

Short Communication

A study on the physico-chemical properties of paper mill sludge

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Received: 14.8.2019/Accepted: 11.10.2019

ABSTRACT

Investigations were done to characterize the paper mill sludge (PMS) as a soil amendment for the production of crops. Laboratory analysis was done at Anbil Dharmalingam Agricultural College and Research Institute, Tiruchirappalli, Tamil Nadu during 2014-15. PMS samples were collected from the Tamil Nadu Newsprint and Papers Ltd (TNPL), Kagithapuarm, Karur district, Tamil Nadu, dried and stored for analysis. PMS was characterized and analysed for its important physico-chemical properties. It was dark brown in colour with unpleasant odour. Important basic characteristics of PMS samples were studied. The physical parameters like bulk density, particle density, porosity and moisture content were 1.37 (Mg/m³), 1.89 (Mg/m³), 39 per cent and 12.19 per cent respectively. The PMS was found to be neutral in reaction having pH 7.26 and the EC was 2.19 dS/m. Among the major nutrients, sulphate (18.21%) was found in higher quantity followed by calcium (2.26%), nitrogen (1.74%), potassium (1.73%) and phosphorus (0.97%). The organic carbon content (OC) was 9.3 per cent. The exchangeable cations like Ca, Mg, Na and K were also present in the same order. The DTPA micronutrients were present in the order of Mn >Fe >Zn >Cu.

Keywords: Diethylenetriaminepenta acetic acid; electrical conductivity; paper mill sludge

INTRODUCTION

The pulp of paper industry plays an integral role in the global economy. India is the 15th largest paper producer in the world with 759 pulp and paper mills with an installed capacity of 12.7 million tonnes producing 10.11 tonnes of paper and paperboards which is 2.52 per cent of the total world production of 402 million tonnes per annum (Kulkarni 2013). In Tamil Nadu there are about 30 paper units with an installed capacity of 0.64 million tonnes producing fine duplex paper boards per annum. The pulp and paper industry is ranked third in the world after primary metals and chemical industries in terms of fresh water use consuming around 250 to 300 m³ fresh water per tonne of paper produced. The corresponding wastewater generation is also much higher ranging from 75 to 250 m³ per tonne of paper produced.

The disposal of industrial waste is a problem of increasing importance throughout the world due to public health menace. Sludges from paper mills are produced in large quantities in most of the industrial

countries of the world. Today the intensive usage of paper is one of our most serious environmental problems. Paper industries produce large amount of solids and its application increases the input of OM and the availability of macro and micronutrients (Trepanier et al 1996). The effect of paper mill sludge (PMS) application on chemical properties is directly associated with the improving of biological properties vital for the nutrient turnover and long-term productivity.

MATERIAL and METHODS

The laboratory analysis was done at Anbil Dharmalingam Agricultural College and Research Institute, Tiruchirappalli, Tamil Nadu during 2014-15.

Collection and analysis of PMS samples

The paper mill sludge (PMS) samples were collected from the Tamil Nadu Newsprint and Papers Ltd (TNPL), Kagithapuarm, Karur district, Tamil Nadu, dried and stored for analysis. PMS was characterized for its important physico-chemical properties and analysed as per the standard procedures.

Table 1. Characteristics of the paper mill sludge

Parameter	Value
Physical properties	
Bulk density (Mg/m ³)	1.37
Particle density (Mg/m ³)	1.89
Total porosity (%)	39
Moisture content (%)	12.19
Chemical properties	
pH _{1:2.5}	7.26
Electrical conductivity (dS/m)	2.19
Organic carbon (%)	9.3
Total N (%)	1.74
Total P (%)	0.97
Total K (%)	1.73
Total Ca (%)	2.26
Total Mg (%)	1.83
Total S (%)	18.21
C-N ratio	5.35
Available N (mg/kg)	257
Available P (mg/kg)	23
Available K (mg/kg)	194
Available Ca (mg/kg)	29.6
Available Mg (mg/kg)	2.17
Available S (mg/kg)	264
DTPA-Zn (mg/kg)	3.74
DTPA-Fe (mg/kg)	8.63
DTPA-Cu (mg/kg)	2.74
DTPA-Mn (mg/kg)	12.65
Exchangeable calcium [cmol (p ⁺)/kg]	11.31
Exchangeable magnesium [cmol (p ⁺)/kg]	5.93
Exchangeable sodium [cmol (p ⁺)/kg]	3.91
Exchangeable potassium [cmol (p ⁺)/kg]	0.39

RESULTS and DISCUSSION

PMS was dark brown in colour with unpleasant odour. Important basic characteristics of PMS samples were analysed and are presented in Table 1. The physical parameters like bulk density, particle density, porosity and moisture content were 1.37 (Mg/m³), 1.89 (Mg/m³), 39 per cent and 12.19 per cent respectively. The PMS was found to be neutral in reaction with pH 7.26 and the EC was 2.19 dS/m. Among the major nutrients, sulphate (SO₄²⁻) was found to be in higher amount followed by calcium (Ca), nitrogen (N), potassium (K) and phosphorus (P). The organic carbon content (OC) was 9.3 per cent. The exchangeable cations like Ca, Mg, Na and K were also present in the same order. The DTPA micronutrients were present in the order of Mn >Fe >Zn >Cu.

Paper mill bio-solids can provide multidimensional benefits to the soil ecosystem (Price and Voroney 2007). Mixed paper mill sludges are an important source of N for crop production

(N'Dayegamiye et al 2003). Over 70 per cent of solid wastes (by-products) generated in the manufacture of paper pulp are presently disposed of in landfills. Most of these by-products are compostable and reusable in horticulture, landscaping and agriculture (Das et al 2001). Paper sludge is the biggest source of lignin. Lignin application to arable soils not only improves the plant growth in vitro but also reduces the accumulation of the heavy metals like Cu, Zn, Cd, Pb, Cr and Ni in plants (Zhang et al 2004). Application of fresh paper mill sludge and its compost creates a sustainable conducive effect on soil aggregation (Bipfubusa et al 2005).

CONCLUSION

The paper mill sludge is essentially a plant extract and contains high level of plant nutrients which are made available to the plants thus resulting in better growth, development and yield of the crops. The results revealed that PMS is useful as soil amendment and nutrient sources.

REFERENCES

Bipfubusa M, N'Dayegamiye A and Antoun H 2005. Effects of fresh paper mill sludges and their composts on soil macro-aggregates. *Canadian Journal of Soil Science* **85(1)**: 47-55.

Das KC, Tollner EW and Tornabene TG 2001. Composting byproducts from a bleached-kraft pulping process: effect of type and amount of nitrogen amendments. *Compost Science Utilization* **9(3)**: 256-266.

Kulkarni HD 2013. Pulp and paper industry raw material scenario-ITC plantation a case study. *Indian Pulp and Paper Technical Association (TAPPI) Journal* **25(1)**: 79-82.

N'Dayegamiye A, Huard S and Thibault Y 2003. Influence of paper mill sludges on corn yield and N recovery. *Canadian Journal of Soil Science* **83(5)**: 497-505.

Price GW and Voroney RP 2007. Paper mill biosolids effect on soil physical and chemical properties. *Journal of Environmental Quality* **36(6)**: 1704-1714.

Trepanier L, Caron J, Yelle S, Theriault G, Gallichand J and Beauchamp CJ 1996. Impact of deinking sludge amendment on agricultural soil quality. In: *Proceedings of the Indian Pulp and Paper Technical Association (TAPPI) Environment Conference*, 1-9 May 1996.

Zhang S, Wang S, Shan X-Q and Mu H 2004. Influences of lignin from paper mill sludge on soil properties and metal accumulation in wheat. *Biology and Fertility of Soils* **40(4)**: 237-242.