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SELECTED PHYSICOCHEMICAL AND MICROBIOLOGICAL ANALYSIS OF VERMICOMPOSTED LIME AND CHROME SLUDGE WASTES FROM TANNERY INDUSTRY

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ABSTRACT

The present stusdy deals with selected physicochemical and microbiological analyses of vermicomposted lime sludge and chrome sludge wastes in two different ratios (1: 1 and 3:1 of lime sludge/chrome sludge and soil.). The results have shown that pH changed to neutral and EC level decreased in both sludges on vermicomposting. Available NPK contents of the vermicomposts were higher than both the raw sludges. The fungal and actinomycete population were higher in raw chrome sludge and its composts than raw lime sludge and its composts. Fungal species such as *A niger, A. flavus, A terreus, Mucor sp.* and *Penicillium sp.* and *Actinomycetes* species such as *Actinomyces sp.* and Streptomyces sp. were present in both the sludges and their composts.*Nocardia sp.* were present only in vermicomposts of both sludges and not their raw forms. This shows that these microbial populations may be involved in the degradation process of toxic wastes. The present study-shows that the negative environmental impact of the tannery wastes can be reduced with the help of microorganisms.

INTRODUCTION

Wastes of the tanning industry, pose serious problems and they pollute the environment with solid, liquid and gaseous discharges (Parvatham et .al., 2001). These wastes are ranked as high pollutants among all industrial wastes posing serious threats to plants, animals and mankind due to their toxicity.

Tannery solid wastes can be recycled into manure by vermicomposting using earthworms (Subash et. al., 2001). Earthworms live in close relationship with soil microorganisms. The alimentary canal of the earthworms itself possesses great numbers of bacteria, fungi and actinomycetes.

MATERIALS AND METHODS

Lime sludge waste and chrome sludge waste were collected from a tanning industry at Erode. These wastes were dried and powdered and mixed with soil in the follwoing ratios 1: 1 and 3:1. four pits of the size 40 x 30 x 40 cm were dug inside the tannery industry premises itself. Each pit was covered at the bottom sheet 3/4 feet of the pit was first filled with the soil followed by 1/2 feet of two pits with the lime sludge waste-soil mixture and the other two pits with the chrome sludge waste-soil mixture. Each pit was inoculated with 60 earthworms of the species *Eistenia foetida*. The pits were then covered with palm leaves and the wastes allowed to be composted for a period of 60 days. Water was sprinkled over the pits twice a week for maintaining the mositure content. The wastes in each pit were mixed once a week. After 60 days, the compost from each pit was harvested, dried, sieved and user for further analysis. The pH, EC and available NPK were studied in the vermicomposts. Fungi and actinomycetes also were isolated, enumerated and identified.

RESULTS

On vermicomposting, the colour of the lime sludge turned from pale to cream to balck, whereas, the chrome sludge turned from bluish green to black. The odour of the lime sludge was changed from an unpleasant one to pleasant one, wheras, in the case of chrome sludge the odour turned from a foul one to a pleasant one. There was a decrease in the level of the pits during vermicomposting. the size of the earthowrms increased on vermicomposting of both the sludges. The number of earthworms were more in lime sludge than the chrome sludge. The pH of lime sludge on vermicompsting was decreased from 8.3 to 7.6 and 7.9 respectively for LC-1 and LC-2, whereras, the pH of chrome sludge increased on vermicomposting from 5.2 to 6.8 and 6.0 respectively for CC-1 and CC-2.

The electrical conductivity values of lime sludge decreased on vermicomposting from 2.26 to 0.79 and 0.98 respectively for LC-1 and LC-2 and from 2.80 to 0.65 and 1.57 resepctively for CC-1 and CC-2. The soil EC value was 0.15 . The chrome sludge vermicomposts had higher EC values than lime sludge composts and the raw chrome sludge also had a higher EC value than the taw lime sludge.

The available nitrogen contents of vermicomposts from lime sludge were significantly ($P < 0.05$) increased when compared to that of the raw lime sludge The chrome sludge vermicomposts had significantly ($P < 0.05$) increased available nitrogen levels when compared to that of the undecomposed chrome sludge. The cermicomposted lime sludge had significantly ($P < 0.05$) higher levels of available potassium when compared to that of the raw lime sludge, The vermicomposted chrome sludge level of available potassium had significantly ($P< 0.05$) increased when comparedto that of the raw chrome sludge.

The fungal population of vermicomposted lime sludge increased from 6 x 10^{-3} CFU g^{-1} to 8 x 10^{-3} CFU g^{-1} respectively for LC^{-1} and LC^{-2}. The fungal population increased on vermicompsting of chrome sludge also from 12 x 10^{-3} CFU g^{-2} to 17 x 10^{-3} and 18 x 10^{-3} CFU g^{-1} respectively for CC-1 and CC-2. Soil had a fungal colony count of 6 x 10^{-3} CFU g^{-1} .Fungal colonies were found to be more in undecomposed and compsted chrome sludge when compared to undecomposed and composted lime sludge.

The vermicompsted lime sludge waste showed the presence of fungal colonies of *Aspergillus niger, Aspergillus flavus, Aspergillus terreus, Mucor sp. and Penicillium sp. Except Aspergillus terreus*, the above mentioned colonies were also indetified in the raw lime sludge waste. The vermicomposted chrome sludge waste showed the presence of more types of fungi than vermicompsted lime sludge waste *Aspergillus niger, Aspergilus flavus, Aspergillus fumigatus, Aspergilus terreus, Mucor sp., Penicillium sp. and Fusarium sp*. The raw chrome sludge also had the above mentioed species with the exception of *Aspergillus fumigatus and Aspergillus terreus*. However, *Rhizopus sp*. was found only in the raw chrome sludge and not in its composts. It can be perhaps stated that the fungal types which might contribute to the vermicomposting process are

Table 1

Physicochemical characteristics of vermicomposted lime sludge waste and chrome sludge waste

Samples	ratio of lime sludge/chrome sludge waste	pH	Electrical conductivity (mmhos/cm)	Available N (kg ha^{-1})	P	K
Lime sludge composts						
LC - 1	1:1	7.6	0.79	763	19.0	320
LC - 2	3:1	7.9	0.98	406	16.5	295
Raw lime sludge	-	8.3	2.26	365	12.0	220
Chrome sludge compost						
CC - 1	1:1	6.8	0.65	512	16.5	287
CC - 2	3:1	6.0	1.57	454	14.0	240
Raw chrome Sludge	-	5.2	2.80	327	11.0	198
Soil	-	7.8	0.15	76	6.5	400
				CD (0.05) 8.648		

Table 2

Enumeration of fungal and actinomycete colonies in vermicomposted lime sludge wasteand chrome sludge waste

Samples	Fungal colony units (CFU g^{-1})	Actinomycete colony units (CFU g^{-1})
LC - 1	8 x 10^{-3}	10 x 10^{-3}
LC - 2	12 x 10^{-3}	15 x 10^{-3}
Raw lime sludge	6 x 10^{-3}	7 x 10^{-3}
Chrome sludge composts		
CC - 1	17 x 10^{-3}	11 x 10^{-3}
CC - 2	18 x 10^{-3}	18 x 10^{-3}
Raw chrome sludge	12 x 10^{-3}	8 x 10^{-3}
Soil	6 x 10^{-3}	27 x 10^{-3}

Aspergillus niger, *Aspergilus flavus, Aspergillus terreus, Mucor sp. and Penicillium sp*. Since all these specices have been identified in the vermicomposts of both lime sludge and chrome sludge.

The actinomycete colony forming units (CFU/g) increased from 7 $x10^{-3}$ CFU g^{-1} to $10x10^{-3}$ and 15 $x10^{-3}$ CFU g^{-1} respectively in LC^{-1} and LC^{-2}. The vermicomposts of chrome sludge were also shown to have an increase in the actinomycetes population from 8 x 10^{-3} CFU g^{-1} to 11 x 10^{-3} and 18 x 10^{-3} DFUg-1 respectively for CC-1 and CC-2. Chrome sludge waste and its vermicomposts were found to have higher number of Actinomycete colony counts than lime sludge waste and its vermicomposts. Soil had an actinomycetes count of 27 x 10^{-3} CFU g^{-1}. The actinomycetes identified in vermicomposted lime sludge waste were *Actinomyces sp., Streptomyces sp.* &*Nocardia sp*. Except *Nocardia sp.* the other colonies mentioned above were indetified in the raw lime sludge waste also.

CONCLUSION

Lime sludge was found to have a higher pH than the chrome sludge. On vermicomposting, the alkaline nature of the lime sludge was reduced and the acidic nature of the chrome sludge was increased. Electrical conductivity reduced on vermicomposting and this might have been due to the complex organic compounds which would have been converted into simpler forms that consume some of the ionic molecules. The higher levels of NPK in vermicomposts might be due to the action of earthworms and microorganisms in converting the unavailable forms of nutrients into the available forms. Fungal colonies were found to be more in undecomposed and composted chrome sludge when compared to the undecomposed ad composted lime sludge. This may be perhaps due to the reason that fungal colonies thrive better in acidic conditions. *Aspergillus niger, Aspergillus flavus, aspergillus terreus, Mucor sp*. and *Penicillium sp.* of the fungal types might contribute to the vermicomposting processes. The above mentioned species have been indentified in the vermicomposts of both lime sludge and chrome sludge wastes. The number of actinomycete colonies were more in number in the vermicomposts than in both raw lime and chrome sludge. In raw lime sludge and chrome sludge the Nocardia sp. were absent but thay were present in the vermicomposted sludges, wheras, both the raw and the composted forms of chrmoe and lime sludge the Actinomyces and *streptomyces sp*. were present. Thus it can be stated that vermicomposting could be used as a simple and effective technology for decomposing lime sludge and chrome sludge from tanneries. This would not only give good compost, but also increase the contents of nitrogen, phosphorus and potassium and also the fungal actinomycetes population.

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