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Research article

Bioremediation of Transport Industry Contaminants Using Vermicompost

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Abstract

Transport industries pose environmental challenges due to leaks of engine oils both to soil and water. Engine oil is highly organic therefore there is need to bio-remediate the contaminated soil and wastewater in order to preserve the environment. Soil and wastewater contaminated with diesel engine oil were bio-remediated using vermicompost containing live *Eisenia Fetida* earthworms and cocoons over a 4 week period. The contaminated soil and water pH and electrical conductivity (EC) were monitored during this period. Furthermore, the wastewater dissolved oxygen (DO) and biological oxygen demand (BOD) were determined. The pH in the contaminated soil decreased from 7.2 to 6.2 whilst that in the contaminated wastewater increased from 5.8 to 7.2. The EC in both the diesel contaminated soil and wastewater showed a decrease of more than 19%. The DO in the wastewater showed a decrease upon addition of vermicompost and then later on increased. Lastly, the BOD in the wastewater, decreased by 16.9% upon addition of the vermicompost. Vermicompost can be used for the vermiremediation of soil and wastewater contaminated with engine oil in the transport industries.

Keywords: BOD, DO, EC, Organic contaminants, pH, Vermicompost, Vermiremediation

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Introduction

The transport industries pose huge environmental, agricultural and human health problems due to leakages of oils as well as unsafe disposal of their used engine oils. There is therefore need for application of bioremediation to cater for these contaminants. Bioremediation involves the removal of contaminants from a given site using micro-organisms [1-2]. Vermiremediation involves the use of earthworms as bioremediation micro-organisms and is becoming popular as a bioremediation technique [1-3]. Earthworms effectively lower water contaminants as well as soil contaminants due to their microbial activity either in water or in the soil hence an attractive way for bio-remediation [3-5]. Earthworms are resistant to chemical and organic contaminants [4]. Earthworms found in vermicompost also promote and facilitate the dispersal of organic contaminates degrading microbes hence the possibility of applying vermiremediation in the transport industries.

This study focused on the potential of vermiremediation of soil and wastewater contaminated with diesel engine oil for Cargo Carriers International which is a haulage company dealing mainly with trucks. The contaminated soil had a potential of leaching out into the already contaminated wastewater which in turn drained off into the Manyame River which is a domestic water source.

Materials and Methods

Materials

Vermicompost which contained live *Eisenia Fetida* earthworms and unhatched cocoons were used as the vermiremediation material [6-15]. The vermicompost was obtained from ZimEarthworm Farms which is a vermicompost producing company. The engine oil contaminated soil and wastewater were obtained from Cargo Carriers International.

Methods

The contaminated soil pH and electrical conductivity (EC) were measured to ascertain the progress of the vermiremediation. In addition, the wastewater pH, EC, dissolved oxygen (DO) and the biological oxygen demand (BOD) were also measured. The pH and electrical conductivity (EC) of the contaminated water were measured using a Hanna Instrument. The dissolved oxygen was measured in mg/L using the Winkler method. Biological oxygen demand (BOD) was measured in mg/L using the standard oxidation procedure after 5 days for each sample at 20◦C. The experiments were replicated 3 times and were carried over a 4 week period with readings being taken every week. The parameters measurements were done thrice to improve on accuracy.

Results and Discussion

Vermiremediation of water contaminated with diesel engine oil

Effect of vermiremediation on water pH

pH measures acidity or alkalinity in a solution. Most aquatic organisms require a narrow pH, hence its important for the pH to be maintained within a certain range. The acceptable range that support aquatic life is 6.5 to 8.5 [16]. The wastewater pH increased by 18.9% upon addition of vermicompost and then became constant afterwards (see Fig 1). The pH range of 6.5-8.5 which was achieved after the vermiremediation was also an indication that the organic contaminants levels had decreased.

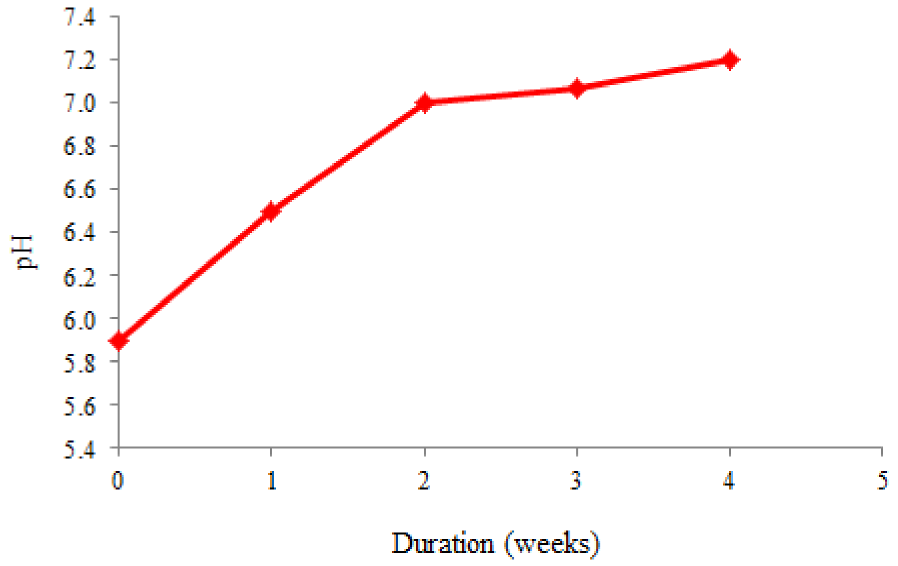

Figure 1: Effect of vermiremediation on wastewater contaminated with diesel engine oil's pH

Effect of vermiremediation on wastewater electrical conductivity

Conductivity measures the ability of a substance to transmit charge. The EC in wastewater contaminated with diesel engine oil showed a 19.5% decrease gradually upon addition of vermicompost (see Fig. 2). Decrease in the wastewater EC was also an indication of decreased organic pollutants hence successful vermiremediation.

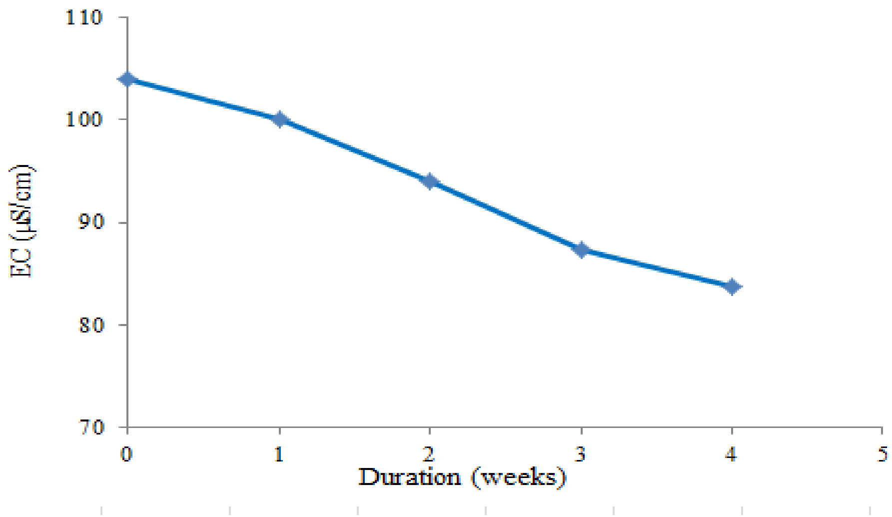

Figure 2: Effect of vermiremediation on wastewater contaminated with diesel engine oil's EC

Effect of vermiremediation on water DO

DO is an indication of aerobic microbial activity in the wastewater. DO initially decreased by 26.8% upon addition of vermicompost after a week and thereafter increased by 38.3% within the 4 week period (see Fig. 3). A decrease in the DO concentration upon addition of vermicompost in the water is an indication that aerobic microbial activity in the water was now more pronounced. Furthermore, the increase in DO, after the first week was attributed to the decrease in the contaminated wastewater BOD (See Fig. 4).

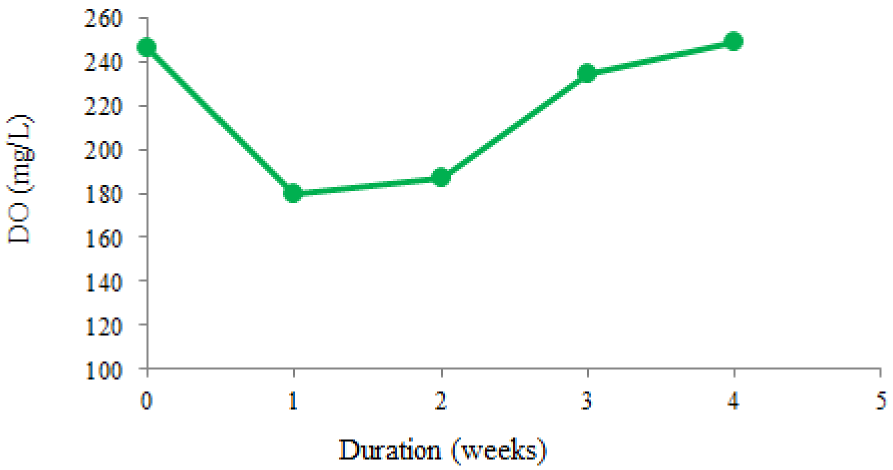

Figure 3: Effect of vermiremediation on wastewater contaminated with diesel engine oil's DO

Effect of vermiremediation on water BOD

BOD measures the amount of oxygen needed by microbes to break down the organic matter in the water body. High BOD values indicated high levels of organic contaminants in the water body. The BOD in the contaminated water decreased upon addition of vermicompost by 16.9% (see Fig. 4). The BOD and EC also indicated a linear decrease upon addition of vermicompost [17].

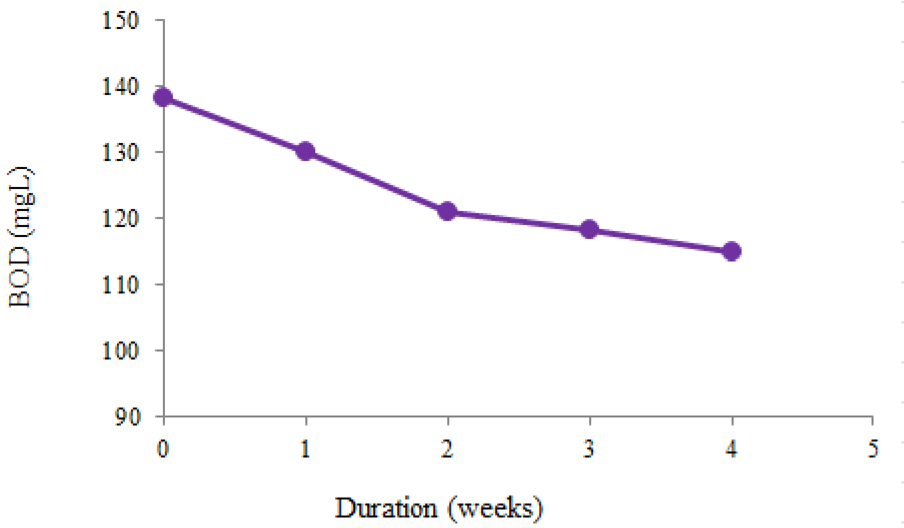

Figure 4: Effect of vermiremediation on wastewater contaminated with diesel engine oil's BOD

Vermiremediation of soil contaminated with diesel engine oil

Effect of vermiremediation on soil pH

Addition of vermicompost to the soil contaminated with diesel engine oil resulted in a 14.5% decrease in pH (see Fig 5). Howeever, the pH range of 6.5-8.5 which was achieved after the vermiremediation was also an indication that the organic contaminants levels had gone down.

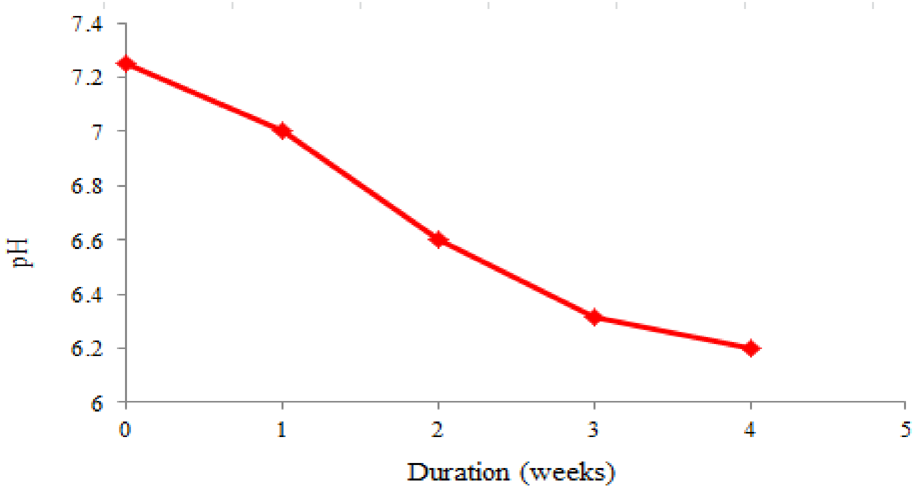

Figure 5: Effect of vermiremediation on soil contaminated with diesel engine oil's pH

Effect of vermiremediation on soil electrical conductivity

Addition of vermicompost to the soil contaminated with engine oil resulted in a 38.4% decrease in EC over a period of 3 weeks and then became constant afterwards (see Fig. 6). A decrease in the soil electrical conductivity indicated a decrease in the soil impurities in this case the engine oil.

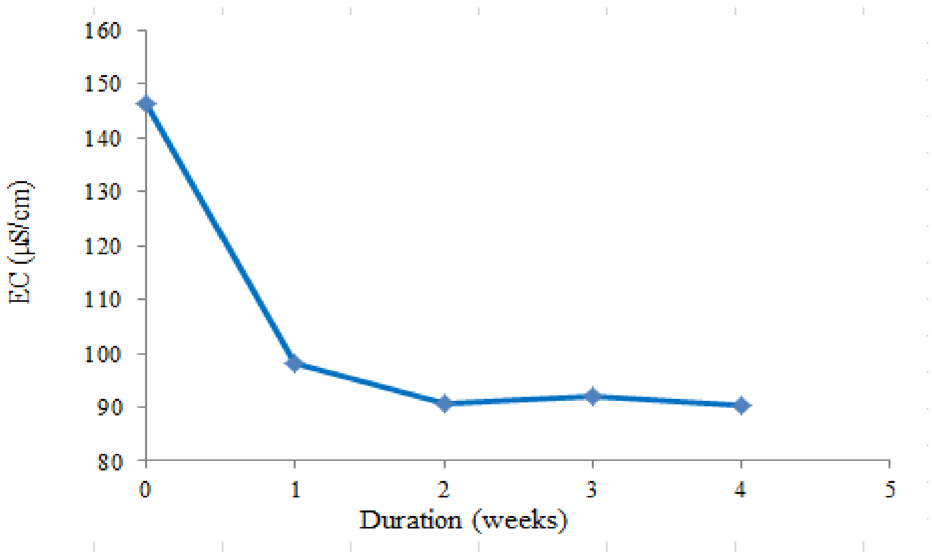

Figure 6: Effect of vermiremediation on soil contaminated with diesel engine oil's EC

Conclusion

Vermiremediation of wastewater and soil contaminated with engine oil can be carried out using vermicompost. Earthworm activity in the water and soil samples results in decreased EC, BOD, neutralisation of pH and slight increase of DO to promote microbial activity. Vermiremediation promotes safe disposal of organic polluted water and soil.

Acknowledgements

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