

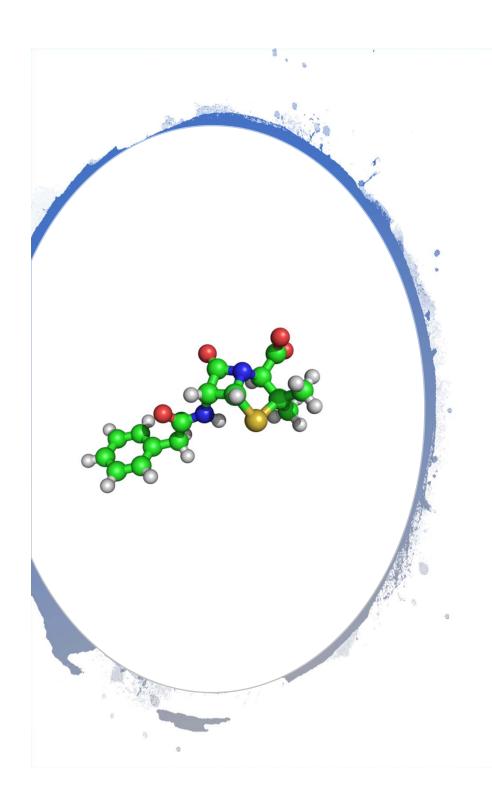
- 40 Years at Sherwin-Williams
- Member of AWWA, NACE, SSPC, ICRI, ASTM
- NACE Certified Coating Inspector / Marine Endorsement
- SSPC Certified Concrete Coating Inspector & Course Instructor
- John D Keane Award of Merit



 The use of glass flake creates a barrier to be formed due to its morphology of being a lamellar platelet, decreasing the risk of contamination of moisture and gas diffusion by creating an extensive permeation path length compared to other coatings, making it a tortuous path through the coating



- Developed in United States in 1959
- Used to reinforce roof light panels made from polyester resin
- Roof panels distorted when exposed to UV
- Need to improve modulus and dimensional stability; therefore research began by investigating its use in organic coatings in 1960s
- Wasn't until the 1980s it became accepted as their performance and the benefits of long life and hence low whole life-cycle cost became apparent



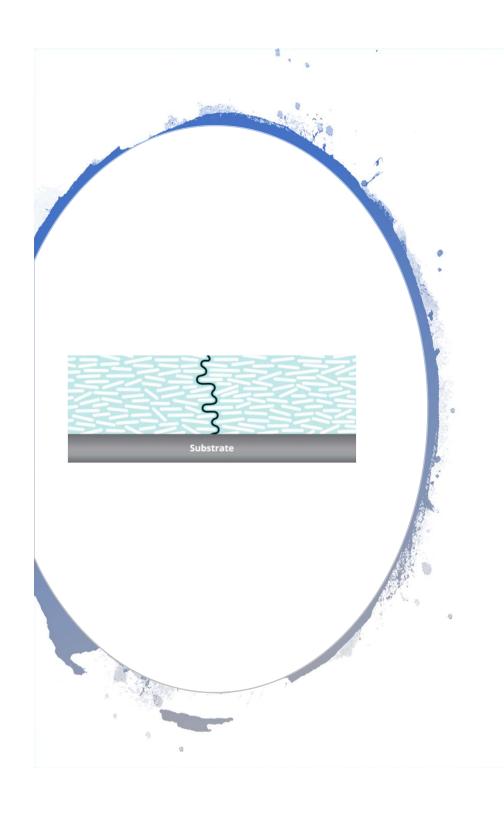
Organic Coatings

- Contain carbon
- Convey moisture vapor allowing gas diffusion
 - If not prevented, it can lead to premature corrosion
 - Glass flake aids in prevention



Platelet form

- Overlap each other, extending path length for diffusion
- Presents a barrier of the passage of moisture and gas diffusion
- Particles of a granular or spherical nature do not overlap and offer only limited resistance to moisture and gas diffusion



Glass flakeprevention of corrosion

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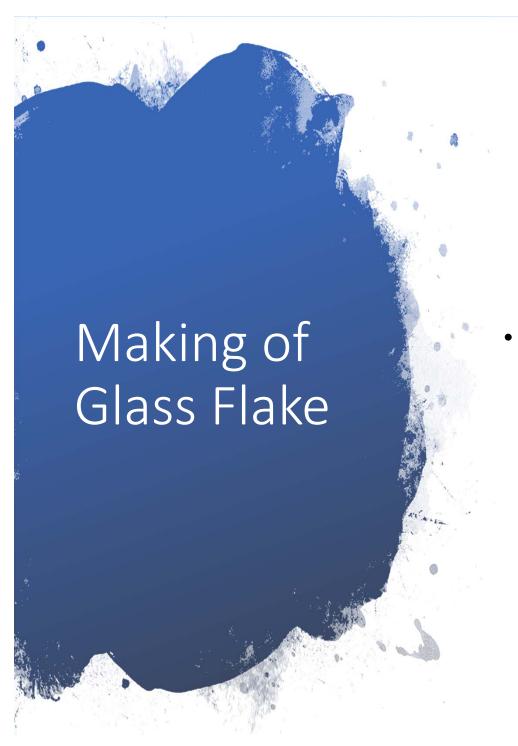


Glass flake

- Do not oxidize
- Impervious to moisture vapor
- Are synthetic
 - Consistent in composition and color
 - Plate like in formation
 - Clear
 - Manufactured from "C" glass



- Offers high levels of chemical resistance
- Inert
- Good mechanical properties
- Non-hazardous
 - Simple mechanical dust hazards



- 2 manufacturing techniques
 - Bubble method
 - Spun method



Bubble Method

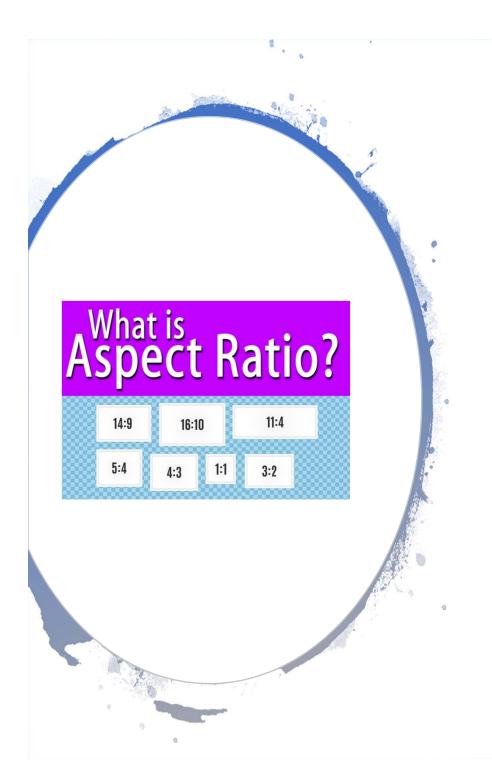
- Cost effective
 - High throughput production
 - Produced from pre-melted glass marbles
 - Technique can result in curved flake



- Tighter product control
- Thickness deviation of +/- 1 micron
- No curved flake
- Drawback is cost; 30% higher
- Can create flake thinner; as low as 100nm with deviation of +/-25nm



- Polyesters
- Epoxies
- Chlorinated-rubbers
- Alkyds
- Coal Tars
- Vinyls
- Waterbased Acrylics



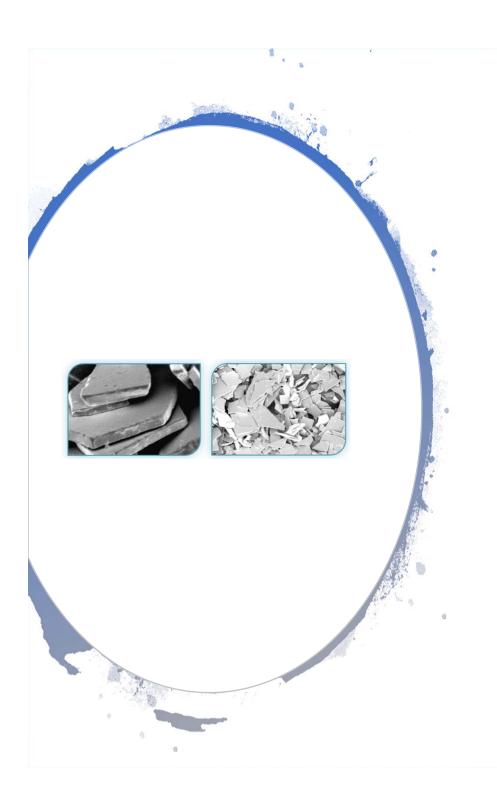
Glass flake aspect ratio

 Generally the higher the aspect ratio the better the barrier presented

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- Out of alignment large aspect ratio flakes can afford a direct path through the film where the film is less in thickness than the nominal diameter of the flake
 - Causing stress raisers for crack propagation
 - Causing decrease in flexibility and elongation to break
 - Produce rough surface finishes



Glass flake thickness

- Once a flake thickness has been chosen it is important to optimize particle size and addition level
- Addition level depends on the type of resin, surfactants, bubble release agent and other pigments or fillers being used



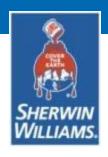
Glass flake adhesion

- Coupling or bonding agents are used to provide better adhesion of the glass flake to the resin and the substrate
 - Silanes
 - Pre-treated flake will often improve the bonding performance to a higher level than that achievable by adding into resin

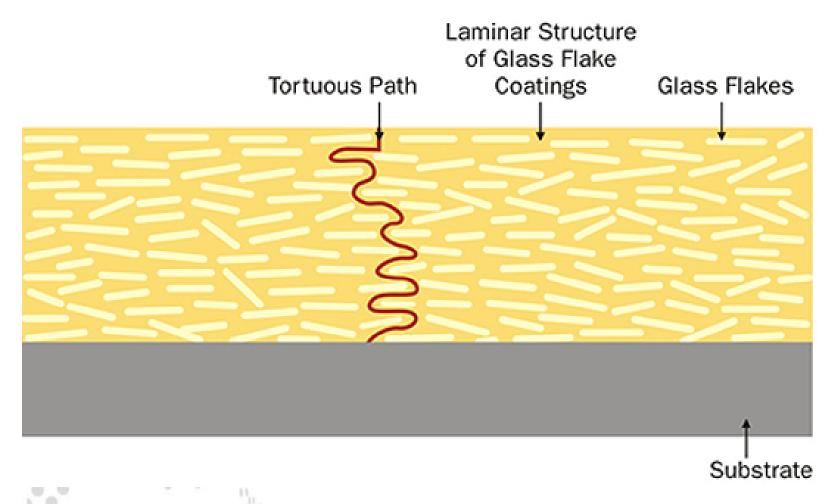


Level of Glass Flake

 The level at which the glass flake should be added, the particle size distribution and ensuring adhesion to the carrier are of paramount importance



Glass flake loading level





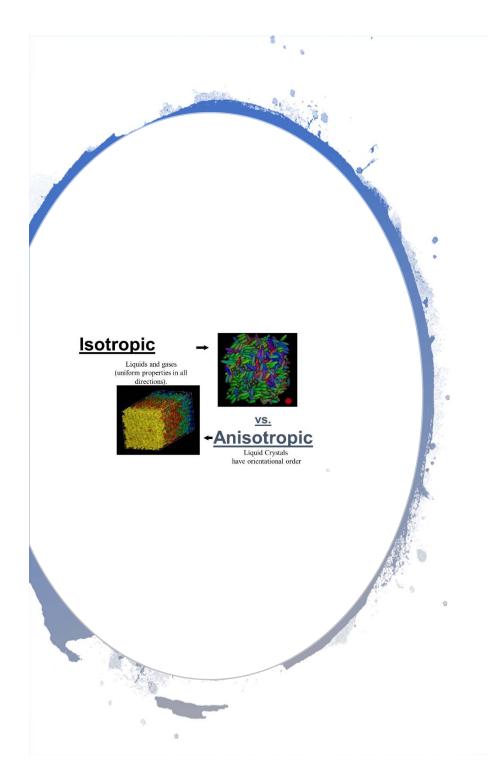
Glass flake- fire resistance

- Reduces smoke emissions
- Improvements in polymerization shrinkage rates, heat distortion and creep



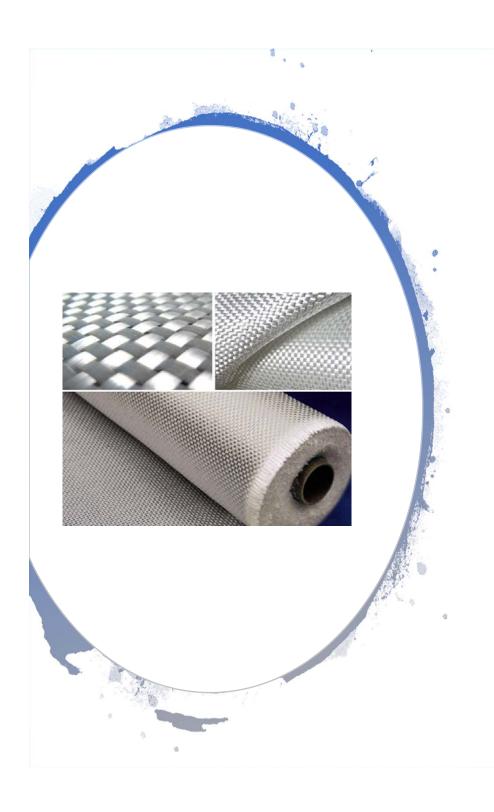
History of Fiber Reinforced Coatings

- Glass wool, which is one product called "fiberglass" today was invented in 1932-1933
- Used as thermal building insulation
- Used as reinforcing agent for many polymer products



What is fiberglass

- Fiberglass is a common type of fiber reinforced plastic using glass fiber
- The fibers may be randomly arranged, flattened into a sheet (called a chopped strand mat), or woven into a fabric
- The plastic matrix may be a thermoset polymer matrix—most often based on thermosetting polymers such as epoxy, polyester resin, or vinyl ester—or a thermoplastic
- Anisotropy property of being directionally dependent

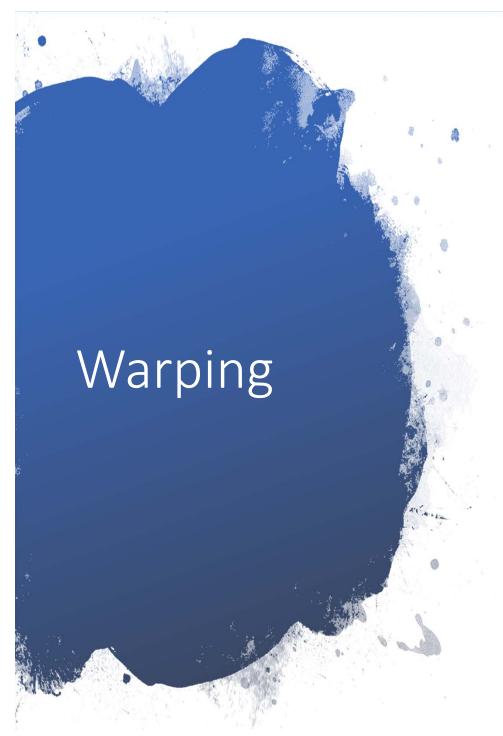


Fiberglass

 The use of glass fibers create a disadvantage, possibly leading to premature corrosion failure, due to their shape



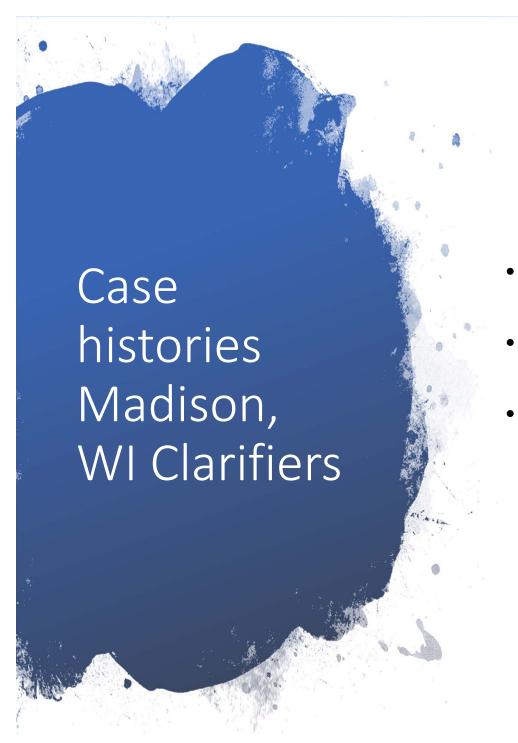
 Glass fibers do not overlap in the way lamellar platelets do; therefore, offering only limited resistance to water and gas diffusion through the coating film



- One notable feature of fiberglass is that the resins used are subject to contraction during the curing process
- For polyester this contraction is often 5–6%; for epoxy, about 2%
- Because the fibers do not contract, this differential can create changes in the shape of the part during curing. Distortions can appear hours, days or weeks after the resin has set.
- While this distortion can be minimized by symmetric use of the fibers in the design, a certain amount of internal stress is created; and if it becomes too great, cracks form

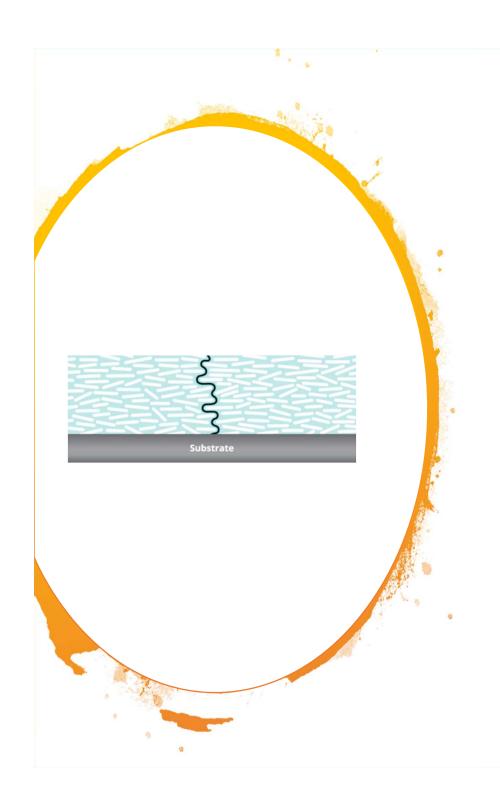


- Built 1984
- Originally Coated with Coal Tar Epoxy
- Desired product with a 25-30 year life span
- Self-Perform Maintenance
- Undertook wide Industry Search



- Determined that GF coating would offer best solution
- Maintenance crew can easily perform application
- Spot repairs were easily done with no special application equipment





Conclusions

 Creates an extensive permeation path length compared to other coatings, making it a tortuous path through the coating.

