SUSTAINABLE AND HIGH-PERFORMANCE FLOORING

Waterborne amine curing agents for high-performance floor coatings and civil engineering applications

Water borne epoxy flooring solutions are fast becoming the choice for concrete protection globally and with the specific needs for workability and performance an emerging trend in Middle East. Low emissions, fast return to service (1 – 3 hours), adhesion on all major substrate's workability under damp conditions (10°C – 35°C @ 85% humidity), permeability and overall cost savings are driving the use of waterborne epoxy floorings. Evonik's Anquamine® waterborne curing agents are designed to meet the great variety of industrial flooring applications and requirements for concrete.

Besides meeting increasingly stringent low emission requirements, the flooring industry is asking for improved efficiency and product performance. These two additional key market drivers comprise minimizing downtime to improve costs and productivity, as well as improved coating robustness and better aesthetics over the service life. To meet these requirements, significant technology advancements of epoxy curing hardeners have been realized over recent years.

Ultimate product choice will depend on performance requirement and type of flooring layer. Whereas eco- and user-friendliness is a key feature requested for all layers of a floor coating, the importance of the other two market trends depends on the respective layer. For instance, aesthetics such as UV and color stability are essential for topcoats but of less relevance for underlying coating layers.

Typically, flooring systems are based on two to three layers. The first layer is a primer which closes porosity and capillary, followed by a thicker self levelling or thinner roller coating (Figure 2). These topcoats are responsible for the functional and decorative features of the final coating. For aesthetics reasons sometimes a final clear coat is also used in addition (not shown in Figure 1).

In this article, we will demonstrate that flooring formulations based on Evonik's Anquamine® proprietary waterborne technology meet these latest market needs for all three coating layers.

PRIMER

Concrete primers are used to close the porosity and capillaries of the surface. In addition, the primer formulation must exhibit a good adhesion to the concrete and has to offer a perfect inter-coat adhesion to the subsequently applied protective or decorative floor coating. Whereas epoxy systems are generally known to show excellent adhesion to dry concrete, flooring systems based on the waterborne hardeners shown in this article also exhibit high adhesion even on damp concrete.

Primer formulations of Anquamine® 721 cured with a standard liquid epoxy resin (LER) and Anquamine® 728 cured with a LER or Ancarez AR 555® as a solid epoxy resin (SER) exhibit 5 - 8 MPa (Mega Pascal) bond strength on dry and wet concrete. The resulting concrete cohesive failure is higher than 95 % (Figure 2). Whereas adhesion is comparable between all formulations, Anquamine® 728 allows a faster curing compared to Anquamine® 721. With a walk on time down to 2 hours on dry concrete and 3 hours on wet concrete at 10°C, these formulations enable the applicators to recoat the primer within one shift and therefore minimizing the down time for the end-user.

SELF LEVELLING DECORATIVE AND FUNCTIONAL FLOORING SYSTEMS.

For self levelling applications, Anquamine® 735 based formulations are recommended. They provide a desirable satin or matte finish to minimize the visibility of any floor defects and reduce scratch sensitivity. However, the surface is very adaptable and can be modified to produce highly decorative surface appearances.

A formulation of a LER cured with Anquamine® 735 exhibits a high level of adhesion as well as excellent mechanical and abrasion properties (Table 1). ›››

RIGHT
Figure 1.
Typical layers of an epoxy floor coating

LEFT
Figure 2.
Concrete cohesion failure

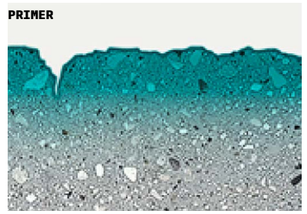


Table 1.
Physical properties of self levelling formulation based on LER/ Anquamine® 735

Physical Properties	Self Leveller 1
Surface appearance	Satin / Matte
Compressive strength (28 days)	40 MPa
Adhesion to dry concrete	4,5 MPa
Adhesion to wet concrete	4,3 MPa
Impact resistance	180-200 kg.cm
Abrasion resistance (Taber C17)	300 mg

TOPCOATS

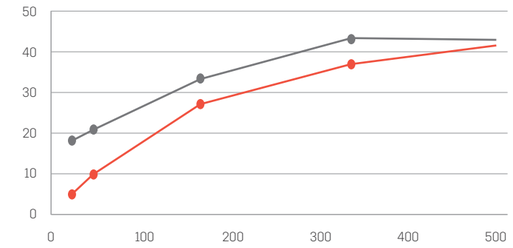
Roller coatings are used for pigmented or clear topcoats. Different waterborne epoxy hardeners have been designed to fulfill the market demands for high product performance and excellent aesthetics. For many applications in the industrial flooring segment, resistance against chemical spills is essential.

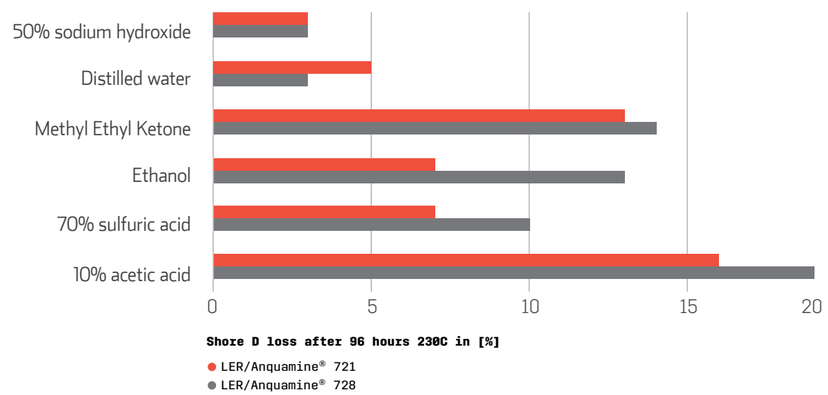
Therefore, the chemical resistance of white model top coatings based on LER/ Anquamine® 721 and LER/ Anquamine® 728 has been evaluated. The results shown in Figure 3 demonstrate that these waterborne systems can fulfill the requirements of the market and must not fear a comparison to solvent free epoxy systems.

CLEAR COAT

Highly decorative surfaces can be achieved by applying an additional clear coat layer. The key requirement for this application is an enhanced UV stability and transparency of the cured film. Clear coats based on Anquamine® 100 exhibit an excellent UV stability and transparency when cured with liquid epoxy resins.

In comparison to a standard hardener UV stability is considerably improved (Figure 4). Furthermore, this clear coat formulation has a long pot life of approximately 8 hours which offers improved working flexibility. »»





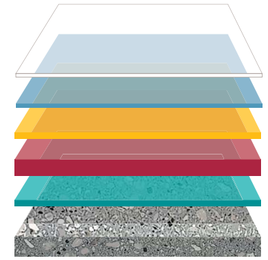
TOP
Figure 3.
Chemical resistance of white top-coating

BOTTOM
Figure 4.
UV-A resistance of waterborne clear coats

Anquamine ® range in a nutshell

Topcoat (Clear)	Anquamine ® 100	Excellent transparency & stain resistance
Coating (Filled)	Anquamine ® 721 or 728	Fast & Aesthetics; High quality finishes
Self Levelling	Anquamine ® 735	Cost-effective, No osmotic blistering
Epoxy Cementitious	Anquamine ® 287	Cost-effective, Impr. Concrete longevity
Primers	Anquamine ® 721 or 728	Recoat 3-4 h at 100C, No carbamation

Figure 5.
Positioning of waterborne epoxy curing agents for different flooring applications



CONCLUSION

Waterborne epoxy hardeners fulfill the increasing demand for environmentally friendly, non-VOC formulations and are meeting the current trends towards faster return to service and improved surface qualities making waterborne the excellent choice for sustainable and high-performance flooring solutions. Evonik offers a well-balanced portfolio of waterborne curing agents with their Anquamine® portfolio which are suited for different cure speeds and performance demands in all three flooring layers (Fig. 5).

In summary, the described epoxy curing agents enable floor coating formulators to comply with low emission and sustainability targets while fulfilling the high expectations on processing speed and aesthetics. •

Sachin Arte,
Senior Business Manager for Middle East & Africa, BL Crosslinkers, Evonik

In conversation with **Sachin Arte**, Senior Business Manager for Middle East & Africa, BL Crosslinkers, **Evonik**

What are the current trends/drivers in the Civil Engineering market?

The Covid 19 pandemic impact is also influencing the Construction industry and will also shape its future. In the current scenario with low oil revenues slowly rising and travel restrictions still in place, the focus is shifting from long term investments to short term. Additionally, a few megatrends which resonate prominently in the Middle East Construction market are climate change, urbanization, mobility, demographics, economic diversification, with focus on reduced dependency on hydrocarbon revenues, energy security and localization of the work force.

On the Industrial and aesthetic flooring scenario in the Middle East, Epoxy Chemistry has the predominant share, with the applicators and end users preferring sustainable, low VOC ready to apply service floorings solutions where Crosslinkers has a pivotal role to contribute in the Industry.

What are the Key innovation opportunities you see in the Civil Engineering Industry?

In the ever changing and disruptive global business conditions, we are always augmenting our value proposition to meet the demands of the industry. We see future opportunities in the Middle East for Composite Rebars, Aesthetic 3 D floorings, UV resistant and Durable floorings, Low VOC and Waterborne solutions, ready to use low maintenance floorings and Thermal shock resistant floorings. The success of our customers is our own success as we support our partners in offering solutions with our innovative product proposition to challenges, they encounter.

How do you envisage the Construction and Civil Engineering scenario in mid-term in Middle East?

Every challenge also offers opportunities and the ME Construction Industry is gearing itself to seize the momentum post pandemic, hence the prospects look bright in mid-term in the region. •