EXPERIMENTAL STUDIES ON HAZARDOUS WASTE SAFE LAND DISPOSAL – TANNERY WASTE

[1]R.JAYASANKAR, [2]S.MOHAN

[1]Department of civil Engineering, Annamalai University, Chidambaram, Tamilnadu, India
[2]Associate Professor, Department of Civil Engineering, Annamalai University, Chidambaram, Tamilnadu, India
E-mail: [1]jayasankarrenu@gmail.com, [2]drsmaufeat@gmail.com

Abstract – In this investigation, treatment of sludge obtained from tannery industries, which contain potentially heavy toxic metals, organics, was characterized and the performance of the solidification/ stabilization (S/S) of the sludge was discussed. The heavy metal characteristics of the sludge were determined by means of AoAc 990.08.2005 test, as defined in both USEPA regulations. S/S studies were conducted using fly ash to solidify the sludge containing high concentrations of total moisture content, volatile solids, Mn, Cd, Pb, Zn, Fe, Ni, Cu, Cl, Total Cr, Cr_3 and Cr_6. The raw sludge stabilized by using lime. To identify the optimum stabilization limit. The waste/blinder ratios of 36 sludge specimens were cured at room temperature for 3,7,14 and 28 days. The compressive strength of the specimen was measured to determine the feasibility of using solidified sludge as safe land fill. The heavy metal and organic contents of the extracts, of each specimen were determined in concentrations which were lower than the standard concentration in USEPA 1311 and 200.8 leaching procedure for the most part.

Keywords – Solidification/ Stabilization – hazardous, waste treatment – chromium – compressive strength – fly ash – leaching – sanitary – land fill.

I. INTRODUCTION

Solidification / stabilization (S/S) process have become widely used technologies as the last treatment step for the treatment of industrial hazardous waste before disposal. (Senem Bayar et.al. 2013) S/S technologies are use for improving chromium and physical characteristics of hazardous waste it can an ultimate level they are suitable for low cost disposal with safe environmental issue. (Stogeman and cote 1996). Stabilization refers to decrease the metallic toxic properties of a waste by means of chemical reactions and solidification refers to generating a solid of high. Structural integrity (coz.et.al 2004) stabilization means of a specific binding matrix. An investigation is made to assess its toxic potential to be used as safe land fill standards. Different experiment process exhibit various setting and caring reactions. Even though there is no separate test to evaluate the efficiency of the waste. But it is possible to identify suitable test based stabilization programme and the position of waste. The performance assessed by using 3 parameters. Leaching behaviors permeability and structural integrity (coben et.al. 1970). When the application of tannery sludge to the land it is spreading just below the soil surface. In this investigation the sludge sample obtained from common effluent treatment plant CETP / Vani – Tech / Vaniyambadi, Vellore district, tamilnadu, India. Most be stabilized and sludge solidification prior to disposal. The immobile phase will also reduced, the hazardous waste effect in the environment. The main aim of S/S is to convert the heavy metals to immobile phase and for easy handing. Generally cement stabilization is commonly practiced in our experiment we use only fly ash obtained from Neyveli Linite Corporation, Tamilnadu, India for this test. This investigation aims to identify how chromium was kept within. fly ash, lime + sludge mixes. The research proves on the use of fly ash as a cementious binder and on the use of stabilization.

II. MATERIALS AND METHODS

During this experimental study, the S/S technology was applied to the tannery waste raw sludge obtained from CETP, VANI TECH, Vaniyambadi, Vellore district, Tamilnadu, India. Has been almost entirely supported by the local raw material recourses. That is baffle and cow hides, goat and sip skins. The tannery industries of vaniyambadi process 175 square feet of raw hide and skin. A large amount of solid waste cobout 17.25 l/day (in lean period) is generated by leather manufactured process in vaniyambadi area. The physical look and small of the area is alarming and intolerable. The sludge was analyzed by means of evaluate and the test procedures as refined, and the metallic toxic properties of the waste were determined based on USEPA regulation by means of toxic chemicals leaching test methods. (USEPA 1311 & 200.8). The sludge was considered a hazardous waste. Lime was used as a stabilizing agent. The main function of adding lime into the raw sludge is to reduce the toxic characteristics and also adjust the pH value. The mixing of lime 10 %, 20 %, 30 %, 40 % and 50 % and determine the optimum percentage of lime. Then this sample mixed with fly ash. In this research fly ash used as a binder. Fly ash obtained from Neyveli lignite corporation, Neyveli, Tamilnadu, India. Compressive strength tests and leaching test were conducted to evaluate the S/S efficiency for solidified materials as shows fig. 1 the compressive strength test was used for determation of

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the physical properties of sludge and also toxicity test. USEPA 1311 & 200.8 test is used the determination of the leaching properties of the sludge.

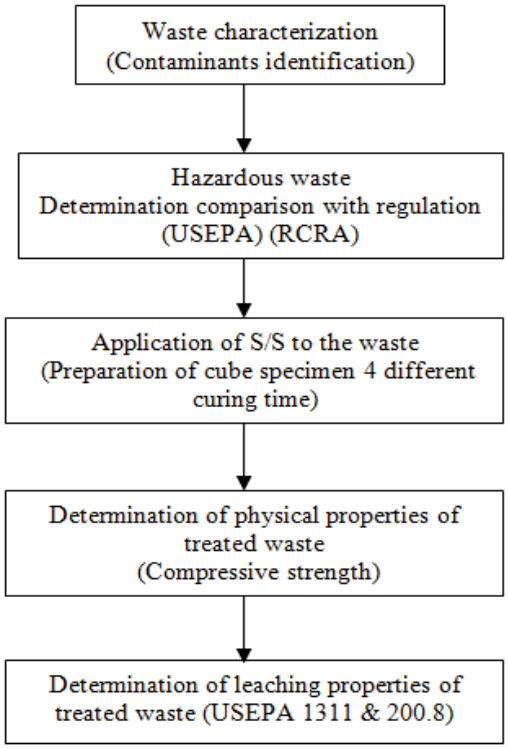

Fig .1 Experimental work flow

Characterization of hazardous waste

The waste raw sludge sample was collected before the dewatering process AoAc 990.08.2005 methods was used to determine the total amount of metals in the sample. Fly ash is cementation coal combustion by product. The fly ash is classified according to ASTMC - 618, class F and C fly ash.

Characteristics	Value
Specific gravity	1.80
Bulk density (kg/m^3)	390
Colour	Gray

Table 2.1
Characteristics of fly ash

Oxide	Percentage of content
Cao	12.90
Sio_2	38.52
Al_2O_3	20.17
Fe_2O_3	12.50
MgO	3.80
K_2O	0.035
Na_2O	0.015
So_3	0.25
Loss on ignition	1.80

Table 2.2
Chemical analysis of fly ash

Oxide	Percentage of content
Cao	< 85
Sio_2	< 16
MgO	< 18

Table 2.3
Chemical analysis of lime

The tannery sludge was analyzed for various physical and chemical and heavy metals. The characteristics of Vani Tech, Vaniyambadi, sludge shown fig 1. In this analysis the value of chloride is maximum and the chromium level is not acceptable. Te level of moisture content as per IS 2720 (Part 2) 1973 is 2 % total volatile solids present in the raw sludge is as per ADHA 25 G the value is 25.44 %.

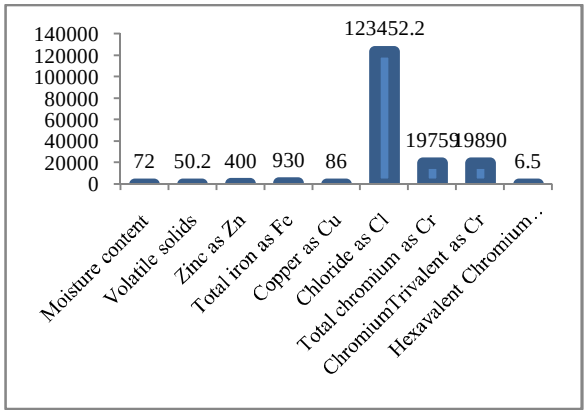

Fig.2 Physical and chemical analysis of raw sludge.

III. METHODS EMPLOYED

3.1 Mix preparation

The CETP sludge sample is mixed with lime in the ratio 10 %, 20%, 30%, 40% and 50%. Then the characteristic of each ratio was analyzed. The result has tabulated.

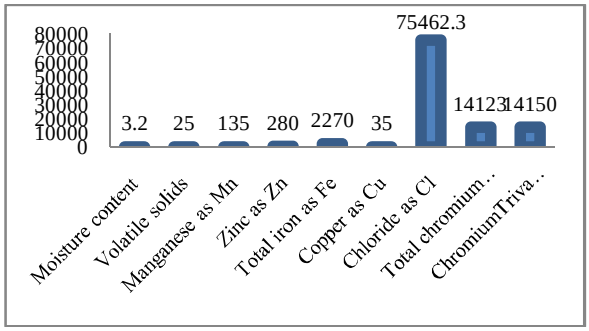

Fig.3 Physical and chemical analysis of raw sludge + 10 % lime

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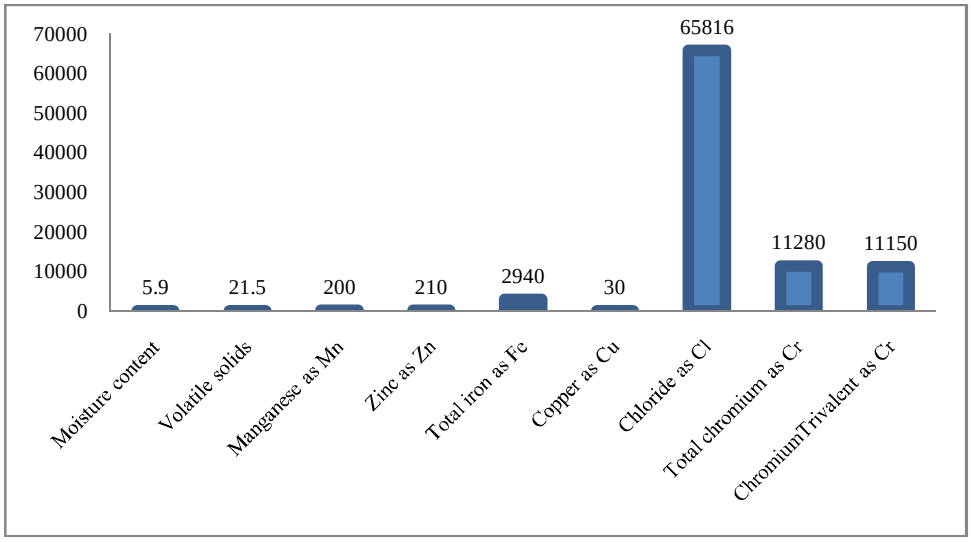

Fig.4 Physical and chemical analysis of raw sludge + 20 % lime

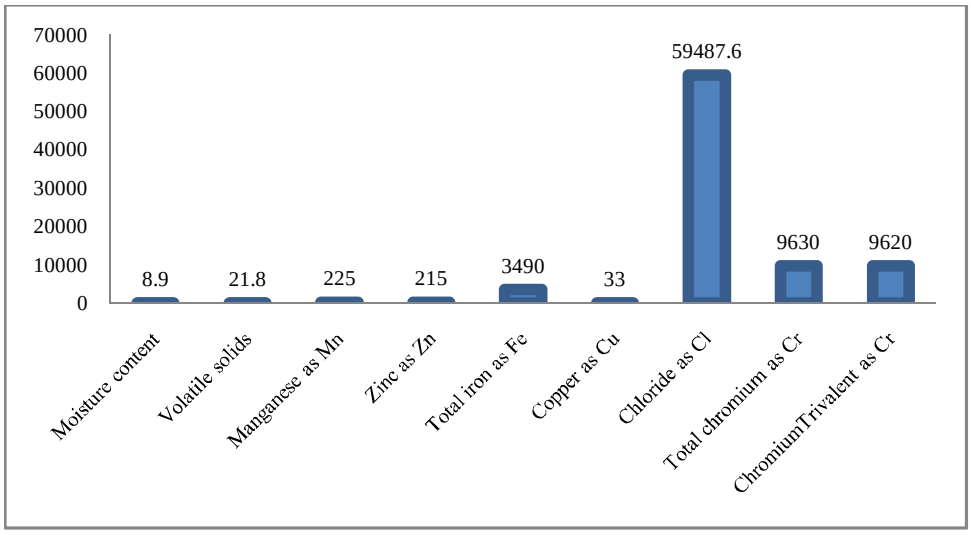

Fig.5 Physical and chemical analysis of raw sludge + 30 % lime

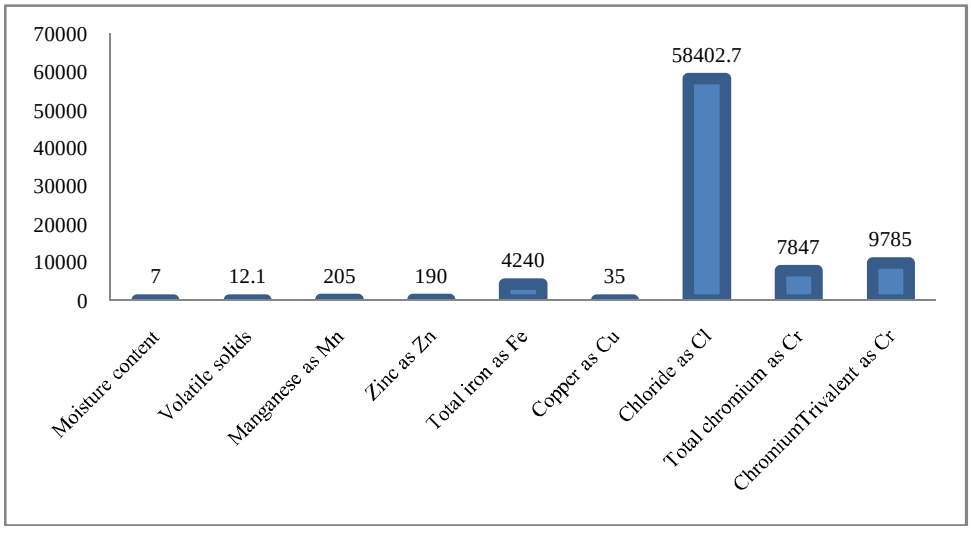

Fig.6 Physical and chemical analysis of raw sludge + 40 % lime

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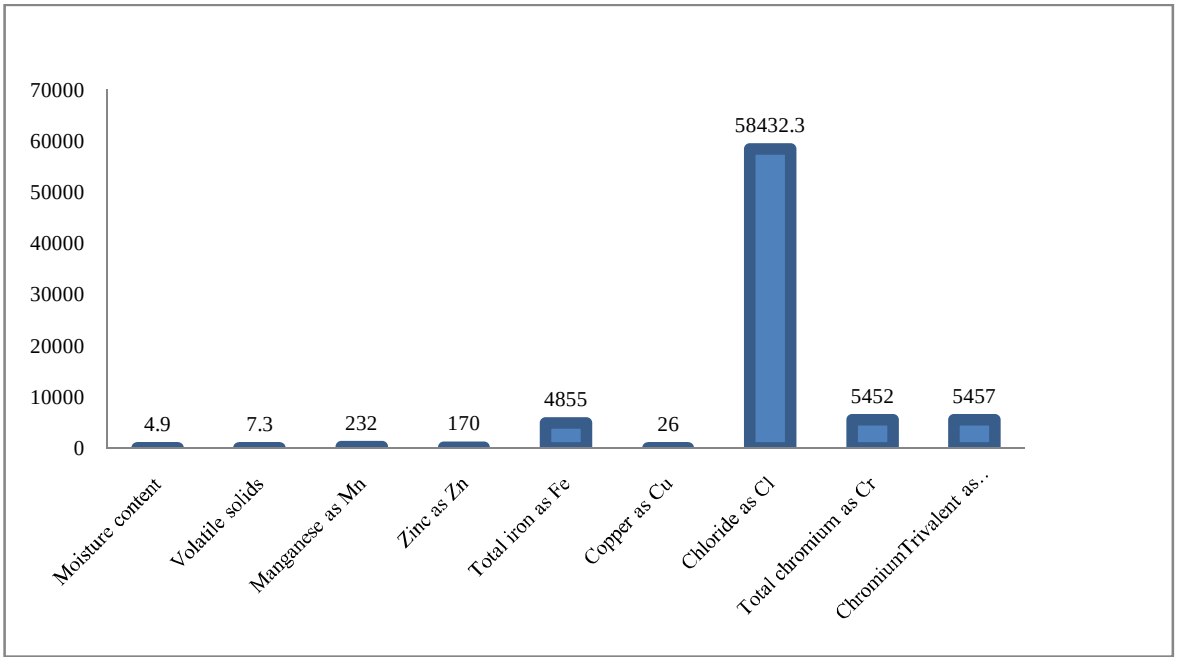

Fig.7 Physical and chemical analysis of raw sludge + 50 % lime

From the above results of lime the level of chloride is maximum, the volatile solids and copper as in minimum. The test shows the increase of lime will decrease the metallic pollutants levels. In our research we finalize 50 % lime for our further investigation. During the course of this experiments the next level. The sludge with 50 % lime. The sludge was first dried in an oven at 103° C and ground for monitoring uniform size then sieved by 2.5 mm sieve. It helps to use to increases the workability.

Mix	**Sludge + lime**	**Fly ash**
M1	90	10
M2	80	20
M3	70	30
M4	60	40
M5	50	50

Table 3.1
Composition of different mixes

The sludge – fly ash mixture was cast in 70.6 (50 cm^2) cubes and left to air curing. Wet curing was initially done. The reason for air curing air adopted to control the thermal cracking in the cubes.

Compressibility test:
The compression strength of the test specimen by using FIE compressive testing machine (CTM) - 100 tones capacity with a maximum load of 5 kN. The cubes were tested for 3 days, 7 days, 14 days and 28 days curing at the rate of 200 kgf/min.

IV RESULT AND DISCUSSION

4.1 Mechanical properties

The compressive strength the specimens was determine for 7, 14, 21 and 28 days of curing period. Compressive strength value of the specimens was compared to an average compressive strength as per the RCRA recommendation.

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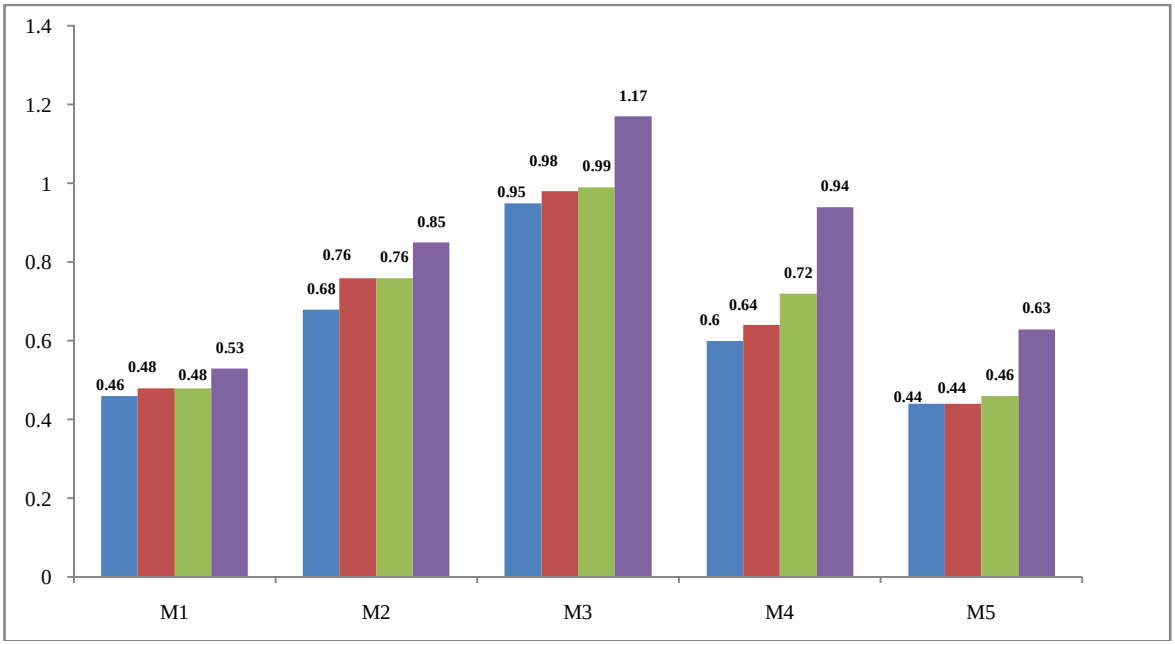

Fig.8 Compressive strength different curing times

The results shown that higher W/B ratio, lower the compressive strength 1.17 Mpa were obtained at M1 and M3 ratios of W/B, respectively for 28 days curing periods. Compressive strength of cubes shown in longer the curing time the high compressive strength for this solidified sludge. This investigation concludes the stabilization of the toxic hazardous compounds of the industrial sludge by S/S technology and helps solve problems on the management alternatives of hazardous wastes. There is lots of recommended minimum compressive strength required for solid waste land fill. The recommendations from RCRA the minimum compressive strength required for land disposal is 0.3 Mpa. The compressive strength of our investigation shows. If 10 % of fly as added to the sludge mixes achieve the target strength.

Sl.No	Sludge (%)	Identification mark	No. of days	Size of specimen (mm)	Load in (N)	Compressive strength (N/mm^2)
1	90	M1	3	70 x 70	2256	0.46
2			7	70 x 70	2354	0.48
3			14	70 x 70	2354	0.48
4			28	70 x 70	2630	0.53
5	80	M2	3	70 x 70	3335	0.68
6			7	70 x 70	3727	0.76
7			14	70 x 70	3727	0.76
8			28	70 x 70	4185	0.85
9	70	M3	3	70 x 70	4659	0.95
10			7	70 x 70	4806	0.98
11			14	70 x 70	4855	0.99
12			28	70 x 70	5760	1.17

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13	60	M4	3	70 x 70	2943	0.60
14			7	70 x 70	3139	0.64
15			14	70 x 70	3531	0.72
16			28	70 x 70	4650	0.94
17	50	M5	3	70 x 70	2158	0.44
18			7	70 x 70	2158	0.44
19			14	70 x 70	2256	0.46
20			28	70 x 70	3115	0.63

4.2 Heavy metals leachability

Table 4.2

Elements	**Standard**	**TCLP Concentration of mix mg/lit**				
		M1	**M2**	**M3**	**M4**	**M5**
Total chromium	**5**	**BDL**	**BDL**	**BDL**	**BDL**	**BDL**
Zinc	**100**	**BDL**	**BDL**	**BDL**	**BDL**	**BDL**
Nickel	**5**	**BDL**	**BDL**	**BDL**	**BDL**	**BDL**
Iron	**100**	**900**	**850**	**720**	**695**	**640**
Chloride	**-**	**238**	**230**	**220**	**240**	**220**
Hexavelent chromium	**-**	**BDL**	**BDL**	**BDL**	**BDL**	**BDL**
Trivalent chromium as Cr	**-**	**BDL**	**BDL**	**BDL**	**BDL**	**BDL**

The table show the heavy metals take Cr, Ni were found below detect level that is 0.1 mg/lit

CONCLUSION

The results of study confirmed that the fly ash added lime sludge matrix which is suitable for land fill. The study also proved a better economy and good compressive strength, the fly ash with sludge of M1 mix that is 90% of sludge and 10% of fly ash. On the bases of this study, it may be concluded that the stabilized/solidified waste can be satisfy for secured land fill.

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