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SOIL STABILIZATION OF ROAD BY USING SPENT WASH

Rushikesh Pawar[1], Tanmay Badhe[2], Akshay Jadhav[3], Ajinkya Avaghade[4] and Prashant Mahadik[5]

[1,2,3&4] Students, B.E, Dept. of Civil Engineering, Bharati Vidyapeeth's College of Engineering, Lavale, Pune, Maharashtra, India

[5]Professor, Dept. of Civil Engineering, Bharati Vidyapeeth's College of Engineering, Lavale,Pune, Maharashtra, India

ABSTRACT

Road transport plays very important role in development of country. Developing an honest network of road in villages in India may be a difficult drawback because it wants stabilization of sub grade and sub base with economical choice. Spent wash is works waste product of sugar trade and harmful if not properly treated and distributed in water. The present study deals with the study of impact of blending spent wash in water on index properties of black cotton soil. It is economical and environmental friendly replacement choice to water with improvement in index properties of black cotton soil.

Keywords:black cotton soil, index properties, road construction, spent wash, Soil Stabilization,

1. INTRODUCTION

Roads plays an important element of transit by the suggests that of obtaining agricultural crops to promote and sustaining the lives of farmers. Hence, smart road network could be a key of development of any country. In Asian country just about 69,000 miles of those roads square measure stable with gravel or crushed sedimentary rock as a result of their low traffic volume doesn't justify paving with asphalt or Portland cement concrete. With the exaggerated world demand for energy and increasing native demand for aggregates it's become high-ticket from material value purpose of read to get rid of inferior soils and replace them with foreign soil which may offer higher appropriate. Hence, it becomes essential to change the properties of regionally out there thusil to the extent that it is utilized in the development of roads so on minimize the price of construction of roads and to create best utilization of assorted industrial by-products like, Spent wash and ash as a soil modifying, soil helpful agents.More recently, the high costs of waste disposal techniques have sparked an interest in the possible use of waste materials such as fly ash, steel slag, waste tires, lignin and spent wash etc. These materials may be added individually or in combination with soils in various geotechnical engineering works to reduce the quantum of waste required to be disposed off. During last 35 years, the capacity of nations to produce consumes and discard waste has grown dramatically requiring innovative techniques of management of complicated and varying type of waste.

2. SPENT WASH USED AS ROAD CONSTRUCTION:-

Types of Spent Wash:-

1) Cane Spent wash: -Spent wash is contamination escalated squander water produced by refineries its dim earthy colored tone is expected to the headstrong melanoidin shade. Distillery spent wash is perceived as one of the serious pollution problems of the countries producing alcohol from the fermentation and subsequent distillation of sugar cane molasses Spent wash is the most valuable by-product from the Sugar Industry. The spent wash referred to in this article is blackstrap spent wash, which is the spent wash from the production of raw sugar from Sugar cane.In this study spent wash was obtained fromGhodganga Sahakari Sakhar Karkhana Ltd, Shirur, Dist. Pune, Maharashtra.

3. LITERATURE STUDY

The locally available rice husk ash is successfully used for construction of road. (Roy, 2014).The soil was stabilized with different percentages of Rice Husk ash and small amount ofcement. This helped reduce the cost of stabilization of soil. Addition of Fly ash makes Blackcotton soil less plastic and increases its workability (Mehta, 2013).The study was done withvarying proportions of fly ash mix with BC soil. The surface and ground water was foundpolluted due to the rapid industrialization (Mathura, 1999). He also found that the interactionsbetween effluents of the sugar industry, soil and moisture tend to influence the water qualitydue to production of glucose, fructose, alcohol and acetic acid. A comprehensive study ofdistillery spent wash was done in concrete (Arunvivek, 2013). It was also concluded thatwide use of distillery spent wash within the housing industry cement, improves thequality of concrete mixes and solves ecological problems. Cane molasses was used for thestabilization of expansive soil (Julius, 2011). Stabilization of black cotton soil with molasses increased the CBR values and also reduced its swelling tendencies. The sub base stabilizationwith lime and industrial waste mixes improved the strength behaviour of sub base (Joe,2015). He concluded that there was an appreciable improvement in the optimum moisturecontent and maximum dry density for the soil treated with industrial waste. Elias (2015)investigated the waste materials in geotechnical applications and evaluated the effect of papersludge on strength development of soft soil. It was also found that the addition of waste paper sludge increased the strength of soil in a good manner.

4. METHODOLOGY

The materials used in this study are locally available black cotton soil and spent wash. Thesoil for experimental investigation is collected from Mulshi, Mulshi Dist. Pune, Maharashtra. The spent wash is collected from Ghodganga Sahakari Sakhar Karkhana Ltd, Shirur, Dist. Pune, Maharashtra.

Table 1 Properties of Black Cotton Soil

Properties	**Value**	**Properties**	**Value**
Colour	Light grey	Shape	Rounded /subrounded
SiO2 (%)	52%	Coefficient of uniformit, Cu	5.88
Al2O3 (%)	23%	Coefficient of Curvature ,Cc	1.55
Fe2O3 (%)	11%	Specific Gravity, G	2.38
CaO (%)	5%	Fineness as surface area m2/kg	420

Sr.No.	**Properties**	**Value**
1	Liquid Limit	73.88%
2	Plastic limit	40.39%
3	Shrinkage limit	84.64%
4	Plasticity index	33.09%
5	Consistency limit	1.23
6	Specific gravity	2.59
7	Maximum dry density	1.405
8	Optimum moisturecontent	29.91

Distillery spent wash is that the unwanted residual liquid waste generated during alcohol production. The pollution caused by it's one among the foremost critical environmental issues. Despite standards imposed on effluent quality, untreated or partially treated effluent fairly often finds access to water courses. The distillery waste water with unpleasant odour poses a significant threat to the water quality in neighbouring water bodies. The comparative study of normal water and spent wash contaminated water is presented in Table 2 as follows:

Table 2 Comparative study of water and contaminated water

Sr. No.	**Characteristics**	**Water**	**Spent Wash Water**
1	Colour	Colourless	Reddish Brown
2	Odour	Unobjectionable	Aromatic
3	pH	6.5-8.5	7.7
4	Turbidity (NTU Max)	5	10.7
5	Total Hardness (mg/lit)	150-300	410

The ever increasing generation of distillery spent wash on the one hand and stringent legislative regulation of its disposal on the opposite has stimulated the necessity for developing new technologies to process this effluent efficiently and economically. The qualitative analysis of spent wash is given in Table 3and Table 4.

Table 3 Physio Chemical Composition of spent wash

Sr. No.	Physical properties	Spent wash
1.	Color	Dark brown
2.	Specific gravity	1.2
3.	Viscosity(cp at 200C)	1500
4.	PH	3.80
5.	Litters/tone	714
6.	Appearance	syrupy liquid
7.	Gallons/tone	157
8	Odour	Unpleasent burnt sugar
9	TDS(mg/L)	91700
10	TSS (mg /L)	26560
11	TS (mg/L)	118260
12	BOD (mg/L)	43000
13	COD (mg/L)	128000
14	Organic Carbon (%)	3.7
15	Nitrogen (mg/L)	1460
16	Phosphorus (mg/L)	326
17	Potassium (mg/L)	14300
18	Sodium (mg/L)	356
19	Calcium (mg/L)	6800
20	Magnesium (mg/L)	4384
21	Chloride (mg/L)	10650
22	Sulphate (mg/L)	3000
23	Copper (mg/L)	2.8
24	Manganese (mg/L)	9.2
25	Iron (mg/L)	24.6
26	Zinc (mg/L)	7.8
	Carbonates (mg/L)	Nil
	Bicarbonates (mg/L)	1530

Table 4 Chemical analysis ofspent wash Constituent Amount

Sr.No.	**Constituent**	**Amount**
1	pH	5.0
2	Electric conductivity (EC)(dsm-1)	7.5

3	Calcium + Magnesium (mg/lit)	160
4	Sodium (mg/lit)	10.9
5	Potash (%)	1
6	Zinc (ppm)	3.7
7	Organic carbon	1.33
8	Total nitrogen (%)	0.114
9	Total phosphorus (%)	0.219
10	Ash (%)	2.44

Water in and beneath a road pavement features a major impact on the road‟s performance and its survivability clean and potable water is employed for the testing.

5. EXPERIMENTAL WORK

In this study, various tests like plastic limit test, liquid limit test and shrinkage limit test on soil were conducted to review the stabilization of sub base using spent wash. Optimum moisture content and maximum dry density was observed to be significant for a mix of water & 5 % spent wash. Hence the consequences were studied for this proportion of spent wash. the whole tests were conducted within the controlled conditions as per the quality procedures given within the respective codes of the Indian Standard.Plastic limit is defined because the present moisture content and expressed as a percentage of the oven dried soil at which the soil are often rolled into the threads one – eighth inch during a diameter without soil breaking into pieces. this is often also the moisture content of a solid at which a soil changes from a plastic state to a semi solid state. The averages of plastic limit for black cotton soil without and with 5% spent wash are 40.79 and 42.15 respectively.Liquid limit is defined because the moisture content at which soil begins to behave as a liquid material and begins to flow. The importance of the liquid limit test is to classify soils. Different soils have varying liquid limits also, once must use the plastic limit to work out its plasticity index. The results of liquid limit for black cotton soil without and with 5% spent wash are presented in Table 5.

Table 5 Liquid limit test on black cotton soil without and with water + 5% spent wash

Sr.No.	**Description**	**Trial1**	**Trial2**	**Trial3**
Without spent wash				
1	Moisture content(%)	71.60	73.70	75.50
	Average (%)	73.56		
With spent wash				
1	Moisture content(%)	61.50	64.40	70.50
	Average (%)	65.46		

Shrinkage limit is the water content after which further decrease in water content does not cause any decreased in the volume of the soil mass. In other words, it is the minimum water content at which a given soil will be fully saturated. The results of shrinkage limit for black cotton soil without and with 5% spent wash are presented in Table 6.

Table 6 Shrinkage limit test on black cotton soil with water

Sr.No.	**Test**	**Average**
Without spent wash		
1	Shrinkage limit	84.40
2	Shrinkage ratio(R)	6.50
With spent wash		
1	Shrinkage limit	69.60
2	Shrinkage ratio(R)	5.65

Soil samples were tested with and without spent wash replacement of water. From the above tests, the summary of the test results is given in following Table 7 and Table 8.

Table 7 Test summary for Plasticity Index, Consistency Limit and Optimum Moisture Content

Sr No	Tests	Replacement of water by spent wash (%)			
		0	5	10	15
Black cotton soil					
1	Average Bulk Density (gm/cm^3)	1.765	1.745	1.735	1.840
2	Average Water content(%)	29.832	27.991	25.906	30.695
3	Average Dry density (gm/cm^3)	1.365	1.370	1.375	1.408
Murum					
4	Average Bulk Density (gm/cm^3)	1.832	1.809	1.868	1.863
5	Average Water content(%)	30.692	29.65	26.185	22.785
6	Average Dry density (gm/cm^3)	1.405	1.396	1.486	1.525

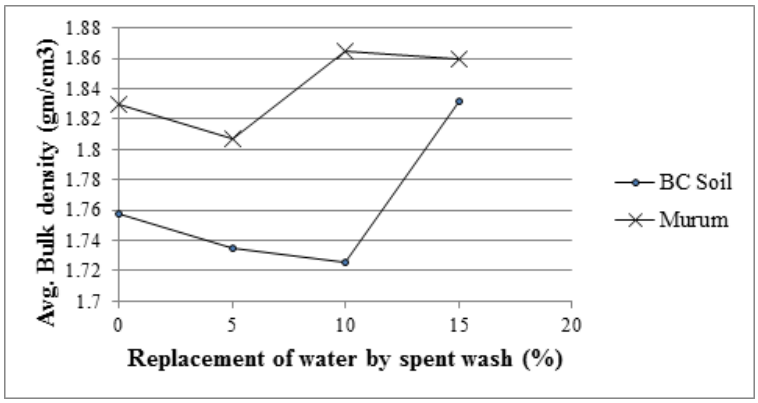

Figure 1 Bulk density of BC soil and murum

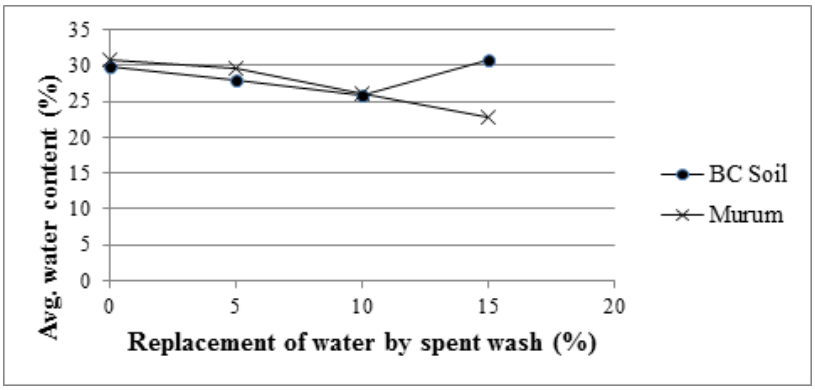

Figure 2 Water content of BC soil and murum

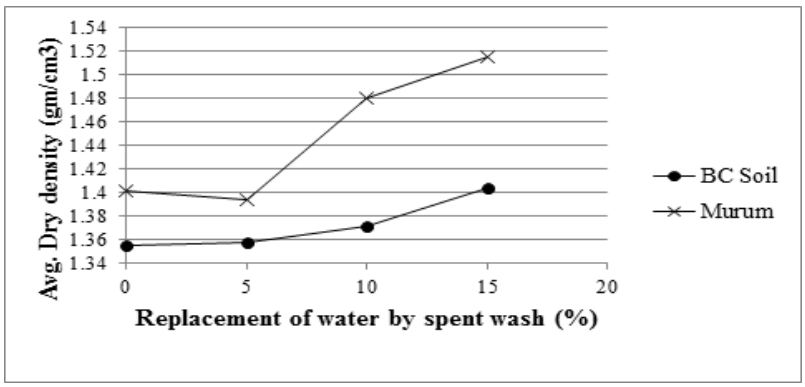

Figure 3 Dry density of BC soil and murum

Uses of Spent wash to improve Soil properties for Road Construction

In road construction water is required for soil stabilization. As per current market rates, a tank of 10,000 liters water is available at cost of Rs 2500 including transportation cost up to 10km. As per above tests conducted with 5% of spent wash replacing water in black cotton soil there is an increase in dry density and decrease in watercontent. Spent wash is available with no extra cost and without any transportation charges. When spent wash is used in road project, the disposal issue gets solved to some extent.

6. CONCLUSIONS

From the present experimental study we concluded that 5% and 15% spent wash with water is effective for stabilization of black cotton soil and murum respectively.
This chapter present a summary of work, the major conclusions and future scope of the investigation. The following conclusions are drawn based on the results discussed in the previous chapters.
1) The plastic limit and liquid limit for black cotton soil increases with increases in percentage of spent wash.
2) Shrinkage limit decreases for black cotton soil with increases in percentage of spent wash.
3) Consistency limit increases for black cotton soil with increase in percentage of spent wash.
4) There is an appreciable improvement in the optimum moisture content and maximum dry density. For the black cotton soil and murum treated with industrial waste (spent wash).

The varying proportions of spent wash with water such as 0, 5, 6.5, 7.5, 10, &15 are taken for black cotton soil stabilization and varying proportion of spent wash with water such as 0, 5,10,15,20 are taken for murum soil stabilization.
a) Stabilization with 5% of spent wash with water was effective for black cotton soil.
b) Stabilization with 15% of spent wash with water was effective for murum soil.
5) Use of spent wash with water for black cotton soil and murum soil stabilization, reduces water content 5.33% and 5.83% respectively hence become economical.
6) Spent wash contaminated water is harmful for aquatic life and human beings as pH,

Hardness, Turbidity, where highly greater as compared to potable water.

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