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# S/S Technology acts as a tool for protecting the environment from hazardous pollutants

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## ABSTRACT

In stabilization/ solidification (S/S) of solid wastes by means of adding cementitious binders, like lime and cement the toxic constituents present in the waste form are physically as well as chemically "fixed", that is, their mobility is significantly reduced so as to minimize the threat to the environment and also ensure compliance with existing regulatory standards. This paper not only studies the role of stabilization of waste from some industries by adding binders like lime, cement and flyash in various ratios but also analysed its leachability and cost effective ratio.


## KEYWORDS

Solidification/ Stabilization;
Binder;
Hazourdous Waste;
Leachability.

## INTRODUCTION

Protecting the environment from hazardous pollutants associated with waste generation and disposal is a major concern in today's heavily industrialized world. Thus far, various technologies have been developed which transform hazardous wastes to nontoxic, or reduce the potential release of toxic species into the environment. One such promising technology is stabilization/ solidification (S/S) of solid wastes by means of adding cementitious binders, like lime and cement. During S/S applications, the toxic constituents present in the waste form are physically as well as chemically "fixed", that is, their mobility is significantly reduced so as to minimize the threat to the environment and also ensure compliance with existing regulatory standards. This paper not only studies the role of stabilization of waste from some industries by adding binders like lime, cement and flyash in various ratio but also check its leachability and most cost effective ratio.

## MATERIAL AND METHOD

### Physico-chemical characterization of waste

Waste taken for study was from three industries i.e. Metal Industry, Automobile Industry and Steel industry. The results indicate us that whether the waste is to be treated before landfilling or is incineration. The heavy metal concentration was also analysed for these waste and accordingly subjected to stabilization (TABLE 2&3).

### Mechanism of stabilization:

To develop stabilization recipe for the specific waste series of experiment with the different percentage of stabilization were performed. A known quantity of waste

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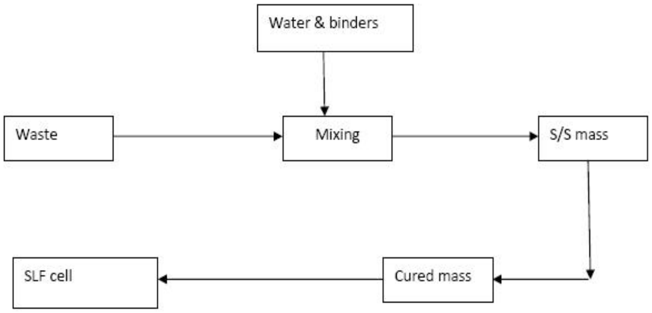


**Flow chart of mechanism of stablization**

to be stabilized is taken in 200ml beaker. If a waste was solid or semi solid sufficient amount of water was added to make free flowing waste slurry then known quantity of absorbent material was added like fly ash until the thick slurry stop appearing. Then known quantity of lime, sodium silicate and cement was added as waste characteristics and mixed well. If liquid rises within 30 minutes than again add absorbent material and leave the beaker for 24 hours to cure and then perform the TCLP test for analysing its leachability. (TABLE 2.3)

## RESULT AND DISCUSSION

### Physico-chemical characterization

Waste from all the industry were subjected to various physical and chemical test for various parameter like physical test, calorific value, and heavy metal concentration etc. (TABLE 2 & 3)

From the TABLE 2, it is seen that all industrial waste has calorific value below 2500 cal/gram, so these waste were not suitable for incineration and they required treatment before disposal.

**TABLE 1 : Preparation of Samples for Stabilization of waste**

| Samples | Sample Weight (gm) | Fly Ash (%) | Cement (%) | Lime (%) | Sodium. Sulphite (%) |
|---|---|---|---|---|---|
| 1 | 30 | 16 | 8 | 5 | 0.5 |
| 2 | 30 | 10 | 10 | 5 | 0.5 |
| 3 | 30 | 20 | 10 | 5 | 0.5 |

**TABLE 3 : Heavy Metals Concentration**

| Parameter | Method | Result | | | TCLP Test Limits as per CPCB Guidelines HAZWAMS /32/ 2005-2006 |
|---|---|---|---|---|---|
| Metals | | TCLP (mg/l) Metal Industry | TCLP (mg/l) Automobile Industry | TCLP (mg/l) Steel Industry | |
| Cadmium as Cd | WLT Method | BDL | 0.01 | BDL | 1.0 |
| Chromium as Cr | WLT Method | BDL | BDL | BDL | 5.0 |
| Copper as Cu | WLT Method | BDL | BDL | 0.1 | 3.0 |
| Iron as Fe | WLT Method | BDL | BDL | BDL | 30.0 |
| Lead as Pb | WLT Method | 7.0 | 0.1 | BDL | 5.0 |
| Manganese as Mn | WLT Method | BDL | 15.0 | 0.7 | Not Specified |
| Nickel as Ni | WLT Method | 0.3 | BDL | 7.9 | 3.0 |
| Zinc as Zn | WLT Method | 0.1 | 13.0 | 0.2 | 15.0 |

**TABLE 2 : Physico-chemical characterization**

| Parameter | Unit | Method | Result | | | CPCBGuidelines HAZWAMS/32/2005-2006 |
|---|---|---|---|---|---|---|
| | | | Metal Industry | Automobile Industry | Steel Industry | |
| Physical State | - | SW 846 | Solid | Solid | Semi Solid | Not Specified |
| Colour | - | SW 846 | Black | Grey | Grey | Not Specified |
| Texture | - | SW 846 | Solid | Dry Powder | Wet Lumps | Not Specified |
| Specific Gravity | $g/cm^3$ | ASTM-D 5057-90 | 1.4 | 0.7 | 1.9 | Not Specified |
| Calorific Value | cal/g | IS:1350 Part II-1970 | 275.0 | 545.0 | 2311.0 | <2500 cal/g |
| Flash Point | $^oC$ | SW 846 1020 A | >60 $^oC$ | >60 $^oC$ | >60 $^oC$ | > 60 $^oC$ |
| LOD @ 105 $^oC$ | % | APHA 2540 | 0.6 | 6.97 | 45.3 | Not Specified |
| LOI @ 550 $^oC$ | % | APHA 2540 | 2.7 | 10.7 | 17.3 | < 20 % |
| pH (at room temperature) | - | SW 8469045 C | 6.7 | 7.0 | 3.8 | >4 to <12 |

From the TABLE 3, it is seen that in metal industry only lead concentraion is above the TCLP permisible limit and rest heavy metal within TCLP permisible limit, likewise in automobile industry manganese and zinc concentration is above TCLP limit, also in Steel industry Nickel concentration is above TCLP limit and rest are either below detectible limit or within the TCLP limit.

## Satbilization of waste

Waste from the three industries gets sucessfully stabilized as shown by the results obtained by TCLP test. On the basis of cost of each binders and quatity used in for stabilizing waste and also on the basis of TCLP test result cost effective sample were sorted out.

**TABLE 4 : Metal Industry**

| Metal Industry | | |
|---|---|---|
| **Before Stabilization** | **After Stabilization** | |
| Pb concentration | | Pb concentration |
| 7.0 mg/l | Sample 1 | 0.5 mg/l |
| | Sample 2 | 0.2 mg/l |
| | Sample 3* | BDL |

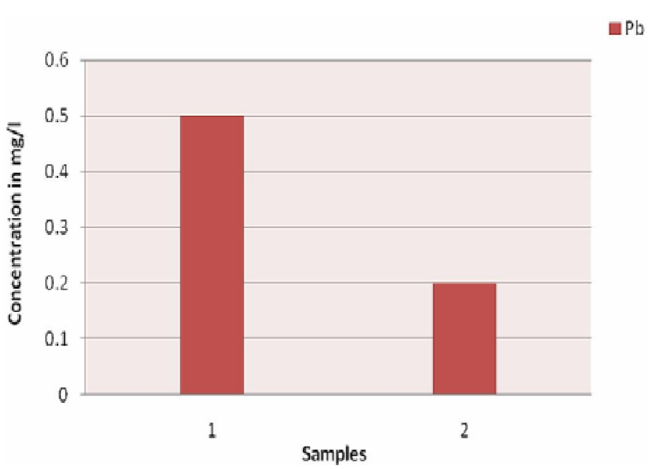


**Figure 1 : Pb Concentration After Treatment**
***Sample 3 is BDL in Figure**

From the Figure 1 and TABLE 4, it was found that Sample no. 1, 2 &3 are successfully stabilized and the concentrations in all three samples are within the permissible limit. Sample no.1 is more cost effective than other samples.

From the Figure 2 and TABLE 5, it was found that Sample no. 1&3 are successfully stablized and the concentration of zinc and mangnese are within permissible limit. But on cost effective point of view, the Sample no. 1 is best.

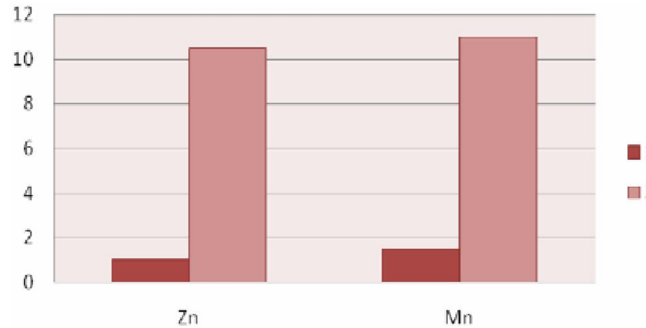


**Figure 2 : Zn & Mn Concentration After Treatment**
***Sample 3 is BDL in Figure**

**Table 5 : Auto mobile industry**

| Auto mobile Industry | | | | |
|---|---|---|---|---|
| **Before Stabilization** | | **After Stabilization** | | |
| **Zn concentration** | **Mn concentration** | | **Zn concentration** | **Mn concentration** |
| 25mg/l | 13mg/l | Sample 1 | 1.0 mg/l | 1.5 mg/l |
| | | Sample 2 | 10.5mg/l | 11.0mg/l |
| | | Sample 3* | BDL | BDL |

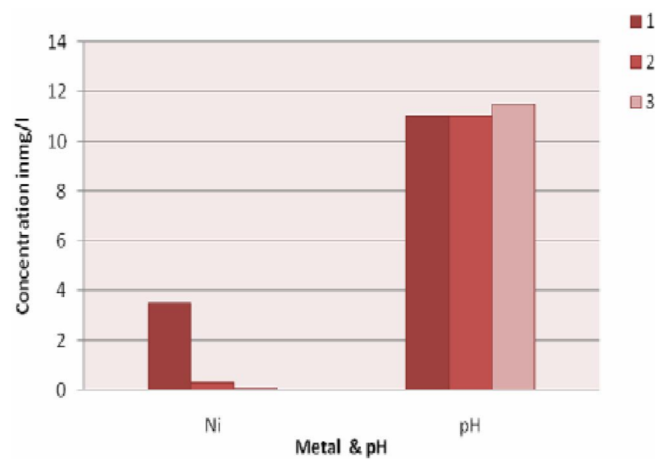


**Figure 3 : Ni Concentration & pH After Treatment**

**TABLE 6 : Steel Industry**

| Steel Industry | | | | |
|---|---|---|---|---|
| **Before Stabilization** | | **After Stabilization** | | |
| **Ni concentration** | **pH** | | **Ni concentration** | **pH** |
| 7.9 mg/l | 3.8 | Sample 1 | 3.5 mg/l | 11.0 |
| | | Sample 2 | 0.3mg/l | 11.0 |
| | | Sample 3 | 0.1mg/l | 11.5 |

From the Figure 3 and TABLE 5, it was found that Sample no. 2&3 are successfully stabilized and not only nickel concentration falls within permissible limit but even pH also gets higher. But on cost effective point of view, the Sample no. 2 is found best.

## CONCLUSION

The physico- chemical parameters had shown that waste was not to be incinerated and need treatment before disposal. The waste of different Industry was completely stablised when mixed with the different proportion of binders. It is also seen that flyash, lime and cement are very effective binders. Ratio of binders used sample one is more environment friendly and cost benificial for metal industries and auto mobile industry but for steel industry sample two is found to be more environment friendly and cost beneficial.

The stablised waste after landfill does not affected the quality of Soil, Ground Water & Air. It is also recommended that the stabilized waste can be used for making concrete, bricks, blocks etc. for green construction material.

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