Technical Information Bulletin (TIB):

Minimizing, Identifying, and Remediating Amine Blush

GENERAL OVERVIEW

Blush is a phenomenon feared when over-coating epoxy materials. It can cause imperfections in the coating surface, faster yellowing, compromised cleanability, decreased stain resistance, lower gloss retention, compromised re-coatability, and a number of other concerns, with re-coatability being among the weightiest of installation concerns. While well designed and manufactured epoxy coatings can be more resistant to blush, some formulations are, by their nature, more subject to blush. But even a well designed epoxy coating can blush if conditions are favorable (or unfavorable, depending on your perspective).

This TIB is intended to communicate a basic understanding of blush on epoxy coatings so you can have the knowledge required to minimize, identify, and remediate blush on epoxy coatings and linings. It contains valuable information and concepts that will be helpful in most situations. Use these concepts along with your experience, common sense, and caution to minimize problems when applying or over-coating epoxy materials.

ADDITIONAL RESOURCES

Wolverine Coatings Corporation (WCC) has developed this bulletin along with other technical information to help all interested parties, from specifiers to applicators to owners, have a better understanding of the considerations, materials, and techniques required for proper installation. Consult all relevant information before using WCC materials.

WCC Technical Information Bulletins
TIB: Over-Coating Existing Materials

WCC Technical Detail Drawings
TDD: N/A

WCC Technical Data Sheets
TDS: N/A

WCC Safety Data Sheets
SDS: N/A

SAFETY

Prior to commencing work, carefully read and follow all SDS (formerly MSDS), Technical Data Sheets, and any Instruction Manuals for products and equipment used during installation. Following the safety regulations of jobsite, local, state, and federal authorities is the responsibility of the installation company, general contractor, and/or facility owner.

DISCLAIMER

This Document does not purport to address all applicability and safety concerns, if any, associated with its use. It is the responsibility of the user to determine applicability of the information and to establish appropriate safety practices.

WHAT IS BLUSH?

For the purposes of this TIB, the term blush will be used to describe multiple surface phenomena, including blush, bloom, sweating, water spotting, etc. While prevention, identification, and remediation techniques are similar, these phenomena are different.

Blush is caused when an amine hardener, present in most mixed epoxy coatings, reacts with moisture and carbon dioxide to form undesired materials at the surface of the coating. The products of this reaction result in blush. Note: This is a very simplified definition of a very complex phenomenon, but adequate for the applicator of industrial epoxy coatings whose main concern is getting expected performance from the coatings they install. For a more detailed discussion of the mechanics and chemistry involved, refer to 'The Chemistry of Blush' at the end of this TIB.

Basic knowledge of some key concepts about blush will go a long way in minimizing, identifying, and reducing its occurrence. Understanding these points is critical to addressing problems associated with blush.

- Any coating containing amine is subject to blush to some degree.
- Moisture must be present, whether on the surface, within the coating, or from the air.
- Carbon dioxide must be present, whether on the surface, within the coating, or from the air.
- Reduction of the presence of any of these reactants will reduce the likelihood and/or severity of blush.
- The severity of blush varies greatly from micro-blush (not readily noticeable) to greasy, oily, yellowish or whitish material over the entire surface.
- The products of blush are present at the surface and act as contaminants, affecting many performance characteristics; drastically in some cases.
- Typically blush is material remaining on a coating's surface that can normally be removed by cleaning. The surface integrity and/or aesthetics of the cleaned coating may or may not be affected by blush. There may be a permanent shade difference, varying surface texture, and/or other degradation that cannot be adequately repaired without recoating.

HOW TO MINIMIZE BLUSH

The best way to minimize blush is to control exposure of highly reactive amine to moisture and carbon dioxide. There are many considerations to minimize these.

MINIMIZE AMINE: Since amine is present in most ambient temperature cured epoxies available, taking amine out of the equation is unlikely with today's prevailing technology. But amine curing agents exist which are less likely to blush. Also, proper formulation and manufacturing techniques can greatly reduce the occurrence of blush. But be aware, a coating containing amine may be resistant to blush, it is not 'blush-proof.'

TEMPERATURE: It is critical to understand how temperature affects the occurrence of blush by affecting the speed of reaction, and possibly, the material's exposure to moisture.

It stands to reason that if an epoxy cures at a slower rate because its temperature is lower, there is more time for amine in the material in its liquid state to migrate to the surface and undergo alternative reactions with moisture and carbon dioxide in the air. Therefore, applying a coating in low temperature increases the likelihood of blush because of longer amine exposure.

Lower temperature also increases the likelihood of condensation of moist air. If the substrate, coating, or air temperature is hovering around the dew point, any drop in temperature due to changing conditions during application and cure, may result in a source of moisture due to condensation.

It may seem that a good way to minimize this concern is to simply use faster curing materials. This may or may not work. Some fast curing epoxies happen to be blush-prone. Consult the TDS of the specific product for guidance.

Blowing warmer air into the area is another way to minimize blush. But air movement over the curing coating's surface may cause other problems such as contamination with debris. Care should be exercised when using a fuel burning heater such as a salamander or torpedo heater. This method will heat the area, but it will also introduce moisture and carbon dioxide into the area, possibly increasing the likelihood of blush. A very effective method for reducing moisture and lowering dew point, is using dehumidification equipment.

MINIMIZE MOISTURE: Moisture in the air comes into contact with amine in the presence of carbon dioxide to form blush. Since there is water vapor in all but the most controlled environments, an epoxy coating's surface will come into contact with moisture in the air. It stands to reason that higher humidity in the air has more available moisture for reaction. But, water vapor in the air is normally not the culprit when blush occurs. Typically the problem is condensation from the higher dew point of humd air.

Water in its liquid phase has a far greater impact. A wet substrate is an obvious source of moisture, but a more covert source is from condensation. Substrates and materials with low temperature are subject to condensation if their temperature is hovering at the dew point of the surrounding air. Therefore, it is good practice to apply an epoxy coating when the temperature of the substrate, as well as the coating itself, is more than 5 degrees F above the dew point of the air. Since temperature and dew point typically change during installation and cure, care must be taken to ensure proper conditions throughout the process. Also, in the case of coating large areas, conditions may vary wildly throughout the area, possibly resulting in random blush.

As mentioned in the 'Temperature' section, moisture and carbon dioxide are the primary products of reaction when burning fossil fuels. So engines and burners in an area can drive up the concentration of two components of the blush reaction unless the area is well ventilated. Therefore be very careful when heating an area with a burner or using engines.

MINIMIZE CARBON DIOXIDE: Carbon dioxide is normally in low concentration in well ventilated areas. But, carbon dioxide producing processes, and even a crowd of people breathing in a stagnant area can drive up the concentration. Ensure proper ventilation while avoiding high air movement at the coating's surface.

Refer to the warning on the use of internal combustion engines and burners back in the 'Moisture' section.

HOW TO IDENTIFY BLUSH

When blush can be easily identified, it typically presents itself as lower surface gloss, oily or greasy film, haziness, and/or a slight yellowish or whitish tint. Since the surface is slightly tacky or greasy, it can easily stain with dirt and other contaminants, giving further indication of blush. It can also manifest itself in white patches which may or may not be imbedded in the coating's surface.

The more troublesome aspect of blush is that it may not be evident. An argument could be made that any coating containing amine, may blush to a degree, but to what degree will its blush cause problems? Imagine walking onto a large area of floor coated with an amine cured primer, preparing to install $200,000 worth of top coat, and wondering if it is going to peel like an onion because of blush. A quick glance and a touch shouldn't make you rest easy.

Not only is blush sometimes not evident, blush can also be a highly localized phenomenon because of uneven ventilation and/or many other factors. One area may be perfectly fine, while not ten feet away, a bond-inhibiting blush has occurred that will cause certain delamination of successive coats. Carefully survey the entire area to be coated before installation of a top coat.

Fortunately there are field tests that aid in quantifying blush. These tests give an indication of the amount of blush (carbamates) on a surface in relation to that of a clean sample. While not a go/no-go test, they will help you determine the amount of contamination on a surface. A quick search on the internet will give you plenty of options and information. There are also blush tests which measure pH as an indicator of blush. Avoid these tests in favor of one which measures carbamates because a ph test may yield a false negative or a false positive.

HOW TO REMEDIATE BLUSH

It should be obvious that remediating blush involves physically removing blush from the surface. Since blush is often oily or waxy, cleaning the surface with a degreaser is typically a good first step. For more stubborn blush, use of an abrasive scrubbing pad on a floor machine or auto scrubber is great for a floor, while a scouring pad may be used for vertical and uneven surfaces. Always thoroughly rinse the area to remove all cleaner residue.

Whether the coating will receive a subsequent coating or not will play a critical role in choosing remediation methods. If the material will be over-coated, more aggressive methods may be employed for thorough cleaning and preparation to obtain the desired bonding surface. If the coating is not to receive a subsequent coating, great care must be taken when removing blush to avoid damaging the texture, shine, or color of the coatings surface.

For a blush affecting the coating surface texture or color, more aggressive grinding and sanding may be necessary before recoating. First remove blush from the surface with a degreaser and scrubbing pads. Then sand the area until the surface imperfection is removed. Consult WCC TIB: Over-Coating Existing Coatings for more information on further preparation and methods.

THE CHEMISTRY OF BLUSH

While this TIB lumps numerous phenomena under the term 'blush', there are two main surface defects that will be discussed in more depth here: blush and bloom. Both typically occur when there is moisture on the substrate, within the coating itself, and/or on the surface. The predominant reason for the existence of this moisture is condensation from high humidity air contacting a cool surface, but can occur because of moisture trapped in the substrate or from some other source.

Bloom, or leaching, occurs when moisture causes water soluble coating components to migrate to the surface. When the moisture evaporates or is used up in the blush reaction, the coating is left with the water soluble components on the surface. This can cause surface texture irregularities as well as color differences. If the surface is to receive subsequent coatings, the components of bloom can act as bond breakers, leading to coating failure.

Blush is a chemical reaction between water, carbon dioxide, and the amine present in most ambient temperature cured epoxy coatings. While the reactants and products of reaction may vary, amines typically attract moisture (hygroscopic) and react with available moisture and carbon dioxide to form ammonium carbamate, salts of ammonium (bi) carbonate, and/or hydrates of amine carbonate. If the surface is to receive subsequent coatings, the products of blush can act as bond breakers, leading to coating failure.

TIB: Minimizing, Identifying, and Remediating Amine Blush on Epoxy Coatings Guide - Rev 191219

SAFETY

For your safety, all required personal protection equipment should be used when operating machinery or handling chemicals. Concrete dust is a source of silica particles and other hazardous materials that can cause silicosis and other illnesses. Proper safety equipment and methods are the responsibility of the installation company, general contractor, and/or facility owner.

WARRANTY

Wolverine Coatings Corporation warrants its products to be free from defects in material and workmanship. Wolverine Coatings Corporation's sole obligation and Buyer's exclusive remedy in connection with the products shall be limited, at Wolverine Coatings option, to either replacement of products not conforming to this Warranty or credit to the Buyer's account in the invoiced amount of the nonconforming products. Any claim under this warranty must be made by the Buyer to Wolverine Coatings in writing within five (5) days of Buyer's discovery of the claimed defect, but in no event later than the expiration of the applicable shelf life, or one year from the ship date, whichever is earlier. Buyer's failure to notify Wolverine Coatings of such nonconformance as required herein shall bar Buyer from recovery under this warranty.

Wolverine Coatings makes no other warranties about the product. No other warranties, whether expressed, implied, or statutory, such as warranties of merchantability or fitness for a particular purpose, shall apply.

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LITERATURE REVISION

Published literature is subject to change without notice. Wolverine Coatings Corporation is constantly formulating innovative products, new technologies, and practices. Please check www.wolverinecoatings.com for the latest product data sheets.

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