ITW Ransburg

TECHNICAL LITERATURE
TL-00-02.4
(Replaces TL-00-02.3)
October - 2006

SOLVENT SELECTION

Introduction

ITW Ransburg research engineers have been working for more than thirty years on a continuing development of electrostatic coating processes and equipment, as well as techniques and service to further improve the high efficiency of this process. These techniques can be quite useful for paint formulators and users of the ITW Ransburg No. 2 Process by providing better wraparound, higher quality finishes requiring less touch-up and, increasing paint film build.

This literature is a guide to solvent selection to improve electrostatic sprayability. An ITW Ransburg standard method for measuring coating resistivity is also described.

Controlled Paint Resistivity - A Factor in Formulation

It has been determined that coating formulations for No. 2 Process application, in addition to meeting customer requirements for durability, drying time, gloss, etc., should have an electrical resistance within a specified range for best atomizing characteristics and electrical deposition. (See Figure 1.)

Electrical resistivity is a characteristic which must be built into the paint formulation. It has generally been found that most materials can be adjusted to have suitable resistance and still meet other requirements.

We have found that no single, simple characteristic or adjustment provides optimum sprayability for any given coating. However, adjustment of paint resistivity through appropriate selection of solvents improves many paints that otherwise could not be sprayed efficiently by the electrostatic process.

Solvent Classification for Electrostatic Usage

Solvents may be classified as POLAR or NONPOLAR. For our purposes, the differences in polarity between different solvents provides a means to adjust the total resistivity of a paint mixture.

NONPOLAR Solvents normally do not improve sprayability. These solvents include the aliphatic and aromatic hydrocarbons, chlorinated solvents, and the terpenes.

The addition of POLAR Solvents compatible with the basic coating material often improves electrostatic sprayability. Polar solvents include the ketones, alcohols, glycol ethers, esters, and nitroparaffins.

Viscosity Guide

The initial trial paint formulation should be of high viscosity (preferably exceeding 50 seconds on a No. 4 Ford cup) so that the reduced formula will have satisfactorily high solids content after solvent additions. It is usually best to adjust viscosity after resistivity, since viscosity is a less critical factor for electrostatic sprayability.

Procedure for Electrical Resistance Adjustment of Coating Formulations

Proceed as follows:

1. Formulate paint sample with high viscosity, preferably exceeding 50 seconds with No. 4 Ford cup.

2. After thorough mixing, measure the resistance of the unreduced paint with any one of the following test instruments as available:

- Paint Test Equipment (76652-01)
- Paint Test Equipment (76652-02)
- Paint Test Equipment (76652-03)
- Paint Test Equipment (76652-04)
- Paint Meter (70408-00)

Follow test procedure instructions provided with the test equipment. Record resistance reading. If resistance is above the recommended values in Figure 1, proceed to steps 3 and 4. If resistance is below the Figure 1 values, proceed to step 5.

3. Add minimum amounts of preferred polar solvents to adjust paint resistivity to the optimum range. Several trials may be necessary. (See section on solvent classification on page 1.)

4. Adjust viscosity by adding the minimum amount of a nonpolar solvent to obtain the desired film-flow characteristics.

5. When measured resistance is below the desired value, add nonpolar solvents to adjust the resistivity.

Resistance Adjustment by Solvent Selection

Nonpolar solvents may be used as extenders to vary paint viscosity or flow properties without seriously changing the electrical resistance of the mixture. An exception occurs with paints that are of low resistivity, for example vinyl solutions or nitrocellulose materials. The conductivity of these special mixtures may sometimes be reduced to a usable factor by the addition of nonpolar solvents.

Generally, the addition of solvents of highest polarity will give the greatest electrical resistance reduction to a mixture; solvents of intermediate polarity provide intermediate resistance reductions, etc. Figure 1 lists commercially available solvents in the order of their increasing polarity. Use this figure as a guide for the selection of solvents to adjust the resistance of the paint to the desired sprayability range as indicated in Figure 1. The adjustment of paint resistivity to the specified optimum ranges will usually improve its sprayability.

A specific selection should be based on the best compromise to obtain the desired resistivity, viscosity, flow rate, evaporation rate, cost, and other conventionally considered factors.

Evaporation Rates vs. Electrostatic Equipment Used

All ITW Ransburg No. 2 Process disk equipment requires slower formulations than normally used for conventional hand air guns. The larger the disk diameter and higher the speed of rotation, the slower the evaporation rate should be made. No. 2 Process bells require paints in about the same evaporation range as for conventional air guns, while the No. 2 Process handguns require still faster solvents.

Because of complex interactions of solvents, resins, and binders, it may happen that a solvent of a certain polarity will reduce the mixture resistance more than an equal amount of a second solvent which has a higher polarity. As these reactions are not always predictable, the adjustment of resistivity is necessarily a guided trial-and-error procedure.

Coating Materials Guide

Short oil length alkyd vehicles, with small amounts of high polarity modifying resins like amino resins, epoxy, or phenolic, respond well to the adjustment of resistivity by solvent addition.

Air-dry lacquers and similar fast drying materials usually contain so much polar solvent that their resistivity is below the desired range. In such cases, incorporating the maximum allowable quantity of nonpolar dilutant (example: the substitution of esters for ketones) will improve sprayability.

Organosols dispersed in hydrocarbons can be improved by thinning just before use with polar solvents of high solvency. Reduction long before use with polar solvents of low solvency and swellability for the dispersed resin is also beneficial.

Most paints of high pigment volume concentration and paints where the binder is highly nonpolar, such as bodied linseed oil, styrenated alkyds, lacquers based on hydrocarbon resins (like cyclized rubber or butylene copolymers), and long oil alkyds, may be improved by solvent adjustment, but the possible upgrading of these materials by this method is limited. Preliminary ITW Ransburg research seems to indicate that the use of concentrated additives with paints of these types offers a better prospect for sprayability improvement.

PAINT AND SOLVENT SPECIFICATIONS

	REA™ VECTOR™ EFM™ EVOLVER™	REM™ / M90™	NO. 2 HAND GUN	TURBODISK™	AEROBELL® II*** AEROBELL® AEROBELL® 33 RMA-101™
RECOMMENDED VISCOSITY USING A ZAHN NO. 2	18 TO 30 SEC	18 TO 30 SEC	20 TO 60 SEC	20 TO 60 SEC	20 TO 60 SEC
PAINT ELECTRICAL RESISTANCE**	.1 MΩ TO ∞	.1 MΩ TO ∞	.1 TO 1 MΩ	.1 MΩ TO ∞	.1 MΩ TO ∞
RECOMMENDED DELIVERY (UP TO)	1000 cc/min	1500 cc/min	180 cc/min	1000 cc/min	500 cc/min

GUIDE TO USABLE SOLVENT SELECTION

Chemical Name	Common Name	Category	Flash Point†† (TCC)	*CAS Number	Evap. Rate†	Elec. Res.**
DICHLOROMETHANE	Methylene Chloride	Chlorinated Solvents		75-09-2	**14.5**	HIGH
VM & P NAPHTHA	Naptha	Aliphatic Hydrocarbons	65°F	8030-30-6	**10**	HIGH
ACETONE		Ketones	-18°F	67-64-1	**5.6**	LOW
METHYL ACETATE		Esters	90°F	79-20-9	**5.3**	LOW
BENZENE		Aromatic Hydrocarbons	12°F	71-43-2	**5.1**	HIGH
ETHYL ACETATE		Esters	24°F	141-78-6	**3.9**	MEDIUM
2-BUTANONE	MEK	Ketones	16°F	78-93-3	**3.8**	MEDIUM
ISO-PROPYL ACETATE		Esters	35°F	108-21-4	**3.4**	LOW
ISOPROPYL ALCOHOL	IPA	Alcohols	53°F	67-63-0	**2.5**	LOW
2-PENTANONE	MPK	Ketones	104°F	107-87-9	**2.5**	MEDIUM
METHANOL	Methyl Alcohol	Alcohols	50°F	67-56-1	**2.1**	LOW
PROPYL ACETATE	n-Propyl Acetate	Esters	55°F	109-60-4	**2.1**	LOW
TOLUOL	Toluene	Aromatic Hydrocarbons	48°F	108-88-3	**1.9**	HIGH
METHYL ISOBUTYL KETONE	MIBK	Ketones	60°F	108-10-1	**1.6**	MEDIUM
ISOBUTYL ACETATE		Esters	69°F	110-19-0	**1.5**	LOW
ETHANOL	Ethyl Alcohol	Alcohols		64-17-5	**1.4**	LOW
BUTYL ACETATE		***Esters***	**78°F**	***123-86-4***	***1.0***	***LOW***
ETHYLBENZENE		Aromatic Hydrocarbons	64°F	100-41-4	**.89**	HIGH
1-PROPANOL	n-Propyl Alcohol	Alcohols	74°F	71-23-8	**.86**	LOW
2-BUTANOL	sec.-Butyl Alcohol	Alcohols	72°F	78-92-2	**.81**	LOW
XYLOL	Xylene	Aromatic Hydrocarbons	79°F	1330-02-07	**.80**	HIGH
AMYL ACETATE		Esters	106°F	628-63-7	**.67**	MEDIUM
2-METHYLPROPANOL	iso-Butyl Alcohol	Alcohols	82°F	78-83-1	**.62**	LOW
METHYL AMYL ACETATE		Esters	96°F	108-84-9	**.50**	LOW
5-METHYL-2-HEXANONE	MIAK	Ketones	96°F	110-12-3	**.50**	MEDIUM
1-BUTANOL	n-Butyl Alcohol	Alcohols	95°F	71-36-3	**.43**	LOW
2-ETHOXYETHANOL		Glycol Ethers	164°F	110-80-5	**.38**	LOW
2-HEPTANONE	MAK	Ketones	102°F	110-43-0	**.40**	MEDIUM
CYCLOHEXANONE		Ketones	111°F	108-94-1	**.29**	MEDIUM
AROMATIC-100	SC#100	Aromatic Hydrocarbons	111°F		**.20**	HIGH
DIISOBUTYL KETONE	DIBK	Ketones	120°F	108-83-8	**.19**	MEDIUM
1-PENTANOL	Amyl Alcohol	Alcohols		71-41-0	**.15**	LOW
DIACETONE ALCOHOL		Ketones	133°F	123-42-2	**.12**	LOW
2-BUTOXYETHANOL	Butyl Cellosolve	Glycol Ethers	154°F	111-76-2	**.07**	LOW
CYCLOHEXANOL		Alcohols	111°F	108-93-0	**.05**	LOW
AROMATIC-150	SC#150	Aromatic Hydrocarbons	149°F		**.004**	HIGH
AROMATIC-200		Aromatic Hydrocarbons	203°F		**.003**	HIGH

FASTER ⇑ SLOWER ⇓

***** CAS Number: Chemical Abstract Service Number.
****** Electrical Resistance using the ITW Ransburg Meter.
******* Solvent Base Configuration Only.
† Information Obtained From: http://solvdb.ncms.org
†† The lowest temperature at which a volatile fluid will ignite.
Evaporation Rate is Based Upon Butyl Acetate Having a Rate of 1.0

NOTE: Chart provides resistance and control information that we feel is necessary when using ITW Ransburg equipment.

Figure 1: Paint and Solvent Specifications

Technical/Service Assistance

Automotive Assembly and Tier I: Telephone: 800/ 626-3565 Fax: 419/ 470-2040
Industrial Systems: Telephone: 800/ 233-3366 Fax: 419/ 470-2071
Ransburg Guns: Telephone: 800/ 233-3366 Fax: 419/ 470-2071

(Technical Support Representative will direct you to the appropriate telephone number for ordering Spare Parts.)

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