As Published in Master Builders Jan 2011 Issue

Presented by : B M Nagarajan, Director, Neocrete Technologies Pvt Ltd

Epoxy Vs Polyurethane – A contest or no-contest?

As everyone would agree, epoxy flooring has become so ubiquitous in most of the industries that the days of epoxy flooring being in the sole jurisdiction of pharmaceutical industries are long past gone. Whether the user is in automobile, auto-ancillary, electronic, textile, food, dairies, aircraft hangars or electrical industries, the uppermost question that reigns in his mind is to arrive at the suitable system that meets his requirements optimally. The idea of this article is to empower the user with the knowledge to decide on the right system, right thickness, right material, right application and above all right price.

GUIDELINES FOR SELECTION

Before selecting any floor topping/coating, it is important to understand the basic requirements for such a topping. Questions such as why do I need a topping/coating, what are the limitations/advantages of the present flooring (concrete or otherwise), what kind of traffic pattern etc. are to be asked. Generally the requirements of a flooring are as-under:

- Should be chemical resistant
- Levelled surface
- Should be capable of withstanding the traffic conditions without developing pot-holes etc.
- Does not catch up dust and not allow oil/grease to penetrate into the base floor
- Preferably scratch-resistant
- Should not peel-off under moisture or traffic conditions
- Should be smooth, easily cleanable and aesthetic in appearance
- Joint-less and monolithic
- Does not enable bacterial / fungi growth
- Should be highly abrasion resistant
- Fire retardant (few specific instances)

As with any flooring materials, it is not always possible to achieve all the above properties with any single product and hence it is necessary to prioritise the above requirements in terms of its importance to one's specific needs. It is essential to rank the factors from 'most critical' to 'least important' to help narrow the choices. Questions should be asked on the following issues:

User performance requirements

- Appearance : Matt or gloss finish, textured or un-textured with or without joints etc
- Turnaround time : How many days are available for laying the flooring and returning to service?
- Expected life : <3 years, 3-7 years or >10 Years
- Tolerance of failure : In case of damages to flooring, what are the secondary consequences that are likely to occur?
- **Cost** : Life-cycle cost

Service/exposure conditions

- Loads : Impact, abrasive, compressive loads, type of traffic etc
- Atmospheric gases : Any chemical vapours or gases likely to be in contact with the floor
- Chemical contact : Any other liquid chemicals in contact with the floor
- UV exposure : Is the floor exposed to sunlight?
- Moisture : Moisture on the floor as well as the likelihood of its travel through the base concrete / walls ?

- Temperature : Temperature and humidity during application as well as service

Placement conditions

- Operating conditions during placement & curing : Conditions existing or likely to exist during application

- Placement technique : Does method of application will have any effect on existing plant & machinery or any other plant operations etc ?

The answers should lead to the following decisions :

a. What type of flooring should I choose – Epoxy, polyurethane, acrylic, tiles or no topping
b. What type of surface finish do I need – smooth, rough, coloured, transparent
c. What should be the thickness of the topping – 150 microns, 500 microns, 1 or 2 mm, 3 to 8 mm
d. What type of underlay to choose: Epoxy, PU, moisture-barrier membrane, cementitious etc

We will try to address these issues by identifying the defining properties vis-a-vis the requirements and analyzing the suitable system to meet these requirements. (Only epoxy and PU are considered for comparison as they are most suitable)

User performance requirements

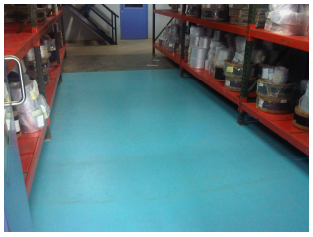
		Epoxy	PU
Appearance	Matt or gloss finish, textured or un-textured with or without joints etc	Gloss (can be matted by additives)	Semi-gloss (Can be matted by additives)
Turnaround time	How many days are available for laying the flooring and returning to service?	24 hrs minimum to resume traffic	Traffic can be resumed after 8 hrs
Expected life	<3 years, 3-7 years or >10 Years	Directly proportional to thickness and load factors. Service life is same as PU	Directly proportional to thickness and load factors. Service life is same as Epoxy
Tolerance of failure	In case of damages to flooring, what are the secondary consequences that are likely to occur?	Epoxy is rigid and likely to crack under heavy impact	PU being flexible, can withstand impact better
Exterior or interior		Epoxy, typically is not recommended for exterior application	Aliphatic PU has high UV resistant and is suitable for exterior applications
Anti-fungal, Anti-bacterial		Due to high gloss and rigid film, epoxy is recommended	
• Cost	Life-cycle cost	Lower than that of PU	

Service/exposure conditions

		Epoxy	PU
Loads		Epoxy is recommended for high compressive loads as well as abrasive loads	PU is recommended for high impact as well as abrasive loads
Atmospheric gases	: Any chemical vapours or gases likely to be in contact with the floor	Epoxy is known to resist most chemicals. Special epoxies are available to resist acids and solvents	PU is also known to resist most chemicals
Please refer to chemical resistance charts of manufacturers before deciding on the system			
Chemical contact	: Any other liquid chemicals in contact with the floor	Epoxy is known to resist most chemicals. Special epoxies are available to resist acids and solvents	PU is also known to resist most chemicals
Both the systems are, typically, not meant for containment systems			
UV exposure		Epoxy, typically is not recommended for exterior application	Aliphatic PU has high UV resistant and is suitable for exterior applications
Moisture	: Moisture on the floor as well as the likelihood of its travel through the base concrete / walls ?	Water-based epoxy-cement composite systems are available as moisture-barrier membranes	PU is very susceptible to moisture and humidity
Temperature	: Temperature and humidity during application as well as service	Most of the epoxy systems withstand a maximum service temperature of 80^{o}C and minimum 5^{o}C	Typical service temp. Of PU is -10^{o}C to 80^{o}C. Special PU floors are available to perform between -25^{o}C to 120^{o}C

Placement conditions		Epoxy	PU
Operating conditions during placement & curing	Conditions existing or likely to exist during application	Temperature and humidity are the conditions that directly affect the curing period and performance of epoxy systems. It is recommended to ly these flooring between 10^{o}C to 30^{o}C	PU is more susceptible to temperature and humidity. PU systems are generally lower pot-life systems and sets faster at higher temperatures. Higher humidity adversely affects the finish and performance
Placement technique	Does method of application will have any effect on existing plant & any other ons etc ?	It is highly recommended to use 100% solids systems or water-borne systems, when flooring needs to be done in existing or operating plants	Same as epoxy

3mm Epoxy self-leveling



Epoxy textured coating

ESD Epoxy system

Typical flooring options available in epoxy system:

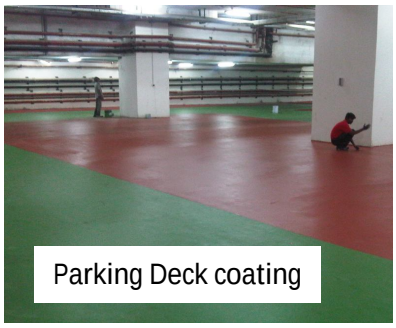
- **Solvented systems : Generally coatings from 100 microns to 500 microns**
- **100% solids system : Self-leveling floorings from 500 microns to 3mm**
- **100% solids system : Trowellable floorings from 3 to 8mm**
- **Water-based systems : Generally coatings from 100 microns to 300 microns**
- **Water-based epoxy-cement composite systems: Typically used as moisture-barrier underlays between 2 to 3mm**
- **Specialized systems: Acid-resistant or solvent-resistant epoxy-Novalac systems : Typicall 500 micron coatings**
- **Specialized systems: Anti-static (ESD) self-leveling system: Typically 2 to 3mm thick**

Epoxy systems are ideally suitable for priming and underlays in all types of industries due to its high bond strength and compressive strength. The toppings are suitable for all interior applications in pharmaceuticals, textiles, electrical and electronics, chemical plants, automobiles and auto-ancillaries

Typical flooring options available in PU system:

- **Solvented systems : Generally coatings from 100 microns to 300 microns**
- **100% solids system : Self-leveling floorings from 500 microns to 2mm**
- **Water-based systems : Generally coatings from 100 microns to 200 microns (Both single component and two-component systems)**
- **Water-borne system : Trowellable floorings from 6 to 9 mm**
- **Water-borne system : Self-leveling floorings from 2 to 4 mm**

PU systems are ideally suitable for applications in Food industry, dairies, light and heavy engineering industries, parking deck coatings, air hangars, helipads, chemical plants etc



Parking Deck coating

Trowellable flooring in Food industry

Conclusion:

In the final analysis, Epoxy and PU complement each other and can perform extremely well to suit all differing requirements for different industries. A detailed discussion with the manufacturer with details of requirements will help in deciding the correct system, which will go a long way in providing the customer an optimal cost-effective floor

The author is B M Nagarajan, director of Neocrete Technologies Pvt Ltd which provides innovative solution s to most of flooring related problems. He is well-known in the industry, having served over 17 years in the field of construction chemicals

The following table provides comparative cured properties for each type of chemistry;

PROPERTY	EPOXY	URETHANE
Adhesion	Excellent	Very Good
Abrasion Resistance	Good	Excellent
Chemical Resistance	Excellent	Average
Component Stress	Poor	Good
Cost	Variable	Variable
CTE (Coefficient of thermal expansion)	Low	Medium
Elongation	Low	High
Exotherm (heat generated during cure)	Higher	Medium
Handling	Good	Good
High Temperature Operation	Good	Poor
Impact Resistance	Good	Excellent
Low Temperature Operation	Average	Good
Moisture Sensitivity (Prior to cure)	Low	High
Thin Film Cure	Slow	Variable
Tensile Strength	High	Medium
Tear Strength	N/A	Good
Thermal Cycling ability	Very Good	Very Good