc. with the expectation that the coatings can withstand degradation for at least six months to a year.

Selecting an appropriate coating for tubular applications depends on many factors such as the type of performance expectations, economic considerations, technical requirements, regulatory concerns, and process equipment availability.

DEFINITION
Generally defined in the dictionary as “a covering applied to a substrate (surface)”, a coating has functional properties, but can also have a dual purpose to be decorative as well. From a functional standpoint, the coating would primarily be used to change or improve the substrate’s properties such as corrosion resistance and color coding grades of pipe. Most coatings are applied on the outer diameter (OD) of the pipe. In some situations, the inner diameter (ID) of the pipe also requires coating to prevent corrosion and to aid the flow within the pipe.

Within the tube & pipe industry, there are three types of coatings based on its chemistries – solvent based, water based, and ultraviolet curable (UV) – with each type having advantages and shortcomings.

All coatings contain binders (resins), diluents (water, solvent, monomers), and often pigments and additives.

SOLVENT BASED COATINGS
Conventional solvent based coatings often contain an alkyd resin and solvent diluents. The solvents can be aromatics, ketones, alcohols, and other chemistries. They are established technologies and are widely available with a wide range of choices based on chemistry and durability.

Economically, the solvent based coatings have a very competitive pricing structure based on unit price. The application of these coatings vary from a standard airless/air assisted system to a simple brush system. Due to the versatile ease of application, lack of specialized drying equipment, and low cost, solvent based coatings are considered the technology of choice among tube producers.

However, the use of solvent based coatings impacts the environment due to its higher VOC (Volatile Organic Compounds) and HAPS (Hazardous Air Pollutant Sources) components. High VOCs generated into the atmosphere pose
SKILL BUILDER

TUBE AND PIPE COATINGS

Health hazards and pollution and contribute to the greenhouse effect. With the creation of stringent laws regulating VOC emissions, the use of solvent based coatings are faced with growing limitations.

Solvent based coatings advantages:
- Fast dry time
- Inexpensive
- Can be applied over poor or oily substrate
- In some cases, overspray can be reduced for reuse
- Minimal application and minimal to no curing equipment required

Solvent based coatings disadvantages:
- High VOC and HAPS
- Flammable
- Fumes and odor

WATER BASED COATINGS

Water based coatings use various resins and water as a diluent. The resins varieties can include water reducible, water dispersible, or emulsions. For improved compatibility and controlled drying, water based coatings will often contain small amounts of compatible solvents. They are often applied with spray coaters.

Water based coatings advantages:
- Often non-toxic and non-flammable
- Fairly low total applied cost
- Offer excellent adhesion and flexibility

Water based coatings disadvantages:
- Slower dry in low temperature/high humidity conditions
- Lower transfer efficiency
- Require drying ovens which consume natural gas or electricity

ULTRAVIOLET (UV) COATINGS

UV coatings are based on acrylate resins and monomer diluents which are instantly cured in the presence of high powered UV light. They are commonly applied by spray or vacuum coater, then cured with a bank of UV lamps.

UV coatings advantages:
- 100% solids with very high transfer efficiency
- Generally emit zero VOC and HAPS
- Application temperature and humidity have little effect on cure rates
- Can be installed with a very small foot print
- Can be scaled up with enough lamps to run as fast as needed (10 lamps are twice as fast as 5 lamps)

UV coatings disadvantages:
- Higher unit prices
- High initial capital equipment costs
- Potential skin irritancy issues if spitted
- Difficulty running full hide colors
## TUBE AND PIPE COATINGS

### COATINGS COMPARISON

<table>
<thead>
<tr>
<th></th>
<th>SOLVENT BASED FORMULAS</th>
<th>WATER BASED FORMULAS</th>
<th>UV BASED FORMULAS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Solvent Carriers</strong></td>
<td>Aromatics, Ketones, alcohols, others</td>
<td>Water, alcohols, glycols</td>
<td>Monomers</td>
</tr>
<tr>
<td><strong>Average % Weight solids</strong></td>
<td>~30 - 50%</td>
<td>~22 - 34%</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Average % Volume solids</strong></td>
<td>~35 - 45%</td>
<td>~19 - 30%</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Total VOC (lbs/gal)</strong></td>
<td>3.5 and above</td>
<td>0.0 - 3.0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Resin Type</strong></td>
<td>Alkyds, Acrylics, Epoxies</td>
<td>Acrylics, Alkyds, Epoxies</td>
<td>Acrylates</td>
</tr>
<tr>
<td><strong>Surface Preparation</strong></td>
<td>» Surface can be oily, scaly, dirty</td>
<td>» Surface can only have slight scale, slight dirt</td>
<td>» Surface can only have slight scale, slight dirt</td>
</tr>
<tr>
<td></td>
<td>» Requires dry surfaces</td>
<td>» Requires dry surface without any grease/oils present</td>
<td>» Requires dry surface without any grease/oils present</td>
</tr>
<tr>
<td><strong>Application</strong></td>
<td>Spray, electrostatic, dip-tanks</td>
<td>Spray, vacuum, dip-tanks, electrostatic</td>
<td>Paint or vacuum coated</td>
</tr>
<tr>
<td></td>
<td></td>
<td>» Requires drying assistance; usually an oven is needed</td>
<td>» Requires UV curing lamp unit</td>
</tr>
<tr>
<td><strong>Clean up</strong></td>
<td>MEK, Xylene or other flammable material</td>
<td>Soapy water or slight solvent mixture (non flammable material)</td>
<td>Solvent such as MEK or monomer</td>
</tr>
<tr>
<td><strong>Durability</strong></td>
<td>3 - 12 months depending on environmental conditions</td>
<td>3 - 12 months depending on environmental conditions</td>
<td>3 - 12 months depending on environmental conditions</td>
</tr>
<tr>
<td><strong>Environmental</strong></td>
<td>High VOC and typically often contains HAPS</td>
<td>Zero to low VOC</td>
<td>UV light protection</td>
</tr>
<tr>
<td><strong>Economics</strong></td>
<td>» Low unit price/gallon</td>
<td>» Lower unit price/gallon</td>
<td>» Zero VOC</td>
</tr>
<tr>
<td></td>
<td>» Competitive price/ft²</td>
<td>» Competitive price/ft²</td>
<td>» Higher unit price/gallon</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>» Lowest price/ft²</td>
</tr>
</tbody>
</table>

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