The Detection and Removal of Invisible Contaminants

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This Applicator Training Bulletin will review several basic procedures to detect and remove invisible contaminants on surfaces prior to coating. Since many coating failures can be traced back to a contaminant on the substrate or previously applied protective coating, the importance of having the surface clean cannot be overestimated.

Contaminants on the surface can cause the protective coating to fail in many ways. When the coating fails, the environment that the protective coating is designed to keep away from the surface attacks the substrate and starts the corrosion process. Therefore, the detection and removal of contaminants on surfaces is crucial to the integrity and longevity of the protective coating.

Contaminants

Webster’s Ninth Collegiate Dictionary defines a contaminant as “something that contaminates.” Contamination implies the intrusion of or contact with dirt or other substances from an outside source, making the contaminated substance unfit for use.

The contaminants that will be reviewed are common to the application of most protective coating systems and are found on most coating projects. The detection and removal of 3 contaminants, soluble salts, hydrocarbons, and dust will be reviewed.

Soluble Salts

Soluble salts are commonly found on a surface that is to be painted when the project is located in an area where chemical plants are concentrated, such as the Gulf Coast. The chemical plants produce by-products that are emitted into the air by venting. They are present in the offshore environment on offshore platforms, pipelines, and other fixtures that have been laid in the waters surrounding the continental U.S. and inland as well. They are also found on bridges where road salts are used. There have also been cases of salt contamination from dirty abrasive.

When soluble salts are deposited on a surface after blasting for whatever reason, they can cause a reaction in the protective coating, causing the system to blister. Once a blister forms in the protective coating, it can allow the substrate to be attacked by the environment that it was designed to act as a barrier against. Then, the destructive action of corrosion will begin.

In the field, salt contamination is suspected if the steel flash rusts...
quicker than normal. A black rust starts forming in the pits of the steel and spreads over the contaminated area. When this occurs in anywhere from a few minutes to a few hours, salt contamination is the likely cause.

**Testing for Chloride Contamination**

One of the first tests to perform is for determining the acidity of the surface. A piece of pH paper is placed on the surface and wetted. The surface should be neutral (the same pH as the water used to wet the strip). If the paper turns red, the surface is acidic, and it is contaminated. This condition is more likely to occur in industrial facilities (or to be caused by industrial facilities) than in open environments.

Other methods are available to identify the amount of contaminant on the surface. In one method, a known area is swabbed, and the washings are placed in a beaker. Special indicator papers and meters are used to measure chlorides and conductivity. A test kit to make these measurements is commercially available (Fig. 1).

For water-soluble contaminants such as salt, methods such as pressurized water washing, steam cleaning (Fig. 3), detergent cleaning, or emulsion cleaning are most effective.

**Hydrocarbons**

Surfaces can be contaminated with oil and grease that are not visible and thus not noticed when the surface is examined in accordance with SSPC-SP 5, 6, 7, or 10. The 2 most important sources of hydrocarbons found on coating operations are the oils on the hands of the applicator, helper, or inspector on the project site and the oils used to lubricate the compressor or power tools.

Oils from workers’ hands can contaminate the substrate any time workers touch the surface with their bare hands. Lubricating oils can be transmitted to the surface through airlines during blasting operations, power tool cleaning, or blowdown. Another source of hydrocarbon contamination is diesel exhaust. Deposits from compressors or vehicles driving...
under the structure are possible. If the primed surface is allowed to sit for a length of time before the next coat is applied, diesel exhaust can be deposited and cause delamination between coating layers.

If any of these oils remain and the protective coating is applied, a number of defects can affect the coating and once again allow the environment to attack the substrate that the coating was designed to protect.

### Detecting and Removing Non-Visible Hydrocarbons

A simple test to detect the presence of non-visible hydrocarbons on the surface prior to applying the protective coating is to place a drop of water on a horizontal piece. If the drop remains in a ball as it would on a newly waxed car, there is oil on the surface.

Another method to use is ultraviolet light or black light (Fig. 4). The ultraviolet light will not allow the proper detection of hydrocarbons if the substrate is exposed to daylight or artificial lighting. Therefore, a hood made of black cloth has to be used with the black light to shield the surface if it is being inspected during daylight, or the surface could be inspected at night. However, to inspect at night would most likely not allow the application of the coating after acceptance of the surface. Therefore, the black hood is the best method to properly inspect the surface prior to coating.

The presence of hydrocarbons will be indicated by bright yellow or lime green lights on the surface. If a fingerprint is present, ultraviolet light will outline the print. If a small spot of oil was deposited by contaminated air, the area will be indicated by a bright light on the surface.

The ultraviolet light will also give false indications the same way that it detects hydrocarbons. For example, under a black light, lint from a rag or clothing will produce non-relevant indications that resemble the black light’s indications of hydrocarbons.

It is important to be very sure that indications of hydrocarbons are valid before actually rejecting the surface for coating. Also be aware that some synthetic oils will not show up under a black light.

To remove the hydrocarbons, apply a solvent wash on the areas that were judged to have hydrocarbons present. Follow the latest edition of SSPC-SP 1, Solvent Cleaning. It is most important that the solvent be compatible with the designed coating system. Therefore, verify the solvent to be used with the proper authority, such as the coating manufacturer, and then document all activities and conversations in the daily reports.

Use the ultraviolet light to re-examine the areas that were rejected to be assured that the surface is clean.

### Dust

Dust is found on every surface during a coating operation. The reason is simple. During an abrasive blasting operation, the abrasive is forced out of the nozzle at the designed pressure, and when it impacts the surface, it breaks up into many pieces. Some pieces are large enough to be seen on the ground or floor around the project site. Other pieces are smaller but can still be seen because they resemble dirt in size. Still others break down to the size of fine dust that is difficult to detect with visual inspection.

The dust then settles on the surface that is to be coated, and, since the dust is not easily detected visually, it remains on the surface during the application of the coating. A portion of the paint is applied on the dust and not the surface. Since there is no adhesion of the dust to the surface, the integrity of the coating system is lessened. The amount of coating sticking to the surface compared to the amount of coating sticking to the dust will determine the adhesion.

### Methods of Detecting and Removing Dust

To detect the presence of dust and other air-borne contaminants on the surface, wipe the surface with a clean rag. If the rag is visibly dirty, the surface is too contaminated. Another method is to take several strips of clear tape and press them to the surface to be coated. Then remove the tape and perform a visual inspection of the sticky side of the tape to determine if any fine particulates are attached to the sticky side of the tape. If an excessive amount is found, then the surface is contaminated. It is almost impossible to remove all dust and dirt from a blast-cleaned surface, so some judgment is needed when using the tape test.

Dust contamination can occur at any time, not just when applying the primer to the substrate. Painting over a primer contaminated with dust can cause the coating to peel at a later date. So check each surface before it is coated.

To remove the dust found on the surface to be coated, you can use the air supplied by the air compressor employed during the blast operation. If you are not careful, the process of removing dust can also deposit contaminants.

It is very important to assure that the compressed air has remained clean and does not have moisture or oil in it that will be deposited on the surface. You can check the air by performing a white rag cleanliness test. Take a white rag and hold it in front of the air stream. If you are using the blast nozzle, make sure that the blast medium valve is turned off. Turn
the air on, and allow it to blow on the white rag for at least a full minute. Turn the air off, and inspect the rag. If the rag is clean, then the air system is free of impurities. If moisture or oil is present, either black dots or wet spots will be present. Clean the traps and separators, and perform the test again until there are no indications of moisture or oil on the rag.

After the air is clean, blow down the surface to be coated and perform the tape test again. If contaminants are still present, continue to blow the surface clean until there are no more indications on the pieces of tape.

The tape should then be affixed to the daily reports for a permanent record of the cleanliness of the surface prior to the application of the coating.

Conclusion
This ATB has been an introduction to the subject of detecting and removing invisible contaminants on the job.

A great deal of research has been conducted on the subject, including a major study just completed by SSPC. If you want to learn more about invisible contaminants, you can start by reading the following JPCL articles.

- “Blistering in Immersion Service,” July 1987, pp. 13-14
- “Painting Over Soluble Salts: A Perspective,” by Bernard R. Appleman, October 1987, pp. 68-82
- “Non-Visible Contaminants in Railcar Interiors: Their Significance and Removal,” by Wallace P. Cathcart, December 1987, pp. 6-10
- “Corrosion Failure from Water-Soluble Contaminants on Abrasives,” by William C. Johnson, September 1990, pp. 54-59
- “Performance Characteristics of Copper and Coal Slag Abrasives,” by John Peart and Benjamin Fultz, September 1990, pp. 21-27 ATB