Textile Mill Sludege as Fine Aggregate in Concrete

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Abstract

The textile industry is one of the oldest and largest sector in India. It generates liquid waste from its different processes. After treatment of the textile waste water in Effluent Treatment Plants, sludge is generated. Government has allotted specific location for its disposal. Generated sludge mostly disposed in landfill and dumping in the specified areas by Government. The transportation and disposal process is very costly. In this study an attempt is made to find out the feasibility of using sludge textile mill sludge as fine aggregates in M:20 grade of concrete. The replacement of fine aggregate with sludge in conventional concrete mix affects workability and density of concrete. The compressive strength gradually reduces with replacement and later it falls below desired value when fine aggregate replaced by textile mill sludge is beyond 32

Index terms— Textile Mill Sludge, Fly Ash, Concrete, Workability, Compressive Strength.

1 Introduction

n the industrial, mining, municipal, agricultural and other processes currently in India about 960 million tons of solid waste is being generated annually as by product out of which around 350 million tones are organic, around 290 million tons are inorganic from industrial and mining sector and around 4.5 million tons are hazardous in nature. The technology advancement has helped in using alternative construction materials as a substitute to traditional materials for manufacturing of bricks, concrete blocks, tiles, aggregates, ceramics, cements, limes etc. At the same time to safeguard the environment the efforts are being made for recycling different wastes and to utilize them in value added applications [Pappu et al, (2007)] .

In India at present the textile industry is amongst the top foreign exchange earning industries. The textile units are scattered all over the country. The Maharashtra state has large number of textile mills in its western part i.e. cities which Solapur and Ichalkaranji, which are away MIDC area have many small scale and large scale textile units. The smaller units cannot afford the seldom treatment, therefore the waste generated is disposed in natural water streams through existing drainage system.

The textile processing consumes enormous quantity of water and chemicals for various operations like washing, dyeing etc. The low efficiency of chemical operations and spillage of chemicals cause a significant pollution hazards and make disposal of treated wastewater and sludge a complex problem. The most of wastewater treatment plants presently adopt methods of chemical precipitation and subsequent clarification. The textile waste water is treated by coagulation i.e. by adding chemicals such as Alum, Ferric chloride, Lime and polyelectrolytes. As a result, the clarifier produces sludge which is dried in sludge drying beds. This dried sludge is basically chemical in nature and hence no further biological treatment can be given to it. Thus the disposal in Landfills is an ultimate option.

The fly ash which is tail end byproduct of a thermal power station is used in concrete. It is well known fact now that the addition of fly ash in prescribed percentage improves compressive strength of concrete.

2 II.

3 Background

In India, the costs of construction material have increased four times in last two decades. Further high transportation costs of raw materials are making situation worser. Increasing demand and environmental restrictions, necessities to the find functional substitutes for conventional building materials in construction industry ??Pappuetal, 2007).

Based on characteristics of waste water from the textile industries coagulation and adsorption treatments are common procedure. Due to its chemical content sludge generated during treatment is hazardous in nature ??Senthilkumar etal, 2008). The conventional methods of sludge disposal and treatment such as composting, land filling etc has many drawbacks. According to Badur and Choudhary (2008), the industrial hazardous wastes and byproducts can be used as green concrete material through stabilization/solidification (S/S) methods. The use of sludge as construction and building materials converts the waste into useful products that can solve disposal problems ??Lin, 2001).I (G) ear 2012 Y III.

4 Significance

The sludge management is becoming a challenge for engineers these days. Except engineered landfills rest of the methods for the indiscriminate Mr.G.J.Kulkarni ? , Prof. A.K.Dwivedi ? & Prof. S.S.Jahgirdar ? dumping lead ground water contamination and thereby other socio-economic impacts. Many studies carried out in this area have reported that the pollution level is high in ground water and nuisance due to dumping. So there is a growing need to find alternative solution for the sludge management. In this research an attempt is made to reutilize the Textile Mill Sludge (TMS) generated as building material to avoid adverse impacts on environment due to disposal methods.

IV.

5 Material & Methods

The dried Textile Mill Sludge was collected from Somani Evergreen Knits, Pvt. Ltd, MIDC, Kondi, Solapur in polythene bags. The chemical characterisation of collected TMS is done by using Scanning Electron Microscope (SEM) at NITK Surthkal.

The physical properties such as specific gravity, particle size distribution, bulk density, and dry density are determined as per the standard procedures. The chemical properties such as pH, EC, TDS are also determined. The concrete mix M:20is prepared with OPC of 43 grade, J. K. Cement is procured from local market. The various tests performed on Cement are as per BIS 2386(I), 4031(V), 650.

The sand required for experimentation is extracted from Bhima River. The sand is tested as per BIS 2386(I, II, III, VI).

The coarse aggregate for concrete is procured from local market and tested in laboratory as per BIS 2386(I, III).

Using the properties obtained from testing the raw material, concrete mix design is done for grade of M:20.

The twelve number 150mm X 150mm X 150mm concrete cubes for M:20grade are casted as per standard practice.

The tests on fresh concrete such as slump test, compaction factor are carried out and. Out of twelve cubes nine cubes are tested for compressive strength after three, seven and twenty eight days respectively in set of three cubes each. The density of the concrete is also measured.

Further using same mix design the fine aggregate are replaced by TMS in range of 4% to 36% by weight at an increment of 4%. All the test on fresh and hardened concrete similar to conventional trial mix (G)© 2012 Global Journals Inc. (US)

ear 2012 Y are carried out and results are compared for different percentage of TMS. The maximum percentage of TMS for which compressive strength is within the range of acceptable value as per BIS is obtained.

With the selected maximum percentage of TMS in concrete, the part of cement is replaced by Fly ash.

Fly ash required for experimentation is obtained from Yamai Brick manufacturer, Solapur who is getting it from thermal power station, Parali, Maharashtra.

In the second stage of experimention 32% Textile Mill Sludge as replacement to fine aggregate is kept constant and cement is replaced by fly ash from 5% to 20% with an interval of 5%, for M:20 grade concrete.

All tests on fresh and hardened concrete as in case of conventional trial mix are carried out and results are compared.

V.

6 Results & Discussion

The percentage of TMS which can be used without compromising compressive strength as determined by testing the concrete cubes with varying percentage of TMS which is 32%. Further in second stage of experimentation keeping TMS as 32% fly ash is used to replace cement as per BIS guidelines. The concrete with combination of TMS & fly ash is tested for its properties in hardened state.

Density of concrete with variation in sludge addition are notes and given in Table3. From Table 4 and Figure (1) it is clear that, slump value is maximum for conventional mix for grade M20. As percentage of sludge goes on increasing slump value reduces to zero. For M20 grade, slump value is zero beyond 24% sludge addition. It means workability reduces from high to low. From Table 5 and Figure (2) it is clear that; compaction factor is maximum for conventional mix for grades M20. As percentage of sludge goes on increasing compaction factor reduces. This indicates workability reduces from high to low.

7 Properties of Fresh Concrete

8 VII. Properties of Hardened Concrete

Compressive strength of cubes after three, seven and twenty eight days of M-20 concrete are given in table 6. From table 5 it is clear that 28 compressive strength for M:20 concrete is above the required compressive strength for it as per BIS code.

9 VIII. Conclusion and Future Scope

i. Textile mill sludge(32%)and fly ash(20%) can be successfully used as building material by adding it in M20 grade of concrete.

ii. Workability of concrete (measured in terms of slump values and compaction factor) goes on reducing as percentage of sludge increases. iii. The values of compressive strength obtained with addition of 32% sludge and 20% fly ash are 20.22N/mm 2 which is just at the verge of characteristic strength with laboratory precision. iv. For site execution quality control has to be equivalent to laboratory with form vibrator and immersed vibrators.

Following points are suggested for future work for reuse of textile sludge in concrete. i. To increase workability of concrete with increase in sludge percentage plasticizer can be used. ii. To increase the compressive strength of sludge based concrete silica fumes from glass industry can be added. iii. As textile mill sludge contains organic matter, it can be turned in to sludge ash by igniting it to 8000c for half an hour. This sludge ash can be used in concrete. iv.

More trials can be taken for higher grades of concrete with various percentage of fly ash and cubes can be tested for 45 and 90 days compressive strength in view of the fact concrete with fly ash shows more compressive strength as compared to conventional concrete with 100% cement, but at higher age. [1]

1

Figure 1: Figure 1 :

1

Element	Mass % in Oven Dried Textile Mill Sludge (ODTMS)	Mass % in Textile Mill Sludge Ash (TMSA)
C	34.11	3.19
O	36.50	39.81
Fe	13.22	24.69
Al	1.03	1.84
Ca	3.690	8.97
Si	3.27	6.21

Figure 2: Table 1 :

2

Sr. No.	Parameter	Value
1	Specific Gravity	1.1
2	Dry density	1080 kg/m 3
3	Sieve Analysis	F.M.= 2.83
4	pH (1:5 sludge suspension)	6.46
5	EC (25 o C)	11.93 mS
6	TDS	6.072 ppm

Figure 3: Table 2 :

3

		Average Density in Kg/m 3		
Age of cube in Days		Percentage of fly ash		
	5	10	15	20
3	2524.19	2496.76	2465.84	2460.36
7	2536.26	2536.58	2496.93	2478.65
28	2572.123	2474.8	2427.145	2533.567
VI.				

Figure 4: Table 3 :

4

Figure 5: Table 4 :

5

Sludge %		Percentage of Fly Ash		
	5	10	15	20
0	0.95	0.955	0.96	0.96
4	0.94	0.935	0.925	0.93
8	0.92	0.922	0.92	0.92
12	0.915	0.913	0.915	0.9
16	0.875	0.88	0.87	0.86
20	0.77	0.78	0.77	0.78
24	0.755	0.765	0.76	0.75
28	0.745	0.745	0.74	0.74
32	0.72	0.72	0.73	0.725
36	0.72	0.713	0.715	0.716

Figure 6: Table 5 :

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