

Utilisation of Epoxy Resin as Filler in Concrete

Dhaval Ghaghretiya¹, Asst. Prof. R. K. Shashanth²

¹Student M. Tech Department of Civil Engineering R. K. University Rajkot., d.r.ghaghretiya@gmail.com

²Asst. Prof. Department of Civil Engineering R. K. University Rajkot, rk.shashanth@rku.ac.in

Abstract— The objective of this research were to compare the split tensile strength and compressive strength of normal concrete and Epoxy Resin as filler in concrete. Specimen were tested for tensile strength and compressive strength after 7 days, 14 days and 28 days of standard curing in order to find out if concrete would show an increase in strength. Mix design used in this research work is based on previous research work. The water-cement ratio, cement, aggregate all content were kept same except epoxy resin.

Keywords— Epoxy Resin, Tensile strength, Compressive strength, Standard curing.

Received: 25/10/2021, **Accepted:** 14/11/202, **Published:** 28/11/2021

I. INTRODUCTION

Epoxy resin used in concrete construction due to its compressive and tensile strength properties as well as adhesive properties. Application of epoxy resin is bonding concrete to concrete for repairing damaged structure. In concrete by replacing cement paste with epoxy resin increases compressive as well as tensile strength. It is not widely used because of its high cost and less knowledge of handling. Damaged bridges with high traffic rate can be repaired by using epoxy resin due to its fast setting properties and bridges can be opened in few hours.

Advantages of Epoxy Resin Filled Concrete:

- 1) It increase compressive strength as well as tensile strength of concrete.
- 2) It prevents crack in concrete
- 3) It is used in bridge repair work.
- 4) It gives dynamic looks of flooring
- 5) Repair any type of crack, honeycomb, voids in concrete
- 6) It is chemical and electric resistant

II. MATERIALS AND METHODOLOGY

Materials:

- 1) **Epoxy:** Epoxy has indefinite self-life and in uncured condition epoxy is clear plastic. Epoxy resin is classified in different grades by its viscosity and epoxide equivalent. While adding diluents in epoxy it reduce its viscosity. Sometimes diluents also decrease physical properties of epoxy. Epoxy required additional influence to convert in to solid mass.
- 2) **Hardener:** this is a additional influence which convert epoxy resin in to a solid mass. The conversation of solid mass produces heat. Large quantities of mixture increased the speed of hardening than the smaller ones because of its heat loss in large mass. Mixture of epoxy resin must be used in short times because of its fast hardening properties. Usable time limit of mixture is called “pot life”. Pot life depends on grade of resin and hardener, quantity of hardener, compound formulation process.
- 3) **Cement:** PPC 53 grade Tata Brand cement is used for the test throughout the work. 53 grade cement has average compressive strength at 28 days as per Indian standard code is 53 N/mm².
- 4) **Aggregate:** well graded coarse and fine aggregate conforming to IS 383-1970 are used for project work. Maximum size of fine aggregate is 4.75mm.



Fig: 1 Epoxy Resin and Hardener

Slump Test:

Concrete slump test measures the consistency of fresh concrete before it sets. It is performed to check workability of fresh concrete. To check flow property, mixtures are tested to flow intensity after mixing component.

Mix proportion of concrete:

Table 1 Mix proportion of concrete

Mix ID	Cement(Kg)	Coarse aggregate(Kg)	Fine aggregate(Kg)	Water
M30	455	1070	605	191.5

Mix proportion of epoxy resin and hardener is in ratio 2:1. For ex ER5 mix means quantity of epoxy resin is 5ml where 3 ml resin and 2 ml hardener is mixed for 5 to 10 minutes. Epoxy resin and hardener quantity are shown in below table.

Table 2 Epoxy resin Proportion

Mix. No.	Mix. ID	Resin	Hardener
1	ER5	3	2
2	ER10	6	4
3	ER15	9	6
4	ER20	12	8
5	ER25	15	10

III. RESULTS AND DISCUSSION

Cubes and cylinder are casted for normal concrete and epoxy resin filled concrete. Testing of concrete respectively for 7 days, 14 days and 28 days. The result of testing and graphs are shown below.

3.1 Results of compressive strength of concrete cube containing epoxy resin as filler:

Table 3 Epoxy Resin filled concrete compressive strength

Mix No.	Mix ID	Resin	Hardener	7 days Compressive strength	14 days Compressive strength	28 days Compressive strength
1	ER5	3	2	28.03	33.02	38.15
2	ER10	6	4	34.59	36.35	40.18
3	ER15	9	6	38.25	40.29	41.90
4	ER20	12	8	40.16	41.93	44.08
5	ER25	15	10	44.30	43.30	46.85
6	ER30	18	12	44.90	45.08	48.19

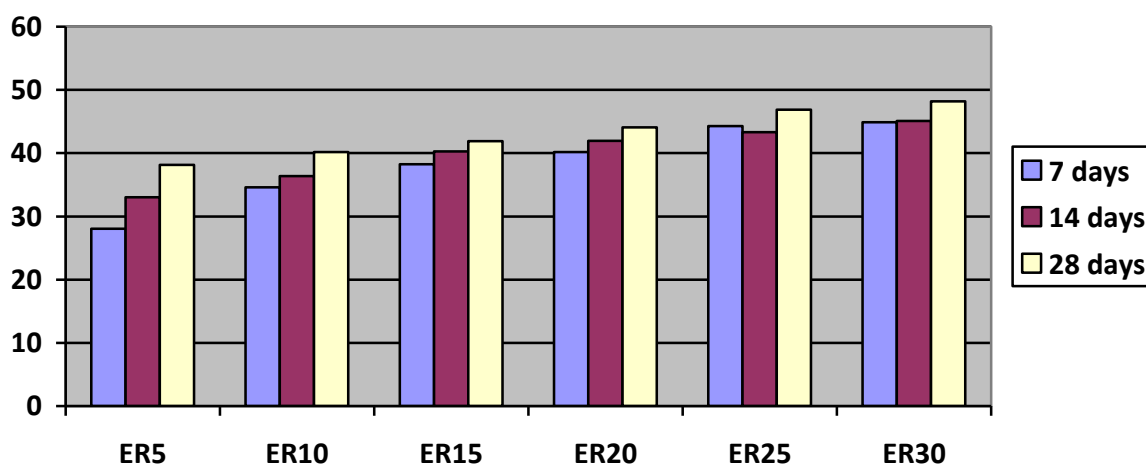


Fig: 2 Epoxy Resin filled concrete compressive strength

3.2 Results of Split Tensile Strength of Concrete cylinder containing epoxy resin as filler:

Table 4 epoxy resin filled concrete tensile strength

Mix No.	Mix ID	Resin	Hardener	28 days Compressive strength
1	ER5	3	2	2.0
2	ER10	6	4	2.19
3	ER15	9	6	2.53
4	ER20	12	8	3.0
5	ER25	15	10	3.10
6	ER30	18	12	3.35

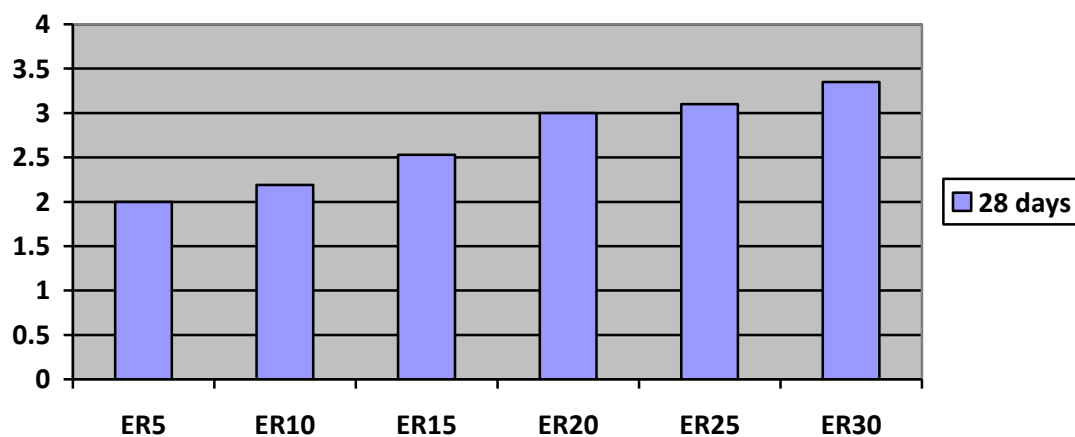


Fig: 3 Epoxy resin filled concrete Split Tensile strength

3.3 Results of compressive strength of cement mortar containing epoxy resin:

Table 5 Epoxy resin filled cement mortar compressive strength

Mix No.	Mix ID	Resin	Hardener	3 days Compressive strength	7 days Compressive strength	28 days Compressive strength
1	ER5	3	2	17.25	23.19	32.10
2	ER10	6	4	18.50	25.30	33
3	ER15	9	6	19.10	25.90	33.50
4	ER20	12	8	20.00	26.15	33.80
5	ER25	15	10	22.20	27	35.30
6	ER30	18	12	23.30	28.25	36.60

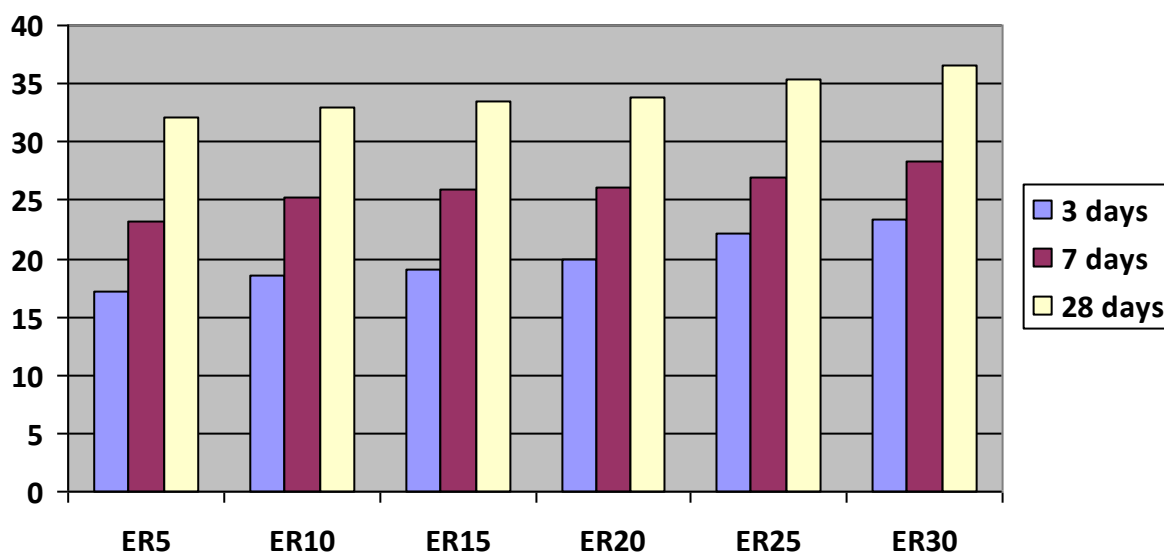


Fig: 4 Epoxy Resin filled Cement mortar compressive strength

IV. CONCLUSIONS

Result of epoxy resin filled concrete for M30 grade concrete were compared with control mix concrete. The compressive strength of concrete increases with increase in quantity of resin and hardener. Hardener increase the process time for epoxy resin to convert in to solid mass. Results shows the increases in compressive strength as well as tensile strength. For making mixture of epoxy resin proper care should be taken. For ER30 compressive test gives better excellent result as 44.90, 45.08 and 48.19 respectively for 7days, 14 days and 28 days. By more increases content it increase strength for some proportion but it affects cement bonding properties.

1) Future Scope of Work:

- Effects of epoxy resin on different grade of concrete can be done.
- Use of epoxy resin in steel structure and its properties.
- Used with Different fibers materials, polymer material and its affects.

REFERENCES

- [1] Costas A. Anagnostopoulos and Giorgos Sapidis, "Fundamental Properties of epoxy resin modified cement grouts", *Construction and building materials*, vol. 125, pp. 184-195, 2016.
- [2] Camille Issa and Pauls Debs, "Experimental study of epoxy repairing of cracks in concrete," *Construction and Building Materials*, vol. 21, pp. 157-163, 2007.
- [3] V. K. Srivastava and P. S. Shembekar, "Tensile and Fracture properties of epoxy resin filled with fly ash particles," *journal of material science*, vol. 25, pp. 3513-3516, 19903
- [4] Zainab Ismail and Enas Al-Hashmi, "Use of waste plastic in concrete mixture as aggregate replacement," *Waste management*, vol. 28, pp. 2041-2047, 2008.
- [5] M. Golestaneh and G. Amini, "Evaluation of mechanical strength of epoxy Polymer Concrete with Silica Powder as Filler," *World Applied Science Journal*, vol. 9, pp. 216-220, 2010.
- [6] Ribeiro and A. T. Marques, "Flexural Performance of Polyester and Epoxy Polymer mortars under severe thermal conditions," *Cement and Concrete Composites*, vol. 26, pp. 803-809, 2004.
- [7] Pacheco-Torgal and F. and S. Jalali, "Sulfuric acid resistance of plain, polymer modified and fly ash cement concretes," *Construction and Building Materials*, vol. 23, pp. 3485-3491, 2009.
- [8] Rebeiz and A. P. Craft, "Properties of Polymer Concrete Using Fly Ash," *Journals of Materials in Civil Engineering*, vol. 16, pp. 15-19, 2004.
- [9] Muthukumar, M. and D. Mohan, "Studies on Furan Polymer Concrete," *Journals of Polymer Res.*, vol. 12, pp. 231-241, 2005.
- [10] Vipulanandan, C. and N. Dharmarajan, "Flexural Behaviour of Polyester and Polymer Concrete," *Cement and Concrete Res.*, vol. 17, pp. 219-230, 1987.