Tech Tip 28

# Amine Blush

Ambient cured epoxy sometimes appears sticky, tacky, and less glassy and smooth on the surface, when compared to oven cured samples. The cause is most likely due to a side chemical reaction of moisture (humidity) in the air, interacting with a curing agent. This phenomenon is known to epoxy chemists as "amine blush" or "amine bloom".

**What >** Amine Blush with Epoxies

**Why >** Amine blush can be avoided with appropriate precautions.

## What is Amine Blush?

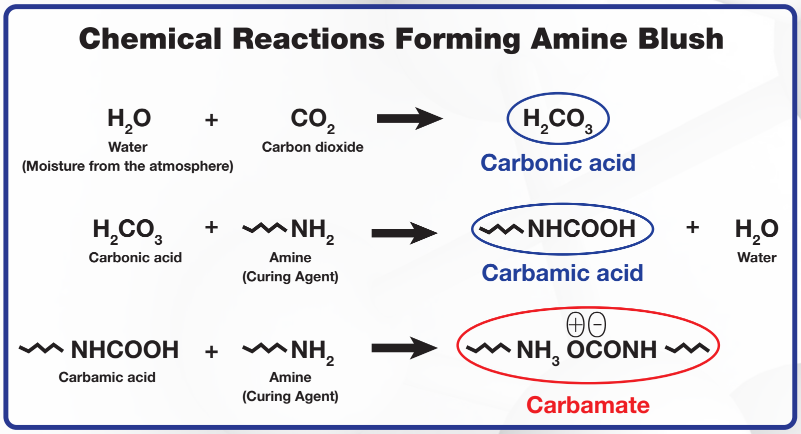
Amine blush can be described as a sticky, oily, or waxy appearance on the surface layer of a cured epoxy. It can appear as greasy white spotting, or even salt-like, crystalline deposits. Many times, it can also be cloudy, milky or gray colored, with opacity and dullness.

## What are the differences between blush and bloom?

Amine blush and bloom generally yield the same unwanted cured appearance, but differ in their chemical mechanism. Where **blush** refers to moisture condensing on the surface of the epoxy, **bloom** or leaching is essentially the converse reaction where water-soluble compounds migrate, or "leach" to the surface, resulting in sticky deposits or patches, like water marks in the sand.

## Why does Amine Blush occur?

Amine cure agents being hygroscopic (absorbing moisture), can react with moisture in the air to form ammonium carbamate by-products.




Amines with a longer pot-life are more prone to amine blush/bloom, since they are much slower to form oligomers during the gel stage. This then allows more time to negatively interact with humidity, instead of the epoxide groups.

## Where can Amine Blush be seen?

Ambient or room-temp curing applications are very common in molding medical implants, medical device coatings, white reflector paint coatings in X-ray scintillator crystals, LED array potting, and large scale PCB encapsulation. All of these applications can be prone to amine blush, when using ambient curing.

EPOXY TECHNOLOGY

## Common EPO-TEK® Ambient (Room Temperature) Curing Products

| Product | Viscosity (cPs) | Pot life (hrs) | Maximum Mass | Application/Comments |
|---|---|---|---|---|
| 301* | 150 | 1.5 | <25 grams | Molding headers of implantable microelectronic packages like pacemakers, ICDs and cochlear implants. Epoxy paint for scintillator, X-Ray detection. ISO 10993 biocompatible |
| 301-1 | 90 | 1.5 | <25 grams | Lower viscosity version of EPO-TEK 301 |
| 301-2 | 325 | 8 | <1 kg | Potting LVAD, molding various implantable header packages, opto-coupler in photodetector arrays. ISO 10993 biocompatible |
| 301-2FL | 150 | 10 | <1 kg | Large scale LED array potting. USP Class VI compliant |
| 310M-1 | 315 | 2.0 | <25 grams | Compliant, flexible epoxy for bonding and potting. USP Class VI compliant |
| 320 | 1050 | 1 | <25 grams | Black, opaque, USP Class VI compliant for medical devices, used in electro-optics such as NIR shielding, IR detection and camera/video |

****EPO-TEK 301 has a short pot life and forms a gel much faster than EPO-TEK 301-2, thus less likely to blush or bloom.***

## How to Avoid Blush/Bloom?

Here are several ways to overcome this issue, essentially by "starving" the curing process of moisture.

1. *Avoid ambient and open benchtop curing processes.* Curing at 23°C inside an oven is better than curing at 23°C in a lab.
2. *Cure using a "closed system" technique.* Similar to #1, sealing your parts off from ambient humidity, in a box oven, a fume hood, desiccator, a nitrogen dry box or glass bell jar is suggested.
3. *Avoid fluctuations in ambient temps and humidity, due to monthly or seasonal changes.* Curing at 28°C, is better than curing at 25°C; curing at 23°C is better than 21°C.
4. *Always cure at a temperature above the dew point.* When temperatures are below, or close to the dew point, condensation occurs and blush will be more frequent. By curing a few degrees above the dew point, you can avoid sticky cures and an unsightly appearance. A common practice is to go up at least +3°C above the dew point. If this is not possible, fans and heater lamps can be used to prevent moisture interactions upon the epoxy surface.
5. *Pay attention to small mass curing; less then one gram.* Expecting mg or ug amounts of epoxy to be cured properly in your parts is risky, under an ambient cure, since their exothermic nature is reduced. Mixing more mass than needed for your parts is recommended.
6. *"Fuel" the reaction.* "Fueling the exotherm" is a mass favored chemical reaction like gelling and curing. In this step, amine-epoxide reactions are forming favorably, instead of amine-moisture unwanted interactions. Allow the mixed epoxy to sit in one container, advancing towards its gel stage. "Staging" the epoxy, is another term used to express this. As a general rule, the shorter the pot-life, the quicker the gel stage, and thus the faster the time to fuel the exotherm.
7. *Extra potting thickness.* In most cases, the epoxy layer in contact with ambient conditions is problematic, whereas the same epoxy is fine at deeper sections, especially towards the bottom of the potting container or mold. One trick is to over-pot, over-mold or over-encapsulate the specimens. In other words, if a potting thickness of 10mm is required, some processes will use a 12mm mold, where the extra 2mm are removed by mechanical means, such as dicing, cutting, lapping or milling.

## Conclusion

When using room temperature curing epoxies, extra precautions regarding humidity should be taken into consideration to avoid amine blush or bloom.

**For other useful tips, contact our Tech Service Group:**
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