# EXPERIMENTAL INVESTIGATION OF USE OF EPOXY RESIN IN FLOOR TOPPING

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## ABSTRACT

*Polymers are widely used to coat the flooring material in indoors such as schools, sport halls and yards, hospitals, factories and washrooms. Thus because it has many advantages such as low manufacturing cost, low shrinkage, great chemical corrosion resistance, low creep, high stiffness and good mechanical properties.*
*In the present work, the main objective is to investigate epoxy resin flooring and compare it with traditional ceramic tile. Epoxy resin serves the purpose of beauty, toughness and utility.*
*Epoxy flooring in industry will serve the best purpose of utility as industrial flooring should be tough, impact resistance and abrasion resistance.*
*In this study, our focus is to test the Epoxy flooring from different aspects like compressive strength, Flexural strength and modulus of elasticity, Tensile strength, Bond strength, water absorption etc.These test will be conducted from flooring point of view, as per IS 9162-1979, IS 13630 (Part 2) 2006.*

**Keyword : -** Epoxy resin, Bond strength, *M*odulus of Elasticity of Epoxy, Flexural Strength of epoxy, Water Absorption of epoxy,Epoxy compared with traditional flooring etc.

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### 1. INTRODUCTION

Epoxy is a type of polymer, a group of chemical compounds that consist of large molecules with repeating subunits. The molecular structure of polymers give them their toughness and elasticity, making polymers (both natural and manmade ones) ubiquitous in daily life. Wool, rubber, Styrofoam, and epoxy are just a few of the polymers that we likely already know.

Epoxy is the family of basic components or cured end products of epoxy resins. Epoxy resins, also known as polyepoxides, are a class of reactive prepolymers and polymers which contain epoxide groups. The epoxide functional group is also collectively called epoxy.The IUPAC name for an epoxide group is an oxirane. Epoxy is widely used in construction industry for flooring, painting, waterproofing etc.

### 1.1 Types of Epoxy Resin used for flooring

(1) Self-dispersing
(2) Self-levelling
(3) Mortar
(4) Gravelled
(5) ESD (Electrostatic Dissipating)
(6) Vapour barrier
(7) Flaked
(8) Quartz-filled

### 1.2 Chemical properties of epoxy flooring

I. In most of the epoxies chemical constituents found are Epichlorohydrin with Bisphenol A .
II. Epoxy is an organic compounds made up of chain of carbon linked to other elements such as hydrogen or nitrogen . The term epoxy can also be used to refer to epoxy resins that appear after curing. Curing is a chemical process in which a material hardens after exposure to air, heat or chemical additives.
III. Epoxy resins usually comprise four ingredients: the monomeric resin, a hardener, an accelerator and a plasticiser.

### 1.3 Problem statement

Traditional flooring breaks due to heavy load and during transportation of machines and materials from one place to another place. Hence, In industries there is a requirement of hard impact resistant and chemical resistant flooring,
Also reinforced cement concrete (RCC ) OR plain cement concrete ( PCC ) if provided as a flooring ,it has pores in it, which enables the microbes and bacterias to grow, resulting in unhygienic conditions.Epoxy may provide tough floor for industry and areas where heavy load and high impact is applied.

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## 2. LITERATURE REVIEW

### 2.1 LITERATURE REVIEW

**Francesca Ferrari et.al (2021)[(6)]** Organic wastes represent an increasing pollution problem due to the exponential growth of their presence in the waste stream. Among these, waste flour cannot be easily reused by transforming it into high-value-added products. Another major problem is represented by epoxy-based thermosets, which have wide use but also poor recyclability. The object of the present paper is, therefore, to analyze both of these problems and come up with innovative solutions. Indeed, we propose a completely new approach, aimed at reusing the organic waste flour, by converting it into high-value epoxy-based thermosets that could be fully recycled into a reusable plastic matrix when added to the waste epoxy-based thermosets. Throughout the research activity, the organic waste was transformed into an epoxidized prepolymer, which was then mixed with a bio-based monomer cured with a cleavable amine. The latter reactant was based on RecyclamineTM by Connora Technologies, and in this paper, we demonstrate that this original approach could work with the synthesised epoxy prepolymers derived from the waste flour. The cured epoxies were fully characterised in terms of their thermal, rheological, and flexural properties. The results obtained showed optimal recyclability of the new resin developed.

**N. Domun et.al (2015)[2]** The incorporation of nanomaterials in the polymer matrix is considered to be a highly effective technique to improve the mechanical properties of resins. In this paper the effects of the addition of different nano- particles such as single-walled CNT (SWCNT), double-walled CNT (DWCNT), multi-walled CNT (MWCNT), graphene, nanoclay and nanosilica on fracture toughness, strength and stiffness of the epoxy matrix have been reviewed. The Young's modulus (E), ultimate tensile strength (UTS), mode I (GIC) and mode II (GIIC) fracture toughness of the various nanocomposites at different nanoparticle loadings are compared. The review shows that, depending on the type of nanoparticles, the integration of the nano- particles has a substantial effect on mode I and mode II fracture toughness, strength and stiffness. The critical factors such as maintaining a homogeneous dispersion and good adhesion between the matrix and the nanoparticles are highlighted. The effect of surface functionalization, its relevancy and toughen- ing mechanism are also scrutinised and discussed. A large variety of data comprised of the mechanical properties of nanomaterial toughened composites reported to date has thus been compiled to facilitate the evolution of this emerging field, and the results are presented in maps showing the effect of nano- particle loading on mode I fracture toughness, stiffness and strength.

**Bodo Fiedlerthe et.al (2005)[4]** yield and fracture behaviour of the neat resin was investigated. The parabolic failure criterion was applied to experimental results. From a neat resin slab, specimens for the tensile-, torsion- and compression - tests were manufactured and the failure behaviour of the neat resin due to the actual stress-state was tested at low and elevated temperatures and discussed in detail. The results of the mechanical tests and the fractographic study of the fracture surfaces were correlated to the stress-state dependent ultimate strength of epoxy resins. This plays an important role in fibre reinforced composites, because just after cooling to room temperature the resin matrix is in a tri-axial residual stress-state. The mechanical properties of the neat resin described by the parabolic failure criterion is able to explain the low strain to failure of unidirectional laminates under transverse tensile loading.

**Shengguo Wang (2001)[5]** In this study, a new test method for evaluating the crack resistance of epoxy resins under thermal shock is proposed. A series of epoxy resins of varying toughness are tested by this method. We also study influence of geometry and dimensions of moulds on the experimental results. It is shown that crack resistance of epoxy resins under thermal shock can be evaluated by this method. Our study also suggests that this method can be performed conveniently in laboratories and factories so that it can be widely applied in many fields to evaluate the crack resistance of epoxy resins.

**M. Golane et.al (1999)[3]** Many companies in Europe are using the floor/footwear system as a primary means for grounding personnel. The ECF are qualified according to the IEC 61340-4-1 based on their Rtg only. The conductive shoes are also qualified based on their Rtg only. We have found in many locations, qualified conductive epoxy floors, used in conjunction with qualified ESD shoes, giving peak voltage values up to 600 volts and very long decay times. This paper reviews the situation in detail.

## 3. METHODOLOGY

We are referring the methods as stated for floor resins in IS codes
IS4631-1986 ,
IS9162-1979,
IS2114-1984,
IS9197-1979,
IS4832-1969(PART 2).

The following tests will be done to investigate the strength of epoxy flooring as per
IS 9162-1979,

**3.1 Compressive strength**
**3.2 Flexural strength**
**3.3 Water absorption**
**3.4 Abrasion resistance**

## 4. EXPERIMENTAL ANALYSIS

The aim of the project study is to investigate epoxy flooring for floor topping and compare it's strength with ceramic tiles .We investigated epoxy flooring according to IS 9162-1979 and IS 13630.1-5.2006. The following tests were conducted on ceramic tile as well as epoxy flooring to compare their strengths.

We conducted tests on epoxy resin with following specimen sizes :

1. Compressive Strength :- 50 mm x 50 mm x 50 mm
2. Flexural Strength :- 300 mm x 300 mm x 4 mm
3. Water Absorption :- Cylindrical Specimen
4. Diameter-25 mm, Height-30 mm.
5. Abrasion Resistance :- 70 mm x 70 mm x 20 mm
   samples were prepared using APCOFLOR TC ASIAN PAINTS.

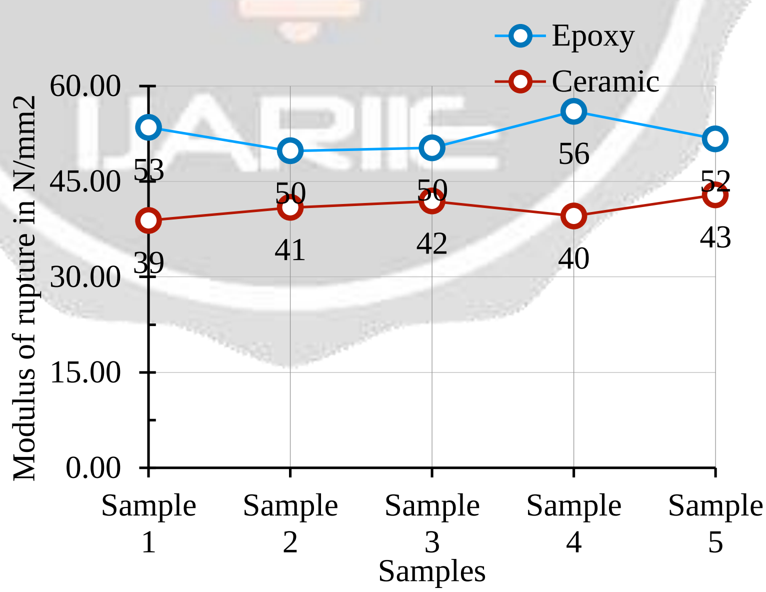
We investigated ceramic tile according to IS 13630.1-5.2006.
We conducted tests on ceramic tile with following specimen sizes :

1. Flexural Strength :- 300 mm x 300 mm x 10 mm
2. Water Absorption :- 70 mm x 70 mm x 10 mm
3. Abrasion Resistance :- 70 mm x 70 mm x 10 mm

## 5. RESULTS AND DISCUSSION

### 5.1 FLEXURAL STRENGTH TESTING RESULTS

The average flexural strength for epoxy flooring was 52.24 N/mm$^2$, and for ceramic tile was 40.82 N/mm$^2$.



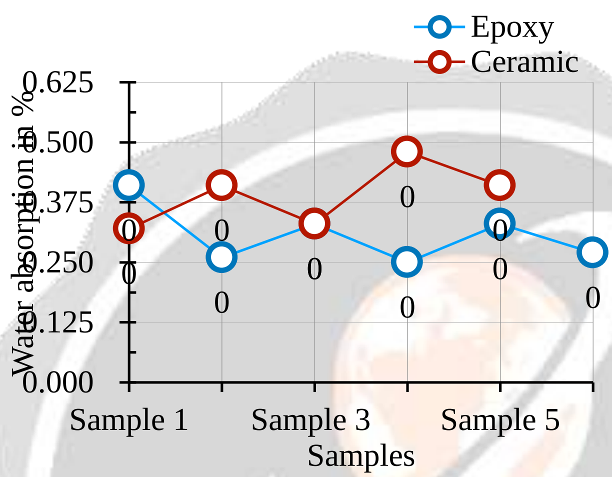

**Graph 1 : Flexural strength comparison**

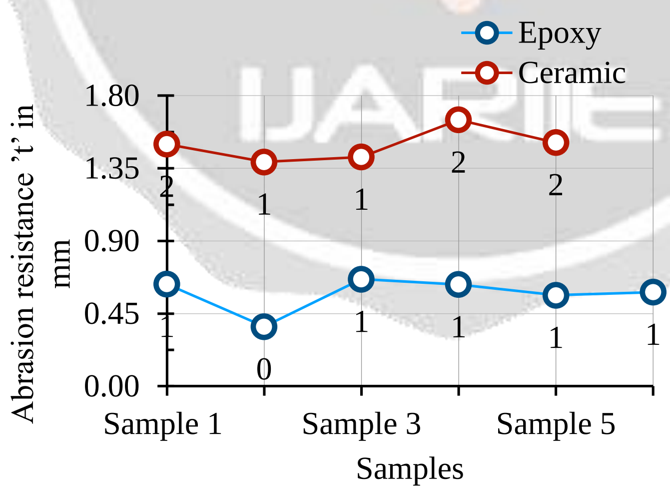
### 5.2 WATER ABSORPTION TESTING RESULTS

The average water absorption for epoxy flooring and ceramic tile was 0.31 and 0.39 which is approximately the same.

### 5.3 ABRASION RESISTANCE TESTING RESULTS

The average Abrasion Resistance for epoxy flooring was 0.573 mm, and for ceramic tile was 1.49 mm.



## 6. CONCLUSIONS

The aim of the study is to investigate epoxy flooring using epoxy resin binder and compare it's strength with traditional ceramic tile. Epoxy flooring and ceramic tile were tested on different properties which are their flexural strength test, water absorption test and abrasion resistance test. The experiments were conducted according to IS standards as discussed earlier.

**Table 1: Test conclusion**

| Sr. No. | TEST | Sample Type | SPECIFICATION AS PER IS CODE | TEST CONDUCTED | REMARK |
|---|---|---|---|---|---|
| 1 | Compression strength test | Not prepared | - | - | - |
| 2 | Flexural strength test | Epoxy | 20 N/mm$^2$ | 52.24 | Test conducted were successful |
| | | Ceramic | Average value 35 N/mm$^2$ , individual 32 N/mm$^2$ min. | 40.82 | |
| 3 | Water absorption test | Epoxy | 0.5 % max. | 0.31 | Test conducted were successful |
| | | Ceramic | Average < 0.5 % , individual 0.6% max | 0.39 | |
| 4 | Abrasion resistance test | Epoxy | Average wear 2 mm, max. individual value 2.5 mm | 0.573 | Test conducted were successful |
| | | Ceramic | Average wear 2 mm, max. individual value 2.5 mm | 1.49 | |

The results showed that epoxy flooring has good abrasion resistance as compared to ceramic tiles and for water absorption both the types of flooring showed approximately same results. Also, the flexural strength of epoxy tile was greater than that of ceramic tile.

So from the present study it can be concluded that epoxy resins are stronger, durable and have high abrasion resistance as compared to traditional flooring. They have wide applications in industries where smooth, dust proof, chemical resistant, abrasion resistant flooring is needed.

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**Name of all group members**

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