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REVIEW ON CONCRETE FROM BIO MEDICAL WASTE

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Abstract - India is one among the many countries, has a serious concern on biomedical waste disposal. Now-a-days hospital waste can be used in production of concrete. Many hospitals in India are directly disposing their waste by burning used needle, syringe etc. According to Biomedical Waste Rule (2000), hospitals are collecting dead human bodies and other waste from laboratories in yellow plastic bags and waste like needle and syringes in red bags. For reducing massive volume of medical waste generated in country, **incineration** is the only process from which fly ash can be produced. Partial replacement can be done by Biomedical Waste Ash (BWA) in concrete to prevent hazardous effect into the environment. The permeability and compaction characteristics of soil fly ash mixture made with different percentage of medical fly ash are compared to evaluate the effectiveness of recycled medical waste ash.

Keywords **: Biomedical waste, Incineration**

I. INTRODUCTION

As per the Biomedical Waste (Management and Handling) Rules (1998) of India, ‘‘Biomedical waste’’ means any waste, which is generated during the diagnosis, treatment or immunisation of human beings or animals or in research activities pertaining thereto or in the production or testing of biological, and including differentcategories.Presently in India, about 960 million tones of solid waste is being generated annually as by-product during industrial, mining, municipal, agricultural, and hospital or Bio-medical waste.

Hospital waste is a special category of waste, which has a hazardous , infectious or toxic characteristics. The management, handling and disposal of these wastes have become a growing environmental concern mostly in thedeveloping countries.The consequences of which may increase the airborne pathogenic bacteria, which could adversely affect the hospital environment and community atlarge. The recent outbreaks of Ebola, Lassa fever and Zikainfections are great concerns in Nigeria.The hospital, generates a total waste of 545 kg/month of which 15% of this is classified as infectious giving a value of approximately 82 kg/month.

II. LITRETURE REVIEW

In the present investigation the review was carried and program was carried out to investigate the suitability of use of biomedical waste ash as partial replacement of cement in concrete and effect of replacement of cement of biomedical waste ash on Suitability of Biomedical Waste Ash in Concrete.

Workability of concrete and compressive strength in particular. The properties of materials used in this investigation are discussed here in after-:

Table 1 : Chemicals Composition which are included in Hazardous Waste

Compound	Present (%)	Compound	Present (%)
SiO_2	20.60	V_2O_5	0.04
P_2O_5	0.95	Cr_2O_3	0.04
SO_3	1.50	MnO	0.22
CI	2.38	Fe_2O_3	8.06
K_2O	9.78	NiO	0.01
TiO_2	1.20	CuO	0.08

2.1 CEMENT

Portland pozzolana cement is used throughout in the investigation

Table 2.Physical Properties of cement (Method of test refers to IS: 4032: 1985)

Properties	**Reviewed Value**	**Followed IS specification**
Standard consistency %	31 %	IS : 4031 (4)
Initial setting time	235 minutes	IS : 4031 (5)
Final setting time	325 minutes	
Soundness (lechatelier expansion)	0.5 mm	IS : 4031 (3)
Finness (% retained on 90 µ is sieve)	3.50 %	IS : 4031 (1)
7^{th} day Compressive strength	32 MPa	IS : 4031 (6)
28^{th} day Compressive strength	43 MPa	
Specific gravity	2.71	IS 40.31 (11)

Physical properties	Test results
Consistency	28.5
Initial setting time	130 min.
Final setting time	360 min.
Specific gravity	2.79
Bulk density of cement	1500 kg/m^3

2.2 FINE AGGREGATE

Locally available jamuna sand was used in this investigation as fine aggregate. The specific gravity of fine aggregate was 2.30.

Table 2-The review Result of Sieve Analysis Test for Fine Aggregate (FA)

Sr. No.	**IS Sieve Size**	**Weight Retained (g)**	**Cumulative Weight Retained (g)**	**Cumulative Weight Retained Percentage (g)**	**Cumulative Passing Percentage (FA)**	**Standard Passing Percentage Limits for Zone II**	
						Lower Permissible Limit (UPL)	**Upper Permissible Limit (UPL)**
1	10 mm	0	0	0	100	100	100
2	4.75 mm	50	50	5	95	90	100
3	2.36 mm	58	108	11	89	75	100
4	1.18 mm	170	278	28	72	55	90
5	600 µm	170	448	45	55	35	59
6	300 µm	432	880	88	12	8	30
7	150 µm	100	980	98	2	2	10
8	Pan	20	1000	-	-	-	-

Fineness Modulus = $\frac{250}{200}$ = 2.75.

2.3COARSE AGGREGATE

In the present investigation coarse aggregate of 20 and 10 mm nominal size was used.

Table 3 - Result of Recorded sieve analysis test for 20 mm Nominal size coarse aggregate (20mm CA)

Fineness Modulus = 701.18/100 = 7.01

Sr. No.	IS Sieve Size	Weight Retained (g)	Cumulative Weight Retained (g)	Cumulative Weight Retained Percentage (g)	Cumulative Passing Percentage (FA)	Standard Passing Percentage Limits for Zone II	
						Lower Permissible Limit (UPL)	Upper Permissible Limit (UPL)
1	25 mm	0	0	0	100	100	100
2	20 mm	64	64	1.28	98.72	95	100
3	10 mm	4932	4996	99.9	0.1	25	55
4	4.75 mm	4	5000	100	0	0	10
5	2.36 mm	0	5000	100	0	-	-
6	1.18 mm	0	5000	100	0	-	-
7	600 µm	0	5000	100	0	-	-
8	300 µm	0	5000	100	0	-	-
9	150 µm	0	5000	100	0	-	-
			Total	701.18			

Physical properties	Fine aggregate	Course aggregate
Specific gravity	2.850	2.433
Bulk density	1600 kg/m^3	1700 kg/m^3
Fineness modulus	4.65	2.2
absorption	0.4 %	0.22 %
Free surface moisture	Nil	2.0
Grading of aggregate	IS : 383-1970 Confirms, 20mm and lesser size	IS : 383-1970 confirms zone 3

2.4 BIOMEDICAL WASTE ASH

Biomedical waste ash was taken from from Nain, Allahabad incinerator plant. It is grey in colour, coarser than cement but lighter in weight than cement. Biomedical waste ash which the used throughout their experiment was collected from Nain, Allahabad incinerator plantwhich was grey in colour and lighter in weight and coarser than cement.

Super plasticizer (Water Reducer)Sulphated naphthalene formaldehyde (SNF) based Super plasticizer (KEM SUPLAST 101 S)of CChembond chemicals was used which conforms to IS:9103-1999 specifications. It was in liquid form compatible with the used Cement, brown in colour having specific gravity 1.2 and It was observed that good deflocculating and dispersion with cement particles to fluidly the concrete mix results with enhancement in workability of concrete mix.

table.4 Percentage replacement of biomedical ash of different research paper

Cube Designation	% Replacement of biomedical waste ash)	Water cement ratio (Cement = Biomedical Waste Ash)	Dose of super plasticizer (%)	Slump (mm)
C1	0	0.45	0.6	110
C2	2.5	0.45	0.6	110
C3	5	0.45	0.6	100
C4	7.5	0.45	0.6	90
C5	10	0.45	0.6	80
C6	12.5	0.45	0.6	70
C7	15	0.45	0.6	60

Percentage of waste plastic content	**Strength after 7 days**		**Strength after 28 days**	
	M15	**M20**	**M15**	**M20**
0	**12**	**18**	**19.5**	**24.5**
10	**17.5**	**18**	**20.5**	**20.5**
15	**16.5**	**17**	**20.5**	**20.5**
20	**16.5**	**16.5**	**20**	**20**

2.5 DENSITY

The density of concrete is a measurement of concrete's solidity. The process of mixing concrete can be modified to form a higher or lower density of concrete end product. Table Density of concrete at different replacement Workability of Concrete at different replacement level of cement.

Table.5 effect on density due different replacement level.

Sr. No.	% Replacement of Biomedical Waste Ash	Density of Concrete (kg/m^3)
1	0	2571
2	2.5	2566
3	5	2560
4	7.5	2554
5	10	2551
6	12.5	2546
7	15	2542

C. SOUNDNESS TEST ON CEMENT AND PARTIAL REPLACEMENT OF BIOMEDICAL WASTE .

MIX NO.	SOUNDNESS(mm)	CONSISTENCY(%)	SETTING TIME	
			INITIAL	FINAL
M-10	11	34	185	876
M-20	9.6	36	300	985
M-30	11.3	39	490	1075
M-40	13.3	41	690	1100

Tableshows the effect of replacing part of the cementwith HWA on the soundness, water affinity and slump. It isobserved that at 20% replacement, the value of the soundness (9.6 mm) is within the code specification of 10 mm.However, within experimental errors, the values of 11.0 mmand 11.3 mm, at replacement levels of 10% and 30%respectively, can be accepted as okay.

Table.6 average results of water absorption of two different research papers.

MIX NO.	Water absorption (%)			
	3d	7d	3d	7d
M-10	2.0	2.1	2.0	2.0
M-20	2.0	4.0	2.0	3.6
M-30	3.0	4.6	3.5	4.8
M-40	2.7	4.3	3.0	4.2

CHEMICAL, PHYSICAL AND MINERALOGICALCHARACTERIZATION PROCEDURES

Major oxides composition was estimated on the basis of the macroelemental analysis carried on digested samples by InductivelyCoupled Plasma-Atomic Emission Spectrometry (ICPAES)and the minor elements by Inductively Coupled Plasma-Mass Spectrometry (ICP-MS). The water content (drying at100 ◦C) and the loss on ignition (calcinations at 1000 ◦C) werealso measured. The metallic aluminium content was determinedwith a method measuring the amount of hydrogen gas producedby the oxidation reaction of metallic aluminium .The calcite($CaCO_3$) content was determined from the CO_2 volume measuredduring acidic dissolution.

2.8 LEACHING BEHAVIOR DUE TO REPLACEMENT OF WASTE MATERIALS.

The TFA were characterized for heavy metal leachabilityaccording to the European standard EN 12457-1 extraction test:100 g (dry weight) of TFA samples were extracted using distilledwater at an L/S ratio of 10 for 24 h. The eluates werefiltered using a 0.45 m membrane filter. Various tests weredone on the leachates: measurement of the pH, of the SolubleFraction (SF), of sulfate content and minor elements content.

2.9 REACTIVITY IN PRESENCE OF CALCIUM HYDROXIDE

Mineral additions used in hydraulic binders may be categorizedas inert, pozzolanic materials or latent hydraulic cements.The pozzolanic reaction is a reaction of the pozzolanic materialwith water and CaO. It produces hydrates and leads to the hardeningof the mixture. The calcium hydroxide $Ca(OH)_2$ could beintroduced into the mixtures but it generally comes directly fromthe hydration of Ordinary Portland Cement.

2.10 REACTIVITY IN PRESENCE OF LIME

The pastes tested were 2, 14 and 28 days old. The pattern of anhydrous mixtures is also presented. In both cases, we observe a significantconsumption of calcium hydroxide and the formation of calcium aluminates hydrates. In some cases the consumption ofcalcium hydroxide is accompanied by a strong consumption ofanhydrite ($CaSO_4$). No gypsum is detected. So the consumptionof anhydrite is not due to its hydration but to its reactionwith calcium hydroxide.

2.11 SUPER PLASTICIZER (WATER REDUCER.)

Sulphated naphthalene formaldehyde (SNF) based Super plasticizer of Chambord chemicalswas used which conforms to IS:9103-1999 specifications. It was in liquid form compatible with the used Cement, brownin colour having specific gravity 1.2 and It showed good deflocculating and dispersion with cement particles to fluidly theconcrete mix results with enhancement in workability of concrete mix.

III. CONCLUSION

On the basis of some research papers we observed and can concluded that replacement of waste obtained from biomedical waste can only be used if low degree workability is to be obtained. It is observed that workability decreased with increase in replacement level at constant dose (0.6%) ofsuperplasticizer. Moreover it can also be concluded that by partial replacement of waste material can decrease the density of concrete up to 2542 kg/m^3also Compressive strength of concrete made using biomedical waste ash is more than that of conventional concrete up to 7.5% replacement level. Up to 10% replacement level compressive strength of concrete with biomedical waste ash is comparable to the conventional concrete.

