

MOISTURE MITIGATION SOLUTIONS FOR FLOORING SYSTEMS USING EVONIK'S EPOXY CURING AGENTS

Moisture related problems with floor coverings and coatings applied over concrete slabs have created significant problems over the years for formulators, specifiers, contractors, and owners in the construction industry. Concrete is one of the most commonly used materials in the construction industry due to its strength, durability, resilience, safety, and low cost. However, concrete is a permeable material and allows moisture contained below the slab, or trapped in the concrete itself, to migrate as a vapor phase to the concrete surface. This moisture transfer phenomenon accounts for many flooring failures with millions of dollars lost annually; and, the construction team from manufacturers, installers and project architects have to bear the liability.

Over the years, there have been various methods that the industry employed to mitigate moisture problems when installing flooring over

concrete in new and existing construction. One of the methods includes the use of vapor retarder films under the concrete to prevent moisture migration from the soil. This approach is only effective, however, in new construction jobs as the film needs to be laid down before the concrete is poured. It also does not address any migration from moisture contained within the concrete itself. Another technique is to use reactive silicates to reduce moisture and soluble alkali transfer to the concrete surface by combining them with hydroxides within the cement paste. When used properly and in the right amounts, reactive silicates can be beneficial to concrete, improving its density and reducing permeability. Nonetheless, if these materials are over-applied, they can be more deleterious to concrete as water soluble cations (K^+ , Li^+ , Na^+) from the silicates can promote salt formation in the top layer of the concrete. This formed layer can cause osmotic pressure to



occur which could potentially lead to blistering or disbondment of the surface coating or floor covering.

The most common means to address flooring failures due to moisture vapor is to apply moisture mitigation coatings on the surface of the concrete slab. A moisture mitigating coating can be a very effective solution to address moisture vapor originating from either the ground soil or concrete itself as water is one of its ingredients. Applicators can use this method for

both existing and new construction jobs since it is the final step before applying the floor covering, such as tile, wood, carpet, laminate etc. or a seamless flooring system consisting of multiple coating layers such as broadcast floors, Terrazzo, etc.

There are two types of moisture mitigation coatings; (1) moisture vapor permeable or “breathable” (MVP) and (2) moisture vapor blocking or barrier coatings (MVB). A MVP coating system is typically preferred where

there is a significant possibility of osmosis to occur due to high alkaline salts and moisture presence in the concrete. As the osmotic pressure is considered to be more severe, compared to other moisture transmittance mechanisms such as hydrostatic and capillary pressure, a moisture breathable system could be the best choice assuming that the top layer is also breathable. A MVB prevents a moisture vapor from migrating to the surface of the concrete slab due to hydrostatic pressure or capillary flow and is preferred when a non-permeable floor covering or seamless coating is applied on top of the moisture mitigating layer. If no MVB is applied, over time even a small amount of moisture collected under the non-permeable floor covering can lead to adhesive failures between concrete and a top floor coating or covering. The moisture vapor transmission difference between moisture vapor permeable coating systems such as Anquamine® 701 and moisture vapor barrier system such as Ancamine® 2800 is shown in Figure 1. These results were obtained by ASTM E96 wet cup method and demonstrate well a significant difference in the rate of moisture migration through the different type of moisture mitigating coatings.

Evonik offers products for both MVP and MVB applications. Evonik can provide curing agents to formulate a complete breathable flooring system including primers, self-leveling floors and cementitious concrete floors. Our waterborne curing agents such as Anquamine® 701 and 731 can be formulated as overlays which cure at > 3 mm thickness to give a porous morphology that allows moisture vapor to transmit while preventing soluble salts within a concrete layer to move to the surface and therefore avoid osmotic blistering or delamination (Figure 2). Another Evonik curing agent, Anquamine® 287 can be formulated with cement, aggregates and additives in a low binder-to-cement ratio to provide a high-performance, breathable coating that can avoid floor failures due to moisture.

For MVB applications, Evonik provides a number of curing agents, including Ancamine® 2739 and 2800. The MVB coatings are 100% solids epoxy systems applied directly to surface of prepared concrete at >10 mils (0.25 mm) to suppress moisture transmission down to ≤ 0.1 perms. Ancamine® 2739 and 2800 employ Evonik's patented "very low emission technology" that allows the coating to

Figure 1
Moisture vapor transmission of Anquamine® 701 (moisture vapor permeable) and Ancamine® 2800 (moisture vapor barrier) coating as tested using ASTM E96 wet cup method.

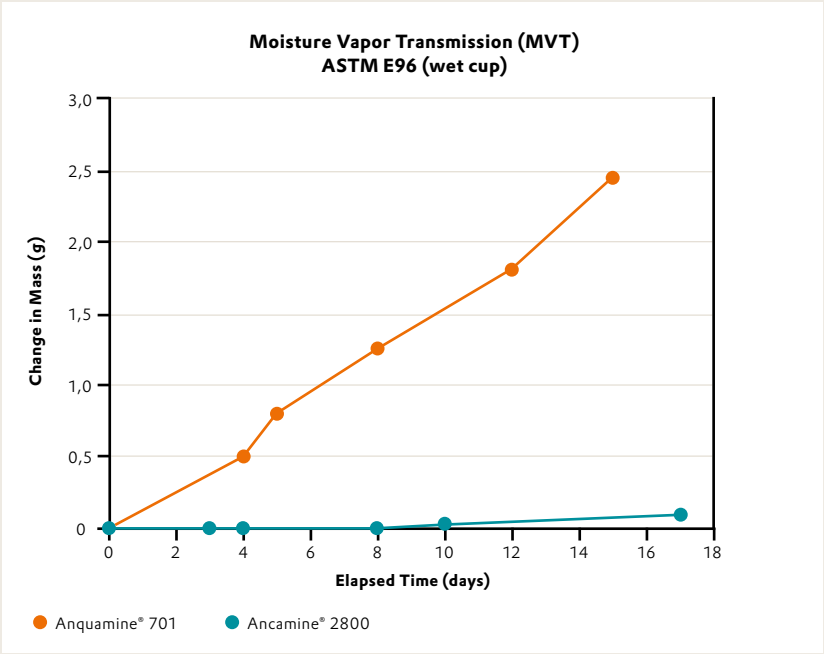
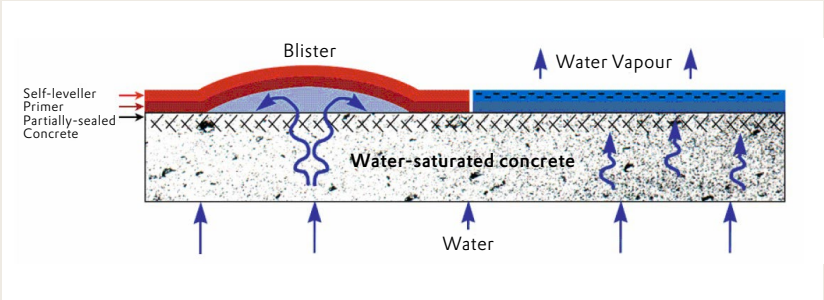


Figure 2
Blister formation in coatings due to osmotic pressure from the concrete slab.



cure without the use of non-reactive diluent such as benzyl alcohol. Benzyl alcohol, a common diluent used in most conventional epoxy floor coatings, emits out of the coating over time leaving voids in the film. This could allow moisture vapor to pass through, or if the voids occurs at the interface of the coating-concrete layer, it could cause blistering or delamination as the epoxy coating would start peeling off from the substrate. Ancamine® 2739 and 2800 do exceed the new moisture mitigation systems standard ASTM F3010 -13 as

certified by third party testing. This is a standard practice for two-component resin based membrane-forming moisture mitigation systems for use under resilient floor coverings. One of the main requirements to meet the compliance is that MVB coating should not exceed permeance greater than 0.1 grains/h/ft²/in. Hg (perm) when tested in accordance with Test Method ASTM E96 when applied at the recommended thickness designated by its manufacturer. The handling properties and third party testing results of Ancamine® 2739 and 2800 are shown in Table 1.

Table 1

The handling properties and third parting testing results of Ancamine® 2739 and 2800.

	Ancamine® 2739*	Ancamine® 2800*
Curing agent viscosity @25 °C (cPs)	350	500
Mix viscosity @25 °C; (cPs)	500	594
Gel time, 150 g mass @25 °C ; (min)	85	41
Thin film set time, phase 3 (hr) ASTM D5895	11	6
Adhesion to concrete** ASTM D7234	360 psi Bulk concrete failure	380 psi Bulk concrete failure
Permeance; (grains/hr/ft ² /in.Hg) ASTM E96 wet method at specified thickness (mils)**	0.064 (16 mils)	0.051 (16 mils) 0.062 (14 mils) 0.10 (10 mils)

* Used with resin blend consisting of liquid epoxy resin (LER), Epodil® 748 and Epodil® 749 (80:10:10)

** Results from third party testing (CTL Group)

Figure 3

Adhesion testing of Ancamine® 2800 and Anquamine® 287 cementitious coating using ASTM D7234 method on damp concrete.



Ancamine® 2800



Anquamine® 287

In summary, preventing moisture related failures is becoming one of the most critical demands in the flooring industry and Evonik's epoxy curing agents can help to mitigate these problems. Anquamine® 701, 731 and 287 are excellent choices for a moisture mitigation system where there is a need for permeability. Ancamine® 2739 and 2800 would be the products of choice when a moisture barrier is required. All these curing agents have outstanding adhesion to dry and damp concrete which is also an important requirement for this type of application (Figure 3). In addition to having excellent performance in moisture mitigation application, all the

mentioned epoxy curing agents are eco-friendly and do not use volatile organic components (VOC), or other harmful materials such as nonyl phenol. They are proven technology that has been used in the construction industry for quite some time and continues to grow due to the new requirements and market drivers.

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