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Use of the Rmocol Waste in Fiber Reinforced Concrete

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Abstract— ***Different types of wastes generated in today's world causes great harm to environment, resulting mainly in air, water and soil pollution. In civil engineering concrete plays a vital role in construction purposes. Keeping in mind the effects of global warming and air pollution Thermocol which when treated as a waste creates a lot of trouble when it is burned releases poisonous gases causing respiratory problems causing to death. Thermocol when buried makes the soil infertile and thus cause great harm to environment hence reducing the crop production. Thermocol is a pre expanded closed cell foam of polystyrene beats. It gives non-hydroscopic odorless rigid closed cell. So we can combined it with concrete to make a fiber reinforced concrete and it can be mixed easily because of its property of light weight and dimensional stability. This concrete can offers thermal resisting property as taken from Thermocol which can be used in ceilings and walls and also due to sound proof nature it can be used in sound proof structures. This fiber reinforced concrete offers improve tensile strength and energy absorbing properties in addition with improved impact strength and fatigue strength which in uncommon in normal concrete.***

I. INTRODUCTION

Concrete is a compound made of cement, sand with mixing of fine and course aggregates in a definite proportion with addition of water by following proper water cement ratio. Mainly concrete shows compressive properties and it contains only one tenth tensile strength of its compressive strength for providing adequate tensile strength in concrete structures normally, we use steel bars of different diameter size. In this study we deal with the compressive strength of the concrete with mixing of desired fiber waste so that what other properties we will get after adding of fiber waste and what affect does it creates on compressive strength of concrete and what is the scope of that concrete in construction purposes. Since we know many types of fiber waste are there in our environment some of them are glass fiber, synthetic fiber including plastic, nylon and Thermocol fibers, natural fibers including rice husk and jute fiber.

II. LITERATURE REVIEW

Parhihkar in 2011 investigated the properties of volcanic pumicelightweightconcreteusingtwosamplesonewith course aggregates with natural fine aggregates and other with course aggregates and fine aggregates. After the result of compressive strength, tensile strength and drying shrinkage the study concludes that the light weight concretemeetstherequirement of structural light weight concrete. **Sivalingarao** in 2013 studied on light weight aggregate concrete with natural pumice stone. M20 grade was used in that and result was came that more target mean strength was achieved by 20% replacement of naturalaggregateswithpumicestoneand1.5%offiber.

Also when 40% of pumice and 0.5% of fiber target mean strength of M20 was achieved. **DjWantoroHardjito** in 2004 investigated over the properties of fly ash based geopolymer concrete mainly dealing with compressive strength. Author concluded that the compressive strength of geopolymer concrete has no relation with age of concrete however curing in high temperature and long curing will give the higher strength and above all water in the concrete mix plays an important role in strength.

Mohd. Mustafa in 2011 gave ecofriendly concrete by replacing OPC with fly ash. He concluded that this concrete can be better than normal concrete in aggressive climate and high temperature. **Lloyd** in 2010 put efforts to make geopolymer based concrete and tests were done on large scale concluding the usage of the same in precast members also.

III. APPLICATIONS

By producing fiber reinforced concrete using Thermocol thermal and sound resistant properties increases hence can minimize Thermocol waste as well from environment. This concrete can be treated as light weight concrete and can provide desired structural integrity as well. This concrete is useful in road pavements, industrial footings, bridge decks, canals linings, explosive resistant structures, refractory linings, fabrication of pipes, boats, beams, stair case steps, roof panels, wall panels, manhole covers.

Moreover it can be used in industrial footings, sprayed concrete can also be termed as guniting, fire resistant structures, slender structures. Lastly can also be used in precast members and mortar making works.

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IV. MATERIAL REQUIRED AND MIXING DETAILS CEMENT & RESULTS

Chemical compound made of silica, lime, alumina, iron oxide, magnesia, and Sulphur. Good quality cement should feel smooth on hands when rubbed and must contains good binding property when mixed with water and other constituents.

FINEAGGREGATES

Sand passed through 4.75mm sieve having specific gravity 2.63 ad fineness modulus 2.94

COURSE AGREGATES

Aggregates used was passed through 12.5mm and retained on 10mm sieve.

THERMOCOL

a closed cell foam, rigid, tough, having pre- expanded polyester beads figure 1 shows below.

Figure no.1 Thermocol

Density range 15-30 kg/m^3, compressive strength range 0.8-1.6 kn/m^2, tensile strength range 3-6 kn/m^2, melting point 100-200 C, thermal conductivity is low, sound absorption high and moisture absorption low.

CONCRETE MIX

Various types of concrete grades classified from M5-M25 are considered as nominal mix and M30 and above are consideredas design mix. Cement, sand and aggregates (fine and course) can be taken by volume as well as by weight. Here in our study we took it by weight. We have used here M15 grade of nominal mix concrete by reference of IS 456-2000.

Figure no.2 Nominal Concrete Mix

V. FACTORS AFFECTING CONCRETE MIX

- Compressive Strength
- Workability
- Durability
- Maximum Nominal Size of Aggregates

MIX	**MIX DETAILS**
Ratio	**1:2:4**
Plain conc.	**Cement: Fine agg. Coarse agg.**
Sample 1	**Cement: Fine agg.: Coarse agg.+ 1%thermocol**
Sample 2	**Cement: Fine agg.: Coarse agg.+ 2%thermocol**
Sample 3	**Cement: Fine agg.: Coarse acc.+ 3%thermocol**

Table no.1 showing mix details

VI. TESTING METHODS AND RESULTS

WORKABILITY CHECK: -

Can be done by performing 2 tests as follows.

SLUMP TEST

In this test we generally observe 3 types of slumps (true slump, shear slump and collapse slump). After testing in plain concrete a true slump was observed whereas after adding Thermocol a shear slump was seen.

Figure no.3 True Slump

Figure no.4 Shear Slump

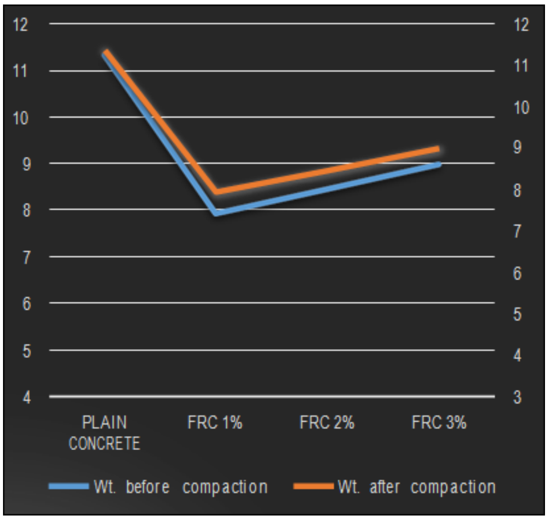
COMPACTION FACTOR TEST

Consistency of prepared concrete is observed by finding the ratio of weight of partially compacted concrete to weight of fully compacted concrete. Following details were observed from this test below.

Type of concrete	**Wt. of concrete before compaction**	**Wt. of concrete after compaction**
Plain concret e	**11.32kg**	**11.36kg**
1% FRC	**7.910kg**	**7.940kg**
2%FRC	**8.440kg**	**8.460kg**
3%FRC	**8.970kg**	**8.990kg**

Table no.2 showing compaction details.

Figure no.5 Compaction Factor Apparatus.



Graph no.1 Compaction factor

COMPRESSIVE STRENGTH TEST

This test gives the desired compressive strength of the cube made from fiber reinforced concrete cubes of (150x150x150) mm were designed and fully compacted on vibrating table and by tamping. Thermocol was added in designed proportions.

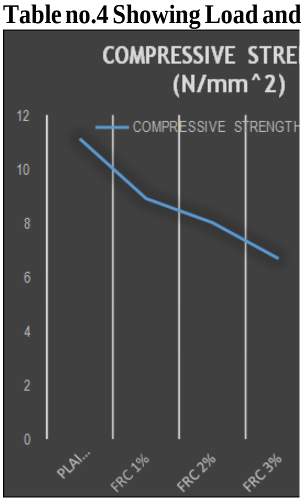
Figure no.6 (a) showing cube preparation (b) showing tamping

S. NO.	Mix Proportion Of Concrete	Plain Concrete	Sample 1	Sample 2	Sample 3
1	Fine Aggregates	2kg	2kg	2kg	2kg
2	Coarse Aggregates	4kg	4kg	4kg	4kg
3	Cement	1kg	1kg	1kg	1kg
4	Fibre (Thermocol)	Nil	1%(10g ms	2%(20g ms	3%(30g ms)

Tableno.3ShowingMixProportionDetails

S.NO.	Age Of Cube	Type Of Concrete Cube	Load Applied (kN)	Cross-section area (mm^2)	Compressive Strength (N/mm^2)
1	28days	Plain Concrete	250	22500	11.11
2	28days	Sample 1	200	22500	8.89
3	28days	Sample 2	180	22500	8.00
4	28days	Sample 3	150	22500	6.67

Table no.4 Showing Load and Compressive strength Details



Graphno.2showingcompressivestrength

The average 28 day strength of concrete sample is found to be 8.67N/mm^2. A decrease in compressive strength shown by gradual addition of Thermocol of 1%, 2%, & 3%.

NON-DISTRUCTIVE TESTS

Non-destructive parameters are tested by using **ultrasonic pulse velocity test** and **rebound hammer test** to determine the homogeneity of concrete as well as to detect the voids, cracks and segregation in compacted concrete and hence concluding the overall quality of concrete.

Figure no.7 Performing Pulse Velocity Test

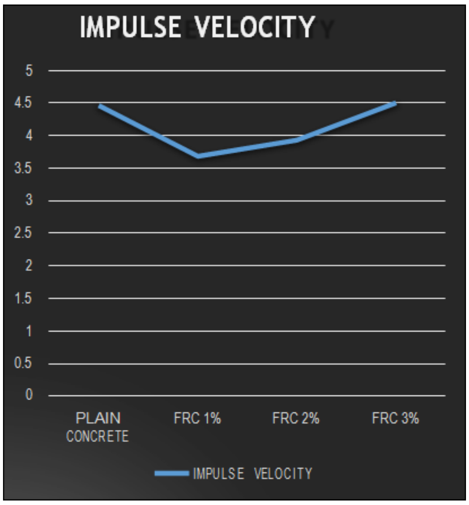
Figure no.8 ultrasonic pulse velocity Apparatus

S.No.	TYPE OF CONCRETE	DISTANCE (km)	TIME (sec)	IMPULSE VELOCITY (km/sec)
1	PLAIN CONCRETE	150*10^-6	33.6*10^-6	4.46
2	FRC 1%	150*10^-6	40.7*10^-6	3.68
3	FRC 2%	150*10^-6	38.1*10^-6	3.93
4	FRC 3%	150*10^-6	37.5*10^-6	4

Table no.5 showing impulse velocity details

For concrete quality grading impulse velocity above 4.5 is considered as excellent from 3.5-4.5, it is termed as good from 3-3.5 it is termed as medium and below 3 it is termed as bad.

The impulse velocity of plain concrete found to be excellent as it is above 4.5 and after comparing it with fiber reinforced concrete it is good. Most suitable FRB is of 3% Thermocol mixture having value 4.



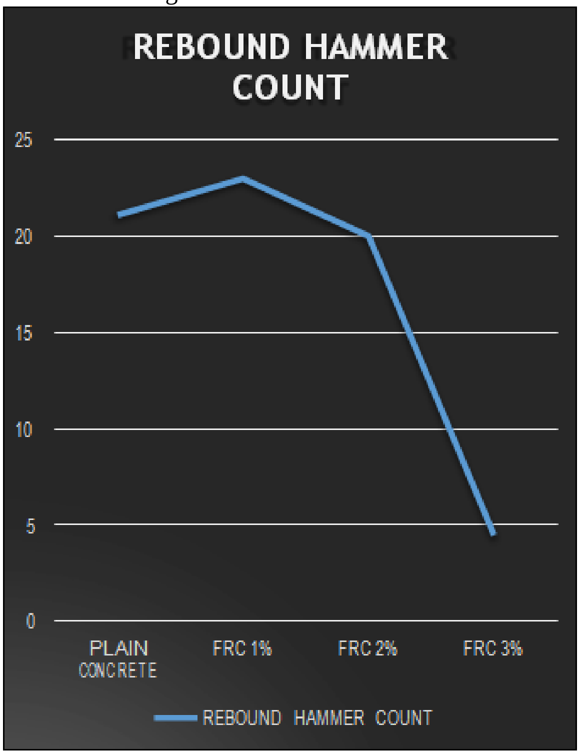
Graph no.3 showing Impulse Velocity

REBOUND HAMMER TEST

Suitable co-relations found between rebound index and compressive strength. Assessing the suitable uniformity of concrete and determining the quality of one element in relation to other.

Figure no.9 Rebound Hammer Apparatus

For testing normal weight concrete the impact energy required for rebound hammers is 2.25Nm, for testing light weight concrete or impact sensitive parts of concrete it must be 0.75Nm and for testing mass concrete value must be 30Nm



Graph no.4 showing Rebound Hammer Count

Rebound count decreases with increasing proportions of Thermocol n concrete. It shows that the uniformity decreases and ultimately compressive strength decreases as compared to normal plain concrete.

VII. CONCLUSION AND DISCUSSIONS

We observed that some of the isotropic strength properties added in fiber reinforced concrete with increased thermal resistance, impact strength, and energy absorbing characteristics. It cannot be concluded that the use of Thermocol based fiber reinforced concrete will overcome the use of conventional concrete but it can provide a suitable crack resistant structure and higher ductility. Above mentioned properties of FRC may be useful in some specified conditions where conventional concrete is less suitable. This can be a new approach in designing and utilization of waste material of Thermocol and to manage some of waste generating is today's environment thus can also be useful in managing economy.

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