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A COMPARATIVE STUDY ON STRENGTH ASPECTS OF HD PET THERMOPLASTIC WITH METAKAOLIN AND GROUND GRANULATED BLAST FURNACE SLAG"

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Abstract –

When we talking about the most versatile, reliable and durable material in the field of construction first name comes is Concrete, after that cement comes. These materials make the world beautiful but this is one aspect, the other aspect says that it pollutes the environment, as the cement plants that emit a lot of carbon die oxide. The main aim of this study is to concern towards the environment and provide the best alternate amongst GGBFS and Metakaolin.

resent study evaluates strength parameters of the concrete containing the combination of above mentioned materials. The experimental program consists of preparing concrete mixes with Meta kaolin and GGBFS as a partial replacement of cement (5%, 10% and 15%) and similarly Fine aggregate replaced by the HD Pet thermoplastic in proportion of 5% and 10% simultaneously. The performance of the concrete mixes for compressive strength at the age 28 days, flexural strength at 28 days test were investigated. After checking the strength with various replacement levels, we finally concluded the variation in strength parameters.

1. INTRODUCTION

Concrete is quite possibly the most flexible and generally acknowledged construction material around the world. The explanation for this is the normally, efficiently and effectively accessibility of fixings as concrete, river sand, coarse aggregate and water. After the water, concrete is the second most construction material on the planet. At present day time of innovation concrete plays, a significant part exceptionally the green substantial which utilizes industrial waste. The fast construction on the planet needs imaginative green construction materials. Anyway a few issues related with this fast construction exercises is that it is liable for roughly 40% normal assets utilization. The fast construction on the planet need quick creation of cement which makes two major natural issues for which we need to figure out inventive Civil engineering solutions. The extraordinary ecological issue is emanation of CO2 in the production cycle of the cement. It is realizing that CO2 emanation is exceptionally hurtful which makes bunches of natural changes inexact 1 tons of carbon dioxide is assessed to be delivered to the climate when 1 tone of standard Portland cement is made, so it is fundamental for control the production of cement. As there is no alternative binding material which totally replace the cement so the utilization of partial replacement of cement is well accepted for concrete composites. As a Supplementary cementitious material Ground granulated blast-furnace slag, fly ash, silica fume, Meta kaolin, calcium carbide residue can be used. The Use of Supplementary Cementitious Material in concrete buildings now not best prevents these materials to check the pollution but additionally to decorate the properties of concrete in clean and hardened states and additionally make them durable specifically GGBFS. Present look at consciousness on the durability and strength parameters with partial substitute of cement with some above noted substances. Ground-granulated blast-furnace slag and Meta kaolin is known to produce a high strength concrete and is used as a cement replacement, in order to reduce the cement content (usually for techno economic reasons) and as an additive to improve concrete properties in both fresh and hardened states. A lot of studies have already been done on GGBS and Meta kaolin, as it provides satisfactory results to researcher but the present study deals with GGBFS used as a partial replacement of Cement at different proportions along with the CCR and Hd Pet thermo plastic as a partial replacement of fine aggregate, similarly the work is to be repeated for Meta kaolin as partial replacement of Cement at different proportions along with the CCR and Hd Pet thermo plastic as a partial replacement of fine aggregate, not so much studies have done on this combination and comparison so far.

1.1 Materials

High Density Polyethylene Terephthalate Thermoplastics

Thermoplastic is a material which turns out to be delicate when warmed and hard when cooled. Thermoplastic can be cooled and warmed a few times, and they can likewise be reused, they additionally freeze to a glazy state when cooled enough.

Thermoplastics are the materials which are produced by the reusing of waste plastic as plastic granules of size going from 4-5mm long.

Ground-granulated blast-furnace slag GGBFS is acquired via quenching molten iron slag from a blast furnace in water, to supply a glassy, granular product this is then dried and convert into a fine powder. GGBFS is used to make long lasting concrete structures in combination with normal Portland cement or other pozzolanic materials. GGBFS reacts like Portland cement whilst in touch with water.

Meta kaolin - Metakaolin is not a by product. It is obtained by calcimine pure or refined kaolinite clay at a temperature of 6500 to 8500 ° C and then grinding to a fineness of 700 to 900 m 2 / kg. Metakaolin is a pozzolanic supplement / product that has many specific properties. Metakaolin is available in many different varieties and qualities. The purity determines the binder capacity or the free lime. When used in concrete, the empty space between the cement particles is filled, making the concrete more impenetrable. Metakaolin, a relatively new material in the concrete industry, causes an increase in strength.

2. Studies Related to Present Research:

Sayed Imran Ali et. Al. (2018) have explored the slump and strength parameters essentially compressive strength of M-40 Grade of cement with partial supplanting of cement with GGBS and fine aggregate with Kota stone powder slurry. Compressive strength test was completed for 7, 28 and 56 days while flexural and split tensile strength test was done at 28 days curing period. The cement has been supplanted by GGBS in the scope of 20%, 30%, 40% by weight of cement, Kota stone powder slurry in the range of 5% to 20% by weight of fine aggregate for M40 grade. The following conclusions are reported –

• The workability of concrete was found to increment with the increase in GGBS in concrete. It further declines as the level of KSPS increments.

• Indeed, even by lessening cement substance by 40% with GGBS, the compressive strength of M 40 Grade concrete doesn't diminish (at 56 years old days) and it is seen to be practically like the control mix concrete (without GGBS).

Narmatha and Felixkala (2016) investigated meta kaolin as a partial replacement with cement with 5%, 10%, 15% and 20% levels. The specimens were casted with M-60 Grade of concrete. The following conclusions were drawn-

• The strength of all Meta kaolin concrete mixes over shoot the strength of concrete with OPC 15% cement replacement by Meta kaolin is superior to all other mixes.

- The utilization of waste PET in concrete gives a few benefits like decrease in the utilization of normal aggregate, removal of waste and counteraction of ecological contamination.

Nadeem and Rohan (2015) present the investigation of the halfway substitution of fine totals by HD-PET thermoplastics and concrete by matte staple glass filaments in M20 grade concrete. In this pioneering work, endeavours were made to look at the compressive, breaking and flexural strength of M20 grade substantial concrete utilizing HD-PET thermoplastics and glass strands as a fragmentary swap for fine totals. also concrete. The compressive strength test was completed to zero in on the strength of the concrete during the 7 and 28 days of the relieving time frame and the rigidity and split bowing was coordinated to concentrate on the strength during the 28 days of the restoring time frame.

Sachin Patil, Veeresh and Sagar (2019) Present study focused on the increase of the investigation explores and evaluates the outcomes of the of concrete with a variety of replacing of

Sunny and Mohan (2017) investigated the characteristics of M-35 Grade of concrete with w/c ratio 0.42. the meta kaolin used in study were 5% to 25% with 5% replacement levels. The closures made by investigators on Slump, compressive and tensile strength on the concrete for 7 and 28 days are –

Based on the experimental investigation the following conclusion are reported –

- Meta kaolin concrete upgrade the compressive and flexural strength satisfactorily as compared to conventional concrete. Work ability decreases as level of meta kaolin in concrete increments.

2.3 Proportion of Meta kaolin and HD-Pet thermoplastic

In present review Meta kaolin and HD-Pet thermoplastic both utilized as an incomplete substitution of concrete and fine total separately, the trade level for Meta kaolin utilized in present review differs from 5% and 10% by weight of concrete. Likewise the substitution level for HD-Pet thermoplastic varies from 5% to 15%, with 5%interval.

2.4 Materials properties

Table -1: Properties of HD Pet thermoplastic

S. No	Physical Properties	HD Pet thermoplastic
1.	Density	350 – 400 kg/m^3
2.	Young's modulus	1900 MPa
3.	Colour	Whitish lustrous

Table -2: Properties of Meta kaolin

S.No	Chemical Properties	Meta kaolin
1.	CaO	0.09% (max)
2.	SiO_2	52%
3.	Al_2O_3	46%
4.	Fe_2O_3	0.60% (max)
5.	SO_3	-
6.	MgO	0.03% (max)
7.	TiO_2	0.65% (max)

Table -3: Properties of Ground granulated blast furnace slag

S.No	Chemical Properties	GGBFS
1.	CaO	30-34%
2.	SiO_2	30-36%
3.	Al_2O_3	18-25%
4.	Fe_2O_3	0.8-3%
5.	SO_3	0.1-0.4%
6.	MgO	6-10%

3. Proposed Tests on concrete (Fresh and Hardened State)

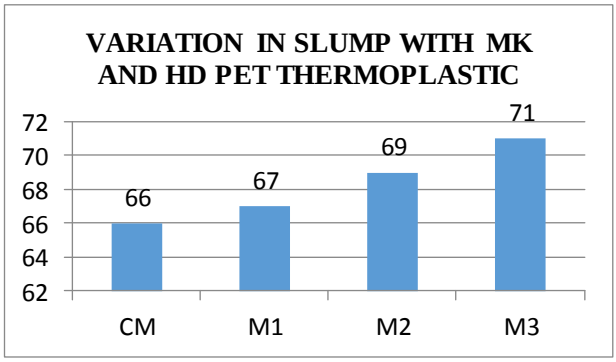
The following tests were conducted on concrete.

1. Slump test
2. Compressive Strength

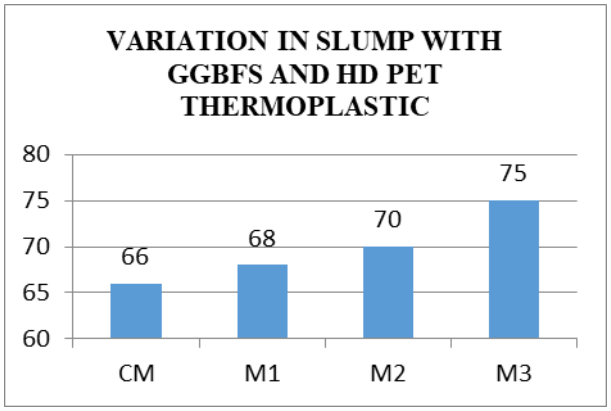
4 RESULTS

4.1 Slump variation in mix –

Variation in slump with Mk and HD pet thermoplastic



Variation in slump with GGBFS and HD pet thermoplastic



4.2 Comparison in Compressive Strength Test Results

The Comparison in Compressive strength test results of control mix and concrete prepared with 5% replacement of cement by Meta kaolin and the replacement levels of fine aggregate by Hd Pet thermoplastics ranging from 0% to 15% with the interval of 5% and the similar replacement with GGBFS are presented in Table.

F.A + HD PET	COMPRESSIVE STRENGTH	
	CEMENT + GGBS (95 + 5)	CEMENT + MK (95 + 5)
100 + 0	49.54	50.34
95 + 5	49	49.35
90 + 10	48.12	48.87
85 + 15	47.23	48.24

The Comparison in Compressive strength test results of control mix and concrete prepared with 10% replacement of cement by Meta kaolin and the replacement levels of fine aggregate by Hd Pet thermoplastics ranging from 0% to 15% with the interval of 5% and the similar replacement with GGBFS are presented in Table.

F.A + HD PET	COMPRESSIVE STRENGTH	
	CEMENT + GGBS (90 + 10)	CEMENT + MK (90 + 10)
100 + 0	50.87	52.76
95 + 5	50.01	51.54
90 + 10	49.34	50.11
85 + 15	48.67	49.47

The Comparison in Compressive strength test results of control mix and concrete prepared with 15% replacement of cement by Meta kaolin and the replacement levels of fine aggregate by Hd Pet thermoplastics ranging from 0% to 15%

with the interval of 5% and the similar replacement with GGBFS are presented in Table

F.A + HD PET	COMPRESSIVE STRENGTH	
	CEMENT + GGBS (85 + 15)	CEMENT + MK (85 + 15)
100 + 0	51.9	51.43
95 + 5	50.78	50.23
90 + 10	49.8	49.57
85 + 15	49	49

5. CONCLUSIONS

By evaluating the test results of Slump, Compressive Strength and Flexural Strength test on Concrete mix following conclusions have been made-

Slump Values - The Value of slump increases with increase of GGBFS and Meta kaolin content in the mix.

Compressive Strength - The concrete mix prepared with 5% Cement replaced by GGBFS and fine aggregate replaced by HD Pet thermoplastics in the range of 5% to 15%, then the compressive strength of mix achieved highest with the combination of 5% GGBFS and 5% HD Pet thermoplastics. Similar pattern follows by the mix prepared with 5% Cement replaced by Meta kaolin and fine aggregate replaced by HD Pet thermoplastics in the range of 5% to 15% i.e this combination also shows the maximum strength at 5% Meta kaolin and 5% HD Pet thermoplastics at the age of 28 days.

The concrete mix prepared with 10% Cement replaced by GGBFS and fine aggregate replaced by HD Pet thermoplastics in the range of 5% to 15%, then the compressive strength of mix achieved highest with the combination of 10% GGBFS and 5% HD Pet thermoplastics. Similar pattern follows by the mix prepared with 10% Cement replaced by Meta kaolin and fine aggregate replaced by HD Pet thermoplastics in the range of 5% to 15% i.e this combination also shows the maximum strength at 10% Meta kaolin and 5% HD Pet thermoplastics at the age of 28 days.

The concrete mix prepared with 15% Cement replaced by GGBFS and fine aggregate replaced by HD Pet thermoplastics in the range of 5% to 15%, then the compressive strength of mix achieved highest with the combination of 15% GGBFS and 5% HD Pet thermoplastics. Similar pattern follows by the mix prepared with 15% Cement replaced by Meta kaolin and fine aggregate replaced by HD Pet thermoplastics in the range of 5% to 15% i.e this combination also shows the maximum strength at 15% Meta kaolin and 5% HD Pet thermoplastics at the age of 28 days.

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