

A STUDY ON FLY ASH - BASED POLYMER CONCRETE WITH EPOXY RESIN & GLASS FIBER: A BRIEF REVIEW

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Abstract: Polymer concrete is a composite fabric wherein the aggregate is bound collectively in a matrix with a polymer binder. It's miles growing recognition as a brand new creation fabric because of its high compressive, tensile and flexural strengths, quick curing time and impact resistance. This paper explores a studies take a look at which has been initiated to improve essential information of this cloth and to offer the expertise required for its vast utilization. Hence a contrast has made between the conventional concrete and polymer concrete in conjunction with resins and fibers of version proportions. As consistent with IS10262:2009 the combination layout of M25 grade concrete is calculated and Estimation of fabric amount is carried out. In implementation of experimental application check methods such as compressive power take a look at, Flexural electricity test and workability test is completed for traditional concrete, Polymer resin concrete at the side of Flyash having resin percentage 3% and 5% is finished and in comparison the effects with Polymer fiber concrete with Glass fiber percent 0.Five% and 1%.On this experimental program, Epoxy resin and glass fiber blended with fly ash and sand had been used to make polymer concrete . The impact of resin (binder), and fly ash contents on the compressive power, flexural electricity, cut up tensile strength and Hardness of epoxy resin primarily based polymer filler is pronounced. The epoxy composites, like every other fiber reinforced polymer composites, provide many benefits over the traditional structural substances. Those substances have correct corrosion resistance, desirable longevity, suitable insulation property and excessive unique electricity. These houses have recommended their use in numerous Civil Engineering programs, Aerospace Engineering, transport and Marine Engineering. But, those substances be afflicted by massive moisture absorption residences, moisture coming from each the ambience and direct immersion in normal/sea water in the course of the path in their use. The absorbed moisture reasons high residual stresses whilst badly affecting the structural integrity of the composite.

Keywords: Polymer concrete, Glass fibre, Epoxy resins, Ordinary Portland Cement

INTRODUCTION

Traditional concrete is understood to be vulnerable in tensile electricity, brittle and effortlessly erodible by way of chemical compounds and excessive speed water flow. This is turning into an ever growing hassle in these days's society with the want for the least quantity of renovation and longer lasting structures. In early 1950 studies right into a exclusive form of concrete turned into determined, polymer concrete. Polymer concrete has improved power traits in addition to improved resistance to environmental elements and a quicker curing time. With such advanced residences, Polymer concrete have become a fast growing region of studies. Whilst two or greater materials with special houses are combined collectively, they Shape a composite cloth In widespread, the properties of composite materials are advanced in lots of respects, to those of the individual constituents. The curing response paperwork a series of cross hyperlinks Molecular chains in order that one large molecular community is formed, ensuing in an intractable stable that can't be reprocessed on reheating. Epoxy resin is the most commonly used polymer matrix with reinforcing fibres for advanced composites packages. Epoxy resin possesses so many blessings which includes excellent mechanical properties, and electrical traits, chemical resistance and environmental resistance etc. Glass fibres are to be had in different bureaucracy like woven fabric, continuous and chopped

CLASS OF COMPOSITES

Composite materials may be classified in specific approaches. Classification based totally on the geometry of a consultant unit of reinforcement is handy given that it's miles the geometry of the reinforcement which is answerable for the mechanical properties and high overall performance of the composites. The 2 vast classes of composites are:

- Fibrous composites
- Particulate composites

Typically the resinous binders [polymer matrices] are decided on on the premise of adhesive strength, fatigue resistance, warmth resistance, chemical and moisture resistance and so on. The resin ought to have mechanical strength commensurate with that of the reinforcement. It need to be clean to apply inside the fabrication manner decided on and additionally get up to the carrier situations. Apart from these residences, the resin matrix must be able to wetting and penetrating into the bundles of fibres which offer the reinforcement, replacing the dead air spaces therein and offering those bodily characteristics capable of enhancing the overall performance of fibres. Shear, chemical and electrical properties of a composite rely on the whole on the resin. Once more, it's far the character of the resin on the way to decide the usefulness of the laminates within the presence of a corroding environment.

CLASSIFICATION OF POLYMER CONCRETE

There exist 3 foremost classes of polymer concrete materials:

- A) Polymer-Portland Cement Concrete [PPCC]
- B) Polymer impregnated Concrete [PIC]
- C) Polymer Concrete [PC]

Polymer Portland Cement Concrete [PPCC] : A monomer, pre polymer of dispersed polymer is incorporated right into a Portland cement blend and a polymer network shaped in situ at some stage in curing of the concrete.

Polymer-Impregnated Concrete [PIC]: previously fashioned concrete is impregnated with a monomer which is ultimately polymerized in situ. Polymers enhances the energy traits of the original concrete.

Polymer Concrete [PC]: it is also referred to as Resin Concrete. A polymer is used to bind an mixture together.

Glass Fibre

Glass fibre within the shape of filaments is likewise usually utilized in FRC. Glass fibers are furnished in a non-stop roving and can be chopped into quick fibre. Glass fibres have excessive tensile electricity and excessive fracture strain. However, those fibers have low modulus of elasticity. Furthermore, normal borosilicate glass fibers [E-glass] and soda-lime glass fibers [A-glass] may be effortlessly attacked by alkali solution in cement-primarily based composites. For this reason, they're much less durable and should be used with warning. Alkali-resistant glass fibers [AR glass] contain approximately 16% to twenty% of Zirconium [ZrO₂], which protects the fibers from excessive alkali attack.

AR glass is the most famous glass fibre used in cement-based totally composites. Disadvantages of glass fibers include low resistance to sustained loads and cyclic hundreds. Extended publicity of glass fibre reinforced concrete [GFRC] to herbal climate situations result in adjustments in mechanical houses. Moreover, publicity of GFRC to normal herbal weathering cycles result in cyclical volumetric dimension adjustments. Most commercially synthetic GFRC composites revel in a discount in tensile energy, flexural energy, and ductility with age if exposed to an out of doors environment. The strength of absolutely-aged GFRC composites decreases to about 40% of the initial energy prior to getting older. However, stress capacity [ductility or toughness] decreases to approximately 20% of the preliminary strain potential previous to getting older. This loss in Pressure capability is called composite embrittlement.

OBJECTIVE OF THE STUDY:-

Primarily based on the review of the literature it became discovered that the manufacturing of fly-ash will maintain on growing in coming years which wishes massive vicinity to keep which creates a trouble for its safe financial disposal and reasons surroundings dangers .A enormous utilization of fly ash is most effective possible in civil engineering fields as a replacement to earth cloth as its homes are quite just like that of the herbal earth. To use the fly ash a alternative of earth or geo-cloth it's far critical to stabilizing it the usage of a few proper stabilizing agent.

The aim of the present paintings are-

- To manufacture Fly ash polymer composite at extraordinary proportions of Glass fibre & epoxy resins
- To make guidelines to sell utilization of industrial waste
- Evaluation of mechanical properties of both epoxy & glass fibre composites consisting of tensile electricity, Compressive, & Hardness and so on
- To study the impact of the usage of Epoxy resin and Glass Fibers in polymer fly-ash concrete
- To assess the compatibility of commercial solid waste as uncooked fabric/ blending cloth/ admixture
- To investigate exclusive fundamental residences of concrete such as compressive electricity, splitting tensile energy, flexural energy and comparing the outcomes of different proportioning.

MATERIALS & METHODOLOGY

Fly ash has been utilized in various architectural and industrial applications on big scale. As a result intake of this large quantity of fly ash greatly reduces the difficulties met through coal based totally TPPs for its dumping. Evaluation on the performance of FA at numerous states is essentially required earlier than its utilization. To be able to apprehend the traits capabilities of FA, experiments cannot be done on area area. There is no any exchange alternative besides studies laboratory check to assess its importance. The studies conducted in laboratory gives a calculative approach to govern several parameters that encounter throughout exercise.

Quick description of the types of cloth used, pattern guidance and its characterization thru SEM, XRD, and FTIR, Mechanical and surface properties like Compressive power, Hardness and wear resistance, Thermal conductivity size and others are mentioned in this section.

MATERIAL USED:-

Ordinary Portland Cement

Cement can be described as the bonding material having cohesive & adhesive homes which makes it succesful to unite the different production substances and form the compacted assembly. Regular/regular Portland cement is one of the most extensively used form of Portland Cement. The call Portland cement turned into given via Joseph Aspdin in 1824 because of its similarity in coloration and its exceptional while it hardens like Portland stone. Portland stone is white grey limestone in island of Portland, Dorset.

Composition of OPC

The leader chemical additives of ordinary Portland cement are:

1. Calcium
2. Silica
3. Alumina
4. Iron

Calcium is normally derived from limestone, marl or chalk while silica, alumina and iron come from the sands, clays & iron ores. Different uncooked substances may also encompass shale, shells and business by products.

Contents	%
CaO	60-67
SiO ₂	17-25
Al ₂ O ₃	3-8
Fe ₂ O ₃	0.5-6.0
MgO	0.5-4.0
Alkalis	0.3-1.2
SO ₃	2.0-3.5

Table 1: Basic Composition of OPC

Chemical Properties of Ordinary Portland Cement

Portland cement consists of the following chemical compounds

(a) Tri-calcium silicate	CaO.SiO ₂ (C ₃ S)	40%
(b) Di-calcium silicate	CaO.SiO ₂ (C ₂ S)	30%
(c) Tri-calcium aluminates	CaO.Al ₂ O ₃ (C ₃ A)	11%
(d) Tetra-calcium aluminates	CaO.Al ₂ O ₃ .Fe ₂ O ₃ (C ₃ AF)	11%

There can be small quantities of impurities gift inclusive of calcium oxide (CaO) and magnesium oxide (MgO). While water is brought to cement, C3A is the first to react and purpose initial set. It generates extraordinary amount of warmth. C3S hydrates early and develops strength within the first 28 days. It additionally generates warmth. C2S is the following to hydrate. It hydrates slowly and is answerable for increase in ultimate energy. C4AF is comparatively inactive compound.

Epoxy Resin

Epoxy resin is generally utilized in applications including the aerospace enterprise, motor racing and racing yachts and takes the better stop of the performance spectrum. Note that the aerospace enterprise uses the best performance epoxy resin, in which curing temperatures of the resin are at approximately 180oC. Some epoxies are cured at ambient temperatures, thus giving a discount in production fees. Such epoxy resins are of unique interest in structural engineering programs, due to their structural overall performance and durability.

Epoxy polymer concrete has superior chemical resistance, exquisite structural houses, excellent adhesion to a variety of surfaces and well-knownshows a minimum degree of shrinkage throughout curing. Epoxy primarily based polymer concrete additionally inherits top creep and fatigue resistance and occasional water absorption. It is suggested that epoxy polymer concrete showcases a flexural energy up to ten times greater than that in cement concrete, fantastic for structural engineering programs.

The resin turned into the primary binding cloth for the polymer concrete and changed into required to be blended with a catalyst. The reason of incorporating the catalyst turned into to chemically begin the curing system of the resin and for this reason harden the mixture into a polymer concrete. It become important that the catalyst and resin have been completely combined collectively to make certain that the molecular structure of the aggregate became uniform and that the resin might therapy nicely. For epoxy polymer concrete, a extent percent of 3 & 5% catalyst to resin became used.

Fly-ash

The Fly ash used on this undertaking become accumulated from electrostatic precipitators of the captive energy plant (CPP-II) in dry circumstance. The satisfactory powders have been oven dried at 110oC-160oC and kept in air tight bottle for later use. For the experimental advise Fly Ash is accumulated from“ Bhilai steel Plant , Sirsa Gate (C.G)”.

Training of Samples:-

Powder metallurgy path essential is used for the practise of pattern. Powder metallurgy may be defined because the artwork of producing powders of metals, alloys, ceramics and so forth. Mixing them in essential quantities which might be combined, pressed right into a preferred shape (compacted), after which heated (sintered) in a managed environment to bond the contacting surfaces of the particles and set up the desired homes. It is usually distinct as P/M

Blending

The three specific weight percentages of Fly ash and resin powder with (75%, eighty% and 85%) and (25%, 20% and 15%) had been taken respectively for analysis. These compositions were blended very well by a mechanical vibrator (Abrasion Tester version PEI-three hundred), to get a homogenous mixture. Extraordinary compositions of Fly ash along with resin powder have been stored in three special small length bottles. Around 6-10 small steels balls are kept inner for correct blending. Mixing turned into achieved till the vibrator suggests one thousand revolutions which nearly took five hours.

Compaction

The compaction experiments were achieved to make cylindrical FA compacts. Cylindrical die and punch having 15 mm diameter product of chrome steel changed into used to make cylindrical Fly ash compacts. Mixture of about 5 gm. Turned into taken for each composition. Then the punch & die turned into cleaned with cotton followed through acetone so that all the dirt is removed from the inner floor of the die and outside floor of the punch. Then greasing turned into performed to avoid sticking. The aggregate organized in advance became poured interior cautiously. At some stage in the packing moderate shaking changed into accomplished to deal with the maximum feasible amount of cloth. Eventually the entire gadget turned into subjected to hydraulic seal valve made tight, mounting became carried out coaxially. Maximum of 6tons of load become applied on it very slowly. Once the maximum load become finished, the apparatus changed into powered off. The whole machine became comfortable for 5 mins which then accompanied through unloading. Compact turned into ejected from the Die in the identical route as the compression and changed into saved in normal surroundings for 1 day.

CONCLUSION

The results of experimental study on polymer concrete with epoxy resins & glass fibre have been discussed. This investigation contains an experimental observation in which the comparison between Conventional concrete, polymer resin concrete and Polymer fibre concrete has made. As per the results obtained, increases the compressive strength and flexural strength by polymer resin in normal concrete. Increase of resin content from 3% to 5% had improved in workability and also in compressive strength and flexural strength. Addition glass fibre to the polymer concrete improves the compressive strength.

All the batches gain their maximum strength around the age of 28 days. At the age of 7 days all the batches reached at least 80% of the 28-day compressive strength under the adopted curing method. Increasing fly ash content reduced the voids and increased the compressive strength for polymer concrete. Nevertheless they argued that the strength level of the resin itself will contribute to the overall compressive strength of polymer concrete. Epoxy resin has the greater degree of toughness and bond strength. Therefore, with increasing fly ash epoxy based polymer concrete shows increasing strength.

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