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# Comparitive Study On Reduction Percentage Of Iron From Dye Industry Sludge Using Vermicomposting And Myco-Vermicomposting

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**ABSTRACT**

Vermicomposting of solid waste is an important waste management strategy. Heavy metals occur in the natural environment through the process of geogenic activity of solid waste. The high amount of solid waste from industries make them ill equipped to provide high cost involved in collection, storage, transportation, processing etc. As a result a substantial part of Solid Waste generated, remains unattended and grows in heaps at collection centre. This project deals with the reduction of heavy metal Iron (Fe)using the EarthwormEudrilus Eugenia with cow dung, spent tea waste and fungus (two different kinds of white rot fungi) as substrates. The possibility for removal of heavy metal, the tendency of compost to be used as organic manure for agriculture and accumulation with earthworms in solid waste will be investigated, by taking them in different ratios with replicates.

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## INTRODUCTION

Solid waste is defined as the unwanted organicand inorganic waste materials disposed of by humans from different sources (Solid, 2013). Textile industry involves conversion of fabric into finished cloth involving various processes andproduces extremely pollutedsolid waste. Textile sludge (Physico-chemical, 2008) contains both inorganic and organic substances and is typically colored due to the presence of residual dyestuffs.

Vermicomposting (2003) is a simple biotechnological process of composting in which certain species of earthworms are used to convert the biodegradable solid wastes or organic wastes into a nutrient-rich end product. At the present time, vermicomposting is the better option of solid waste management than all the other options because it is a biological process, it is not associated with any kind of soil or groundwater pollution, no risk of gas leakage, cheaper method, less land requirements, resulting earthworm castings (worm manure) that are rich in microbial activity, plant growth regulators, and fortified with pest repellence attributes as well. During vermicomposting, the important plant nutrients such as N, P, K and Ca are converted to more soluble forms which are easily utilized by plants.

*EudrilusEugenia* is a species of earthworm native to tropical West Africa and now widespread in warm regions, also called the African night crawler. Earthworms derive their nourishment from the microorganisms that grow upon organic materials, only few microorganisms support earthworms while others can cause toxic effects. Microbial groups that are of nutritive value to earthworms are fungi, protozoa, algae, bacteria and actinomycetes. Retention time of the waste in earthworms is short. Worms can digest several times than their own weight each day and large quantities of excreta are passed out through an average population of earthworms. Amount of substrate consumed depends upon substrate properties and environmental conditions. Vermicomposting systems should be maintained at temperatures of 1 5 to 25°C and moisture content must be 60 to 80%.

Fungi (2014) feature among Nature's most vigorous agents for the decomposition of waste matter, and are an essential component of the soil food web (Rhodes, 2012), providing nourishment for the other biota that live in the soil .The white-rot fungus *Phanerochaetechrysosporium* is an ideal model for vermicomposting by fungi, since it is more efficient than other fungi in degrading toxic or insoluble materials. The white-rot fungi are so effective in degrading a wide range of organic molecules is due to their release of extra-cellular

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lignin-modifying enzymes, with a low substrate-specificity, so they can act upon various molecules that are broadly similar to lignin.

To obtain stabilized end products appropriate for agricultural purposes, industrial sludge should be mixed with other nitrogen rich organic wastes in order to provide nutrients and inoculums of microorganisms. It is very important to know the chemical composition and the best mixture ratio to have a good quality and stabilized final product (Vermicomposting, 2003). This study evaluates the role of earthworm in reduction of heavy metal from dye industry sludge mixed with cow dung and spent tea waste.

## MATERIALS AND METHODS

### *2.1 Eudrilus Eugenia:*

Healthy adult earthworms commonly known as African night crawler were randomly picked for use in the experiment from several cultures of 500 – 700 earthworms each maintained with cow dung as culturing material. Each worm weighed between 0.5 and 0.7 g

### *2.2 Solid Dye Industry Sludge (Sdis):*

Fresh solid SDIS was obtained from the wastewater treatment plant of a dye industry located near tirupur, India. The main characteristics of the sludge were : total solids,196 g/kg ; pH,8.7 ; total organic carbon (TOC), 140 g/kg ; total kjeldahl nitrogen (TKN) , 0.7g/kg and C:N ratio,235

### *2.3 Cow Dung And Spent Tea Waste:*

Fresh cow dung was obtained from a nearby cow shed and spent tea waste obtained from college canteen. The characteristic of cow dung were total solids,452 g/kg ; pH, 7.5 ; TOC,425 g/kg ; TKN,6.4 g/kg; total phosphorous (TP),6.9 g/kg and C:N ratio ,70

### *2.4 Fungus:*

*Phanerochaetechrysosporium and Pleurotus ostreatus are* types of white rot fungi. *Phanerochaetechrysosporium* was extractedin laboratory and *Pleurotus ostreatus was*grown and cultured in kitchen garden

### *2.5 Stoichiometry:*

All the SDIS, cow dung- spent tea waste and cow dung-fungi were used on dry weight basis that was obtained by natural drying and oven drying with known quantity of material at $120^0$C to constant weight

### *2.6 Experimental Design:*

Plastic bins were filled with mixtures containing different percentage of dye industry sludge; cow dung-spent tea waste and fungus as substrates in different proportions viz.., 0:25, 25:50, 50:75 on dry weight basis. The total weight of each tray is 300 g .The bins were placed inside laboratory. The moisture content was maintained to 60-70% throughout the study period by periodic sprinkling of adequate quantity of water.

Plastic bins with contaminated soil (at different ratios)

↓

[Moisture maintained (60-70%)]

↓

Cow dung and spent tea waste (dry) as substrate1

↓

Fungus as substrate 2 (*Phanerochaete chrysoporium and Pleurotus ostreatus*)

↓

Precomposting for 15 days

↓

Earthworm ( *Eudrilus eugenia*)

↓

Biofertilizer production and removal of heavy metals (analysis on initial and final day)

↓

Sample analysis (count and analysis on initial and final day)

↓

Vermicompost

Vermicomposting bin

Compost with earthworms

## RESULTS AND DISCUSSION

### *3.1 Changes In The Nutrient Content:*

The vermicompost was much darker in color. A large fraction of total organic carbon was lost as carbon dioxide by the end of vermicomposting.TKN has been increased by the end of vermicomposting period from 5.1 to 9.4 g/kg. The final nitrogen content of the compost would be dependent on initial nitrogen present in the feed material and the extent of decomposition. The amount of TP in the feed mixtures increased gradually with incubation period. The feed mixture having more cow dung had more TP after 30 days sampling. The feed mixtures under earthworm treatment exhibited faster increase in TP content than the feed mixtures without earthworms, which showed the efficiency of earthworms in mineralization of TP in the feed mixture. Theconcentration of TK in the final cast was slightly lower than in the initial feed mixtures. Table 1 and 1.1 shows the nutrient content in initial and final product of vermicomposting and mycocomposting

**Table 1:** Nutrient Content (g/kg) in the initial mixture (IM) and the final product (FP) after 30 days- vermicomposting.

| Cow dung + dye industry sludge ratio | TOC | | TKN | | TP | | TK | |
|---|---|---|---|---|---|---|---|---|
| (in grams) | IM | FP | IM | FP | IM | FP | IM | FP |
| 300+0 | 126 | 102 | 5.1 | 9.4 | 5.9 | 10.2 | 5.2 | 3.3 |
| 225+75 | 113 | 73 | 4.4 | 8.5 | 5.4 | 7.5 | 4.9 | 3.6 |
| 150+150 | 106 | 55 | 3.6 | 7.7 | 4.9 | 5.7 | 4.7 | 3.5 |
| 75+225 | 87 | 51 | 3.3 | 6.2 | 3.6 | 4.5 | 2.8 | 1.6 |

**Table 1.1:** Nutrient Content (g/kg) in the initial mixture (IM) and the final product (FP) after 30 days- myco vermicomposting

| Cow dung + dye industry sludge ratio | TOC | | TKN | | TP | | TK | |
|---|---|---|---|---|---|---|---|---|
| (in grams) | IM | FP | IM | FP | IM | FP | IM | FP |
| 300+0 | 135 | 112 | 5.5 | 9.2 | 6.9 | 11.2 | 5.7 | 3.7 |
| 225+75 | 123 | 78 | 4.7 | 8.9 | 5.9 | 7.8 | 5.1 | 3.4 |
| 150+150 | 114 | 60 | 4.0 | 8.1 | 5.1 | 6.5 | 4.8 | 2.1 |
| 75+225 | 89 | 56 | 3.8 | 6.7 | 3.9 | 4.5 | 3.1 | 1.8 |

### *3.2 Changes In C: N Ratio:*

The C: N ratio decreased with time in all the experiments due to decomposition .Initial C: N ratio was very high. The overall decrease in the C: N ratio was associated with increase in TKN during the study period. The changes in C: N ratio during vermicomposting and mycovermicomposting is shown in table 2 and 2.1

**Table 2:** Changesin C: N ratio during vermicomposting

| Cow dung + dye industry sludge ratio | Days | |
|---|---|---|
| (in grams) | 0 | 30 |
| 300+0 | 20.9 | 16.9 |
| 225+75 | 23.3 | 13.0 |
| 150+150 | 25.69 | 17.5 |
| 75+225 | 39.69 | 25.1 |

**Table 2.1:** Changesin C: N ratio during myco vermicomposting

| Cow dung + dye industry sludge ratio | Days | |
|---|---|---|
| (in grams) | 0 | 30 |
| 300+0 | 21.8 | 18.9 |
| 225+75 | 24.5 | 15.0 |
| 150+150 | 27.9 | 16.5 |
| 75+225 | 42.7 | 26.1 |

### *3.3 Changes In Heavy Metal Concentration:*

In this study the total heavy metal concentrations in the final products were slightly lower than in the initial feed mixtures. Table 3 and 3.1 shows the change in heavy metal concentration in initial and final product after 30 days of vermicomposting and myco vermicomposting.

**Table 3:** Heavy metal content (mg /kg) in the initial mixture (IM) and the final product (FP) after 30 days - vermicomposting

| Cow dung + dye industry sludge ratio | Total –Fe | |
|---|---|---|
| (in grams) | IM | FP |
| 300+0 | 58 | 54 |
| 225+75 | 60 | 58 |
| 150+150 | 64 | 62 |
| 75+225 | 66 | 61 |

**Table 3.1:** Heavy metal content (mg /kg) in the initial mixture (IM) and the final product (FP) after 30 days - Myco vermicomposting

| Cow dung,Tea waste + dye industry sludge ratio | Total –Fe | |
|---|---|---|
| (in grams) | IM | FP |
| 300+0 | 58 | 54 |
| 225+75 | 60 | 56 |
| 150+150 | 64 | 62 |
| 75+225 | 66 | 60 |

***Conclusion:***

The information presented here provides a basis for the utilization of sludge from dye industry mixed with cow dung, spent tea waste and fungi in small as well as large scale vermicomposting systems .although best nutritional quality was obtained when worms were allowed to feed on cow dung and fungi. The final product was more stabilized, because of significant decrease in C:N ratio. Therefore the use of dye industry sludge as raw material can help to convert this waste into a value added product, so avoiding its disposal in open dumps. Finally, this study proved that mycovermicomposting can be introduced as an effective technology for the removal of heavy metal (Fe) from dye industry sludge using cowdung, spent tea waste and fungi.

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