ISSN: 0976-3031

Available Online at http://www.recentscientific.com

CODEN: IJRSFP (USA)

International Journal of Recent Scientific Research
Vol. 10, Issue, 07(A), pp. 33384-33387, July, 2019

International Journal of Recent Scientific Research

DOI: 10.24327/IJRSR

Research Article

COMPRESSIVE STRENGTH OF CONCRETE BY PARTIAL REPLACEMENT OF CEMENT WITH TEXTILE MILL SLUDGE

Harpreet Kaur* and Dr Jaspal Singh

Department of Civil Engineering, Punjab Agricultural University, Ludhiana-141004

DOI: http://dx.doi.org/10.24327/ijrsr.2019.1007.3659

ARTICLE INFO

Article History:
Received 4th April, 2019
Received in revised form 25th May, 2019
Accepted 23rd June, 2019
Published online 28th July, 2019

Key Words:

Concrete, textile waste, cement, compressive strength and workability

ABSTRACT

This study Scrutinize the potential utilization of Textile Mill Sludge (TMS) in concrete. The sludge from the textile treatment plants is considered as perilous (hazardous) in nature as it contains heavy metals of chemicals and dyestuffs. After the treatment of textile water the generated sludge mostly disposed in landfills. The processes related to transportation and disposals are very costly, so in this study attempt are made to find an eco-friendly and cost effective solution for the sludge management. All the tests were conducted on used materials as per Bureau of Indian Standard (BIS) codes by partial replacement of TMS up to 35% of cement in M20 grade of concrete. An experimental program was conducted to find out the workability and compressive strength of concrete. The replacement of TMS in concrete mix affects the workability as it has low values of specific gravity and density. The compressive strength of concrete reduces with the replacement of cement. When cement was replaced by TMS beyond 25% with the estimated quantity of plasticizer, the compressive strength falls below the required values. This study is mainly gives us the knowledge about the management of textile mill sludge and its applications in construction materials rather than disposing it into landfills.

INTRODUCTION

Today, the world is advancing too fast and our environment is changing progressively. With growing population the need of industries has been increased. This industrial growth led to waste generation every day, every hour which has become the greatest problem to our environment. Every production leads to waste generation such as ashes, sludges and other waste materials. Hence it is very important to recycle these wastes into something useful and environment friendly. As we know that the textile industry plays an important role in Economy of any country as it is one of the biggest sector of production. The textile industries produces liquid waste from various processes and after the treatment of waste water, sludge is generated known as Textile Mill Sludge(TMS). Chemical precipitation methods are mainly used for treatment of wastewater. A specific location for the disposal of TMS has allotted by the government. TMS is a hazardous chemical waste and used for land filling. The conventional techniques for sludge disposal like compositing, land filling, agricultural utility, open dumping and thermal techniques are found to have some drawbacks such as land losing its fertility, possible contamination of underground water, requirement large surface area for storage and high cost of disposal. If the proper disposal techniques are not adopted, it creates bad impacts on our environment. So, there is a need to find the alternative solutions of TMS management.

The compressive strength of concrete is the important and useful property of concrete. It helps us in determining other properties of hardened concrete. The compressive strength of concrete mainly depends on Watercementratio, types aggregate used and their strength etc.

Review of Literature

The use of Textile ETP sludge in applications of building materials could serve as an alternative solution to disposal. The strength and other properties met the Bureau of Indian Standards for non structural materials such as flooring tiles, solid and pavement blocks and bricks. However, the addition of sludge to the cement delays the setting process of the building components (Balasubramanian J*et al*, 2005).Dyeing wastewater has the possibility to be used as the construction material. As far as the structural applications were concerned, it was fulfilling the criteria of some of the classes (C to K) as per

Corresponding author:* **Harpreet Kaur
Department of Civil Engineering, Punjab Agricultural University, Ludhiana-141004

BIS Standards of the bricks up to strength of 25 N/ mm ^{2}. The use of sludge can definitely be explored for other structural and non-structural applications depending upon the requirement of strength. It can be used for applications load-bearing and non-load bearing walls, the chemical sludge from textile wastewater treatment plants has a potential to be reused as construction materials for different applications (Patel and Pandey, 2009). The replacement of fine aggregate with sludge in conventional concrete mix affected workability and density of concrete. The compressive strength gradually reduced with replacement and later it fell below desired value when fine aggregate replaced by textile mill sludge was beyond 32%Kulkarni*et al* (2012).

Materials Used

Ordinary Portland cement (OPC 43-grade) confirming to BIS, IS: 12269 was used. Mortar cube steel moulds of 70.6 x 70.6 x70.6 mm size were used to find the compressive strength of cement. It was fresh and free from any lumps. Cement was carefully stored to prevent deterioration in its properties due to contact with the moisture. The physical properties of the cement as determined from various tests.

The river sand was used as fine aggregates confirming the zone II and all the physical properties as per IS 383-1970. Aggregates most of which passes 4.75-mm BIS Sieve known as fine aggregates. The properties of fine aggregates such as specific gravity and fineness modulus were determined.

The coarse aggregates were used as a mixture of two locally available crushed stone of 10 mm and 20 mm size in 50:50 proportions as shown in following figure. The aggregates were washed to remove dirt, dust and then dried to surface dry condition.

The properties of course aggregates such as specific gravity and fineness modulus were determined.

Textile wastewater sludge samples were collected in plastic bags from Ludhiana district, Punjab (from various dyeing industries).Each bag contains 20 kg of sludge at the time of collection. Firstly the sludge samples were tested for moisture content which was found to be near about 30 to 35% moisture content. The collected sludge was dried in sunlight (sun dry). After drying; the sludge was ground using a mixer grinder. The sludge passed from 150-micron sieve and retained on 90-micron sieve was used in this study. Sludge particles contain very small size and low density, so because of this it had very low specific gravity than cement. Some handling problems were also occurred while used, as it is finer than cement. The sludge had a very hydroscopic nature as it contains more volume and required more water, causes the reduction in strength of concrete.

Textile Mill sludge

METHODOLOGY

Textile mill sludge -Sludge samples were kept in a air tight plastic bags for the analysis and analysis was done with in short time duration after the collection of samples. As the sludge was chemical in natue and it contains dye products, some metals and inert solids. The properties of sludge waste can vary with many factors like chemical used, treatment process and composition, so the properties can be vary from mill to mill. The physical and chemical properties of textile sludge used for the research work were analyzed in soil science department, (Punjab Agricultural University, Ludhiana, Punjab) with the help of the ICAP-AES Analyzer.

The present investigation includes design of concrete mix for M20 grade of concrete. The guideline given in codes BIS: 10262-2009 and BIS: 456-2000 has been adopted for mix design of concrete and the proportions of different materials are shown in following table:

Water	Cement	Fine aggregates	Coarse aggregates
186 liters/m^3	334 kg/ m^3	785.90 kg/ m^3	1156.64 kg/ m^3
0.50	1	2.353	3.462

Testing for compressive strength of concrete was conducted as per BIS: 516 -1959.In this experimental program, to determine the values of compressive strength, total eight mixes were prepared using different replacements of cement with TMS. The water to cement ratio was kept 0.50. The quantities of cement, coarse aggregates (20 mm and 10 mm), fine aggregates, TMS and water for each batch (varying the percentage of textile sludge) were weighed separately. Firstly, the cement and TMS were uniformly mixed in dry state than fine aggregates and coarse aggregates were mixed to get uniform distribution. Water was added to the mix and then all the ingredients were mixed thoroughly for 3 to 4 minutes.

Compressive strength of concrete was determined from cubes of 100 mm × 100 mm × 100 mm in size. Cube moulds were cleaned and oiling was done. Then the concrete was filled into the cube moulds. Concrete moulds were vibrated to ensure proper compaction,. Trowel was used for surface finishing. The finished specimens were left for 24 hours. The specimens were removed from the moulds after 24 hours of casting and were placed in the water tank, filled with potable water in the laboratory. In this study total seventy two (72) Specimens were prepared by varying percentage of textile sludge. Specimens were taken out from the curing tank at the ages of 7, 14 and 28 days. Surface water was wiped off and specimens were immediately tested after removal from the curing tank. The compressive strength of concrete cubes was tested under Universal Testing Machine (UTM).As shown in following Figure.

The load was applied gradually without shock till the failure of the specimen occur and thus the compressive strength of concrete cubes was found.

RESULTS AND DISCUSSIONS

Various tests for Preliminary analysis of textile sludge samples was conducted in material testing laboratory (civil Engg. department) as shown in following table-

Sr.No	Parameter	Result
1	pH	7.82
2	Electrical conductivity	0.37
3	Specific gravity	1.93
4	Moisture content	30-35%

The various chemical properties of textile sludge used for the research work were analyzed in soil science department (Punjab Agricultural University, Ludhiana, Punjab) with the help of the ICAP-AES Analyzer. Results are shown in following table-

Heavy metal	Result (unit mg/kg)
Ca	78.5
Cu	81.725
Fe	486
K	144.825
Mg	92.75
Mn	98.4
Na	960
P	120.975
Si	54.5

Cement (OPC 43 grade) was carefully stored to prevent deterioration in its properties due to contact with the moisture. The physical properties of the cement as determined from various tests and the corresponding standard for that parameter as per BIS: 8112-2013 is also listed in following Table

Sr. No.	Characteristics	Value Obtained experimentally	Value specified by BIS: 8112-2013
1.	Specific Gravity	3.15	-
2.	Standard Consistency	30%	-
3.	Initial Setting Time	80 minutes	30 minutes (minimum)
4.	Final Setting Time	125 minutes	600 minutes (maximum)

The coarse aggregates used were a mixture of two locally available crushed stone of 10 mm and 20 mm size in 50:50 proportions. The aggregates were washed to remove dirt, dust andthen dried to surface dry condition. Some important properties are shown in the following table:

Properties of Coarse Aggregates

Colour	Grey
Shape	Angular
Maximum Size	20 mm
Specific Gravity	2.67
Water Absorption	0.93%
Fineness modulus	8.22

The fine aggregates brown in colour was used in this study. Specific gravity of fine aggregates was experimentally determined as 2.55 and fineness modulus was 2.73. Sieve analysis of fine aggregates was done for confirming the zone (zone II) as per BIS: 383-1970.

Effect of Addition of TMS on Compressive Strength

The compressive strength is the resistance to failure under the action of compressive forces. it is an important parameter to determine the performance of the concrete during service conditions. Compressive strength of concrete depends on many factors such as strength of cement, quality of concrete material and water cement ratio etc. This paper is mainly dealing with the compressive strength of concrete with partial replacement of cement with TMS. The results were obtained from specimens at different curing days are shown in following table-

From the results shown in the above table, shows the workability of concrete goes on decreasing after the replacement of cement up to 25%. After this value the workability of concrete becomes very low. The value of water absorption in concrete is directly proportional to the quantity of TMS addition. The compressive strength of concrete was also depends upon the type and nature of waste material added to it.

The addition of TMS affects the result of compressive strength.

Percentage of sludge	Slump (mm)	7days (Compressive strength) N/mm^2	14days (Compressive strength) N/mm^2	28days (Compressive strength) N/mm^2
0	95(medium)	20.53	21.25	27.46
5	80(medium)	19.66	20.61	25.16
10	90(medium)	20.22	21.80	23.65
15	85(medium)	15.99	16.59	22.63
20	85(medium)	16.59	15.79	21.03
25	70(medium)	16.13	14.51	21.66
30	55(low)	6.50	11.91	14.42
35	50(low)	8.46	8.50	13.69

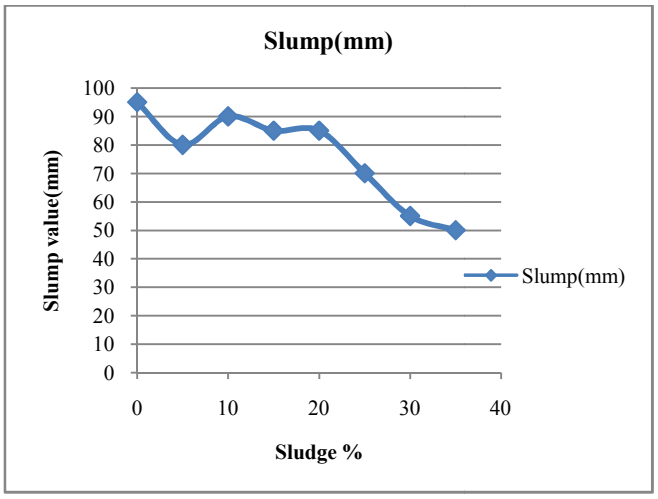

Fig 1 (Workability of concrete)

Graphical Representation of Compressive Strength Results

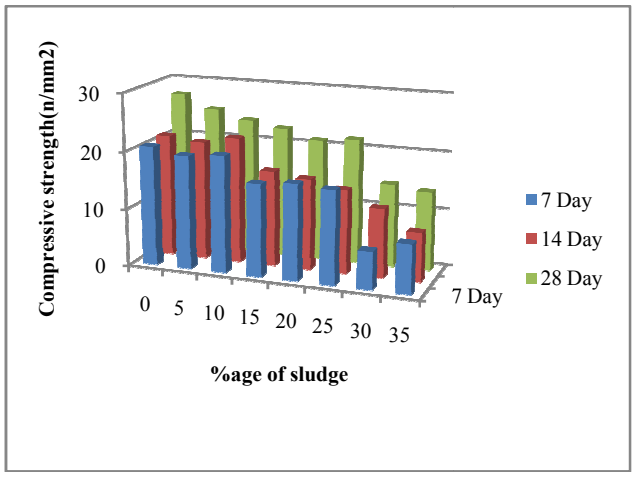

Fig 2 (Compressive strength of concrete)

CONCLUSION

From whole of this study it was Concluded that

1. The compressive strength of concrete is extremely dependent on the amount of sludge waste used in concrete.
2. Textile Mill Sludge is hydroscopic in nature, requires more water, with addition of sludge.
3. The maximum percentage of textile mill sludge that can be used is up to 25%,corresponding to compressive strength 21.66 N/mm^2
4. Use of plasticizer helps in improving the workability of concrete.
5. The results of compressive strength of concrete showed the decrease in strength with the increase in the percentage Textile mill sludge above 25%.

References

Balasubramanian J, Sabumon P C, John U L and Ilangovan R Reuse of textile effluent treatment plant sludge in building materials. *Waste Manage* (2005) **26**:22-28.

Baskar R ,Meera S B K M and Sundaram S Characterisation And Reuse Of Textile Effluent Treatment Plant Waste Sludge In Clay Bricks. *J Univ Chem Technol Metallurgy* (2006) **42** (4):473-478

BIS: 456-2000 (Reaffirmed 2005): Code of practice- plain and reinforced concrete, Bureau of Indian Standard, New Delhi-2000.

BIS: 516-1959 (Reaffirmed 2004): Methods of tests for strength of concrete, Bureau of Indian Standard, New Delhi-2004.

BIS: 8112-2013: Specification for 43 grade OPC, Bureau of Indian Standard, New Delhi-2005.

Iqbal S A, Mahmud I and QuaderA K M A Textile sludge management by incineration technique. *10th International Conference on Mechanical Engineering (Procedia Engineering)*. (2013) pp686-91,Bangladesh.

Kulkarni G J, Dwivedi A K and Jahgirdar S S Textile mill sludge as fine aggregate in concrete. *Global J Res Eng* (2012) **12** (2): 21-26.

Lekshmi S and Sheeba S Experimental investigation on the use of textile sludge in concrete.*IntJ AdvEng Tech*(2015) **8**(4): 559-65.

Patel H and Pandey S Physico-chemical characterisation of textile chemical sludgegenerated from various Common effluent treatment plants (CETPs). *J Environ Res Develop* (2008) **2** (3): 329-39.

Patel H and Pandey S Exploring the reuse potential of chemical sludge from textile wastewater treatment plants in India-A hazardous waste . *Am J Environ Sci* (2009) **5**: 106-10.

Raghunathan T, Gopalsamy P and ElangovanR Study on strength of concrete with effluent treatment plant (ETP) sludge from dyeing industry. *Int J Civ Struct Engg Res* (2010) **1** (3):379-89.

Sathanandham T,VijayanV, Kumar R D, Kumar M M, Kumar K N, Raj K N and Raj P R Studieson effective and ecofriendly utilization of textile and dyeing effluent sludge in construction industry**.** *Int J Innov Res Adv Stud* (2015) **4**(3): 42-64.

How to cite this article:

Harpreet Kaur and Dr Jaspal Singh., 2019, Compressive Strength of Concrete by Partial Replacement of Cement with Textile Mill Sludge. *Int J Recent Sci Res.* 10(07), pp. 33384-33387. DOI: http://dx.doi.org/10.24327/ijrsr.2019.1007.3659