

Eliminating red rust – UV coatings technology for line pipe producers

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In today's manufacturing environment, it is critical to utilise proven technology to eliminate problematic red rust and continue to improve overall customer satisfaction. This can be accomplished with UV coatings technology that delivers improved return on investment.

Over the years, pipe producers have been utilising liquid coatings to offer short-term red rust protection for their product during storage and shipment to their end-user customers.

Too many times, end-user customers of OCTG/line pipe are dissatisfied with the delivered product – red dust and overall poor coating appearance. Serious quality costs and overall lost opportunity costs are experienced and are costly to the OCTG/line pipe producer. These can be reduced/minimised with the right coating solution.

Pipe producer problems:

- Red rust – end-customer returns
- VOC exposure – volatile organic compounds
- Flammable coatings in production environment
- Overall appearance/performance of coating
- Damage to downstream equipment caused by non-dry coatings
- Overall, poor ASTM B117 salt fog testing results

Some examples of line pipe producer-incurred costs:

- Actual problem engagement with end customer
- Time-to-resolve issue – impact to other business activities
- 'Charge-backs' for return of product/transportation
- Relationship impact
- Opportunity costs – lost future orders

Figures 1 & 2: Examples of red rust on pipe



These problems were very similar in the mechanical tube market place. For the past ten years, mechanical tube producers have evolved their coating processes to eliminate white rust through embracing UV coatings technology. Now it is time for line pipe producers to make similar upgrades and enhancements to optimise their supply chain to their end-customers.

Current landscape

Pipe producers' legacy systems are typically water-based liquid coatings, with a few solvent-based systems remaining. While water-based coating technology had some advantages in the past, it has been surpassed by the evolution and adoption of UV coatings into this market.

Water-based coating technology limitations include:

- Legacy coatings have high VOC content
- Co-solvents added for improved rheology – flammability issue
- Ongoing equipment maintenance – induction heaters, coating build-up on rollers, damage to equipment downstream, etc
- Temperature and humidity impacting quality and performance
- Coatings can freeze – must be transported and stored carefully

UV-based coating technology has the following advantages:

- Improved corrosion performance (see figures 4 and 5)
- No VOCs (volatile organic compounds), no HAPs (hazardous air pollutants)
- Coating cost per linear foot is competitive
- Non-flammable
- Coatings will not freeze/no winter-time shipment restrictions



This article details the following:

- Testing – ASTM B117 salt fog testing – water-based vs UV coating
 - Salt spray test used to produce relative corrosion-resistance information for specimens of metals and coated metals exposed in a standardised corrosive environment
 - Typically measured intervals – 8 hour, 24 hour, 72 hour, 144 hour, 300 hour and 600 hour
- Financial model – water-based and UV coatings cost per linear foot
- UV coating process overview
- Looking forward

Testing – ASTM B117 salt fog testing

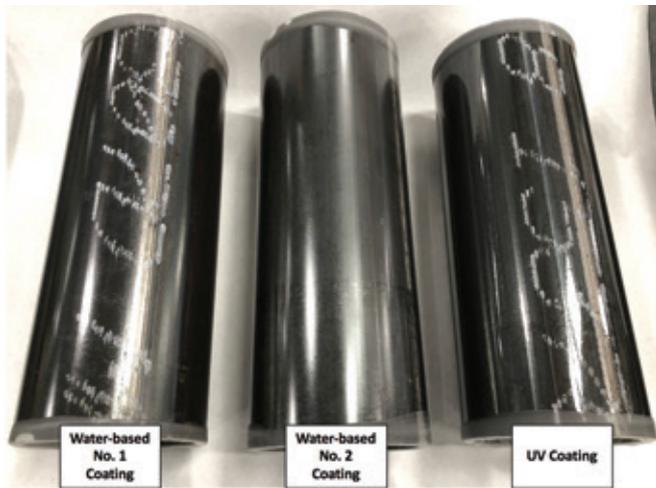


Figure 3: Pipe coating samples – coated (before any testing, 0.4 to 0.5 mils dry film thickness, ASTM D 4138)

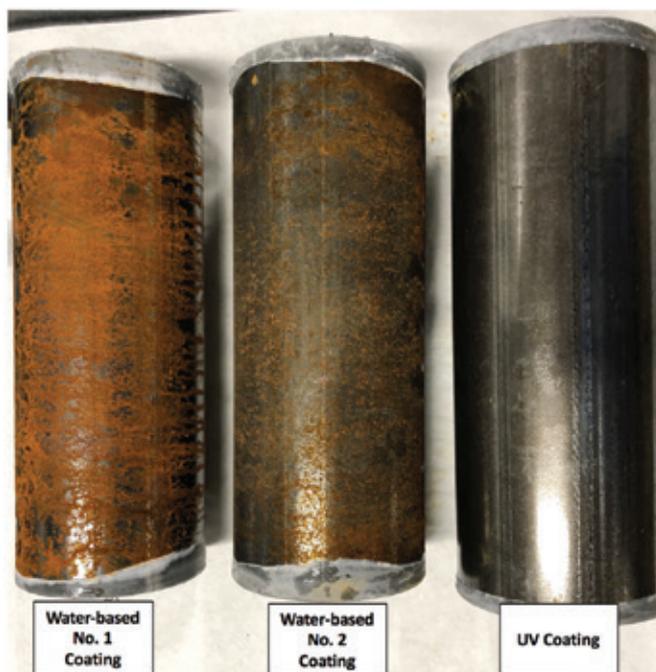


Figure 4: Pipe coating samples – after 24 hours – ASTM B117 salt fog testing cabinet

Observations – after 24 hours ASTM B117 salt fog testing

- Water-based no. 1 coating
 - Coating is offering no red-rust protection and is merely cosmetic in appearance only
 - Coating is flaking
- Water-based no. 2 coating
 - Some red-rust protection, but limited
 - Coating is beginning to flake
- UV coating
 - No presence of red rust
 - Good overall gloss level
 - No coating softening, blistering or flaking

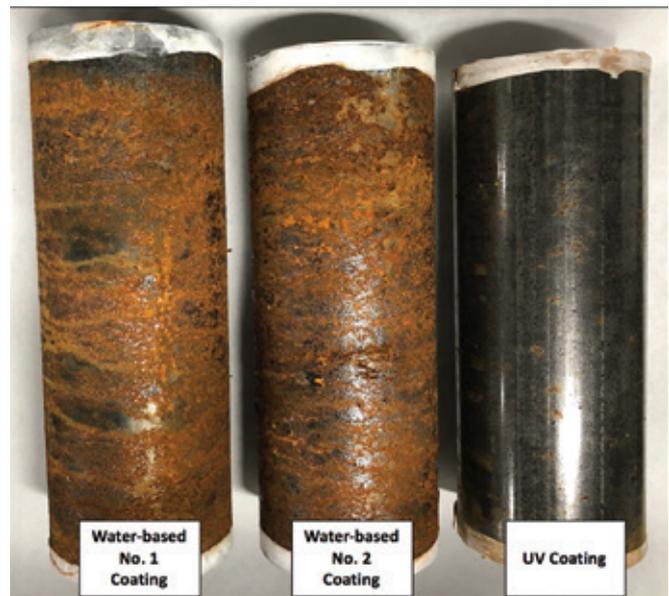


Figure 5: Pipe coating samples – after 600 hours – ASTM B117 salt fog testing cabinet

Observations – after 600 hours ASTM B117 salt fog testing

- Water-based no. 1 coating
 - Total failure of coating
- Water-based no. 2 coating
 - Total failure of coating
- UV coating
 - Less than 2-3% impact
 - Good overall gloss level
 - Very minor coating blistering or flaking
 - Good adhesion (ASTM 3359-17)/impact resistance (ASTM 14-88)

Financial model – water-based and UV coatings cost per linear foot – 9.625" diameter pipe

Table 1 compares water-based coating to UV coating – cost per linear foot. Overall, for 9.625" OD pipe, UV coating is \$0.0173 per linear foot compared to water-based at \$0.0181 per linear foot. UV coatings per linear foot will offer cost savings on a daily, weekly, monthly and yearly production operation, not to mention less incoming freight costs, less material handling, reduced customer complaints, etc (see Table 1)

Directions for Use:		
	Entered Data	Measurement
Enter in Outside Diameter of Tube:	9.625	Inches Diameter
Target Coating Thickness:	0.2	Mils Thick
Cost of Water-Based / Gallon:	\$ 15.60	Dollars
Percent Solids of Water-Based	27%	Percentage
Cost of UV Coating / Gallon:	\$ 55.20	Dollars
FUNCTIONAL PIPE COATING MODEL		
Linear Foot Comparison:	9.625	Inches Diameter
Target Coating Thickness	0.2	Mils Thick
Description	Water-based	UV
Coating cost per gallon	\$ 15.60	\$ 55.20
Percent Solids	27%	100%
Percent Water	73%	0%
Coverage at 1 mil - Square Feet	434	1,608
Coverage at 1 mil - Square Inches	62,519	231,552
Diameter of Pipe (Inches)	30.24	30.24
Linear inches per gallon	2,068	7,658
Linear feet per gallon @ 1 mils thick	172	638
Linear feet per gallon @ specified coating thickness	861	3,191
Cost per linear foot coated specified inch diameter pipe	\$ 0.0181	\$ 0.0173
Other Items to consider delivering cost savings		
1. Less overall freight costs	Significant savings (almost 3/4 less)	
2. Less clean up costs	No coating mess downstream	
3. Quality costs	No red rust - Customer complaints	
4. Etc, etc, etc,		

Table 1: Coating cost per linear foot review

Note:

- Water-based coating is 27% coating and 73% water – Coverage per gallon is 434.2 ft² at 1 mil thick
 - 27% of 1,608 ft² = 434.2 ft² @ 1 mil thick
- UV coating is 100% coating (no water, solvent or fillers) – coverage per gallon is 1,608 ft² at 1 mil thick
 - 100% of 1,608 ft² = 1,608 ft² @ 1 mil thick
- Prices are based on customer feedback and competitive marketplace.

Water-based coatings have a low price per gallon, but you are paying for 73% water in the case outlined above. In addition, these factors have significant impact/cost on your bottom line:

- Transportation costs
- Possibly flammability – use co-solvents to assist in rheology water-based coating faster
- Winter shipment rules – cannot ship water-based coatings in extreme cold conditions
- Storage rules – cannot store water-based coatings in below 32°F conditions

UV coatings have a higher cost per gallon, since you are receiving 100% coating, no water, solvent or fillers. In addition, these factors are a benefit to your bottom line:

- Non-flammable
- No winter restrictions on shipments
- UV can be stored in non-heated areas
- Shipping costs are greatly reduced (over 65% less overall)
- Overall applied coating cost per linear foot price is less (applied cost of \$0.0216 vs \$0.0244 per linear foot)

In addition to the above benefits, the overall UV coating process offers significant process advantages over other technologies:

Smaller:

- Small physical footprint of equipment (see figure 6)

Faster:

- Speed – ability to run faster – produce more pipe feet per minute due to instant cure of coating
- Coating is fully dry – no more sticky, un-cured coating that will damage downstream equipment
 - Safety is not compromised when handling pipe – slippage, lubrication effect, etc
 - Fewer quality rejects

Cleaner:

- No VOCs or HAPs
- No co-solvents

UV coating process overview

The complete UV coating system can be installed with less than 20 feet of in-line space. This includes pre-heat (less than 55°F), reclaim spray booth and UV curing system. Upon exiting the UV curing system, pipe can be immediately processed, stacked, band coated, etc.

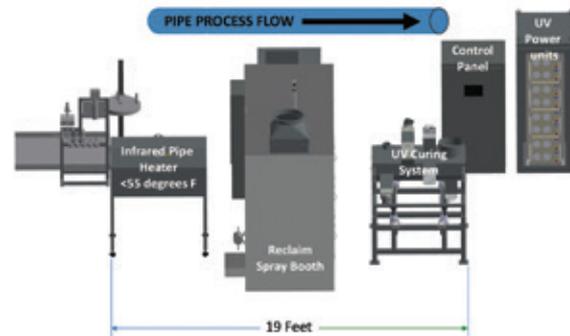


Figure 6: Typical UV coating line (courtesy of Terrell Manufacturing Services)

Line speed capabilities – 50 to 300 or more feet per minute (depending on line pipe producer needs/system design).

Looking forward

Over the past year, several large line pipe producers have implemented UV coating systems as part of their quality improvement effort, significantly reducing their exposure to red rust/corrosion issues with their end customers. The line pipe producer community will need to continue to improve its overall end-product quality, and UV coatings technology offers a cost-effective and improved corrosion-protection solution. This will reward end-customers with an improved overall product and greatly enhanced customer satisfaction.

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