Study on Strength of Concrete by Using Municipal Sewage as Cement

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Abstract: ***Concrete is the most widely used construction material because of its mould ability into any structural form and shape due to its fluid behavior at early stages. Cement is used in concrete is mainly to bind the materials. Municipal solid waste is tending to subject to landfill sites or open dumping. These are hazardous to the environment. Municipal solid waste is the byproduct produced from the combustion of these waste. The waste when burns possess various cementiceous and strength properties. In this project the fine Cement is being replaced by these municipal solid wastes and as a form of admixture to achieve the conservation of resources and to make concrete economical. The concrete mix of M30 grade is design by replacing Cement partially with municipal solid waste. The Cement is replaced in various proportions of 0%, 5%, 10%, 15%, 20%, by mass. The entire test will be carried out on the grade of concrete at 7days, 14days and 28 days. The effect of municipal solid waste on strength of concrete such as compressive strength, split tensile strength, workability is to be investigate.***

Keywords: MSW (Municipal Solid Waste), compressive strength, split tensile strength, workability**.**

1. Introduction

Human activities on earth produce considerable quantities of waste, which increases due to rise in population. That is more than 2700 million tons per year, including industrial and agricultural waste from rural and urban societies. Now a day, concrete is the most used manmade material in the world. The Indian construction industry alone consumes approximately 400 million tons of concrete every year and relative amount of mortar too. Therefore the demand of concrete and the required raw materials is very high this causes hike in the cost of cement, fine and coarse aggregate. To avoid the problems like cost hike and cuts in supply of concrete and mortar, the alternate material or the partial replacement for the cement and aggregate should be developed by the recycling of waste material. This provides us economical, environment-friendly and light-weight construction products. Use of the waste materials also reduces the problems of land filling, environmental and health concern.

Disposal of human sewage has become a necessity for societies, today. The construction of treatment plants has caused problems with huge contents of dry sludge. The production of sewage sludge from waste water treatment plants are increasing all over the world. This kind of sludge includes the solid material left from sewage treatment processes. Specific sludge production in wastewater treatment varies widely from 35 to 85 gm dry solids per population equivalent per day. The dry sludge used in this studied was brought (free of cost) from Delawas, Jaipur, Rajasthan, India. The sewerage treatment plant is connected by mostly residential and commercial areas; hence, the sludge collected is categorized as domestic waste sludge. At the sewerage treatment plant, the sewage sludge was sun dried in the sludge bed. This waste is collected in plastic bags and bought to my research area, where it is spread on land for making it in the direct contact to sun and air.

2. Literature Review

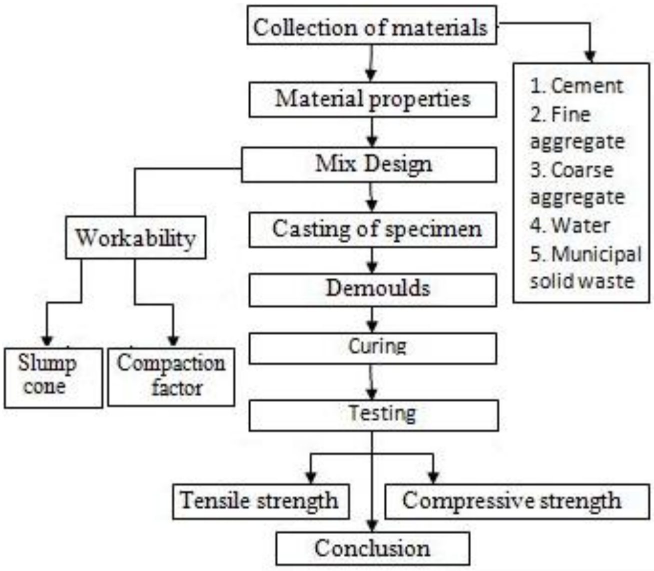
Amit Kumar Gupta, Dr. Rajeev Chandak, et al., (2017): This paper is given report on the use of Municipal Solid Waste Incinerator Bottom Ash as partial replacement of cement in concrete. The municipal solid waste incinerator ash is a waste material that is taken from WTE plant (waste to energy), Jabalpur, M.P. The aim of the study is to investigate the feasibility of Incinerator bottom ash as a partial replacement of cement in concrete.

M.S. Joshi, G.A. Borse, S.A. Bagaw, A.B.Dhakne & O.S. Shinde, et al., (2016): This paper is given report on evaluates the use of dry sludge as an additive in construction material like concrete and cement brick. For which it must be guaranteed that the resulting concrete and mortar has the appropriate compressive strength. In earlier work in the subject it was shown that the addition of sludge reduces compressive strength of concrete.

V. Alivelu manga, et al3, (2016): This paper is given report on the possibility of disposing the incinerator ash by adding it to concrete. Generally very small change we can observe by replacing 10% of municipal solid waste incineration ash mix with cement concrete. So we can increase the percentage of ash quantities into the concrete mixes and check the strength. From this paper it was concluded that the compressive test results on the cement replaced ash cubes did show improvement.

3. Methodology

The methodology of the work is given below.



3.1 Methodology

Basically, concrete is a versatile engineering material which can be mould in to wide verities of shapes when in wet condition. Concrete is a mixture of cement, fine aggregates, coarse aggregates, water, and admixture (if any). This concrete is a mixture of cement, fine aggregates, coarse aggregates, water, msw ash, and admixture.

3.2 Collection of Materials

Materials used in this study are cement, coarse aggregates, fine aggregates, and super-plasticizer, in addition to marble dust and steel fibers. These materials were read in terms of various Indian practices. The detail of various materials which were used in this study is given below:

3.2.1 Cement

Cement is a binder, a substance utilized in production that units and hardens and can bind other materials together. The maximum vital forms of cement are used as a issue inside the production of mortar in masonry, and of concrete- that is a aggregate of cement and an mixture to form a sturdy building material.

3.2.2 Aggregates

Construction aggregate, or absolutely "aggregate", is a huge class of coarse particulate fabric used in production, including sand, gravel, beaten stone, slag, recycled concrete and geo-artificial aggregates. Aggregates are the most mined materials within the world.

3.2.2.1 Coarse aggregates

Crushed stone mixture of 20mm size is added from nearby quarry. Aggregates of length greater than 20mm size are separated by using sieving.

3.2.2.2 Fine aggregates

Locally available sparkling sand, unfastened from natural count number is used.

3.2.3 Municipal solid waste

Municipal solid waste (also called trash or garbage) is defined at the national level as wastes consisting of everyday items such as product packaging, grass clippings, furniture, clothing, Bottles and cans, food scraps, newspapers, appliances, consumer electronics, and batteries. These wastes come from homes; institutions such as schools and hospitals; and commercial sources such as restaurants and small businesses. EPA's definition of municipal solid waste (MSW) does not include municipal wastewater treatment sludge's, industrial process wastes, automobile bodies, combustion ash, or construction and demolition debris. Once generated, MSW must be collected and managed. Common management methods include recovery for recycling or composting, combustion (with the resulting energy used to generate electricity or steam in some cases), and landfill disposal. Many wastes that are disposed of in landfills represent a loss of materials that could be reused, recycled, or converted to energy to displace the use of virgin materials.

Figure 3.1: Municipal solid waste ash

3.2.4 Water

Generally potable water ought to be used. This is to make sure that the water is cheap unfastened from such impurities as suspended solids, organic depend and dissolved salts, which may additionally adversely affect the residences of the concrete, especially the placing, hardening, energy, sturdiness, pit fee, and many others.

3.3 Basic tests on materials

Following tests are conducted on cement, fine aggregates and coarse aggregate:

- Fineness of cement
- Specific gravity of cement
- Normal consistency of cement
- Initial setting time of cement
- Specific gravity of coarse aggregate
- Specific gravity of fine aggregate

Sieve analysis of fine aggregates

3.4 Tests on concrete

Following tests are to be conducted on concrete

- Workability tests

1) Slump Cone Test
2) Compaction Factor Test

Figure 3.2: Compaction Factor Test

3.5 Test to be performed on the Specimens

3.5.1 Compressive Strength

- 7 days specimens age
- 14 days specimens age
- 28 days specimens age

3.5.2 Split Tensile Strength

- 14 days specimens age
- 28 days specimens age

Figure 3.3: Compressive strength system

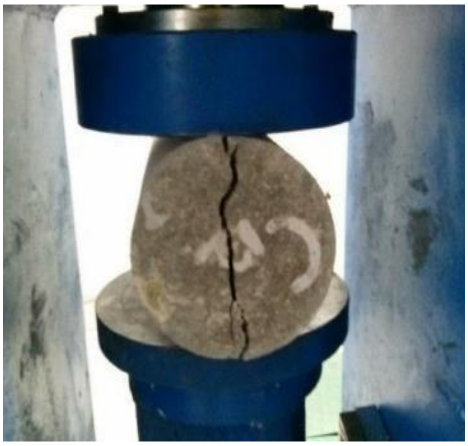


Figure 3.4: Split Tensile Strength system

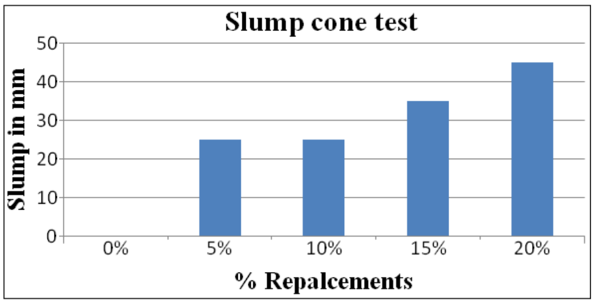
4. Results and discussion

4.1 Workability Test on Fresh Concrete

4.1.1 Slump Cone Test

Table 4.1: Slump Cone Test

S. No	% replacement	Slump in mm
1	0	0
2	5	25
3	10	25
4	15	35
5	20	45

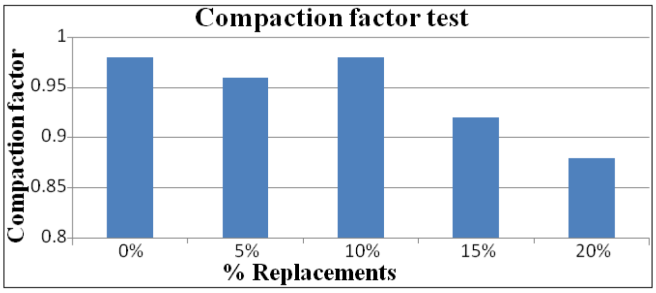


Graph 4.1 Slump cone testFrom the above table and graph it was observed that the value of slump increasing with increase in the percentage of MSW ash up to20%and decreases gradually.

a) 0% replacement

Table 4.2: Compaction factor for 0% replacement

S.No	% Replacements	Compaction factor
1	0	0.98
2	5	0.96
3	10	0.98
4	15	0.92
5	20	0.88



Graph 4.1: Compaction Factor Test Results

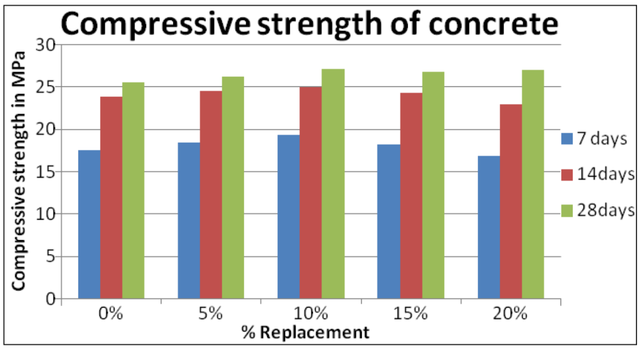
From the above table and graph it was observed that the value of compaction factor increasing with increase in the percentage of MSW ash up to 10% and decreases gradually.

4.2 Test on harden concrete

4.2.1 Compressive strength

Table 4.3: Compressive strength of concrete

S. No	% replacement	Average compressive load (KN)			Cross sectional area (mm^2)	Compressive strength (N/mm^2)		
		7 days	14 days	28 days		7 days	14 days	28 days
1	0	395	535	575	22500	17.55	23.90	25.54
2	5	415	550	590	22500	18.44	24.52	26.25
3	10	435	560	610	22500	19.33	24.98	27.12
4	15	410	545	610	22500	18.22	24.32	26.84
5	20	380	515	605	22500	16.88	22.94	26.98



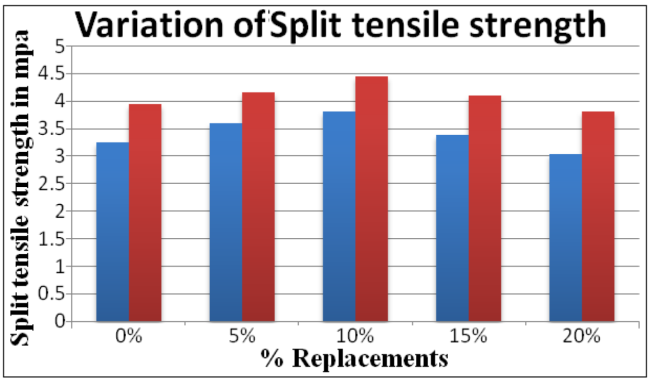
Graph 4.3: Compressive Strength of Concrete

From the above table and graph it was observed that the value of compressive strength increasing with increase in the percentage of MSW ash up to 10% and decreases gradually.

4.2.2 Split Tensile Strength of Concrete

Table 4.4: Split tensile strength of concrete

S No	% replacement	Average load in (KN)		Cross Sectional Area(mm^2)	Average Split Tensile Strength(N/mm^2)	
		14 Days	28 Days		14 days	**28 days**
1	0	230	280	141372	3.25	**3.95**
2	5	255	295	141372	3.60	**4.16**
3	10	270	315	141372	3.81	**4.45**
4	25	240	290	141372	3.39	**4.098**
5	30	215	270	141372	3.038	**3.815**



Graph 4.2: Split tensile strength of concrete

From the above table and graph it was observed that the value of Split tensile strength increasing with increase in the percentage of MSW ash up to 10% and decreases gradually.

5. Conclusion

From this research the following conclusions are made

1) The slump value of concrete increases with increasing in the percentage of municipal solid waste ash in concrete.
2) The compaction factor value of concrete is increased at 10% replacement and gradually decreased in increase in replacement percentage.
3) Compressive strength value of municipal solid waste ash concrete is increase up to 10% replacement and decreases gradually in the percentage increasing of MSW ash in concrete.
4) Also split tensile strength of municipal solid waste ash concrete increase up to 10% replacement and decreases gradually in the percentage increasing of MSW ash in concrete.
5) This study reveals that adding municipal solid waste ash up to certain limit can increases the compressive strength of cubes, split tensile strength of cylinder and flexural strength of the beam.
6) It is identified that e-waste can be effectively used as construction material.

References

[1] Amit Kumar Gupta, Dr. Rajeev Chandak "Effect on compressive strength of concrete with partial replacement of cement by municipal solid waste incineratoror ash" Volume: 04 Issue: 03 | March-2017, IJR.

[2] M.S. Joshi, G.A. Borse, S.A. Bagaw, A.B.Dhakne & O.S. Shinde "Utilization of sewage sludge in construction materials" Volume: 2 Issue: 7 | July-2016, IJIR.

[3] V. Alivelu manga, "Effect on compressive strength of concrete with partial replacement of cement by municipal solid waste incineration ash" volume: 2 issue: 2(1)| July- 2016, IJMART.

[4] S.Deepak, Dr V.Ramesh, "Properties of municipal solid waste incinerator ash in concrete" volume: 4 issue: 6 | July- 2015, IJECS.

[5] Hashim Mohammed Alhassan, Ahmed Musa Tanko, "Characterization of solid waste incinerator bottom ash and the potential for its use" "volume: 2 issue:4 | July-august- 2014 ,IJERA.

[6] M.R. Lavanya, M. Ibrahim Bathusha and B. Sugumaran, "A review on use of municipal solid waste ash in concrete"

[7] Mr. Sandesh R. Patil, Prof. Sharad S Bachhav, Prof. D.Y. Kshirsagar, "Beneficial use of municipal solid waste ash in sub base in road costruction" volume: 5 issue:3 |February 2016,IJEI.

[8] Meenakshi Dixit, Atishaya Jain, Dinesh Kumawat, Arvind Swami, and Manidutt Sharma, "Replacement of fine aggregate in concrete with municipal solid waste bottom ash from incinerator" volume: 3 issue: 7 |July 2016, IJCE.

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