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Cleaning and Organic Phosphating in the 21ST CENTURY

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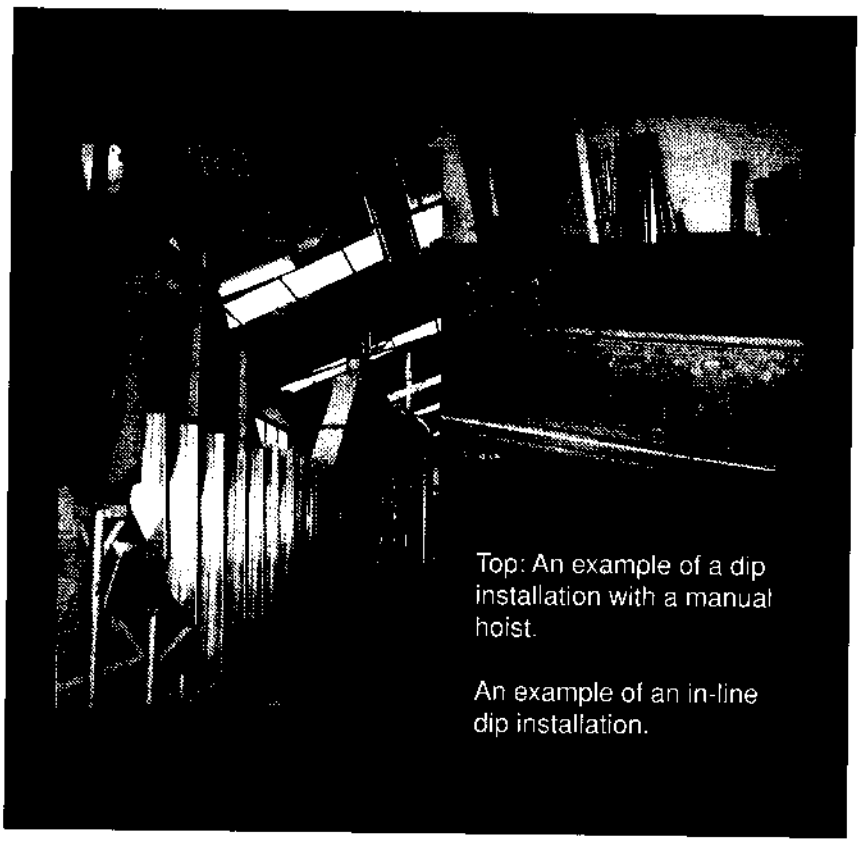
Cleaning has long been considered a "necessary evil" in the finishing industry. Among high costs, specialized training needed and environmental concerns, the goal of a clean part seems to become less important. There are companies, however, that strive to make cleaning a more palatable process.

Preparing metal for painting or other processes is done in several ways, depending on the results desired. There are two general categories of pretreatment: those that are only designed to clean, and those that "convert" the metal surface for extra performance.



Top: An example of a dip installation with a manual hoist.

An example of an in-line dip installation.

Non-converting processes, i.e., cleaning only, no phosphating, include:

- alkaline degreasing
- cold solvent degreasing
- solvent vapor degreasing
- water-based cleaning
  - surfactant cleaners, involving one or more rinses
  - surfactant-free, no-rinse -- Sache®

These processes are designed to clean the metal, removing process oils and fines.

To increase paint adhesion and corrosion resistance, other processes "convert" the surface of the metal by etching it, depositing a layer of phosphate crystals and, in some systems, finishing with a sealant.

Converting processes include:

- hot solvent-based phosphating processes
- inorganic phosphating processes
- organic phosphating processes

- multi-stage
- one-stage -- Plaforization®

Conventional cleaning as well as cleaning-plus-conversion systems require several steps, use substantial energy in the form of heat, and produce sludge and wastewater that has to be treated.

PaiKor, an Italian company, has been in business since the 1920s, evolving over time into the paint field. Some 20 years ago, the owner decided to look at metal pretreatment from a different angle in order to develop systems that would be environmentally friendly, simple to use, space-saving, and lower costing. The company accomplished this and provides two basic product groups, one directed at the cleaning market (Sache), the other at the conversion coating segment (Plaforization).

One-Step Cleaning and Phosphating

When PaiKor decided to address the pretreatment field, the company believed the most pressing need was for a new system for cleaning and phosphating, and Plaforization® was developed to answer that need. Now, 20 years later, there are over 400 installations in Europe treating 14,000,000 square feet of metal every day with the product.

What is it?

Plaforization® is a mixture of special fluids, plus a resin and phosphating chemicals. It is applied at room temperature in a single step without rinsing. It produces no liquid or solid waste, requires only one minute of treatment time, uses a small installation, is simple to use, and is very stable. Thus, the bath only needs to be analyzed once every two months. Bath stability also produces consistent pretreatment results, often not the case with conventional multi-stage pretreatment.

How does it work?

When a part is dipped or sprayed with the product for one minute, a series of actions takes place simultaneously. The oils and fines are cleaned off the part. The oils are taken into solution in the liquid, and the fines are filtered. The metal surface is then etched and phosphate is applied to the surface.

When the part is removed from the treatment tank or spray, the drag-out on the part includes the fluids, the oil that came in on the part (now dissolved in the liquid), and the resin. As the fluids evaporate, the resin polymerizes, and the oil that came in on the part becomes trapped inside that three-dimensional polymer. There, it is used as a plasticizer to give the resin flexibility and impact resistance. So, in that one minute of treatment time, the part is etched, phosphated and sealed with a 1-micron polymer. The sealant gives the part protection against flash rust because the continuous film blocks humidity and oxygen from reaching the metal surface. The product's corrosion resistance with topcoats is between the levels provided by traditional iron and zinc phosphating.

The sealant, being a polymer and having an affinity for similar materials, also provides adhesion to various topcoats, liquid or powder.

How can it be used?

Plaforization® comes in a range of products designed to take into account different production processes and finished product needs. They range from an air-drying product to a 200 degree F flashpoint product designed for recovery of the fluids.

Some of the most clear-cut situations where the product is recommended are:

- Small to medium production throughput -- up to about 30,000 square feet per shift
- Production involving various metals, because they can be treated simultaneously
- Areas where there is a limitation or restriction on water use
- Areas where wastewater treatment, sludge treatment or dumping is a problem
- Areas where space is at a premium
- Areas where discontinuous production is practiced
- Production involving a waiting period between pretreatment and painting
- For start-up powder coating users

Some examples of industries where the product is used include: shelving, cabinets, safes, office furniture, indoor hardware, outdoor applications without extensive salt spray requirements, and auto parts such as seals, braking parts and seat frames.

Where can it be used?

Plaforization® is a flexible process and can be used in many types of installations. Dip or spray (actually low-pressure spray) installations can be set up, and they can be static, indexed or in-line, depending on production needs. For the user who works in a batch process, a static dip or low-pressure spray is recommended; spraying is best for parts requiring proper drainage. In-line dip units are good for treating panels at high production levels. Dip installations are particularly good in situations where part sizes vary.

For small users -- such as job shops just starting a pretreatment operation, or for those users who may need occasional intermittent pretreatment -- an inexpensive option is a combination dip/low-pressure spray unit consisting of a small tank (sufficient to treat the normal range of parts likely to be encountered). The unit, on wheels if necessary, is topped with an exhaust system that flows to a flexible exhaust pipe. An enclosure can be built to fit above the tank sides and exhaust system to any height desired, with a bar across the middle of the top for hanging larger parts. The recirculation/filtration system can be designed so that a valve placed after the filter allows the liquid to either flow back into the tank to provide agitation for the dip function, or to flow to a hose

with a low-pressure nozzle, for spraying larger parts. Such a unit is in successful operation at Custom Powder Coaters in Crown Point, IN, and was designed by the user.

In dip tanks, agitation is provided by means of eductors or Venturi nozzles. This is to facilitate removal of the fines and the oils. In all installations, tanks and other components that are in contact with the liquid should be made of stainless steel, including the filtration/recirculation system. A false bottom is useful for aiding in the occasional removal of larger parts which may have fallen to the bottom. Magnets can be used to remove heavy ferrous impurities.

It is important to maintain a generous amount of freeboard -- the distance between the top of the liquid in the tank and the top of the tank -- in the tank since the vapors are heavier than air and, with adequate freeboard, will tend to remain in the tank. An air exhaust system should be used, providing a slight negative air pressure to the outside to keep vapors out of the plant. Suction over a tank should be on a horizontal plane at the top of the tank to remove vapors that would otherwise overflow the tank, but to avoid disturbing the saturated air just above the surface of the liquid.

The size of the bath is basically a function of the size of the parts to be treated in a dip system. In both dip and low-pressure spray operations, the volume of liquid must also be sufficient to absorb oils efficiently, without being overtaxed in the event one or a few parts are introduced with excess oil on them. It should be kept in mind that the system is capable of absorbing, on average, about four times the amount of oil normally found on cold rolled steel.

In-line systems must be designed, given part size and conveyor speed, so that the parts remain in the liquid for 60 to 90 seconds.

After treatment, parts should be hung carefully to ensure a proper drain path. They should be dripped off and blown off (either cold or warm air can be used) in order to recover as much of the liquid as possible to avoid waste and ensure a uniform surface on the part. Any places where liquid could accumulate should be blown off.

New Plaforization® Line

A new group of products in this line has been developed in the last year in response to specific requests for a product able to provide extended uncoated corrosion resistance. This group of products offers up to 72 hours of uncoated salt spray resistance, and greater corrosion resistance with topcoats -- closer to that provided by zinc phosphating.

"Some examples of industries where the product is used include: shelving, cabinets, safes, office furniture, indoor hardware ..."

The application of these new products is similar to the traditional line except that they are generally used in a two-step process, a degreasing step preceding the application of the new formulations. This is because the oil-absorbing capacities of the new products are somewhat less than with the traditional line. The degreasing can be done with the traditional line or with other products, including Sache.

One-Step Cleaning

What if a user wants only cleaning? This is where the Sache® line comes into play. A concentrate that is mixed in demineralized water at 2 percent and applied in a single step, it is also an environmentally friendly product. Since it contains no conventional surfactants and therefore leaves no surfactant residue on the metal surface, it needs no rinsing. It is recyclable and reusable.

The product is simple to use: The mixture is heated to 140 degrees F, and is then applied with high-pressure spray or, in smaller applications, in a tank with agitation provided (for example, with ultrasonics). Then the part is dried (often the heat of the part is sufficient for this purpose) and is ready for the next stage. The treating liquid is drained to a tank where the oil is removed and dirt and fines are filtered. It is then ready for reuse after the addition, as necessary, of new make-up solution.

The product has several advantages over conventional cleaners. In conventional systems, rinsing is an additional step (or steps) and an additional expense, both in capital cost for the installation and in cost of water, effluent treatment, time and staffing. In addition, rinsing requires re-heating at some point. If the rinse water is applied cold, the part must then be re-heated to dry it and prepare it for subsequent treating. If the rinse water is heated, there is also an additional expenditure of energy.

Water must also be paid for, as must water treatment. Sache® not only does not create rinse water issues, but the bath itself lasts indefinitely if soils and oil are removed. If, after a period of months, the bath needs to be replaced, disposal is not difficult given the environmentally friendly ingredients in the concentrate.

Where can it be used?

- Where a very clean surface is required, such as before brazing
- Where environmental regulation limits water use or makes it expensive
- Where a simple process is desired or space is limited
- For in-plant cleaning between manufacturing steps

Benefits of the Two Processes

The processes developed by Pai-Kor provide many benefits for the user, including:

Plaforization*

Environment:

- Uses no water and therefore creates no effluent
- Creates no sludge
- Never requires changing the bath
- Is used at room temperature and therefore minimizes energy use
- Is safe for the workplace
- Contains no CFCs, HAPs, HHCs, aromatics, chrome, or ozone-depleting substances

Production efficiencies:

- Single-step process
- Stable bath, therefore no daily bath analyses
- Consistent production
- Flash rust resistance, which is effective for batch production
- Flexible design of installations to meet production needs

Cost effectiveness:

- No waste treatment
- Small footprint, small capital costs
- Room temperature operation, which translates into energy savings
- Can treat a variety of metals simultaneously

Sache*

Environment:

- One step
- No rinse
- No sludge
- No waste of heat, goes directly from bath/dry-off to powder coat
- Recyclable
- Is water-based and safe for the workplace

Production efficiencies:

- Singe step process, no rinse
- Easy to use, just separate oil and add solution as necessary
- Easy-to-use cleaner between production steps

Cost effectiveness:

- Virtually no waste treatment because bath is recyclable and no sludge
- Small footprint, so small capital costs
- Concentrate mixed at 2 percent in demineralized water

Conclusion

Environmental regulations are becoming increasingly strict on all fronts -- air, water, soil and workplace. In considering a pretreatment system, the increased costs of compliance must be factored in, along with the capital costs for the pretreatment and waste treatment facilities. Protection of workers and the environment can cost companies up to 10 percent of their revenue. Plaforization* and Sache* were developed with the specific goal of providing pretreatment which is safe, cost-effective, simple and environmentally responsible. Companies can thus effectively implement these benefits at a reasonable cost.

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