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Thermal resistance analysis and strength Studies on cement mortar using Metakaolin and Flyash as fine aggregate cured in seawater

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Abstract - *In this present study the ultimate aim of this project is to investigate whether the partial replacement of sand by the met kaolin and fly ash in the cement mortar will reach the strength , quality and thermal effect of the cement mortar having partially replaced met kaolin and fly ash in fine aggregate by compressive strength , thermal resistance and Fourier Transform Infrared spectrum analysis (FTIR)were evaluated for all combination of the mixes of cement mortar. By studying the various literature reviews, it is cleared that the 5% percentage of replacement of met kaolin and fly ash for cement will produce necessary results.*

Key Words: Cement mortar, metakaolin ,fly ash , Seawater, Thermal resistance ,FTIR.

1. INTRODUCTION

The metakaolin is produced by calcination of kaolin clay at temperature ranging from 700–850°C 00 The main oxides in the metakaolin silica and alumina partial replacement cement with metakaolin can increase the mechanical and durability performance of cement based materials .Fly ash is pozzalonic materials it is finely divided amorphous aluminum silicate with varying amount of calcium .The result of the fly ash in the concrete strength inflected by its physical and chemical properties Fly ash used in concrete 15% to 25% by mass compendious component ,it include the oxide contents of silicon, aluminum, calcium. The sea water temperature and salinity are 0°C -120°Cand 0-120g/kg respectively The atmosphere pressure range 0-12Mpa The properties varies between pure water to salt water about 5% to 10% can have important effect in system level design the specific heat capacity and boiling point elevation are all whose variation affect the distillation system.

In the FTIR Analysis Infrared Radiation is passed through the sample some of the infrared radiation is absorbed by the sample and some of its passed through or transmitted The resulting spectrum represents the molecular absorption and transmission creating molecular fingerprint of the sample .identify the unknown materials and quality or consistency of the sample .and determine the amount of component of mixture In thermal analysis the specimen were put in to an electric furnace and heated up to 700 degree Celsius for two hours it can determine the strength loss of the specimen due to thermal effect by vary of its dry weight and saturated weight .In the compressive strength of the different mortar the control mix can have the higher compressive strength than the replaced metakaolin and fly ash cement mortar

2. MATERIALS USED

2.1. Cement

The Portland pozzolana cement is a kind of blended cement which is produced by either intergrading of OPC clinker along with gypsum and pozzolanic materials separately or thoroughly blending them in a certain proportions. Pozzolana is a natural or artificial material containing silica in a reactive form. It may be further discussed as siliceous and aluminous material which in itself possesses little or no cementations properties, but it chemically react with calcium hydroxide at ordinary temperature to form compounds possessing cementations properties. Portland pozzolona cement produces less heat of hydration and offers greater resistance to attack of aggressive waters than ordinary Portland Cement. Pozzolona cement shall comply the requirements of IS 1489. 53 grade Portland pozzolona cement.

Fig -1: Portland pozzolona cement

2.2 Sand

The sand from river due to natural process attrition tends to possess smoother surface texture and better shape. It also carries moisture that is trapped in between the particles. These characters make concrete workability better. However, silt and clay carried by river sand can be harmful to the concrete. Another issue associated with river sand is that of obtaining required grading with afineness modulus of 3.8. It

has been verified and found, at various locations across south India, that it has become increasingly difficult to get river sand of consistent quality in terms of grading requirements and limited silt/clay content. It is because we do not have any control over the natural process.

2.3 Metakaolin

Metakaolin is white, amorphous, highly reactive aluminium silicate pozzolan forming stabile hydrates after mixing with lime stone in water and providing mortar with hydraulic properties. Heating up of clay with kaolinite.

Fig. 2 Metakaolin

2.4. Flyash

Fly ash material solidifies while suspended in the exhaust gases and is collected by electrostatic precipitators or filter bags. Since the particles solidify rapidly while suspended in the exhaust gases, fly ash particles are generally spherical in shape and range in size from 0.5 µm to 300 µm.

2.5. Seawater

Water is an important ingredient of mortar, which not only actively participates in the hydration of cement but also contributes to the workability of fresh concrete. cement is a mixture of complex compounds, the reaction of cement with water leads to its setting and hardening.The seawater is collected from athiraam pattinam near Pattukottai.

3. PROPERTIES OF MATERIALS

Table -1: Physical properties of Cement

Sl.No.	Property	Value
1	Initial setting time	45 minutes
2	Final setting time	8 hours
3	Specific gravity	3.11
4	Consistency	30%
5	Fineness modulus	6.38

Table -2: Physical properties of river sand

Sl.No.	Property	Value
1	Specific gravity	2.68
2	Water absorption	1.0%
3	Free moisture content	0.2%
4	Finess modulus	3.89

Table -3: Physical properties of Metakaolin

Sl.No.	Property	Value
1	Physical Form	Powder
2	Appearance	Off white ,Gray to Buff
3	Specific gravity	2.40 to 2.60
4	Brightness	80-82 Hunter L
5	Specific Surface	8-15 m^2/g

Table -4: Physical properties of Flyash

Sl.No.	Property	Value
1	water Absorption	3.14
2	Specific Gravity	2.28
3	Fineness modulus	6.42

4. RESULTS AND DISCUSSIONS

4.1 Compressive strength test

The compressive strength of cement mortar cube is tested as per procedure given IS 2250:1981.

The most common strength test, compressive strength, is carried out on a 50 mm cement mortar test specimen. The test specimen is subjected to a compressive load (usually from a hydraulic machine) until failure.

Table -5: Percentage replacement of metakaolin and flyash in mortar

Mix	Cement	River sand	Metakaolin	Fly ash
E	100%	100%	0%	0%
E1	100%	90%	5%	5%
E2	100%	85%	10%	5%
E3	100%	80%	15%	5%
E4	100%	85%	5%	10%
E5	100%	80%	5%	15%
E6	100%	80%	10%	10%
E7	100%	70%	15%	15%

Table -6: Percentage loss of strength

Mix	Compressive strength before heating F_c N/mm2	Compressive strength after heating F_{cf} N/mm2	Percentage loss of strength %
E	62.5	12.2	80
E1	55.68	26.66	51.92
E2	55	12.0	78.18
E3	54.61	11.6	78.76
E4	27.2	8.0	70.59
E5	26.0	9.6	63.08
E6	46.7	16.5	64
E7	38.4	11	71

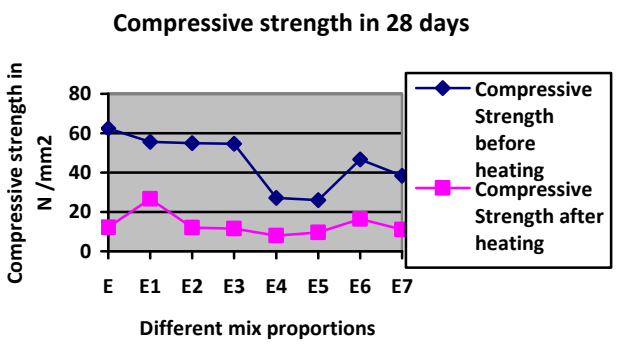

Chart -1: Compressive strength for various Percentage of metakaolin & flyash with and without heating

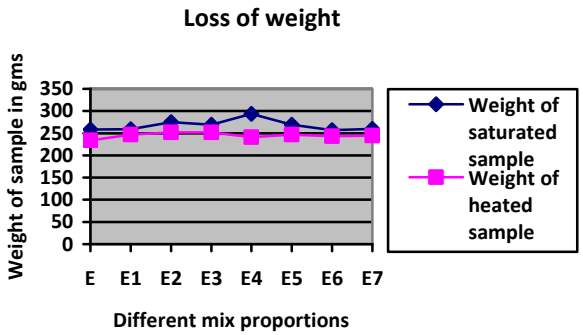

Chart -2: Loss of weight for various Percentage of metakaolin & flyash with and without heating

Here the control mix samples has more percentage of loss of strength and loss of weight when compared to other samples

E1 samples has less percentage of loss of strength and loss of weight when compared to control mix E,E2,E3,E4,E5,E6 & E7.

E6 samples has less loss of strength and loss of weight when compared to control mix E and E7 samples but more loss of strength compare to E1

E7 Samples has less loss of strength and loss of weight when compared to control mix but more loss of strength compare to E1 and E6

3. CONCLUSIONS

The loss of compressive strength is more when mortar specimen containing 15% of replacement of sand by metakaolin and flyash.

The loss of compressive strength is less when mortar specimen containing 5% of replacement of sand by metakaolin and flyash.

The less % of the sand replacement mortar containing less % of the compressive strength when compare to increase % of sand replacement of the of mortar and control mix.

The increased % of the sand replacement mortar containing less % of the loss of weight when compare to less % of sand replacement of mortar and control mix

In Fourier Transform Infrared Test the variation spectrum analysis are found also variation of mix gives the quality (purity)of the materials and component mixture and determine the unknown materials

In thermal resistance anlaysis the thermal effect of the sample were analyzed higher replacement of the matakaolin and fly ash as fine aggregate will have the strength and weigth loss

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