Eliminating VOC emissions in your tube and pipe manufacturing process with UV coating technology

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Imagine being able to eliminate almost all volatile organic compounds (VOCs) in your tube and pipe manufacturing process equalling 10,000s of pounds of VOCs per year. Also imagine producing at faster speeds with more throughput and less cost per part/linear foot.

Sustainable manufacturing processes are key to drive towards more efficient and optimised manufacturing in the North American marketplace. Sustainability can be measured a variety of ways, which are outlined below:

- VOC reduction
- Less energy usage
- Optimised labour workforce
- Faster manufacturing output – more with less
- More efficient use of capital
- Plus many combinations of above listed measurements

Recently, a leading tube manufacturer implemented a new strategy for its coating operations. Its previous go-to coating platforms were water-based, which are very high in VOCs and happen to be flammable as well. The sustainable coating platform that was implemented was ultraviolet coatings technology (UV). So, this customer article is broken down based on the following: customer problem, overall process improvements, UV is a process discussion, cost savings overview, VOC reduction summary and conclusion.

1. Customer problem

Current customer issue: water-based coating process

Water-based coating mess

Further water-based coating mess during during production

While many industry experts will directly compare water-based coatings to UV coatings, this is not a realistic comparison and can be misleading.

The actual UV coating is a subset of the UV coatings process – yes, a process that offers significant environmental advantages, great overall process improvements, improved product performance and also per linear foot coating savings.

So, let's look at the sustainability and environmental advantages:

- No volatile organic compounds
- No hazardous air pollutants
- Non-flammable
- No solvents, waters or fillers
- No humidity or temperature production issues

2. Great overall process improvements

- Very fast production speeds: upward of 800 to 900ft per minute depending on product size
- Small physical footprint – less than 35ft – linear length
- Minimal work-in-process
- Instant dry – no post-cure
- No downstream wet coating issues
- Coating requires no adjustment
- Shift change/maintenance/weekend shutdowns – Just leave UV coating – no issues

- Reduction in manpower costs associated with operators and maintenance
- Reclaim – ability to reclaim overspray, refilter and reintroduce into coating system

Improved product performance:

- Improved humidity testing results
- Great salt fog testing results
- Ability to adjust coating attributes/colour
- Clear coats, metallics and colours available

Lower per linear foot coating costs:

- ROI calculator comparing water-based and UV coatings demonstrates coating savings

Functional pipe coating model

Linear foot comparison	9.625	Inches diameter
Target coating thickness	1.5	Millimeters thick

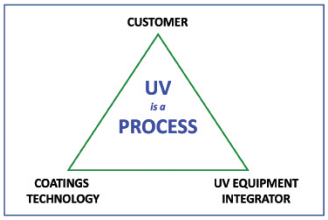
Description	Water-based	UV
Coating cost per gallon	$19.90	$42.00
Percent solids	32%	100%
Percent water	68%	0%
Percent efficiency	65%	96%
Coverage at 1 mil – square feet	334	1,540
Coverage at 1 mil – square inches	48,043	221,737
Diameter of pipe (inches)	30.24	30.24
Linear inches per gallon	1,589	7,333
Linear feet per gallon @ 1 mils thick	132	611
Linear feet per gallon @ specified coating thickness	88	407
Cost per linear foot coated specified inch diameter pipe	$0.225	$0.103

Table 1: Cost spreadsheet – UV vs water-based coatings per linear foot

As outlined in Table 1 above, UV provides an overall linear foot cost savings over water-based coatings.

3. UV is a process discussion

As mentioned above, in order to successfully implement a successful UV coatings project, you have to look at UV as a process. Illustrated in the graphic below, there are three main components: 1) Customer, 2) UV application and cure equipment integrator and 3) Coatings technology partner.



All three of these are critical to the successful planning and implementation of a UV coating system.

UV is a process

So, let's take a look at the overall project engagement process. In most cases, this effort is led by the UV coating technology company.

Project engagement process:

The key to any successful project is to have clearly defined engagement steps, with built-in flexibility and the ability to adapt to different types of Customers and their applications. As defined below, these (7) engagement stages are key for a successful project engagement with the Customer.

Seven engagement steps

These seven engagement stages can be followed serially, some at the same time and can interchanged; but all of them must be completed. This built-in flexibility provides the highest chance of success for the participants.

It may be best to engage an UV process expert; a resource who has valuable industry experience with all forms of coating technology, but most importantly, strong UV process experience. This UV process expert can navigate all the issues and be a neutral resource to fairly evaluate the coating technologies.

Stage 1 – overall process discussion:

This is where initial information is exchanged regarding the customer's current process, with a clear definition of current layout, with positive and negatives clearly defined. In many cases, a mutual non-disclosure agreement should be in place. Then, clearly defined process improvements are identified such as:

- Sustainability – VOC reduction
- Labour reduction and optimisation
- Improved quality
- Increased line speed
- Floor space reduction
- Review of energy costs
- Maintainability of the coating system – spare parts etc

Next, specific metrics are defined based on these identified process improvements.

Stage 2 – return-on-investment discussion

While not to the level of detail for project approval, the customer should have a clear outline on their current costs, which are defined as the following:

- Cost per product, per linear foot etc
- Energy costs
- WIP costs
- Quality costs
- Operator/maintenance costs
- Sustainability costs
- Cost of capital

For access to ROI calculators you can visit:
www.alliedphotochemical.com/roi-calculators/

Stage 3 – product specification discussion

As with every product manufactured today, there are basic product specifications defined. In regard to coating applications, typically, these product specifications have evolved over time, plus are not typically met with their current coating process. We call it today vs tomorrow.

- Understanding your current product specifications
- In most cases, not being met with current coating
- Definition of future needs that are realistic
- Always a balancing act
- Must be realistic

Stage 4 – overall process specifications discussion

The customer should fully understand and define their current process and the positive and negatives. This is important for the UV systems integrator to understand, so all can be considered in the UV system design. This is where the UV Process is key and offers significant advantages.

See some of the process improvements:

- Increase speed: from 150ft per minute to 225ft per minute
- Footprint: instant cure/no drying tables or racks. Eliminates wasted space
- Less energy: no induction heating/fans
- Humidity effect: eliminated
- Temperature effect: eliminated
- Coating adjustments: none – get rid of your Zahn cup
- Transportation: no freeze issues
- Reclaim: coating overspray can be reclaimed/reused for optimal utilisation

A joint visit to the customer's manufacturing facility is highly recommended and provides a great vision and framework to understanding the customer's needs and requirements.

Stage 5 – visit to coating supplier facility

A joint visit by the customer and UV systems integrator allows everyone to participate in a simulation of the customer's UV coating process. During this time, many new ideas and suggestions will surface as physically seeing the impact of the process is the best way to realise its potential. During the customer visit, the following activities should take place:

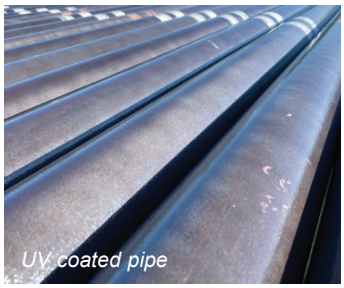
- Visit to coating supplier for simulation and testing
- Test competitive coating products –benchmark
- Review best practices
- Review quality certification procedures
- Meet UV integrators
- Develop detailed action plan moving forward

Stage 6 – RFQ/overall project specification

The customer's RFQ document should include all relevant information as defined in the process discussions/requirements for the new UV Coating operation. Incorporate "best practices" identified by UV coating technology company. Some of these "best practices" are to heat the coating via water-jacketed heat system to gun tip, tote heating and agitation, and scales for measuring coating consumption.

Stage 7 – continuous communication

The means of communication between customer, UV integrator and UV coatings company is critical and should be encouraged. Technology today makes it very convenient to schedule and participate in regular Zoom/conference-type calls. There should be no surprises when the UV equipment/system is being installed.


UV coated pipe

End goal – great performance and attractive products.

4. Cost savings overview:

A critical area for consideration on any UV coating project are overall cost savings, which can be defined by the following items:

1. Energy costs – microwave-powered UV vs induction heating

In typical water-based coatings systems, there is a need for pre- or post-induction heating of the tube. Induction heaters can be expensive, high-energy consumers and also have maintenance issues.

(10) Lamp microwave UV system:
- 9KW/hour energy consumption:
Quantity (10) x 9KW = 90KW/hour

Induction heating system:
- 200KW/hour energy consumption: 200KW/hour

Conclusion: cost savings of greater than 100KW/hour

Estimated cost of electricity: 14.33¢/kW/hour

Savings of 100KW/hour:
100KW/hour x 14.33¢/kW/hour = $14.33 per hour

Yearly savings: two shifts/50 weeks:
50 weeks x 5 days x 20 hours x $14.33 = $71,650

Conclusion: An estimated $71,650 per year cost savings

2. Labour cost reduction – operators and maintenance

As manufacturing entities continue to evaluate their labour costs, the UV process offers unique savings pertaining to operator man hours and maintenance man hours. With the UV process, there is no wet coating that solidifies downstream on the material handling equipment. (See picture below).


Water-based coating waste on downstream material handling equipment

With this customer, its operators consumed a total of 28 hours per week; removing/cleaning water-based coating from its downstream material handling equipment. Cost savings: 28 hours x $36 (burdened cost) per hour = $1,008.00 per week.

Plus, the physical labour requirements for this activity can be frustrating, time consuming and dangerous.

Conclusion: An estimated $50,400 per year cost savings

Water-based coating downstream – waste clean-up

With this customer, every quarter was targeted for coating clean-up. Costs of $1,900 per quarter, plus coating removal costs were incurred total – $2,500.

Conclusion: An estimated $10,000 per year cost savings

3. Coating savings – water-based compared to UV

Pipe production at the customer's site was 12,000 tons per month of 9,625" diameter pipe. On a summary basis, this equates to approximately 570,000 linear feet/~12,700 pieces.

Description	Water-based	UV
Monthly linear feet production	570,000	Linear Feet
Cost per linear foot coated specified inch diameter pipe	$0.271	$0.142
Coating cost per month	$154,335.32	$81,149.81

Coating cost savings per month	$73,185.51
Coating cost savings per year	$878,226.06

Table 2: Coating cost comparison – UV vs water-based coatings per linear foot

Conclusion: $834,480 per year cost savings

4. Less incoming transportation cost and internal coating handling

Description	Water-based	UV
Gallons consumed per month	6,458	1,399
Totes (250 gallons) per month	26	6
Totes (250 gallons) per year	310	67
Cost of shipping per tote ($1,100) per tote	$340,958	$73,874

Shipping cost savings per year	$267,084.04

Table 3: Shipping cost savings

Conclusion: $267,084 per year cost savings

Plus, additional material handling savings at the customer site

5. Other benefits of UV

- UV coatings are reclaimable – allowing for at least 96 per cent efficiency. Water-based coatings are not reclaimable.
- Less time cleaning and maintaining application equipment because the UV coating does not dry unless exposed to high intensity UV energy.
- Faster production speeds – the customer has the potential to increase production speeds from 100ft per minute to 150ft per minute: An increase of 50 per cent.
- UV process equipment typically has a built-in flushing cycle, which is tracked and scheduled by hours of production run. This can be adjusted accordingly to the customer's needs and requirements, which results in less manpower for system clean-up.

Estimated cost savings summary

Summary of overall cost savings with UV coatings:

1.	Energy savings:	$71,650
2.	Labour cost reduction:	$50,400
3.	Waste clean-up savings:	$10,000
4.	UV coating savings:	$834,480
5.	Shipping savings:	$267,084

Estimated total savings: $1,233,614 per year

5. VOC reduction summary:

Water-based coating:	2.2lbs per gallon	77,496 gallons x 2.2lbs/gallon = 154,992lbs
UV coating:	trace per gallon	trace amount
VOC reduction:	~ 154,992lbs	

6. Conclusion

UV coatings technology allows you to virtually eliminate VOC's in your coating operation, plus deliver a sustainable manufacturing process that improves productivity, overall product performance and drives significant cost savings.

As outlined in this article, the customer's total savings are estimated to exceed $1,200,000 yearly, plus eliminated more than 154,000lbs of VOC emissions.

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