ORGANIC FINISHING

One-Step Organic Phosphating

How costs, features, and benefits stack up against conventional pretreatment wash systems.

By Mary Carpenter, President, Carpenter Chemicals LC, Alexandria, Va.

In an article describing one-step organic phosphating published in the February 2006 issue of this magazine, it was stated that the distributors of the one-step process had developed a computer-based method for comparing the costs of a conventional pretreatment wash system with the one-step system. In this article, we explore that in more detail, since a company considering its pretreatment choices must make such comparisons as part of its decision-making process.

Costs, of course, are not the only criteria for the decision to invest in a one-step system. The ease of use, stability of the bath, and consistent performance of the process, as well as environmental considerations, and permitting issues are also part of the equation.

Conventional systems are quite similar to each other in most respects. They all use water, heat, multiple treatment stages, rinse(s), and, perhaps, a separate seal stage. Comparing the differences among them is relatively easy, because there are not very many variables to contend with.

Conversely, the one-step process is different from conventional wash systems, so all costs must be considered from scratch. For example, prospective customers tend to assume, based on their experience with conventional pretreatment wash systems, they will have to continue to pay the high (and rising) cost of fuel to heat water tanks. These same prospects assume they will have to deal with obtaining and maintaining permits for the dumping of water, oil, sludge, and other wastes. They also assume their baths must be constantly tested because they will be unstable. In making these assumptions, they discount the very reasons why a one-step process is so attractive. The one-step organic phosphating process is really differentóit operates at room temperature, creates no sludge, uses no water, is not rinsed, and the bath is extremely stable and never needs to be changed out.

The cost savings associated with these differences in operations are very significant. So how does a potential user compare conventional pretreatment to the one-step organic phosphating process?

RETURN ON INVESTMENT CALCULATOR

The distributor of the one-step process has devel-

General
How many square feet of metal do you treat per day?
How many shifts and days per week do you operate?
What is the price of your natural gas ($/therm)?
What is your price of electricity ($/Kwh)?
What is the cost of your water per gallon?
What is your labor cost per hour for maintenance/general workers?
What is your current chemical cost ($/gallon)?
What is the coverage of your current chemicals (ft^2/gallon)?

Water and heating
What is the rating of your burner (in millions of BTUs)?
How many gallons of water do you use per hour?

Electricity
What is the horsepower total of the pumps, blow-off fans and exhaust in your washer?

Do you have an evaporator? If so:
What is the BTU rating of its burner?
How many hours does it operate per day?
What is the total horsepower for the fan?
How many hours of labor per day are used to operate the evaporator?

Do you pay for waste collection and disposal? If so:
How many drums do you dispose of?
What is your cost per drum, including labor?
How many gallons of water per year are used in refilling the tank?
How many hours of labor per week are used in drum handling?
How many hours of labor per week are used in tank cleaning?

Lost production, quality, rejects
What is the cost of operating your plant (with no production) per hour?
How many hours of production per day are lost due to maintenance?
What is your reject rate?
How many hours of production per day are lost during heating of your tank?
How many hours of production per day are lost during process-driven gaps in production (i.e., for lunch breaks or end-of-day)?
How many hours of labor per year are required for maintenance of the washer?

Figure 1: ROI questionnaire.

oped a questionnaire designed to accomplish two purposes (see Figure 1). Most importantly, of course, is to calculate the customerís true costs associated with their conventional system and compare these to the costs associated with the one-step organic phosphate system. But since no set of questions can possibly cover everyoneís individual situations, the other reason for the questions is to get the user thinking and contributing to the analytical process.

The main questions asked are shown in Figure 1. As is evident, these questions are divided into categories for easier analysis. Some discussion of these categories is in order.

Figure 2: Low-pressure spray washes oils and fines off the parts, then applies a phosphate and a resin. The resin cures during drying.

ANALYSIS

General: This section describes the overall operationóproduction volume, hours of operation and prices of natural gas, electricity, water, chemicals, and labor.

Washer: This section concerns costs that fall into several categories:

- Heating the tank and maintaining it at temperature in a conventional system is a source of increasing concern. The one-step organic phosphating system is not heated. In a conventional system, a typical burner may be rated at 1,500,000 BTU and operating at 75% efficiency (a conservative assumption). If the burner operates one eight-hour shift per day and if natural gas prices are $1.20 per therm, that burner is costing about $35,000 per year in natural gas costs alone. A 2,500,000-BTU burner will cost about $58,000 per year under those same conditions, and, if it operates two shifts, the costs will top $115,000. Heating more than one tank, of course, also adds to the cost.
- Electricity is used in the pumps, blow-off fans, and exhaust. These elements exist in both systems. However, in the case of one-step organic phosphating, the pumps and fans are generally less powerful and thus require less electricity because air flow and liquid flow are minimal in that system. A typical conventional installation might cost $4,000 for electricity per year for the washer, and the one-step organic phosphating system would probably cost about a quarter of that amount.
- **Water**: A great deal of water is used in conventional processes, but the one-step process does not use water at all. Although water costs are not a significant factor for some, others are paying Ω to 2/3 of a cent per gallon. One company we know of uses 300 gallons per hour and pays $14,000 a year just to supply the water for its washer. This cost does not include dumping the water, neutralizing it, or paying the municipality to do it.
- Labor for maintenance is reduced because parts are fewer and simpler and, importantly, there is no natural gas equipment. In addition, the ongoing costs of obtaining water, waste water, and dumping permits and keeping up with reporting and renewals is eliminated.

Evaporator: If a pretreatment system includes an evaporator, the natural gas and labor costs will be important there as well. A 1,500,000-BTU burner operating eight hours per day will generate more than $67,000 in natural gas costs per year if the gas costs $1 per therm, and over $73,000 at $1.20 per therm. Labor, at just an hour a day, will add up to about $5,000 per year. Of course, if the evaporator operates more than eight hours per day, the costs will be higher. None of these costs apply to the one-step organic phosphating system.

Waste collection and disposal questions cover several elements:

- Drums of sludge directly from the tank;
- drums of sludge from the evaporator, if there is one;
- labor;
- and water to refill the tank after it is changed out.

Disposal of a drum of sludge generally costs at least $500. If a company generates 20 drums a year of sludge, getting rid of these drums would cost $10,000. One prospect treating 20,000 square feet of metal a day generates 30 drums of sludge and spends about $15,000 a year on hauling.

Lost production and quality issues are other areas of costs often not considered. It normally takes about an hour a day to heat up a tank, during which time no treatment can be accomplished.

At lunchtime, at the end of the day, when changing the types of metals being treated, and sometimes at other times, a conventional system pretreater must leave gaps in the production line. The reason for the gaps is during those periods (assumed to be an hour per day total), no painters would be available to coat parts, and any parts in process that havenít been seal coated or gone through the dry-off oven can flash rust.

And finally, most companies report about 40 hours per year for maintenance downtime that occurs during the workday.

Summing up these lost production costs, a user for whom goods produced are valued at (for example) $200 an hour would be losing more than $100,000 a year in goods not produced. In a one-step organic phosphating system, the tank is not heated, so work can start right away. Parts are protected from flash rusting for weeks, so line gaps are unnecessary. And maintenance is much less; you just change filters and clean or replace polyethylene curtains a couple of times each year.

In addressing quality, conventional pretreatment systems are quite erratic because the chemistry is inherently unstable and must be monitored daily or even several times each day. When the chemistry is not balanced, performance and quality suffer. This is a difficult cost to quantify, because finished goods may not be defective and continue to be sold and shipped. But the reject rate can be monitored, as can the return rate. Moreover, if a customer is dissatisfied, it costs the pretreater/coater goodwill and can compromise sales if the lost client must be replaced.

GIVING THE PROSPECT AN OVERALL COMPARATIVE COST

As we can see, there are several different high costs associated with conventional phosphating. On the other side, the only major cost in the one-step organic phosphating process is the chemical itself. The higher the square footage of metal treated, the more significant the chemical costs.

At a certain high production level, the cost of the chemicals will outweigh the other operating benefits. But with the cost of natural gas, in particular, going through the roof, that upper limit has been rising steadily.

Putting these costs together is the job of the ROI calculator. A ìtypicalî smaller user treating 8,000 square feet of metal per day, heating a single tank eight hours a day, paying $1 per therm for natural gas, running an evaporator, and creating 12 drums of sludge a year, could save about $200,000 annually using the one-step process compared to a conventional system. If he were paying $1.40 for his natural gas (last fallís price), he would be saving about $220,000 a year.

At a higher production level, a user treating 50,000 square feet per day, paying $1 per therm for natural gas, running an evaporator and creating 75 drums of sludge per year, could look to save about $13,000. If he was paying $1.40 per therm, his savings would be about $39,000 per year. Going to a second shift or heating a second tank would only increase the costs of the conventional system, compared to the one-step organic phosphating process.

CAPITAL COSTS

What about capital costs? These are not included in the ROI calculator at this point, but some discussion is in order.

Preliminary to any capital cost discussion for a one-step system, a prospect should consider seeking government grants or low-cost loans for this process that eliminates natural gas, water use, and solid waste. Such financial incentives are available in many jurisdictions.

Aside from government financing, however, the installations are less expensive in any case. Installations can be a dip or spray (low-pressure flowcoat) process, and they can be batch, indexed, or in-line. These variants affect installation costs, and the choice of installation type depends on the userís individual needs. Whichever option is chosen, though, the costs will be significantly less than a conventional system because it is a single-stage, no-rinse process. There is no natural gas equipment to install, and only one treatment stage. Moreover, because of the low air and liquid pressure required by the process, pumps and fans are smaller and less expensive. Finally, installation labor costs are lower because of the simplicity of the systems.

A small user might want a very simple dip tank holding 100 gallons of treatment chemicals. Such a tank would be made of stainless steel or molded polypropylene, with a pump and filter, a cover for use when the tank is not in operation, and a very low-velocity exhaust system. The cost for such a system is very low and the performance is every bit as good as a larger, in-line flowcoat system. The only difference

Figure 3: Small, efficient batch spray washer: parts are pretreated and dripped off on manual or automatic cycle.

is the dip tank is designed for batch operation.

Another good option is a batch spray washer, which consists of a box dimensioned to the parts (or racks of parts) to be treated, with the chemical reservoir underneath and risers and nozzles lining the inside of the box. The parts rack is placed inside the washer, the door is closed, and parts are flowcoated and dripped off in the chamber. When the process is completed, the exhaust is turned on for a short time, and then parts are ready to be removed.

This system can be made completely manual or may employ timers for the process phasesó and costs will vary accordingly. However, it is a simple and inexpensive way to treat parts in a batch system.

The cost for an in-line tunnel is chiefly dependent on the line speed, because the treatment area and drip-off/blow-off area must be longer for a higher-speed system. But a system running at four feet per minute needs four feet of treatment area and (depending on parts configuration and blow-off) about 25 to 35 feet of drip-off/blow-off areaóplus an entry and exit ìbuffer zone.î Only the tank, risers, nozzles, and other elements that come in contact with the chemicals need to be made of stainless steel, so the drip-off housing area can be polypropylene or galvanized.

Moreover, compared to a conventional system, an in-line tunnel only has one treatment stage, so it is a simpler and less expensive unit because most of the length is simply housing.

CONCLUSION

The cost comparison program developed by the distributors of the one-step organic phosphating process contains a great amount of detail for those who want it, and because it is an Excel file, parameters can be changed to reflect the actual user profile. Prospects may find additional items applicable to their particular operations; those can also be incorporated into the model. The ROI calculator is a solid method for making what would otherwise be rather difficult and complex comparisons.

For more information, contact the author at (e-mail) mcarpen@erols.com. **mf**