

To Reclaim or Not Reclaim

100% Solid UV Coatings

In Multi-color Applications

By Greg Trojan



Propane Tanks 4" ϕ 6" high



Propane, MMP, Oxygen Tanks 3" ϕ
9" high

INTRODUCTION

In a single color or clear-coat coating application capturing and reusing UV overspray can be relatively simple and profitable.

But what about if your production requirements call for the application of multiple colors.

This paper will examine the viability of coating recovery in multi color applications specifically related to the coating of various gas tanks.

WHAT ARE TRUE 100% SOLIDS

100% solid UV curable coatings are technically a non-Newtonian fluid, such as an emulsion or colloidal suspension. It's a fluid which consists completely of solids.

100% solid UV coatings do not contain any Volatile Organic Compound (VOC's) or solvents, do not contain any Hazardous Air pollutants (HAP's) and do not contain any normal vinyl Pyridines (NVP's).

Viscosities of 100% solids range from 500 to 1500 cps.

WHAT ARE UV COATINGS

UV coating are differentiated from conventional coatings by their cure mechanism. Also called "photo polymerization" UV cure is a photochemical process in which the coating, a liquid, is instantly converted to a solid. In UV coatings ultraviolet light (UV) in the 350 – 450 nanometer spectrum range is the predominant method used.

BENEFITS OF 100% SOLID UV COATING

The benefits of utilizing 100% solid UV coatings are quite impressive. Zero air emissions, less energy costs, faster through put, less waste and better quality are just a few of the benefits.

Another benefit in UV coating applications is the opportunity to reclaim and reuse overspray coating immediately. This is due to the fact that UV coatings do not alter their liquid state until exposed to high intensity ultraviolet light.

This is certainly true in single color or clear coat application.

COATING EMISSIONS

To understand the relationship between conventional coating and UV coating emissions, one must understand the emission characteristics of the two coatings.

Conventional coatings consist of two major component, the resins and the solvent. Depending on the coating type the solid content in conventional coatings can range from as low as 10% to as high as 50%. In rare cases, the solid contents can be as low as 2% and reach up to 75%.

Overspray, a mixture of fine mist and volatile organic compounds (solvent) searches for the path of least resistance through the spray booth exhaust system, that is through the filter media and the stack to the exterior environment.

Solvents are emitted directly to the atmosphere, referred to by the Environmental Protection Agency as "VOC Emissions".

The finer the mist ratio and the lower the specific gravity of the coating, the less particles are deposited in the filter media and more are allowed to escape into the atmosphere. Within the Environmental Protection Agency this is referred to as "Micro Particle Emission"

100% solid UV coatings, as they do not contain any volatile organic compounds, do not emit VOC's.

However, UV coatings do also contain two major components, mainly oligomers and monomers.

Oligomers, also referred to as high molecular weight resins, are the backbone of the coating.

Oligomers can be compared to the resins in conventional coatings.

Monomers in turn are low molecular resins and have the same function as solvents. However, monomers become an integral part of the cured coating.

Overspray of UV coating applications, if not recovered, would be considered "Micro Particle Emission"

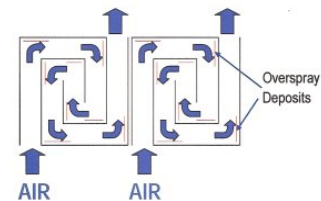
UV COATING RECOVERY

In spray applications, irrelevant of what coating is used, the airflow through the paint booth is set at 100 feet per minute by law. Depending on the exhaust area of the spray booth, say as example 4' x 4', the air requirements are 4' x 4' = 16sqf x 100fpm or 1600 cubic feet per minute (cfm) of air. Static pressure within the booth would be around 3 inches.

The overspray content in UV coatings, as they do not contain solvents, do not evaporate, and do not change their state over time, and can be reclaimed in specially designed recovery units. However, this must be done in a way to divert the airflow so the micro particles can be captured without restricting the airflow.



Stationary Recovery Unit



Baffle System

This is accomplished by using a baffle system as shown above.

As illustrated before, the airflow through a Paint booth has to be 100feet per minute. By decreasing the exhaust area say by a factor of 10 (from 16 sqf to 1.6 sqf) the airflow through the baffles will increase by a factor of 10 to 1000 fpm through the baffle unit.

As a note, I recommend to increase the static pressure of the exhaust intake blower to at least 12" water column.

Depending on the specific gravity of the micro particles within the airstream, micro particles are deposited on the baffles wall every time a airflow direction is changed. The finer the micro particles the greater the airspeed required to collect them.

Tank Colour	Tank Size	Surface Area sq. inches	Annual Production Quantity	Surface Area sq. feet	Sqf/Gal @ 1.7 mil	Coating Required Gallon	Transfer Efficiency	Applied Coating Gallons	Overspray Coating Gallons
Ivory	4"Ø 6"h	103.68	310,400	223,488	943	237.00	0.724	171.59	65.41
Light Green	4"Ø 6"h	103.68	130,160	93,715	943	99.40	0.724	71.97	27.43
Lime Green	4"Ø 6"h	103.68	170,640	122,860	943	130.30	0.724	94.34	35.96
Olive Green	4"Ø 6"h	103.68	74,480	53,626	943	56.90	0.724	41.20	15.70
Rose Red	4"Ø 6"h	103.68	494,768	356,233	943	377.80	0.724	273.53	104.27
Vic Red	4"Ø 6"h	103.68	178,800	128,736	943	136.50	0.724	98.83	37.67
Yellow	4"Ø 6"h	103.68	140,960	101,491	943	107.60	0.724	77.90	29.70
Royal Blue	4"Ø 6"h	103.68	574,480	413,625	943	438.60	0.724	317.55	121.05
Blue	4"Ø 6"h	103.68	76,400	55,008	943	58.30	0.724	42.21	16.09
Black	4"Ø 6"h	103.68	42,160	30,355	943	32.20	0.724	23.31	8.89
Ivory	3"Ø 9"h	98.91	240,880	165,454	943	175.50	0.782	137.24	38.26
Light Green	3"Ø 9"h	98.91	169,440	116,384	943	123.40	0.782	96.50	26.90
Lime Green	3"Ø 9"h	98.91	184,400	126,659	943	134.30	0.782	105.02	29.28
Olive Green	3"Ø 9"h	98.91	74,400	51,003	943	54.10	0.782	42.31	11.79
Rose Red	3"Ø 9"h	98.91	326,400	224,198	943	237.80	0.782	185.96	51.84
Vic Red	3"Ø 9"h	98.91	54,240	37,228	943	39.50	0.782	30.89	8.61
Yellow	3"Ø 9"h	98.91	110,720	76,050	943	80.70	0.782	63.11	17.59
Royal Blue	3"Ø 9"h	98.91	241,600	165,949	943	176.00	0.782	137.63	38.37
Blue	3"Ø 9"h	98.91	60,160	41,322	943	43.80	0.782	34.25	9.55
Black	3"Ø 9"h	98.91	19,296	13,253	943	14.00	0.782	10.95	3.05

PRODUCTION

The above chart shows the annual production requirements of two styles of tanks. A total of 10 colors are required.

THE PROCESS

The tanks being 4" and 3" in diameter are hanging on a overhead conveyor in 6" and 4" inch distances respectively. The conveyor speed is 30 fpm and the tanks are rotated at 160 rpm.

A single reciprocating Bell with a 6" stroke is used in combination with a single stationary HVLP gun.

Coating transfer efficiency was tested by drum weight vs. production method and established as 72.4% for the 4" and 78.2% for the 3" tank.

Applicable coating film thickness is between 1.6 and 1.8

Colour	Total Annual Coating Usage/Gal	Total Annual Overspray Quantity/Gal	Total Coating Cost US \$ \$ 95/Gal	Total Overspray Cost US \$ \$ 95/Gal
Ivory	412.50	103.67	39187.50	9848.65
Light Green	233.70	54.33	22201.50	5161.35
Lime Green	264.60	65.24	25137.00	6197.80
Olive Green	111.00	27.49	10545.00	2611.55
Rose Red	575.60	156.11	54682.00	14830.45
Vic Red	217.20	46.28	20634.00	4396.60
Yellow	188.30	47.29	17888.50	4492.55
Royal Blue	614.60	159.42	58387.00	15144.90
Blue	101.30	25.64	9623.50	2435.80
Black	46.20	11.94	4389.00	1134.30

mil. Coating coverage is 1604 sqf at 1 mil. or 943 sqf at 1.7 mil. average per sqf.

COATING USAGE

Coating usage as well as overspray volumes per color are shown above. Based on a maximum payback period of

12 month and a recovery system cost of approximately. \$ 10,000 per unit, only two colors would warrant a overspray unit. The ivory color could be justified based on adding waste disposal cost of \$ 2.50 per gallon which would increase the overspray cost to \$ 10,107.80.

Based on the calculated cost justification the paint booth design has to incorporate four removable reclaim systems.

Three for the justifiable colors, Ivory, Rose Red and Royal Blue. As well as one collective system for the remaining colors.

The first and most important aspect in coating application with color change requirements is the balance of the exhaust system. By installing, as previously stated, a higher static pressure air blower, and a variable frequency drive exhaust blower, the air balance in the booth can be maintained automatically. A well balanced exhaust system, will have a absolute minimal coating deposit anywhere in the spray booth. Coating deposits on the spray booth walls or floor are an indication of a unbalanced air system.

Second, the reclaim system must be easily removable to limit the time required for a color change.

This can be accomplished in two ways.

First, only the baffle section can be removable as shown.



In this case, the baffle section including the tank is removed from the exhaust system, and replaced with another. However, this utilizes the same secondary filter media for all colors.

Second, the complete exhaust system, meaning the baffle section, the secondary filter media and the stack transition is removable.

The advantage of the second is, that cleaning of the complete system can be done off line.

CONCLUSION

There is no doubt that significant savings can be realized when considering reclaim units. However, both the cost involved, and the design of the spray booth, must be balanced with the overall system requirements and company policy.

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