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Cost effective approach of acrylic resin based flooring applications

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HIGHLIGHTS

- Acrylics give excellent workability owing to lower viscosity.
- Acrylics are at par with epoxy with respect to the tests conducted in this study.
- Economically feasible compared to other resin flooring systems.
- Well suited for IT and software company office jobs with minimum downtime.

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ABSTRACT

Synthetic resin flooring has been used since the early sixties, usually installed in commercial, industrial, healthcare and educational buildings because of its hardwearing nature and versatility as a seamless flooring system. This work is based on providing a cost effective formulation based on acrylic, vinyl ester and polyester resin floorings in comparison to epoxy based systems which posses their own disadvantages. The composites made on same basis of 1:3 for Resin:Sand for the different formulations are developed and tested for their mechanical properties, electrical properties, chemical properties and scanning electron microscopy analysis. An insight in these properties will help us to differentiate between the different formulations developed using these resin based flooring systems. The acrylic formulation works as the cheapest and the best material of choice over the epoxy based resin flooring systems by virtue of superior performance in terms of mechanical & electrical properties along with chemical resistance.

1. Introduction

Synthetic resin floorings are a very important part of existing floorings as they are relatively easy to clean and can be modified to meet enhanced performance requirements. Synthetic resin flooring surfaces can give satisfactory service under many industrial conditions but the resin system selection has to be carefully looked upon based on specific requirements of chemical resistance, hygiene, cleanliness, resistance to high impact or abrasion [1]. The importance of its use can be emphasized because of numerous advantages of synthetic resin floorings. They form a strong permanent bond with the substrate with an improved resistance to a wide spectrum of aggressive chemicals and liquids. They possess high toughness, durability, resilience, and resistance to impact or abrasion, greater resistance to cracking. They are non dusting and can be applied at lower thickness for hygienic and easily cleaned surfaces. They offer excellent aesthetic appearance with the opportunity to produce decorative finishes along with rapid installation and curing with minimum disruption to normal operations [2,3].

The versatility of synthetic resin floorings have been pinpointed as one of the main reasons for the growth in the resins market estimated to be worth 43 to 45 million pounds, split equally between the epoxy and polyurethane markets with a small share of other materials such as polyesters, vinyl esters, polymethyl methacrylate(MMA) etc. Although options are available with other products, the resins are manufactured specifically for each individual situation, so that a vast array of colours, textures and finishes can be achieved [4,5].

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Most importantly, the resin flooring, when professionally laid, it is locked both mechanically and chemically to the underlying substrate, and becomes an integral part of the building structure giving a hardwearing and long lasting surface. Apart from incorporating necessary structural movement its joints are seamless providing a smooth easy to clean surface with no joints where dirt can build up. The systems can be tailored to individual requirements and economy. The thicknesses may range from 70 microns per coat on a two coat application for use as a sealer/dust proofer on walls or floors in general commercial and light industrial situations, right up to 9 mm for the heaviest duty resin screeds [2].

For the floorings based on liquid synthetic resin systems, curing takes place by polymerisation of the resin components [6]. The base resin, a reactive hardener and filler are the components of the matrix. They may also include additional components such as pigments, accelerators, surface dressings, coarse aggregate for aesthetic appearances [7].

The epoxy system comprises an epoxy resin and a hardener. Aromatic hardeners tend to become yellow with age unlike aliphatic ones. They are far lot better in case of chemical resistance. Polyurethane resins are one-pack moisture curing systems which offer good abrasion and chemical resistance. They require a good substrate preparation but are generally cheaper than epoxies. Acrylics are tolerant of poor substrate conditions and extreme temperatures during curing. It is air curing and can cure fast, which makes it ideal for repairs. In fact, loads can be carried after two hours of laying. Polyester curing is done using a catalyst or accelerator. Polyester is very strong and wear resistant but styrene emissions may limit its use to new buildings unless good ventilation is possible [2,8,9].

Due to its ultra fast curing mechanism, floors treated with MMA resin system can be returned to active use in 2–3 h following the final application of resin, depending on adequate ventilation. MMA systems are long lasting resins with a minimum of downtime [10]. Strong odours are present during application, which fades as soon as the floor is hardened. However there are various improved formulations for minimal volatile organic content [11–13].

MMA based systems offer a good set of advantages such as good chemical resistance compared to other flooring materials, weathering and ultraviolet resistance. They reduce the cost dramatically, reducing business disruption and downtime because of ultra fast curing mechanism. The non porous nature allows handling of liquids without risk of seeping into the floor. They have totally seamless finish which prevents impurity and smell build-up in cracks or grout lines. They are easy to clean, maintain and sanitize, because of which it can be used in domestic floorings. The tough, durable bond and finishing makes it highly resistant to scratches, gouges or spills staining. It possesses very good skid resistance which reduces the risk of customer and personnel accidents. It meets aesthetic and design priorities with a wide variety of colour and texture choice and above all it is cost effective.

A comparative study in tests like abrasion resistance, electrical resistance: surface and volume resistivity, compressive strength, slip resistance, flexural strength, impact Strength, hardness, shear strength and chemical resistance, water absorption etc were carried out in this project to access the performance in different flooring materials.

2. Experimental

2.1. Materials

Polyester resin C′POL 301 (acid value 14–18), Vinyl ester resin C′POL 701 (acid value maximum of 10) and acrylic resins C′POL 801 and 841 (acid value of 10 and 1–3 respectively) used for the research were supplied by Crest Composites and Plastics Pvt. Ltd and Epoxy resin LAPOX B-11 (epoxy value 5.25–5.45) was procured from Atul Industries Ltd. The mixture of a mesh size of 80 and 120 of mined sand was procured from a local supplier.

2.2. Sample preparation

The experimental work deals with the preparation of sample specimen sheets and their testing. The experimental work for the resin flooring systems is shown in the Fig. 1. Silica sand obtained from land mines was used. The sand was screened for 80 mesh and 120 mesh. After screening the sand was mixed in a proportion of 1:1 which gives a very good packing factor for the reinforced material. Owing to the presence of calcium shell particles, sand with lower mesh size was not considered. The sand particles are flakes in nature. The sand used is procured from mines which ensure that it is free from impurities and needs no further washing.

The mixing consists of two stages viz. addition of curing system into the resin and mixing of filler particles into the resin. The first stage consisted of addition of catalyst, promoter, accelerator, hardener etc in the resin. Table 2.1 shows the systems which were used for different resins. The second stage deals with slow addition of sand filler into the resin system which was in the initial stage of cure. The resin to sand ratio was kept to be 1:3 keeping an excess of sand which would improve the characteristics as well as reduce the overall cost of the product. The sand was kept in the oven at any temperature at 120 °C for an hour for pre-drying. An overhead stirrer was used for mixing of different components of the resin flooring system (see Table 2.2).

The resin was weighed and poured in a stainless steel vessel. The curing agents were mixed as per specifications given by the manufacturer as per Table 2.3. Slow addition of filler was done to ensure perfect wetting of the filler particles with homogeneous mixing. The mixing stage comprises of the following sequence.

In the present work, five different batches of resin based sheets were prepared and tested.

The sheet size in general was 100 × 150 × 3.5 mm. The sample was made using a two p-ate mould for casting of slurry made by the resin filler mixture. The mould was thoroughly cleaned and mylar sheets cut to exact sizes were applied on all the metal surfaces to prevent the sticking of the filled resin to the surface of the mould before pouring the resin slurry. Also the bottom and the top surfaces were covered using mylar which facilitates easy cleaning of the mould.

The mixed slurry was then poured inside the mould and was properly scattered inside the cavity using a tapping medium from the top ensuring that there were no voids left inside the sheet to be made. After filling the cavity completely, the excess material was swiped off using a straight edge and the mould was kept in a hydraulic press.

After the top part of the tile was covered it was left for 24 h in room temperature to cure. After 24 h of curing schedule, a post cure schedule was followed in which the tile was exposed to a temperature of 70 degrees centigrade for 12 h again

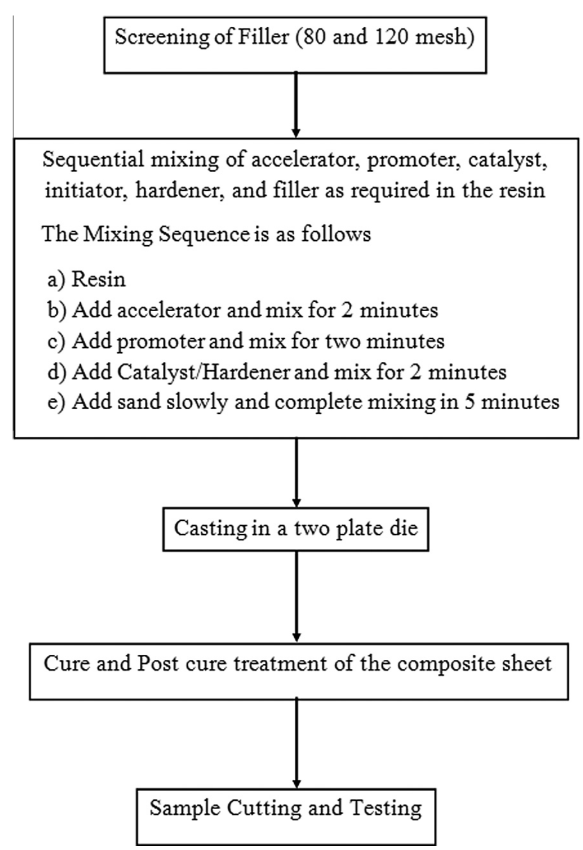

Fig. 1. Process sequence for the Experimental Work Scheme.