An Investigation on The Effect of Partial Replacement of Cement By Slate Powder on The Properties of Concrete And Thermal Conductivity

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Abstract- *In this paper Slate waste powder use as partial replacement of cement in concrete for thermal conductivity test and compressive strength test of concrete have been investigated and reported. Concrete cube of slate waste powder casted yourself and these concrete strength in expression of compressive strength and tensile strength evaluated experimentally. It is found the compressive and tensile strength of slate waste powder concrete can be comparable with OPC concrete .It is found that the strength of Slate waste powder replaced concrete in terms of compression and split tension can be comparable with the conventional concrete. This study is aimed of some partial such as (0%, 10%, and 20%) substitution of cement with slate waste powder in concrete mix that will with partial replacement of cement by slate waste powder (0%, 10%, and 20%) that will give an advantage of pollution reducing, Sinking the caste of construction and most important to maintain indoor temperature of room in different weather condition. The use of Slate waste powder in making of concrete are very useful such as Maintain Indoor temperature of room at different weather conditions, making green building, reduce the caste of construction and pollution control but also helpful in sustainable development.*

Keywords- Slate Powder, Concrete, Cement.

I. INTRODUCTION

Today environmental pollution and social are major issue from disposing of slate waste powder .The aim of this project are evaluating the prospect of using Slate waste powder to partially replacement of cement in concrete for Thermal conductivity (maintain indoor temperature of room at different weather conditions), reduce the cost of construction.
In India Slate waste powder are producing in very huge amount from the construction Industries of , pensile industry, Building flooring material, Slate roof tiles, Electric switch board etc from pulverizing of rock Natural volcanic Eruption. These waste directly polluted of environment it is very harmful for Serving of people in this environment So that slate waste powder use in construction industries so reduce the pollution in environment. It is eco friendly and sustainable development.

"This paper aims to summaries the constraints on the use of slate waste as partial replacement of cement in Concrete due to specifications and to make recommendations to improve the concrete Properties, compressive strength of concrete, Thermal conductivity and maintain the indoor temperature of room in different weather condition".

A. Objectives

- To compare the compressive strength of Slate waste powder used as some partial substitution of cement for Constructional Concrete with OPC concrete.
- To reduce the pressure on naturally available materials by replacing it with recycled plastic aggregate.
- To compare the physical characteristics of natural Slate waste powder with Cement powder.
- To study the behaviour of without replacement of cements fresh and hardened concrete with partial replacement of Cement with Slate waste powder in concrete.

II. MATERIAL USED

In the present experimental work, Slate waste powder, cement and aggregate.

Slate waste powder - Slate powder chemically is Quartz, Sericite mica, chlorite, and Silica in the appearance of iron Silicate, and Aluminium Silicate. In this material the little quantity of Magnesium, Calcium, , and Titanium shown in fig no 1.Slate waste powder are producing in very huge amount from the construction Industries, pensile industry, Building flooring material, Slate roof tiles, Electric switch board etc from pulverizing of rock Natural volcanic Eruption shown in

fig.3. Slate is a good electrical insulator and fire proof material. The current uses of resources in the construction Industry are very high.

Fig 2.1 Slate waste powder

Table 2.1: The most significant mineral constituents of slate

Minerals	% by weight
Quartz	34-43
Sericite mica	36-42
Chlorit	7-20
Rutile	1-2.5
Haematite	2-8

Table 2.2 Chemical composition

	Crockett,1975	Charm bury, 2004	
	Typical	Penrhyn	Ffestiniog
	Weight in %		
SiO_2	46 - 66	97.54	53.97
AL_2O_3	10- 26	18.96	23.28
FEO	0.4 -8	-	-
Na_2O	1- 5	0.16	0.83
K_2O	1 - 7	0.36	5.10
MgO	3 - 8	2.56	1.38
TiO_2	1 - 2.5	0.72	1.53
Mn_2O_3	-	11.27	9.91
Fe_2O_3	-	11.27	9.91
MnO	-	-	-
CaO	-	0.35	0.32
SO_3	-	1.55	0.45
CO2	-	<0.01	0.10
F	-	0.50	-
P_2O_5	-	-	-
Sulphide S	-	-	
Pyritic and organic	-	-	-
Loss on detonation	-	3.78	4.98
Not indomitable	-	1.21	0.23

Cement

Cement is a binder material of concrete to provide that hardens, sets of concrete and adhere to reinforcement, aggregate and sand or other materials to attached them mutually. Cement sundry with fine aggregate or course aggregate making mortar for Brick masonry work. Cement is the most broadly worn material in concrete subsistence and cement reacting with present of water. In this research we are using Ordinary Portland cement.

Table No 2.3. Constituents of Cement

Constituents of Cement:						
Comparison of Chemical and Physical Characteristics						
Property		OPC	Siliceous[b]fly ash	Calcareous[c]fly ash	Slag cement	Silica fume
Content (%)	Fe_2O_3	2.5	13	7	2	—
	Al_2O_3	6.5	24	19	13	—
	CaO	65	6	23	42	< 1
	SiO_2	22.1	54	32	36	82-95
	MgO	2.6	—	—	—	—
	SO_3	1.8	—	—	—	—
Specific surface[d] (m^2/kg)		372	425	425	405	16–32.0
Specific gravity		3.16	2.42	2.71	2.85	2.32

Aggregates

Aggregate are the inert material of concrete it is also known as concur. These aggregate mixed with cement and sand for making the concrete. Aggregate available in standard size in India such as 40mm, 20mm, 16mm and 2.5 mm etc. The aggregate provide strength, durability and hardness of the concrete.

Fine and coarse aggregates locally available were tested and confirmed the requirements as per Indian Standards (BIS 2386-1963, BIS 383-1970).

Fig 2.1:Aggregate

Table 2.4 Aggregate properties

PROPERTIES	FINE AGGREGATE	COARSE AGGREGATE
Specific Gravity	2.32	2.60
Fineness Modulus	2.82	7.10
Water Absorption	1.50%	0.80%

III. LITERATURE REVIEW

A. Introduction

The purpose of this lesson is to have a broad understanding of using materials with the replacement of cement in concrete using Slate waste powder (SWP) for minimize the pollution and maintain indoor temperature at different weather condition.

B. Earlier Researches

1. According toFrias, and R. Vigil de la Villa from from Eduard Torroja Institute (CSIC), 28033 Madrid, Spain. " Activated slate waste at 1000^0 C for retention time 2h**.**

2. According to Wafa Labib and Nick Eden from Liverpool John Moores University,UK They are investigate slate waste use as aggregate in concrete and find out the good workability, strength and durability of alternative aggregate in concrete.

C. Summary of the literature Review

- Concrete is the most broadly used construction such as building ,Dam, Bridge etc using different material in the world but it not control the temperature in different weather condition.
- Hence weather condition also affected the human being and environment so that the human being facing the problem in the indoor or room temperature in different weather condition such as summer time more heating so room temperature are very high in this condition human facing different types of problem such as filling chilly, sleeping uncomfortable, cloth removal, dehydration and different types diseases of problem arising. Same as winter season room temperature very cold as compare to normal temperature there were human body survive comfortable in normal temperature between 18^0C (64 ^{0}F) to 22^0C (68 ^{0}F).
- Since indoor temperature can be too extreme if the building is poorly designed so that the human not stay in the room for long time so properly designed of building and naturally ventilated building keep indoor condition within the range where opening windows.
- So that I want to reduce the these types of problem by using slate waste powder in any construction of building.
- This study is aimed of some partial such as (0%, 10%, and 20%) substitution of cement with slate waste powder in concrete mix that will with partial replacement of cement by slate waste powder (0%, 10%, and 20%) that behaviour of concrete in strength consideration and thermal conductivity test.

IV. METHODOLOGY

1. Compression Testing Machine (CTM)
2. Mould (150 x150 x 150)mm

A. Sieve Analysis

The sieve analysis was carried out on fine aggregate using I.S. sieve. The fine aggregate being used satisfies the guideline of code IS 373:1970. A sieve analysis (or gradation test) is a practice or procedure used to assess the particle size distribution (also called *gradation*) of a granular material by allowing the material to pass through a series of sieves of progressively smaller mesh size and weighing the amount of material that is stopped by each sieve as a fraction of the whole mass.

B. Compression Testing Machine (CTM)

Compression tests are used to determine how a product or material reacts when it is compacted, dense, crushed or flattened by measuring elemental parameters that find out the specimen behavior under a compressive load.

Fig.4.1 Compression Testing Machine

Compression tests can be undertaken as part of the design process, in the production environment or in the quality control laboratory, and can be used to:

- Check the compressive strength of slate waste powder concrete and ordinary Portland cement concrete samples at interval of 7, 14,28 and 90 days
- Evaluate the potency of components e.g. automotive and aeronautical control switches, compression springs,

bellows, keypads, package seals, PET containers, PVC / ABS pipes, solenoids etc.

- Differentiate the compressive properties of materials e.g. foam, metal, PET and other plastics and rubber.

C. Mould

These ISI Cube Moulds are use for making Concrete /cement Cubes which are use for preparation of concrete cube specimens of high strength materials for compression testing.

Fig: 4.2 Casting Mould (150x150x150) mm

V. HYPOTHESIS

Initially outcome has been slate powder as partial replacement of cement mix with concrete the concrete give compressive strength and indoor temperature maintain in different weather conditions. Take the test of different sample such as

- Cube test
- Slump test
- Durability test

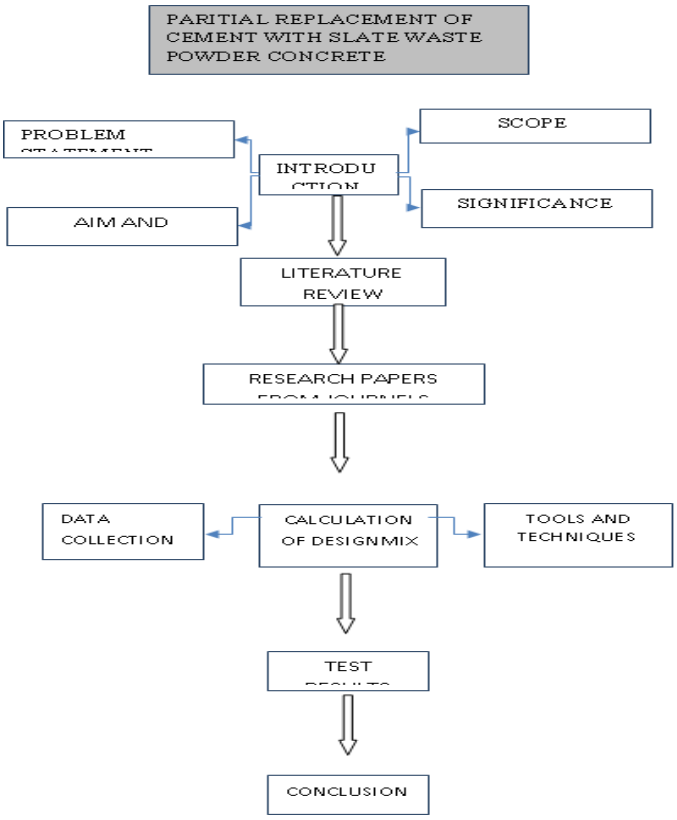


Fig: 4.3 Flow Chart

Experimental Procedure adopted of compressive strength test

1. Take three cube moulds for each mix. Bring together the mould with base plate so that it is rigidly held mutually.
2. Clean the inside of the mould and see that joints (at the edges) are perfectly tight.
3. Use oil in inner face of moulds
4. Pour properly mixed concrete for the given mix to the cube moulds.
5. Compaction by needle vibrator will be preferred. If vibrator is not available, hand compaction is to be done by placing concrete in three layers; each layer be compressed with the help of standard temping rod by means of 34 blows.
6. Keep the cubes in laboratory for 24 hours at room temperature 27- 32º C.
7. After 24 hours, dismantle the plates of cube mould and take out the hardened concrete cubes carefully so that edges specimens are not damaged.
8. Immerse the cubes in curing tank filled with water carry on it for curing up to 28 days
9. Water should be clean and Change the water after 7 days.
10. Test the cubes after 7, 14 , 28 , 90 days of curing to find the compressive strength.
11. Tabulate Compressive strength for each cube and calculate average value for each.

VI. RESULT AND DISCUSSION

a) Calculation of slate powder weight for the mix design for M25

Table 5.1 weight of mix

% replacement By volume	Weight of Slate powder(kg)	Weight of coarse aggt. After replacement
10	2.71	79.2-2.37=76.83
20	5.43	79.2-5.43=73.76
30	8.13	79.2-8.13=71.07

b) Mix calculation for required volume of concrete

Volume of Co. = (0.15^3+π*0.15^2/4*30)*24=0.208m3

Volume of cement =(383*0.208)*1/(3.1.15*1000) = 0.025 m3
Volume of water = (191.6*0.208)/ (1*10^3) =0.04 m3
Volume of all in aggregate0.208-(.025+.04) =0.143 m3
Mass of aggregate=0.143*0.61*2.68*1000=233.77kg
Mass of fine aggregate = 0.143* 0.39*2.68*1000 = 149.46 kg

A. OBSERVATION OF SLUMP TEST

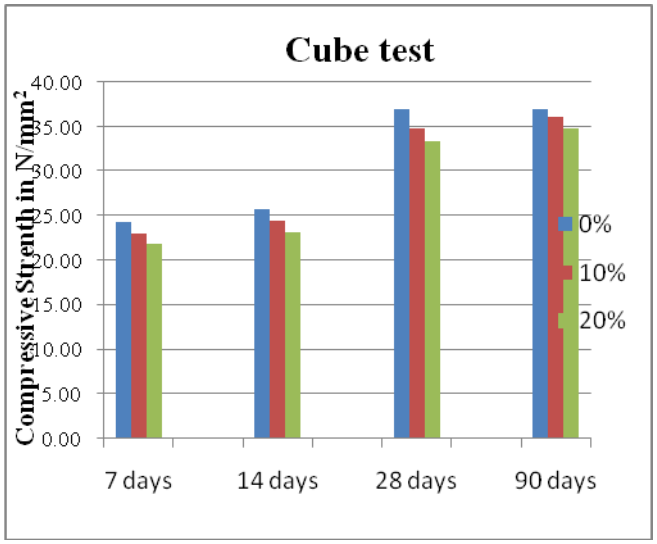
Table 5.2 Slum test

W/C ratio	% Of replca ment	Height of mould (H1) mm	Height of subsided concrete H2 (mm)	Slump (H1-H2) in mm
0.55	0	300	245	55
0.55	10	300	242	58
0.55	20	300	238	62

B. COMPRESSIVE STRENGTH TEST

Table 5.3 Compressive strength Test on M25

% of replac ement	Peak Load in (KN)				Compressive Strength (N/mm2)			
	7-days	14-days	28-days	90-days	7-days	14-days	28-days	90-days
	550	600	825	830	24.44	26.67	36.67	36.89
	535	575	770	775	23.78	25.56	34.22	34.44
0%	555	560	900	895	24.67	24.89	40	39.78
	520	525	790	795	23.11	23.33	35.11	35.33
	500	550	830	820	22.22	24.44	36.89	36.44
10%	530	580	730	805	23.56	25.78	32.44	35.78
	475	520	755	785	21.11	23.11	33.56	34.89
	490	540	800	810	21.78	24	35.56	36.00
20%	510	500	700	775	22.67	22.22	31.11	34.44

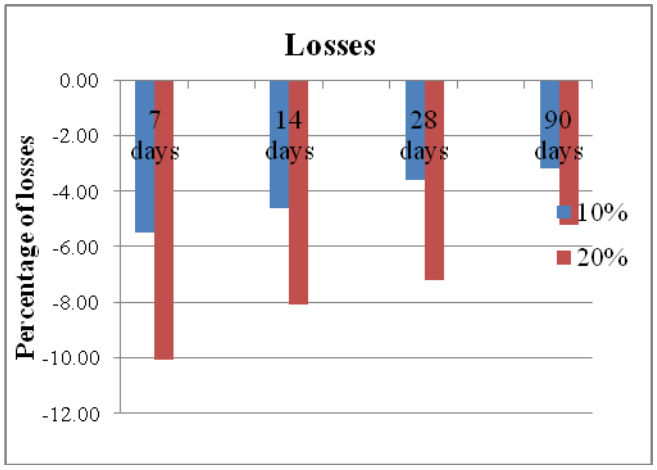


Graph 5.3 Comparison of Compressive strength of 0%,10%,20

Table 5.4 Losses in Compressive strength

Replacement of cement with Slate powder	7 days	14 days	28 days	90 days
10%	-5.49	-4.61	-3.61	-2.40
20%	-10.06	-8.07	-7.21	-5.80

2 Losses in compressive strength



Results:

Compressive strength of partial substitution of cement with slate waste powder concrete is lower compressive strength than the reference concrete. These compression losses

in show fig at 10% and 20% replacement of cement for 7 days, 14 days ,28 days and 90 days.

When we are replacing 10% of cement with slate waste powder then compressive strength losses 5.49% at reaction time 7 days , 4.61% loses at 14 days, 3.61 % loses at 28 days and final losses at 90days is 2.40% losses same as the 20% replacement of cement then losses 10.06% at 7 days , 8.07% losses at 14 days , 7.21 % losses at 28 days and final 5.80 % losses at 90 days. In this result we found the 10 % and 20% replacement at 90 days of reaction, the relative losses were only 2.40% and 5.80 % which are nevertheless.

C. THERMAL CONDUCTIVTY TEST

The slate waste activated at 1000^0 C and with a retention time of 2h , show high pozzolanic activity, manly following 7 days of reaction, taking fixed lime percentages into account. At a reaction time of 90 days , 84 % of the available lime had been fixed by slate waste powder.

"These data taken by following researcher M.Frias, R. Vigil de la Villa, R.Garcia, I.de Soto, C.Medina, M.I. Sanchez de Rojas from Eduard Torroja Institute (CSIC), 28033 Madrid, Spain."

VII. CONCLUSION

The experimental results have shown the Slate waste powder used as 20% replacement of cement in concrete these concrete to maintain indoor temperature of room and minimize the environmental impact due to unscientific disposal of slate waste and also reduce the cost of construction. The following conclusions were drawn:

- The properties of concrete containing various percentage of slate (0%, 10%, 20%) were tested for its physical properties and compressive strength.
- The Slate waste blended cements led to higher SiO_2, Al_2O_3 and Fe_2O_3 Contents than in the reference OPC.
- The slate waste activated at 1000^0 C and with a retention time of 2h , show high pozzolanic activity, manly following 7 days of reaction, taking fixed lime percentages into description. At a reaction time of 90 days ,90 % of the available lime had been fixed by slate waste powder.
- The compressive strength of Slate concrete is compared with plain cement concrete then it is found that the compressive strength up to 90% is achieved for a mix of slate waste up to 20% (as a replacement of cement) in concrete.
- Replacement 10% of cement with slate waste powder then compressive strength losses 5.49% at reaction time 7 days , 4.61% loses at 14 days, 3.61 % loses at 28 days and final losses at 90days is 2.40% losses same as the 20% replacement of cement then losses 10.06% at 7 days , 8.07% losses at 14 days , 7.21 % losses at 28 days and final 5.80 % losses at 90 days. In this result we found the 10 % and 20% replacement at 90 days of reaction, the relative losses were only 2.40% and 5.80 % which are nevertheless.
- The mechanical properties of the test concrete did not display any notable differences depending on the color of the slate waste.
- The replacement of cement with slate powder in concrete then water demand increase 2.6% and 5.2% respectively, in the pastes with replacement of 10% and 20% of cement with Slate waste powder.
- After replacement of 10% and 20% cement with slate then the initial setting of this fresh concrete is 40min.

VIII. SCOPE OF FUTURE WORK

The present research can be extended to

- The test can be carried out for different grades of concrete.
- Thermal conductivity test on addition of slate waste powder.
- Indoor room temperature maintain if addition of more than 30% of slate waste in concrete mortar using Rcc wall ,slab and flooring.
- Filler material may be for roads and embankments
- For manufacturing of bricks.
- Manufacturing of Portland cement.
- Manufacturing of ceramics tiles.
- Manufacturing of thermo set resins
- Reduce the construction cost of building
- Development of green house building.

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