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Effective Utilization of Bio-Medical Waste in Construction Industry

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ABSTRACT: Biomedical waste generated from hospitals, medical research activities and the other medical sources are causing a major problem in India. The waste generated affects adversely environment as well as the human world. Some studies revealed scope of utilization of biomedical waste as used in concrete.

The dangerous dimensions with the dumping of biomedical waste, has a hazardous effect enough to cause an epidemics resulting as Hepatitis B and D, Dengue, AIDS, Japanese encephalitis, tick fever etc. among the people. Improper management of biomedical waste results into serious environmental problems in terms of air, water and land pollution and thereby resulting to cause severe diseases. In order to minimize its hazardous effect in to the environment some studies confirmed the successful utilization of biomedical using biomedical waste ash as partial replacement of cement.

This paper presents result of an experimental program carried out to study the suitability of use of biomedical waste in concrete as partial replacement of coarse aggregate.

KEYWORDS : Biomedical waste, environmental problems, hazardous, partial replacement.

I. INTRODUCTION

1.1 GENERAL

Bio-medical waste is the waste liquids, solids, sharps and laboratory waste that are potentially infectious and dangerous. It is a waste from biological sources or is used in the diagnosis, prevention or treatment of disease. Common producers of BMW include health clinics, hospitals, medical research laboratories, physicians, dentists and veterinarians and home health care.

According to ministry of Environment and Forest about 4,05,702 kg/day biomedical waste generated in India out of which around 72% is disposed off, more than 28% is left unattended[1]. Most common process of disposal of biomedical waste is incineration in specifically made for it.

1.2 TYPES OF BIO-MEDICAL WASTE

Medical wastes are mainly categorized into non-hazardous and hazardous wastes. The hazardous waste includes pathological, infectious, sharps and chemical wastes and are normally produced in labour wards, operation theatres, laboratories etc

- Pathological wastes
- Infectious wastes
- Sharps
- Chemical wastes

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1.3 SOURCES OF BIO-MEDICAL WASTE

Medical wastes arise from various activities. These include general medical treatment, clinical investigation, food preparations and ward activities. The quantities of medical wastes generated among other factors depend on the status of the hospital, level of instrumentation and sometimes location of medical facilities (Mato and Kassenga, 1997). The composition of medical wastes is often characteristic of the type of source. Different units within a hospital and clinic would generate different wastes. In addition, some scattered sources may produce some medical wastes in categories similar to hospital waste (WHO, 2001).

- Medical wards
- Operating theatres and surgical wards:
- Health-care units
- Laboratories

1.4 METHODOLOGY

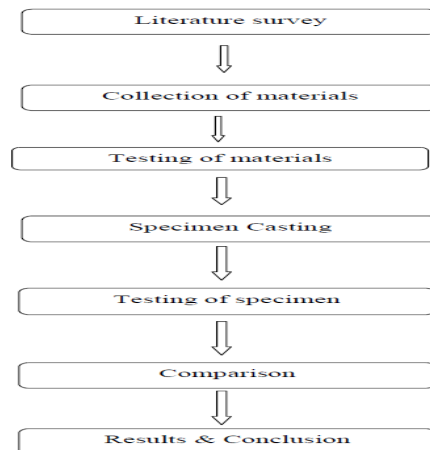


Fig.1.4 Flow chart for methodology

II. MATERIALS USED

2.1 AGGREGATE(COARSE AND FINE)

Various properties of aggregates can influence the performance of concrete; therefore various considerations have to be kept in mind while selecting the material.

2.2 CEMENT

Ordinary Portland cement of 53Grade was used as it satisfied the requirements of IS: 269-1969.

2.3 WATER

The maximum permissible limits of chloride content in water for RCC work has been reduced from 1000 milligrams per liter in IS: 456-1978 to 500 milligram per liter in IS: 456-2000.

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2.4 HOSPITAL WASTE

PROPERTIES	OBTAINED RESULT	REQUIREMENT AS PER IS 12269:1987
Fineness of cement	6.0 %	Not more than 10%
Standard consistency	32%	Between (26-33)%
Initial setting time	35 min	Not less than 30 min
Final setting time	439 min	Not greater than 600 min
Specific gravity of F.A	2.53	Range 2.4-2.6
Fineness modulus of F.A	2.48	Range 2.2 -2.6
Specific gravity of C.A	2.7	Range 2.6-2.8
Fineness modulus of C.A	2.83	Range 2.8- 3.2
Water absorption of F.A	6.65%	
Water absorption of C.A	2.95%	
Specific gravity of cement	3.13	
Water cement ratio	0.55	0.65
Aggregate impact value	22.96%	

BMW that cannot be degraded further been powdered into course particles

III. PRELIMINARY TEST

3. TEST CONDUCTED

3.1 PARAMETERS STUDIED

The experiments are conducted on four series of test specimens. The following properties were studied for all the three grades of concrete.

Mechanical Properties

- ✓ Compressive strength of concrete – cubes
- ✓ Split tensile strength of concrete – cylinders
- ✓ Flexural strength test – beam.

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3.2 DESCRIPTION OF TEST

3.2.1 WORKABILITY

The workability is defined as the property of concrete which determines the amount of useful internal work necessary to produce full compaction.

3.2.2 MEASUREMENT OF WORKABILITY

Some of the tests measure the parameters very close to workability and provide useful information. The following tests are commonly employed to measure workability.

- * Slump cone test
- * Compacting factor test
- * Flexural strength test

3.2.2.1 SLUMP CONE TEST

Slump cone test is the most commonly used method of measuring consistency. It doesn't measure all factors contributing to workability. It is used as a control test and gives an indication of uniformity of batches.

3.2.2.2 COMPACTING FACTOR TEST

Compacting factor test is more precise and sensitive than the slump cone test. This test gives an idea for degree of compaction and adopted to find the workability of concrete where aggregate size does not exceed 20mm and the mixes are comparatively dry

3.2.3 COMPRESSIVE STRENGTH OF CUBE

This test is done according to IS: 516-1959. The specimens of size 150 x 150 x 150 mm are used to determine the compressive strength. Test are carried out at the end of 28 days using compressive Testing Machine (CTM) of 2000 KN capacity. Typical test setup for testing compressive strength of cube is shown in Figure 5.3

3.2.5 SPLIT TENSILE STRENGTH OF CYLINDER

The cylindrical specimens of size 150 x 300 mm are used to determine the split tensile strength as per IS: 516 – 1959. Test were carried out at the end of 28 days using Compressive Testing Machine (CTM) of 2000 KN capacity.

IV. TEST RESULT

4.1 WORKABILITY TEST RESULTS

Slump Cone Test

Slump Value = 48 mm.

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4.2 COMPRESSIVE STRENGTH

The compressive strength of the concrete cubes of M20 grade are determined from the compression testing machine. The results are shown in Table 5.2

COMPRESSIVE STRENGTH (N/MM ²)		
% OF BMW REPLACED	NO OF DAYS	
	7	28
0	21.02	28.89
2	24.74	34.52
4	23.55	33.629
6	21.18	28.148
8	20.59	26.81
10	20.14	25.62

Table 5.1 Compressive strength test

From the results it is noted that the compressive strength decreased with the increase in replacement of BMW. But the strength is acceptable upto 10% replacement. Above 10% the cubes do not satisfy the required strength. Hence 10% replacement can be adopted based on the compressive strength result.

5.3 SPLIT TENSILE STRENGTH TEST

The Split tensile strength of the concrete cylinder of M₂₀ was determined from the compression testing machine. The results are shown in Table 5.3

SPLIT TENSILE STRENGTH (N/MM ²)		
% OF BMW REPLACED	NO OF DAYS	
	7	28
0	1.76	2.64
2	1.83	2.92
4	1.80	2.88
6	1.67	2.69
8	1.54	2.50
10	1.41	2.35

Table 5.2 Split Tensile Strength

The Split tensile strength of normal concrete is 2% of its compressive strength. From the results the split tensile strength also decreased with increase in replacement of plastic. Up to 10% replacement the split tensile strength is also acceptable. Above 10% the replacement is not safe based on split tensile strength also

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4.4 FLEXURAL STRENGTH TEST

The flexural strength of the concrete beams of M₂₀ grade was determined from the universal testing machine and the results are shown in Table 5.4

FLEXURAL STRENGTH (N/MM ²)		
% OF PLASTIC REPLACED	NO OF DAYS	
	7	28
0	2.12	2.63
5	2.56	2.88
10	2.49	2.84
15	2.01	2.60
20	1.87	2.54
25	1.75	2.48

Table 5.3 Flexural strength test

From the results it is proved that the flexural strength of the BMW concrete increases up to 2% but decreases above 6% replacement at 28 days. But the flexural strength obtained with 2% replacement is much sufficient enough for M₂₀ concrete at 28 days. Based on the flexural strength results the replacement of plastic even if increased beyond 2% gives better results but results were not satisfactory for the compressive and split tensile strength. Hence 2% replacement can be best opted..

V. COST COMPARISION

Sl. no	Description	Cost in Rs	
		Conventional concrete	BMW concrete
1	Cement	2600/-	2600/-
2	Sand	7000/-	7000/-
3	Aggregate	1050/-	600/-
4	BMW	-	
5	Other	9800/-	7000/-
	Total	20450/-	17200

Net Profit = 18.89%

VI. CONCLUSION

An evaluation on the use of BWA in the production of concrete has been carried out and the following conclusions are reached on the usefulness of using such materials for concrete production. The advantages of BMW concrete is to reducing the level of Bio medical wastes and it can be effectively used in concrete making for the purpose of increase in strength and also reducing the cost. The work has established linear regression relations of the compressive strength of BWA-concrete with the water absorption and slump. The regression parameters show that the models chosen to represent these behaviors are significant. Normally replacement of BMW can decreasing the workability so we added little percentage of super plasticizer (poly carboxite ether in liquid form) for increasing the

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workability and also increasing the compressive strength. For adding super plasticizer , it will acts as a good binding property and also develop bonding between BMW and course aggregate. The compressive strength test of BMW concrete decreases with increase in the replacement level and the best behavior is at 2% replacement. The compressive strength will increase in approximately 20%. So we suggest Compressive strength of concrete with biomedical waste satisfied the requirement of normal concrete and also the cost will reduced up to approximately 20%.

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