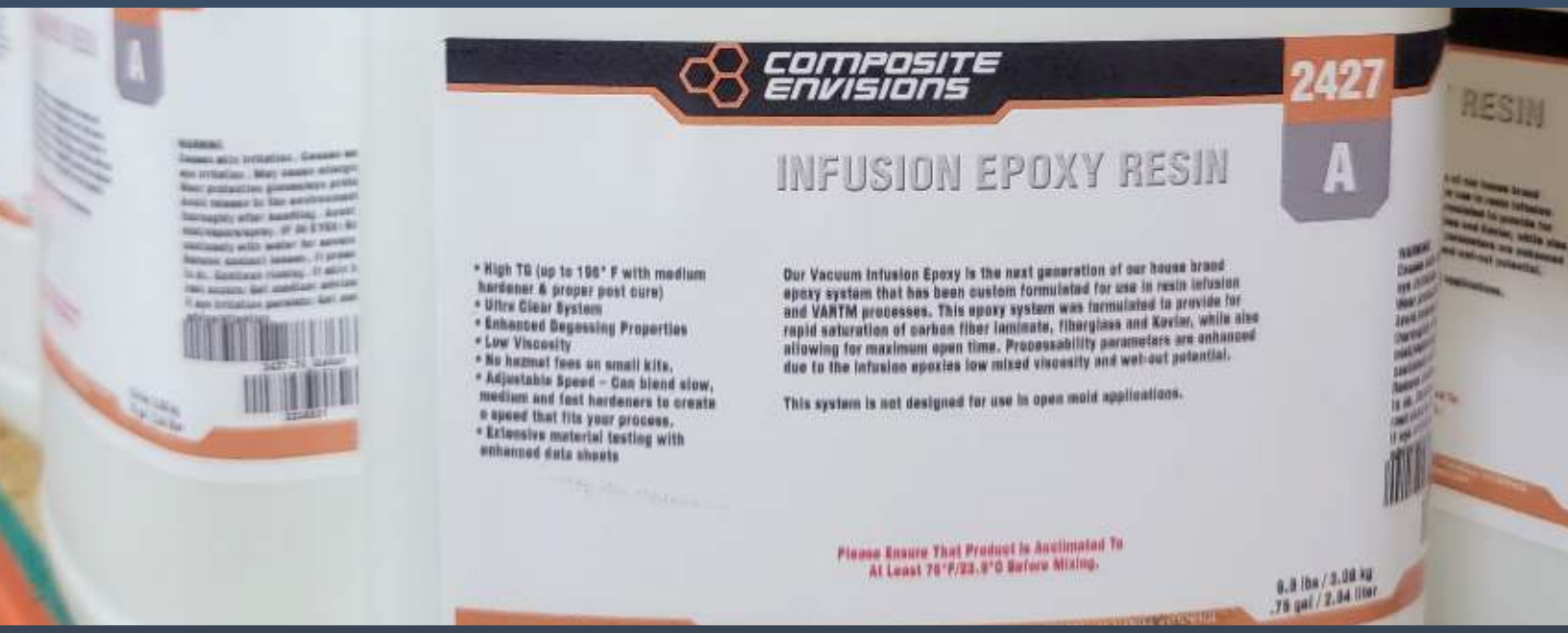
COMPOSITE ENVISIONS KNOWLEDGE HUB
PRACTICAL AND INSIGHTFUL COMPOSITES INFORMATION



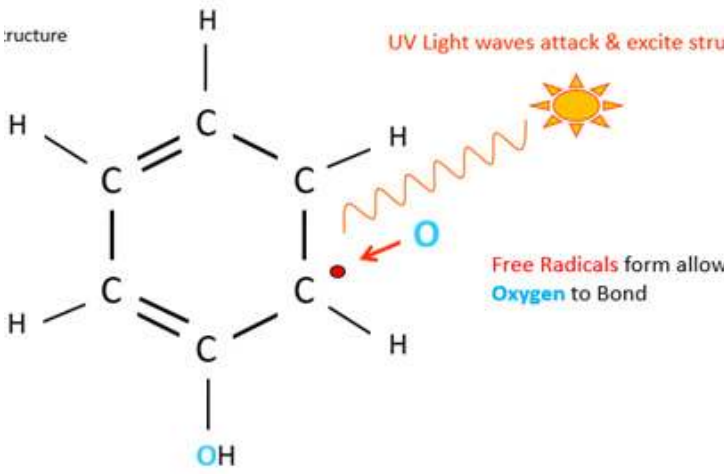
YELLOWING OR CLOUDING OF EPOXY & HOW TO PROTECT AGAINST IT

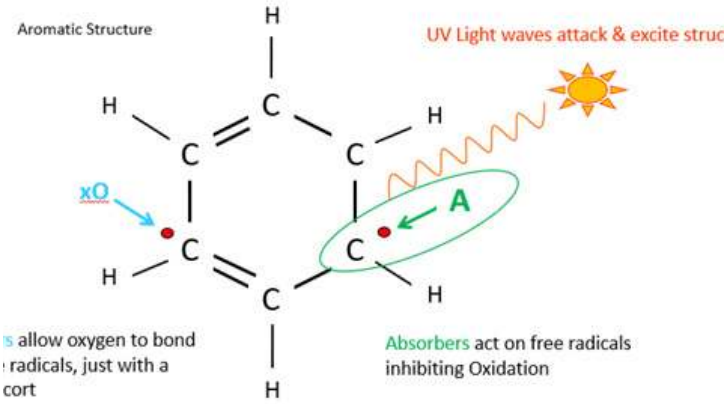
COMPOSITE ENVISIONS

YELLOWING OR CLOUDING OF EPOXY

INTRODUCTION

Epoxies are known for being some of the strongest and most durable resins on the market today. However, one of its main disadvantages lies in the fact that it can degrade when exposed to outdoor environments. This degradation leads to a discoloration reflected by the epoxy “yellowing”. Yellowing is a sign for a loss in mechanical properties and overall performance. Understanding why this degradation happens can help ensure the proper measures of protecting an epoxy are taken and consideration can be taken in selection of various products used.



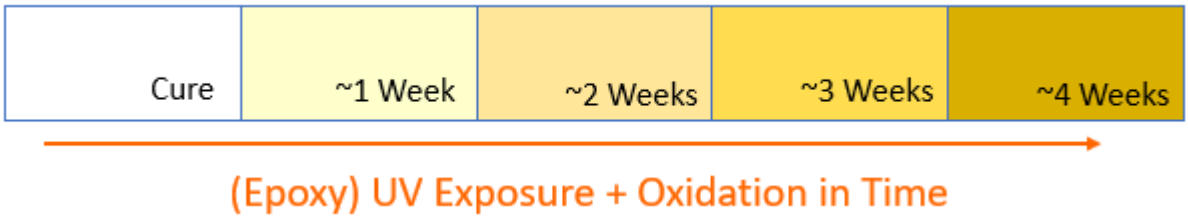


EPOXY: UV EXPOSURE & OXIDATION

Inherently all untreated epoxy resins yellow when exposed to UV light energy from the sun. Epoxy’s aromatic chemical structure is one reason why epoxies perform well mechanically. However, when epoxy is exposed to UV rays, its chemical structure is jarred, and free radicals are formed. These free radicals are quick to bond with oxygen which is (obviously) plentiful on earth. The consequential oxidation of the epoxy leads to resin yellowing. How much yellowing and how fast the onset is dependent on several different factors. How much time the resin is exposed to UV light, the chemical formulation of the resin, how well the epoxy is mixed, applied, and cured are all factors that go into how quickly an epoxy resin will yellow or haze in an outdoor environment. Some resins may take only a few days of direct UV exposure to start turning a clear resin to an oxidized yellow while others may take months to notice. It is an effect that oxidizes and degrades more and more over time. As the epoxy keeps going unprotected from UV light and Oxygen, the further it is irreversibly attacked by the conditions until a composite or resin is rendered useless.

It is important to note that all epoxies variate in UV & Oxidation degradation. Some epoxies are made formulated with UV additives in their chemical formulation while many are not

formulated with any.



1+1= 2^2 COMBATTING UV EXPOSURE: ABSORBERS & STABILIZERS

Slowing degradation from UV exposure can be done with UV absorbers and stabilizers. When added to an epoxy mixture or product, additives work by controlling free radicals from the UV light instead of allowing them to be oxidized. Ultra-Violet Absorbers (UVAs) work to extend the effective life of the epoxy by absorbing free radicals, leaving the chemical structure intact. UVAs effectiveness is limited by how much absorbent that can be placed into the epoxy mixture. Eventually, the epoxy may yellow once all “absorbers” within the resin have been used on the free radicals, however this generally takes a much longer time. Stabilizers (HALs) are placed into epoxy resins, sometimes alongside absorbers, and work by combining with oxygen to provide stability within the epoxy structure instead of degrading it. Stabilizers offer a more long-term solution to UV degradation and yellowing. Products such Ecopoxy’s UVPoxy use this chemistry to provide protection and a lasting clear shine to sunlight exposed parts.

POLYESTER & VINYLESTER DEGRADATION

Polyester and Vinylester resins are highly susceptible to water damage. Water causes these resins to blister and crack and then lose their mechanical properties. So, one may ask, how in the world is the industry leading resin used in boats not even waterproof? The answer lies in Gelcoats & Marine Topcoats. These are applied to a part’s surface to protect it from exposure. Gelcoats & Topcoats make polyester resin highly water & UV resistant. It should be noted that even boats are not totally always waterproof as they may be susceptible to water intrusion from the inside if a marine topcoat is not used. Gelcoats are generally part of the first coatings of a part made with polyester resin, the fiberglass and polyester resin matrix are then applied. Once cured, Marine Topcoats are applied to polyester resins, providing water proofing and chemical protection against degradation.

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THERMAL DEGRADATION

It is important to always mix all resins according to the manufacturer's instructions. Failure to properly mix and apply resins can cause excess heat to be placed onto a resin during its cure. Once mixed properly, a resin can still build up excess heat when applied too thick in an area. This is less common in laminating procedures but more on casting resins or deep-set resins and will cause a hazing or yellowing effect on the cured piece. Proper ratios of resin to hardener, effective mixing, and proper thickness applications will ensure resins do not undergo excess thermal exposure during cure.

TOP COATING (CLEAR COATING)

Polyurethane or Polyester Marine top coatings work by protecting it from oxidation and UV degradation, effectively blocking it. Depending on the application or design, top coating or varnish can be applied on top of the cured epoxy, polyester or laminate part. Top coatings and clear coats have great UV resistance and can be applied over epoxy, polyester, and vinylester surfaces. Top coating applications often give resins a shine like no other and a high degree of protection to go along with it. Top coating is much the same process as "clear coating" parts, it can be applied by spray or by brush. Commonly best results are achieved by using a "2K" or 2-part urethane clear coat or varnish on carbon fiber parts, 1 part urethane will not yield as effective as "2K" products in UV protection or quality. In addition, products such as Duratec's Sunshield, a polyester base, provide protection from UV and chemical degradation without the use of additional urethane protection layers. In addition to its effectiveness to polyester parts, Sunshield will adhere to properly prepped epoxy surfaces.

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