EPOXY CURING AGENTS FOR CHEMICAL RESISTANT APPLICATIONS

Two-component epoxy systems provide excellent mechanical properties, chemical resistance, and adhesion to a wide range of substrates. Therefore, they are frequently chosen over other technologies, especially when chemical resistance is an important attribute. Chemical resistance is required in a variety of applications from construction and infrastructure to protective metal coatings. In the construction and infrastructure sector, epoxy systems are often utilized to improve chemical resistance in flooring, wastewater treatment plants, sewer, power plants, secondary containment, mortars, and grouts. For flooring applications, chemical resistance is critical in areas where the concrete flooring is regularly exposed to various chemicals, for example food and beverage preparation and service areas, meat packaging plants, dairy farms, paper and pulp plants, and chemical and pharmaceutical facilities.

There are a number of key factors to be considered when selecting the right epoxy system for chemical resistance. These

factors encompass the type of application, substrate, classes of chemicals to which resistance is required, duration of resistance, degree of resistance, and processing and application requirements. In addition to chemical resistance, many applications require other important attributes such as low-temperature cure, rapid development of hardness, carbamation resistance, or low color. Epoxy curing agents impart significant influence on chemical resistance and other properties of the cured epoxy systems. Evonik offers a portfolio of products to help epoxy formulators meet their evolving needs for improved chemical resistance epoxy systems.

For ambient-cure epoxy systems, amine curing agents for chemical resistant applications can be separated into two basic categories, aliphatic amine and cycloaliphatic amine curing agents. Cycloaliphatic amine-cured systems offer good resistance to aqueous solutions, solvents, and inorganic acids. Aliphatic amine curing agents provide fast cure speed and high crosslinking density. For grout

and mortar applications where water cleanability is needed, formulated amidoamine curing agents are often selected. For instance, Ancamide® 2886 curing agent is a newly developed curing agent for tile grout application. It provides chemical resistance to hot oleic acid in food preparation areas where high-temperature cooking oil is present. Although cycloaliphatic amine curing agents can also be used in combination with external surfactants to achieve water cleanability, the presence of surfactants would negatively affect the chemical resistance. Table 1 lists the characteristics of selected amine curing agents that offer good chemical resistance. Each of these curing agents offers distinct handling or performance advantages over the others. In many cases, the optimal performance advantages can be obtained by blending the curing agents. For example, a cycloaliphatic amine can be blended with 10% to 30% by weight of a modified aliphatic amine, such as Ancamine® 2432 curing

Table 1
Characteristics of the curing agents formulated with standard bisphenol-A based liquid epoxy resin at 25 °C.

Curing agent	Curing agent viscosity (cP)	Gel time (min.) (150 g mass)	Thin film set time[1] (h)	phr
Ancamine® 1693	100	52	9	50
Ancamine® 2280	450	50	6	58
Ancamine® 2334	1180	42	2	50
Ancamine® 2422	2000	26	NA[2]	26
Ancamine® 2423	1200	17	3.5	60
Ancamine® 2432	300	46	2	46
Ancamine® 2748	2275	50	7	50
Ancamine® 2749	275	49	5	40
Ancamide® 2886	450	83	11	50

[1] BK Drying Recorder, phase 3; 2. Not available.

agent, for faster cure and improved solvent resistance. Table 2 provides the examples of specific chemicals to which the resistance is required and recommended curing agents.

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Table 2
Specific chemicals to which resistance is required and corresponding curing agents.

Specific chemicals	Curing agents
Aliphatic hydrocarbons, gasohol (10% ethanol)	Ancamine® 2432, Ancamine® 1693
Aromatic hydrocarbons (toluene, xylene)	Ancamine® 2422
Phenol	Ancamine® 2422
Ethanol	Ancamine® 2432
Methylene chloride	Ancamine® 2422
Citric acid	Ancamine® 2432, Ancamine® 2423
Lactic acid	Ancamine® 2432, Ancamine® 2423
Acetic acid (low concentration)	Ancamine® 2432
Acetic acid (high concentration)	Ancamine® 2422
Hot oleic acid for coatings	Ancamine® 2334
Hot oleic acid for grout	Ancamide® 2886
Phosphoric acid (low and high concentration)	Ancamine® 2432
Hydrochloric acid (low and high concentration)	Ancamine® 2432
Nitric acid (low concentration)	Ancamine® 2432
Nitric acid (high concentration)	Ancamine® 2748, Ancamine® 2749
Sulfuric acid (low concentration)	Ancamine® 2432
Sulfuric acid (high concentration)	Ancamine® 2748, Ancamine® 2749