Field Application of Protective Coating Systems

by
Charles M. Simpson III
Protective Coatings, Incorporated

ABSTRACT

Our objective is surface protection at the lowest cost per square foot per year. This may call for a coatings application with an initial higher cost but with longer useful life. Follow up with periodic inspection and maintenance of the applied coating.

The application of some coating systems is too critical to be practical for field work. Their cost of application and incidence of failure are high. Field testing reveals new and invaluable information.

A thorough knowledge of generic types of coatings, the application peculiarities of various systems, and the advantages and limitations of both productive and testing tools are essential. Both supervisors and workmen should be properly schooled. A good experienced coatings engineer in the field will cut application costs, improve quality and life expectancy of applications and provide insurance against application errors.

The finest tools for safe and productive scaffolding; for surface preparation, for coating application and for testing must be available as needed. An engineer should be responsible for establishment of a blast cleaning program. Efficient sandblasting is usually the least expensive method of surface preparation.

We must constantly be aware of coating systems, supervision and workmanship, and tools and equipment and their direct effect on coating application for surface protection at the lowest annual cost.

Application of protective coatings cannot be discussed without reference to our prime objective. That is surface protection at the lowest cost per square foot per year. This usually means a thorough and more costly initial application. This to be followed by inspection and repairs to the protective coating systems at regular intervals. Such a program will result in longer coating life and lower annual coating cost.

A contract applicator customarily groups his application costs under three headings: materials, labor and equipment. For our purpose here let us use that same breakdown.

First, let us consider materials -- the coatings themselves. Cost per gallon tells only part of the story. A gallon of 100% solids epoxy coating may cost several times as much as a low solids vinyl coating and yet cost less per dry mil! Also a dry mil of one coating may offer much more protection than a dry mil of another. Consider the inorganic zincs, the cost of which per dry mil is high, but only a couple mils of which offers excellent service life in many environments.

Coatings generally represent a small part of the total cost of an applied protective coating system. The normally higher labor and equipment costs vary in accordance with the application and testing criteria for each particular system. None of these costs by itself is significant. Even combined they have little meaning. To arrive at a significant figure we add to them the annual coating maintenance costs and divide this total by the life expectancy of the system to arrive at a cost of surface protection per year.

Some materials are too critical for field applications. A few manufacturers offer chemically resistant coatings which should be considered laboratory curiosities! With these, it is one thing to prepare a small test coupon in the laboratory, but quite another thing to duplicate the results on a large steel fabrication under field conditions. For this reason field test applications are oftentimes a good investment before undertaking a major field application with a pre-selected material.

The field test might reveal otherwise unknown application peculiarities. Too much time lapse may develop sufficient solvent resistance in the primer so that subsequent coats will not adhere. Some coatings will exhibit a tendency to pinhole or crater from air or solvent entrapment. When overcoating an existing system, the newly applied coating may lift the old or may cause it to "bleed." Under certain field conditions a chemically cured coating may not properly cure. A prepolymer or product of reaction may migrate to the surface and prevent intercoat adhesion. The additional costs of lost time awaiting ideal weather conditions; of washing off exuded organic substances between coats, or otherwise "nursing" along the application may indicate the selection of an alternate coating system.

In some instances a coating that did not have the best showing in the lab tests may still be the best bet for a given coating project. Perhaps all the "tested for" resistance is not required here. The field environment may be less severe than the laboratory test environment. If this is the case, a coating system with less than the best resistance, but less critical and less costly to apply, may be the wisest choice.

Here are some additional considerations of a coating system that directly affect application: There are many coatings, particularly primers, that must be brushed. Some coatings must be sprayed. There are mastic materials that must be troweled or squeeged. Certain "sticky" viscous coatings trap air if rolled. There are chemically cured coatings that require very expensive two component spray equipment. A few coatings must be washed between coats. Some must be sanded between coats. Some coatings have limited shelf life. Some have limited pot life. Certain coatings are toxic and demand additional safety precautions. Some coatings can be applied below freezing temperatures. Others require a minimum temperature of over 60 degrees F. Some coatings will wet the substrate and tolerate surface contaminants. Higher polymer and faster drying coatings will not penetrate surface contaminants and therefore demand a blast cleaned substrate. Most coatings must be applied to a dry substrate. Others may tolerate or even prefer a wetted substrate. These are but a few of the many peculiarities of coating systems that directly affect application procedures and costs.

So much for materials. Let us now consider labor. Do not let anyone tell you that his coating system is foolproof to apply, or that anyone can successfully apply it. Under field conditions, with less than ideal weather, fumes and air borne contaminants, and "coating-wise" poorly designed structures, it can be difficult for an experienced crew to perform successfully even with conventional materials!

Workmen must be trained and experienced. They must know the procedures, precautions and pitfalls when applying the various coating systems. They must know when and how to employ all the special productive tools and special testing devises. They must be alert to detect any unusual condition at once. With some critical lining systems special training is mandatory.

Good supervision is even more essential. The coatings engineer, the coatings technician and the foreman should all be qualified to "call the signals" at any time. They must be prepared to come up with answers for all the strange, unforeseen and unpredictable problems which are constantly arising in the field.

Supervisory personnel should be able to classify coatings generically. They should understand the principles of barrier protection with organic coatings and of cathodic protection with certain inorganic coatings. They should know and use productivity standards as well as quality standards. They should understand the various degrees of blast cleaning. They should know safe and productive rigging and scaffolding. They should know blast cleaning abrasives: shot, grit, mineral slag, flint, silica, walnut shells, pecan shells, corn cobs, etc. They should understand the effects of abrasive size and shape. They should know the answers to questions like: Why multiple coats? Why minimum film thickness? Why maximum film thickness? Why does a particular coating system fail? Why brush primers? He should understand pressure drops in fluid flow systems. He should be able to maintain desired material pressure and air pressure at the spray gun and maximum pressure at the sandblast nozzle. He too should be able to use and maintain all productive tools as well as testing tools. Last, but not least, he should know how to handle men. He should be production minded and be able to obtain the maximum production from his men and equipment.

Where can we find workmen and supervisory personnel of the calibre described? As a rule we cannot. We can, however, still find some men who are willing to work and have the capacity and desire to learn. A good man will acquire many of the desired qualities from direct field experience. Such experience should be complemented with schooling.

As far as schooling is concerned, look first to the manufacturers of coatings and equipment. In recent years many educational movies have been produced. These are movies on the theory of corrosion, fundamentals of protective coating application, principles of good sandblasting, techniques of air spray, hot spray and airless spray. These are normally available for private showings to interested groups. Some manufacturers offer a school for supervisory personnel. Some offer a school for the workmen themselves. Some will offer their salesmen to assist on a particular field application. Some offer field technicians in teaching, supervisory, and/or inspection capacity. There sometimes are additional charges for these services. Regardless, the education so derived is cheap insurance for successful applications.

Part of the education of the coatings engineer, the supervisory personnel, and the workmen themselves stems from coating failures are inevitable. The incidence of failure is higher with the more sensitive, critical to apply coatings. This is particularly true in more severe exposures such as immersion. A failure should be studied thoroughly to determine the cause. The knowledge so gained should be used to educate application personnel and to develop new procedures or preventative measures so that the same failure does not occur again.

When you hear of a coating failure, chase it down. Make a personal inspection if possible. Get all the particulars. There is often a valuable lesson to be learned. Even if it is the other fellow's failure, it may prevent the same thing from happening to you.

Productivity must be considered along with quality. Productivity standards should be established. The workmen must be able to produce to these standards. They must not become so concerned with quality that they lose sight of production. Plant maintenance forces make their worst showing here. We have seen many instances where an experienced contractor's crew outproduced a plant crew of equal size by a ratio of more than two to one! This is particularly true where rigging and scaffolding are involved.

Our third and final item to consider is equipment and its effect upon application. Equipment can be broken down into preparatory tools, application tools, scaffolding tools and testing tools.

Under preparatory tools we find wire brushes, scrapers, chipping hammers, flame cleaners, steam cleaners, high pressure water blasters, power grinders, power sanders, power brushes, von Arx tools, vacuum blast machines and dry and wet blast machines. These are a few of the more useful tools for removing products of corrosion and other surface contaminants to produce a suitable substrate for the protective coating system.

Since blast cleaning is by far the most satisfactory method to prepare steel and other substrates, it is worthy of some special consideration here. Actually for the amount of cleaning it does, blast cleaning can be the least expensive form of surface preparation. No other method can remove the same amount of surface contaminants as quickly or as cheaply. At the same time the blast cleaning will roughen up the surface with a uniform anchor pattern to provide an ideal substrate for mechanical adhesion. There are, however, tremendous wastes in blast cleaning steel as it is often performed today. Anyone can sandblast, but it takes good equipment and a great deal of know how to blast clean profitably.

Blast cleaning steel is a science. Preferably an engineer should be assigned the project of directing the program. The more progressive manufacturers of blast cleaning equipment and compressors will not only provide him with productive tools, but will offer technical guidance toward basic fundamentals and good techniques. Under all conditions he must understand how to measure and how to maintain a minimum of 90 PSI at the blast nozzle. An understanding of pressure drops due to internal friction in air lines will help him select and integrate the compressor, air supply hoses, water separator, blast machine, abrasive hoses and blast nozzles. Some factors having a direct effect upon both the rate and quality of blast cleaning are:

1. Actual free air delivery, not rating, of compressor.
2. Air source, reciprocating verses rotary compressors.
3. Length and size of air supply hose.
4. Type and size of blast machine.
5. Internal resistance of sandblast machine and its piping.
6. Length and size of abrasive hose.
7. Internal verses external hose couplings.
8. Diameter, length and type of blast nozzle.
9. Size and type of blasting abrasive.
10. Water separating equipment.
11. Amount of cover up and clean up.
12. Kind and amount of matter to be removed.
13. Degree of cleaning of the substrate.
14. Desired depth of anchor pattern.
15. Scaffolding.

These are but a few of the many factors that the blast cleaning supervisor must be able to evaluate in order to obtain quality blasting at the lowest cost.

As far as tools of application are concerned, there are many factors affecting their selection. These would include producivity, resultant dry film quality, and cleanliness. Tools to consider for field applications are: brushes, painter's mitts, paint rollers, squeeges, trowels, air spray equipment, airless spray equipment, hot spray equipment, high pressure mastic pumps, two component proportioning and spray equipment and portable electrostatic spray equipment.

As to scaffolding and rigging, equipment and techniques have not changed much over the years. The single outstanding addition in recent years is the self-powered, electric or pneumatic, cable suspended hoists. These tools have greatly reduced scaffolding costs and have increased productivity on high work.

Testing tools would include moisture meters, wet thickness gauges, dry thickness gauges, ohmeters, spark testers and sponge type holiday testers. A thorough knowledge of these testing tools is essential, since when properly used they can provide the best guide as to the quality of a given protective coatings application.

Returning again for a moment to the economics, it is not necessarily advantageous to own all the aforementioned tools. As a matter of fact it is often more economical to rent where possible. Take, for example, an item such as a compressor to provide air for blast cleaning. Unless you have a demand for it for several months or so each year, to rent is less costly. Also, if you rent, you can select the optimum size for each particular job. Then, too, the maintenance of the machine is left to the rental house, whose mechanics are full time specialists on that equipment. Another important point is that to rent permits immediate 100% expensing, whereas to purchase requires capitalization and depletes the company's working capital.

In summary it might be said that there are many facets to the business of applying protective coating systems. The prime objective is surface protection at the lowest cost per square foot per year. This is usually obtained by an initial application of uncompromising quality followed by regular annual inspections and repairs. The actual application should be undertaken with an engineering approach and with due considerations to coatings, personnel and equipment.