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Experimental Investigation on Partial Replacement of Water with Spent Liquor

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Abstract: *Pollution caused by sugar-distilleries has been a challenging problem for environmental engineers and scientists. Recent investigations on the management of wastewater spiked with organic matters have shown no us. In the present study, characterization of distillery-spent wash from sugar industry was done by standards methods. In this project the partially utilization of spent wash is done in cement brick manufacturing as admixtures. The results obtained were very interesting. We can use spent liquor, which has no use & causes water pollution, soil pollution, and land pollution in cement brick manufacturing. The utilization of spent wash is done as well as the strength of cement brick is increased. As the process is technically and economically feasible, it has wide scope for utilizing the effluents from other chemical industries thereby protecting the environment from tremendous pollution.*

Keywords: *20% to100% replacement with water, Compression strength & Spent Liquor.*

I. Introduction

Rapid industrialization of India led to geometrical rise in the level of air, water, space, and noise and land pollution. One of India's major problem is the increasing level of land pollution. This is largely due to the uncontrolled disposal of industrial solid and hazardous waste. With rapid industrialization, the generation of industrial solid and hazardous waste has increased appreciably. In addition, the waste of nature generated has become complex. Their impacts on the ecological bodies are noticeable.

One of the major environmental problems of the sugar industry comes from spent liquor, which is undesirable product from them.

The wastewater coming from sugar industry generally known as spent wash is a dark brown in color, carry high organic load and causes severe fouling of the atmosphere in severe regions of the country. Spent discharged by distillery from sugarcane molasses possesses problems of disposal to acceptable standard due to their high BOD, COD and color. About 12 to 15 litter of spent wash produced per liter of alcohol produced. After fermentation of molasses, alcohol separated by distillation process and the residual liquor discharged of spent- wash. The discharge from the plant is hot, highly colored [Dark brown], acidic and possess objectionable odor. The Biological Oxygen Demand [BOD] Value is extremely high likewise, the values of suspended solid, dissolve solid, chloride, sulphate and nitrogen is also too high. The potassium content of the effluent is use for irrigation. Though the distillery effluents to do not contain any toxic substance, these create toxic resulting in massive fish kills, production of fouls, odors and decolonization of streams. Most of distilleries stagnant their effluents on land as ponds. Water pollution occurs due to seepage & ground water. It is a serious threat to soil and water quality y because of the Melanie coloring compounds present in the effluent. Further, obnoxious odor spreads to a few kilometers, which are cause of serious help problem. India being as an agricultural country various industrial units.

II. Literature Survey

Now days in India, the major problem is wastewater disposal, which is drained from various industries. Miss. Shurtakirti A. Mahajan[1], Dr. M Husain[2] (2016) [1] experimentally studied the utilization of waste sludge in brick making. In India, there are 36,000 hazardous waste generating. Out of 6.2 Millions tones only 2.7millions tones can be processed by Land filling Incinerable Hazardous waste is about 0.4 million tons (7 %) and recyclable hazardous waste is about 3.1 million tones.

Samar A. El-Mekkawi, Ibrahim M. Ismail, Mohammed M. El-Attar b, Alaa A. Fahmy a, Samia S. Mohammed (2011) [2] has investigated on black liquor, produced by the pulp & paper industry in Egypt, as a workability aid & set Retarder admixture. 2.5 million tons of rice straw and one million tons of sugarcane bagasse produced in Egypt in 1996, as agro by-products, by 2006 production had risen to 10 million tons of rice straw and 3.5 million tons of bagasse. Using this liquor as concrete admixture increases the strength of concrete

by 0.3% and decreases the water content by about 10.2%. The use of alkaline black liquor gives workability aid for mortar and concrete has shown in some reports. In addition, shows that alkali black liquor does not have any negative effect on concrete durability or steel corrosion.

III. Objective

In many industries, wastewater is directly released in to the water streams like river, lakes, sea, etc. or disposes of open land. The problem in distillery or sugar industries is disposal of spent wash. In distillery plant obtain waste spent liquor is stored in special tank and dispose on land due to which it affects the fertility of soil or land.

To overcome this problem of spent wash and to overcome the water scarcity problem we can use the neutralized spent wash in casing of cement brick this will help to reduce the water cost and use of spent liquor.

In future this method of using spent wash can help to solve the disposal problem and minimize the water cost require in many process industries.

IV. Properties Of Raw Material

Cement

1. Physical Properties

Portland cements are commonly characterized by their physical properties for quality control purpose. Their physical properties can be used to classify and compare Portland cement. The challenges in physical property characterization are to develop physical tests that can be satisfactorily characterizing key parameters.

- setting time
- Soundness
- Fineness
- Strength

Table 1. Chemical properties

Chemical properties of cement are mentioned in table no: 1 Sr. no.	Parameter	value
1.	Lime	63.5%
2.	Silica	19.0%
3.	Alumina	4.2%
4.	Iron oxide	3.1%
5.	Magnesia	2.9%
6.	Sulphur tri oxide	2.5%
7.	Soda and potash	0.9%
8.	Loss on ignition	2.1%

Table 2. Typical composition of distillery spent liquor

Sr. no.	Parameter	Liquor analysis
1.	Ph.	7.87mg/lit
2.	Suspended solid	241066.6mg/lit
3.	Total dissolve solid	241066.6mg/lit
4.	BOD at 27◦c for 3 days	2400mg/lit
5.	COD	25000-30000mg/lit
6.	Oil and grease	23mg/lit
7.	Sulphate	4000mg/lit
8.	Potassium	13000mg/lit
9.	Chloride	100000mg/lit
10.	Sodium	1200mg/lit
11.	Calcium	2600mg/lit
12.	Magnesium	2700mg/lit
13.	Iron	61mg/lit
14.	Total nitrogen	1350mg/lit
15.	Color	Dark brown
16.	Odor	Smell of burnt sugar
17.	Temperature	90-95°c
18.	Alcohol boiling point	78°c
19.	Water mix	25°c to 28°c brix

V. Mix Design

Indian standard method of mix design of plain concrete is carried out (as per IS 10262: 2009, IS 456:2000, IS 10260:1982)

Sample mix design for M20 grade concrete.

1. Determination of target means strength

$F_{ck} = F_{ck} + (t \times s)$

$F_{ck} = 20$ N/mm2

t = 1.65 (From IS: 10262- 1982, Table - 2)

S = 5.0 N/mm2 (Std. Deviation as per IS 456-2000 clause 9.2.4.2)

$F_{ck} = 20 + (1.65 \times 5)$

$F_{ck} = 28.25$ N / mm2

2. Selection of water cement - ratio

From IS 10262-1982 figure - 1 for target mean strength of 28.25 N/mm the water cement ratio required is 0.39. This value is lower than the maximum value of 0.55 as prescribed for mild exposure.

Adopt water cement ration of 0.55

Design Parameters:-

1. Mix proportion 1:2:4
2. w/c ratio 0.55
3. Size of cube 15cm×15cm×15cm
4. Area of cube 225.59 cm2

These tests taken for 7 days of curing of cement brick.

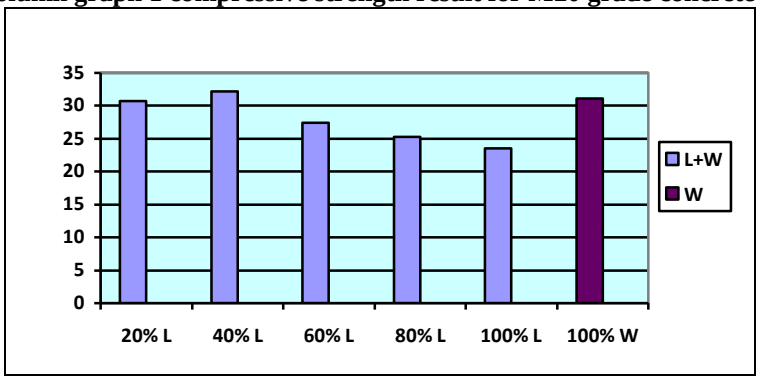
Table 3. Observation Table for Test Results

Sr. no	Sample in %	Maximum load	Area in sq.mm.	Compressive strength	Average compressive strength
1	20% spent wash 80% water	670 740 665	22500 22500 22500	29.77 32.88 29.55	30.73
2	40% spent wash 60% water	690 680 730	22500 22500 22500	30.66 30.22 32.44	32.14
3	60% spent wash 40% water	670 620 560	22500 22500 22500	29.77 27.55 24.88	27.4
4	80% spent wash 20% water	580 610 515	22500 22500 22500	25.77 27.11 22.88	25.25
5	100% spent wash	530 500 560	22500 22500 22500	23.55 22.22 24.88	23.55
6	100% water	730 720 720	22500 22500 22500	32.44 32.00 32.00	31.10

VI. Result

1. When we use 20%, spent wash & 80%, water it gives less strength compared to 100% water.
2. After that we use 40% spent wash & 60% water, the strength obtained by using 40% spent wash & 60 % water is same as that obtained by using 100% water.
3. As we increase the percentage of spent wash the strength obtained decreases, which is minimum for 100% spent, wash.
4. Thus using 40%, spent wash gives the maximum strength.

Column graph 1 compressive strength result for M20 grade concrete



VII. Conclusion

1. Compressive strength of cement concrete brick is found to increase with addition 40% spent liquor and 60% water.
2. Development of cement concrete brick with treated spent liquor is expected to save about Rs. 0.0464 per liter of water.
3. Higher degree of automation thus needs less labor force.
4. Good durability, strength, impact resistance and low maintenance cement concrete brick wall under a variety of exposures;
5. It can be used for thermal insulation & also for Earthquake resistant structure;
6. Needs lower maintenance, has longer life, resistance to insects and moisture, noncombustible and environmentally safe.

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