Making the Switch:

Outlining the Financial and Technical Feasibility for UV Coating Exchange Propane Tanks

By Michael Kelly

It's not difficult to make the case that switching to UV technology offers manufacturers many economic and environmental benefits. When evaluating the financial and technical justification for integrating UV technology into any manufacturing scenario, two critical factors must be realized and understood before implementing any ultraviolet (UV) project.

1. Is the project *financially* feasible with UV coatings technology?

- How does it compare to other coatings technologies?
- Does the project have an acceptable economic return on Investment (ROI)?

2. Is the project *technically* feasible with UV coatings technology?

- How does it compare to other coatings technologies?

For a successful ultraviolet (UV) project implementation, there must be an acceptable Return on Investment (ROI) upfront. Once the economic return has been justified, the project must also be technically feasible. This article will address both the financial and technical side of UV and provide a foundation and roadmap for justifying UV projects, including the best means to evaluate and optimize the process toward successful implementation.

First, a short review of the process and technology of the UV coatings·

Overview of the UV 100% Solids Coating Process

Today, UV 100% solids coatings are utilized for coating exchange 20-lb propane tanks. Early adapters were not adequately prepared for utilizing UV technology as the available coatings were not fully qualified and the

FIGURE 1

Pictorial overview of UV coating and UV cure process

Tank entering spray booth. ➤ Tanks being sprayed, then entering UV light booth. ➤ Tank being cured with UV lights.

equipment design and process were not mainstream. This has changed as 100% solids UV has been tried and tested, incorporated with industry-proven design and process knowledge, resulting in successful UV projects. UV is the fastest growing coatings technology available today.

Outlined in Figure 1 is a pictorial snapshot of the UV-curable process:

1. It can be sprayed like any other technology—i.e. high volume, low pressure (HVLP), Bell and/or a combination.
2. The UV coating is exposed to high-intensity UV lighting.
3. The tank is cured in less than 2 seconds. It can then be sleeved and filled.

Figure 2 shows a basic overview of UV 20-lb. tank layout. Some additional sources for information on UV coatings, process and technology:

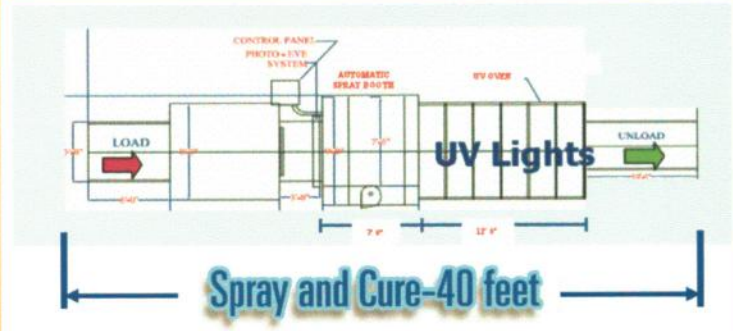
- *www.miracleofUVlight.com*
- *www.radtech.org*

Financial Qualification

There are a variety of coating technologies available in the marketplace today. For this article, we will explore the comparison of 100% solids UV versus solvent-based coating and water-based coating.

FIGURE 2

Basic overview of an UV 20-lb. tank layout



Overall Coating Costs

When comparing coating costs, manufacturers must consider the following (See Table 1):

- **Solids Content**
  - Solvent-based coating—35% solids
  - Water-based coating—33% solids
  - UV coating—100% solids
- **Film Build Applied**
  - We will use 1.4 mils dry across all three coatings technologies.
- **Transfer Efficiencies**
  - We will use 65% across all three coatings technologies.
  - UV 100% solids are reclaimable, so we will use 65% initially, with the ability to reclaim, raising the efficiency to 95%.

Number of Units

Based on a one-shift operation, the plant will run at a line speed of 10 feet per minute. The details are outlined in Table 2.

Table 3 outlines annual coatings savings provided by UV coatings.

TABLE 1

Cost Analysis—solvent-based and water-based coatings versus 100% solids UV coating

Description	Solvent-Based	Water-Based	UV - 100% Solids	Comments
Coating Cost	$ 21.00	$ 18.00	$ 65.00	
Solid by Volume	35%	33%	100%	
Theoretical Coverage @ 1mil (sq ft)	561	529	1604	
Average Film Thickness (mils)	1.4	1.4	1.4	All estimated at 1.4 mils
Actual Coverage (sq ft)	401	378	1146	Optimized based on solids
% Material Utilization (Electrostatic)	65%	65%	65%	Same efficiencies
Actual Applied sqf (sq ft)	260	246	745	
Coating Recovery of Collection	N/A	N/A	95%	Re-claim of 100% Solids
Additional sqf through Recovery (sq ft)	0	0	344	Benefit of Re-claim
Total sqf	260	246	1089	
Coating Cost per Sqf	$ 0.081	$ 0.073	$ 0.060	UV Coating is lowest cost
4.7 square feet at 1.4 mils/No.of tanks:	55.42	52.26	231.70	Tanks per Gallon
Cost of Coating per tank:	$ 0.38	$ 0.34	$ 0.28	Cost per tank

TABLE 2

Number of units—based on a one-shift operation, the plant will run at a line speed of 10 feet per minute

Description	10 Feet per minute	15 Feet per minute	20 Feet per minute
Line Speed (feet per minute)	10	15	20
Center-off-Center (inches)	18	18	18
Tanks per minute	6.67	10.00	13.33
1 shift per day	1	1	1
Minutes per shift	480	480	480
Number of tanks per shift	3,200	4,800	6,400
6 days per week	19,200	28,800	38,400
52 weeks per year	998,400	1,497,600	1,996,800
Solvent-based coating costs	$ 378,332	$ 567,499	$ 756,665
Water-based coating costs	$ 343,901	$ 515,852	$ 687,803
UV-100% solids coating costs	$ 280,084	$ 420,126	$ 560,167

Feasibility of Line Speed

One question to ask is, "what is the feasibility of running solvent-based and water-based coatings at higher line speeds?" Expensive IR ovens or flash ovens will be required, which will add a significant amount of cost to capital system.

UV System Capital Costs

A UV-coating system will require more up-front capital than a typical solvent- or water-based system, but this up-front capital can be justified for the following reasons.

Initial System Costs

- UV Curing $265,000
- Solvent-based with IR Flash $185,000
- Water-based with IR Flash $185,000

UV Curing Means...

1. Spray System costs are comparable

- For UV, solvent- and water-based systems, all three will require identical spray systems, so this cost is a wash. (For best coating optimization, a Nordson RA-20 Bell Atomizer should be utilized.)

2. Almost No Work-in-Process

A UV curing system will have almost NO work-in-process. Both solvent- and water-based coatings technologies will have many units suspended in WIP.

3. Less Needed Floor Space

UV curing systems will consume significantly less floor space when compared to solvent or water-based coatings technologies. See Table 4.

There is a cost associated with each square foot of floor space. This needs to be understood and accounted for.

4. Reduced Energy Costs

- UV Curing system will require UV Oven (6 lights):
  - (6) UV Star Electrode lamps 6kW x 6 lamps = 36 kW
  - Exhaust blower for chamber 3kW

Total UV Energy Cost—
39xkW x $0.0787k= $3.07/hour

- We'll compare that to a solvent-based system—400F/IR front-end and gas:

Gas used after initial start-up—
412,000 BTUs/hour
- 412,000 BTUs/hour / 100,000 BTU/Therm = 4.12 Therms/hour
- 4.12 Therms x $0.6927/Therm = $2.85/hour

Electric Usage
- IR Oven ..... 30.0 kW
- Cool Down Blowers (2) at 30 HP each ..... 45.0 kW

TABLE 3

UV Coatings will provide annualized coating savings (dollars per year in savings)

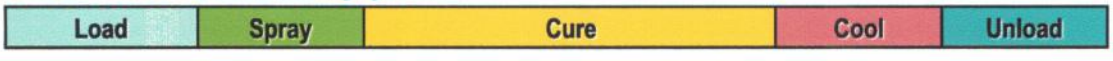
Description	10 Feet per minute	15 Feet per minute	20 Feet per minute
100% UV over Solvent-based coating	$ 98,249	$ 147,373	$ 196,497
100% UV over Water-based coating	$ 63,818	$ 95,726	$ 127,635

TABLE 4

UV curing and solvent-based and water-based technologies comparison

UV coating and curing system

Solvent-/water-based coating system



- Exhaust Blower 1 at 5HP ..... 3.7 kW
- Heat Air Seals 2 at
  15 HP each ..... 22.0 kW

Total..... 100.7 kW

100.7 kW x $0.0787/kWH = $7.93/hr.

Total Solvent-Based Energy Cost

Gas Cost ..... $ 2.85/hour

Electric Cost ..... $ 7.93/hour

Total = $10.78/hour

Yearly Savings
($10.78 oven - $3.07 UV = SAVINGS)
$7.71/hour / 300 days x 8 hours (1 shift per day) =
$18,504 savings/year

Conclusion/Financial Justification

A summary of the financial/ economics of comparing the coatings technologies for propane tanks is outlined in Table 5.

Technical Qualification

This is where manufacturers compare the specifications of the technology. The specifics are outlined in Table 6.

Conclusion

This article addressed the following questions:

- Is the project "financially feasible" with UV Coatings Technology?
- Is the project "technically feasible" with UV Coatings Technology?

The Financial / Economics of UV coatings are very competitive with today's other coatings technologies. UV coatings will continue to improve as the cost of energy, work-in-process, quality and floor space increases. On the technical side, UV coatings are improving at a fast rate, compared to the other coatings technologies; mainly due to improved raw materials and innovative technology companies who understand the technology.

Once a manufacturer has determined that UV coatings technology is the right choice for their project and organization, it is critical to find the right process integration partner; a partner that has extensive UV-process implementation experience. This is very important and should not be taken lightly. Implementation needs to be done right the first time for manufacturers to realize the maximum benefits of UV-curing systems.

—Michael Kelly is CEO/president of Allied PhotoChemical, Kimball, Mich.

TABLE 5

Financial justification

Financial / Economic Details:	Solvent-Based	Water-Based	UV - 100% Solids
Line Speed Flexibility			
Ability to Reclaim			
Floor Space			
Work-in-Process			
Energy Consumption			
Maintenance Costs			
Capital Costs			
Quality Costs			
Zero VOCs, HAPs & NVPs			
Reduce Reporting			
Improved Health & Safety			
Coating Cost per 20lb Tank			

COLOR CODE CHART:	COLOR
Poor	
Acceptable	
Best	

TABLE 6

Technical qualification—manufacturers compare the specifications of the technology

Technical / Specification Details	Specification	UV - 100% Solids
Adhesion: ASTM 3359	5B	
Impact Test: ASTM D2749	60 in-lbs	
Hardness: ASTM D 3363	2H	
Abrasion Resistance: ASTM D968	8 buckets sand	
Thickness Testing: ASTM 7091-05	1.4 mils	
Neutral Salt Fog: ASTM B 117-97	168 hours	
MEK Rubs:	> 100 rubs	

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