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STUDY ON CONCRETE BY PARTIAL REPLACEMENT OF CEMENT WITH WASTE PAPER SLUDGE ASH.

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Abstract - Nowadays, there are many experiments conducted in order to replace the use of cement clinker with other materials such as waste ashes and industrial by-products. The waste ashes and industrial by products are found contain pozzolanic properties and hydraulic activities similar to the properties of cement clinker which can be used as cementitious material (CM). Recently, several types of CM can be obtained in the industry such as fly ash, wastepaper sludge ash (WSA), ground granulated blast furnace slag and silica fume. Those materials are now widely used among CM.

***Key Words*:** Waste Paper Sludge Ash, Cement Clinkers, Ground Granulated Blast Furnace Slag.

1.INTRODUCTION

The materials have been tested and used for various applications. Advantageous of the use of these materials are beneficial for saving of natural resource, energy and reduction of CO2 emissions in the air which causes pollution to the environment. Since there are many wastes have been produced and can be used as CM, in this paper, only WSA would be touch in-depth. WSA is one of the industrial by-products obtain from the paper mill and paper recycling industry. Normally, in the industry of papermaking, the waste paper has been burned and the CO2 has been emitted to the air. However, more than 70 % of WSA has been used in low value application such as land dispersion. While the remaining 30 % of WSA has been thrown into dumpsites in the United Kingdom and annually produce approximately 125,000 tons of WSA. The composition and properties of WSA vary according to the type of raw material whether it is WSA that is sprayed into the bed combustion unit or the combustion state. However, the WSA contains very high yarn.

2. WASTE PAPER SLUDGE ASH.

Wastepaper sludge ash (WSA) is generated during the recycling of paper, which is an industrial by-product can induce pollution to the environment. Due to its effect related to pollution, a generic review on its application is required. Despite many researchers conducted in the world to resolve the application of WSA as a sustainable material, the effects of WSA as a cementitious material in its application is still limited assess. Hence, this paper presents a generic review on the effect of WSA as a cementitious material. The generic review on WSA in term of its physical properties, chemical properties, reactive properties and application of WSA in the industry was carried out. From the review on WSA properties, it is found that the WSA has good potential as one of the important materials in the construction industry especially in the production of concrete, brick, mortar, soil stabilizing additive, rigid pavement and controlled low-strength materials (CLSM). Numerous investigations on WSA have focused on hydraulic properties, pozzolanic reactivity and potential use as a cementitious material. It has been investigated by many researchers worldwide for instance, Chiang et al. Weng et al. and Liew et al. have investigated the use of WSA as a lightweight building brick. The potential of reuse the wastewater sludge for innovative applications in construction aggregates has been investigated by Tay et al. and Yagüe et al. Since the WSA can be used for various applications, its physical properties should be taken into account which it is able to give an input on the understanding on its generic Portland cement is the most important ingredient of concrete and is a versatile and relatively high-cost material. Large scale production of cement is causing environmental problems on one hand and depletion of natural resources on other hand. This work examines the possibility of using waste paper sludge to produce a low-cost concrete by blending various ratios of cement with paper sludge and to reduce disposal and pollution problems due to waste paper sludge. The innovative use of waste paper sludge in concrete as a supplementary cementitious material was tested as an alternative to traditional concrete. In this study waste paper sludge was partially replaced as 2.5%, 5% and 7.5% in place of cement in concrete for M25 mix and tested for its compressive strength, splitting tensile strength and flexural strength up to 28 days of strength and compared with conventional concrete. From the results obtained, it is found that waste paper sludge can be used as cement replacement up to 5% by weight. Test results indicate that use of waste paper sludge in concrete has improved the performance of concrete in strength aspect. At the first occurrence of an acronym, spell it out followed by the acronym in parentheses, e.g., charge-coupled diode (CCD).

3. PHYSICAL PROPERTIES OF WSA.

This material is collected from Vedadri Paper Mills (India) pvt. Ltd. The chemical properties of waste paper sludge ash are Table 1.

Chemical Composition of Waste Paper Sludge Ash are Table 2.

Table -3.1: CHEMICAL PROPERTIES OF WSA.

PROPERTIES	VALUE
Appearance	Fine Powder
Particle Size	Sieved through 90-micron size
Colour	Dark Gray
Specific Gravity	2.09

Table -3.2: CHEMICAL COMPOSITION OF WSA.

ELEMENT	% CONTENT
O	15.83
Ca	14.94
Si	60.57
AL	2.06
Mg	3.59
S	1.07
K	0.16
Fe	0.92
Na	0.2

Fig -1: Waste Paper Sludge Ash.

4. Basic material tests

4.1 Tests on cement

The test results of cement used in the present project work are listed in the below table 4.1

Table 4.1: Properties of cement

Sl. No	Properties	Results
1	Specific Gravity	3.05
2	Normal Consistency	32%
3	Initial Setting Time	38min
4	Final Setting Time	450min
5	Soundness test	5mm

The normal consistency of cement obtained 32%. Hence it is in permissible limits.

4.2 Tests on fine aggregates

Table 4.2: Physical properties of fine Aggregate

Sl. No	Tests	Results	Test Confirming to
1	Specific Gravity	2.06	
2	Water Absorption	0.5%	

Specific gravity is lies between the permissible limits that are 2.5-2.9
Water absorption values generally ranges between 0.1- 2.0%

4.3 Tests on coarse aggregates

Table 4.3: Properties of coarse aggregate

Sl no	Tests	Results
1	Specific Gravity	2.56
2	Water Absorption	1%
3	Aggregate Crushing Value	18.01%
4	Aggregate Impact Value	11.26%
5	Los Angles abrasion value	54.49%

Specific gravity is lies between the permissible limits that are 2.5-3.0
Water absorption values generally ranges between 0.1- 2.0%
Crushing value was found to be 18.01% which is less than 30% hence it lies in permissible limits.
Aggregate impact value was found to be 11.26% which is less than 45% hence it lies in permissible limits.

Aggregate abrasion value was found to be 54.49%

4.4 Tests on hardened concrete

a) Compressive strength test results of various mix proportioned concrete with different mix proportion

Waste paper sludge ash with 2%, 5%, and 7.5% replacement:

Table 4.4 Compressive strength test results of sludge ash

SI No.	Percentage of waste paper sludge ash replacement In (%)	Compressive strength resultsIn (N/mm2)		
		7 Days	14 Days	28 Days
1	0	16.11	21.22	30.43
2	2.5%	19.76	22.84	31.56
3	5%	20.42	24.90	34.83
4	7.5%	18.77	21.32	32.24

b) Split tensile strength results of replaced concrete

Waste paper sludge ash with 2%,5%, and 7.5% replacement:

Table 4.5 Split tensile strength test results of Waste paper sludge ash replacement

SI No.	Percentage of waste paper sludge ash replacement In (%)	Split tensile strength results In (N/mm2)		
		7 Days	14 Days	28 Days
1	0	1.86	2.04	2.48
2	2.5%	1.98	2.25	2.94
3	5%	2.10	2.34	3.01
4	7.5%	1.8	2.23	2.67

5. CONCLUSIONS

1. Basic tests for materials such as cement, sand and coarse aggregates determined successfully.

2. The properties of cement such as specific gravity, standard consistency, initial setting time, final setting time and soundness test results values 3.05, 32%, 38min, 450 min and 5 mm respectively. These are found to be in the range of permissible limits as per code book standards.

3. Then the properties fine as well as coarse aggregates like specific gravity, crushing value, impact value, abrasion value are ranges from 2.56, 18.01%, 11.26% and 54.49% respectively, which comes under permissible limits.

4. Hardened properties like compressive and split tensile strength value for normal concrete found to be ultimate value 30.43 N/mm2 and 2.48 N/mm2 at 28 days of curing.

5. For waste paper sludge ash at 5% replacement compressive strength values are 34.83N/mm2.

6. Split tensile strength for waste paper sludge ash 5 % replacement shows ultimate values 3.01 N/mm2.

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