Reprinted from **POWDER COATING** February 1992

PRETREATMENT TROUBLESHOOTING

Troubleshooting the pretreatment system

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Pretreatment is a complex process. Consequently, coating failures that are related to inadequate pretreatment are rarely the result of a single, obvious cause. Instead, they are usually caused by several small deviations from the chemical supplier's recommendations for controlling chemical solution quality and from the equipment supplier's recommendations for maintaining the equipment properly.

The purpose of this article is not to emphasize how to control the process, pick and use the right chemicals, or design and maintain the equipment. It is to provide information on how to correct pretreatment problems once you have identified that you do indeed have a problem. It gives an overview of pretreatment problems that cause coating failures and lists possible causes and solutions for each.

The failure of powder to adhere permanently to a part may occur immediately after coating and curing, a few hours after, or several months later. Most powder coaters will tell you, "If I'm going to produce a reject or a product that does not meet the minimum standards specified, I'd rather catch it immediately, find the cause, and correct the problem—and not have my customer catch it for me."

Unfortunately, this is not always possible. When a pretreatment system is allowed to operate out of control, there is no way to predict if or when it will fail to perform adequately. (A system is considered to be out of control when proper attention is not paid to the quality of the pretreatment solutions or to the physical condition of the equipment.)

The durable finish that characterizes a cured powder coating can make it difficult for finishers to detect coating failures. When powder is applied over a properly pretreated part, its great cohesiveness provides excellent adhesion and corrosion properties. But powder's cohesiveness also may hide poor pretreatment initially, keeping a coating failure from being noticed until after the customer or consumer has bought the product. To avoid this, get control of your pretreatment process: Make sure the various chemical solutions are at the temperatures and concentrations recommended by your chemical supplier and that the equipment is maintained for optimal performance. For quality, nothing beats consistent control, well-chosen chemicals that are used correctly, and well-designed equipment that is functioning properly.

Operating and maintenance manuals—the foundation for troubleshooting

It is impossible to overemphasize the importance of two items in troubleshooting on-line pretreatment problems. The two items are the operating manual and the maintenance manual, both supplied by your chemical vendor

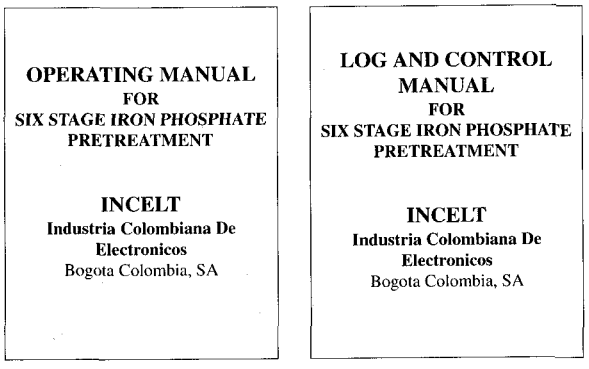
(see Figure 1). They provide a baseline for controlling pretreatment chemicals and for maintaining the mechanical power washer.

The operating manual. The bulk of the operating manual provides an overview of the washer, the chemicals specified for each stage, and recommendations for controlling the quality of each chemical and rinse stage. The operating manual usually also includes the following:

- Chemical product fact sheets and current Material Safety Data Sheets (MSDS)
- The format for a daily log
- Tank labels
- Descaling procedures
- Titration information
- Safety information
- Effluent neutralization procedures

FIGURE 1

Typical operating and maintenance manuals



The maintenance manual. The mechanical washer maintenance manual contains the maintenance procedures you, your equipment manufacturer, and your chemical vendor have agreed are necessary to keep pretreatment equipment operating efficiently.

The topics covered usually include the following:

- Recommendations on nozzle size and type for each stage
- The routine for checking, cleaning, and replacing nozzles
- Recommendations for water levels and information on operating and maintaining fill mechanisms
- Procedures for screen cleaning
- Pressure and temperature recommendations for each stage
- Dump and recharge schedules
- Oil and lubrication information for pumps, motors, and monorail
- Information on maintaining the washer exhaust system
- Maintenance log sheets for noting the data gathered from daily, weekly, and monthly inspections and the corrective actions taken

Proper training and consistent use of the two manuals will decrease the likelihood that the pretreatment process will go out of control, creating a situation that requires troubleshooting. Unfortunately, loss of process control is a real-world occurrence, and there are times when a troubleshooting guide is necessary. Figure 2, on the following pages, presents a troubleshooting guide with a problem-cause-solution format. Because of the variations in pretreatment chemistries, the guide will not be able to solve all problems that develop in all pretreatment systems. But it does provide a starting point for action when the pretreatment line is producing parts unacceptable for powder coating.

FIGURE 2

Troubleshooting guide for three- and five-stage iron-phosphate systems

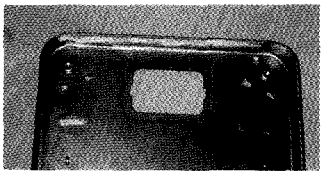
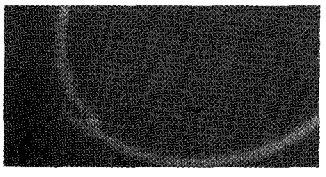
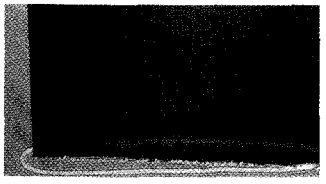
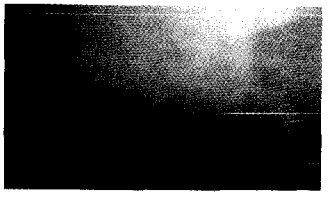
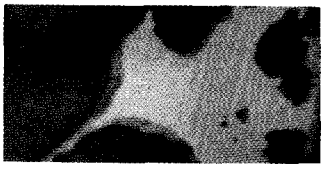
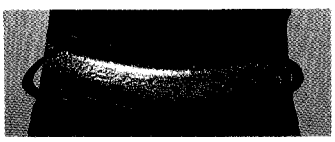
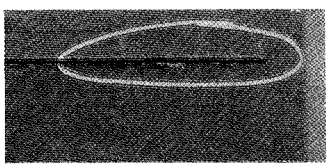
Problem	Cause	Solution
1. Poor cleaning 	1. Variables such as chemical concentration, pH, process time, or temperature not at recommended levels	1. Bring variables to recommended levels
	Spray nozzles blocked or misaligned	Check condition of nozzles, and clean, repair, or replace as necessary
	Change in soil composition	Use detergent additive for better wetting; increase temperature of cleaning stage if soil is determined to be heat sensitive or contains waxes
2. Flash rusting 	2. Good cleaning but poor phosphate development; light phosphate coating and low pH, producing pickling of metal substrate	2. Bring phosphate solution up to recommended level; increase pH if necessary
	Time to complete dry off too long or dry-off temperature too low	Reduce time needed to complete dry off by raising solution temperature in last stage; use fans or blowers prior to dry off
	Low, recessed areas on parts retain excessive moisture	Rerack parts to promote proper moisture runoff
3. Water spotting 	3. Contaminated rinses; stage-to-stage overspray	3. Dump, clean, and recharge rinse stages; increase overflow; check nozzle direction for overspray
	Contaminated final rinse	Use low concentration of detergent additive in last stage (this may be detrimental to salt-spray results, however)
	Poor raw water quality	Check total dissolved solids (TDS) in rinse tank; dump and clean rinse tanks or increase overflow rate
4. Solids drip line 	4. Contaminated final rinse	4. Compare TDS of rinse and raw water; dump and recharge final rinse to reduce TDS; reposition parts to minimize solids drip line; use directed air blow off
5. Insufficient phosphate coating 	5. Phosphate concentration too low or pH too high	5. Add phosphating material to attain proper concentration or lower pH with pH-acid additive
	Contact time too short; workpiece too dirty and phosphatizing time too short	Raise temperature; preclean parts or use detergent additive
	Temperature too low	Raise temperature to recommended level
6. Mottling 	6. In five-stage system, pH too low	6. Adjust pH to recommended level
	In three-stage system, more easily cleaned areas develop heavier phosphate coating; irregular spray causes mottling	Employ alkaline precleaning; control pH of phosphate stage by increasing or decreasing operating pH and acidity

FIGURE 2 (cont.)

Troubleshooting guide for three- and five-stage iron-phosphate systems

Problem	Cause	Solution
7. Powdering 	7. Excessively high pH	7. Use pH-acid additive to bring pH to desired range
	Excessive sludge in bath	Remove sludge, renew bath, or improve rinsing
	Phosphate concentration too high	Dilute phosphating solution to proper concentration
	Dry-off temperature too high	Maintain dry-off temperature below 300° F
	Chemical solutions allowed to dry between stages; line allowed to stop	Install misting nozzles between stages; prevent line stoppage
	Insufficient rinsing	Check TDS of rinses and final rinse
8. Smut and inorganic soot 	8. pH too high	8. Lower pH, phosphate, or cleaner-phosphate to be more reactive to smut
	Poor cleaning	Bring cleaner concentration up to recommended level
	Deficient spray pattern; insufficient impingement	Check condition of washer nozzles; ensure proper impingement
	Poor quality steel; improper storage of steel	Prequalify incoming steel; store steel correctly—indoors and away from plating lines, for example
	Poorly regulated dry-off combustion leaves residue	Check for proper ignition and combustion; check air-to-fuel ratio
9. Poor adhesion on nonferrous casting 	9. Poor cleaning	9. Check that cleaning solution is producing a surface free of water breaks
	Insufficient etch	Check for sufficient etch in cleaning and/or phosphatizing stage; check nozzles for coverage and impingement; check that chemicals are at recommended levels
	Change in soil composition	Check for changes in die lubricant or aging of soil
10. Outgassing on nonferrous casting 	10. Casting too porous	10. Check for casting change
	Aggressive chemical attack	Check that chemicals are at recommended levels
	Contaminants retained in casting	Prebake casting or raise cleaning temperature
11. Oil bleed out 	11. Soil entrapped in metal	11. Preclean metal before fabricating
	Change in amount of soil load	Reduce soil amount
	Change in soil composition	Change to lighter weight soil
	Pretreatment variables out of control	Recheck all process variables, particularly temperatures
		If oil bleed out continues, prebake parts to fluidize soil

Editor's note

For more information on chemical and mechanical maintenance of pretreatment systems, see "Pretreatment system maintenance" in *Powder Coating*, February 1991. **PC**

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