

Performance of Oxidation Ponds in Removing Heavy Metals from Pig Farm Wastewater

Teck-Yee Ling, Sylvia Lipan and Harwant Singh

Faculty of Resource Science and Technology, Universiti Malaysia Sarawak, Kota Samarahan 94300, Malaysia

Abstract: Pig manure is a source of heavy metals which may cause pollution if not properly managed. Oxidation pond system is an economical method of wastewater treatment commonly used in pig farms to reduce water pollution. However, the fate of heavy metals in different oxidation pond systems in pig farm are lacking in literature. Therefore, in this study heavy metals in pig feed, fresh manure and wastewater and sediment from pond inflow and outflow of farms with one pond, two ponds, two ponds with separator and three ponds in series were investigated. Results indicate that heavy metals content in manure were in decreasing order of $Cu > Zn >> Cr > Pb > Ni > Cd$ and they were highly correlated with the feed ($r=0.90$). Reduction of heavy metals in the wastewater was in decreasing order of $Cu(62\%) > Zn(36\%) > Ni(34\%) > Pb(31\%) > Cd(16\%) > Cr(9\%)$ and the reductions were significantly higher in the 3-pond system than the other systems. Copper and zinc were the highest in concentrations in the pond sediment (833 and 655 mg/kg respectively) whereas the other heavy metals ranged from 17 to 81 mg/kg. Reductions of heavy metals in the sediment between inlet and outlet sediment of the 3-pond system (47%) was significantly higher than the other three systems (<16%). The concentration of Cd in the outflow of all the pond system studied exceeded the 0.02 mg/L Malaysian standard set for the discharge downstream of water intake indicating its mobility and thus the need of other methods to polish the effluent for compliance.

Key words: Animal feed · Heavy metals · Oxidation Pond · Wastewater treatment · Retention

INTRODUCTION

Heavy metals have drawn the attention of the public in recent years due to their toxicity when present in excess and their long-term persistence [1]. According to the estimate of Pirkle [2] lead poisoning affected more than 800,000 children between the age of one and five in the USA. Root, leaf and fruit crops irrigated with sewage were found to be contaminated with heavy metals such as Pb, Cd, Se and As [3]. Azeez *et al.* [4] reported high accumulation of heavy metals in the soil due to nine years of animal waste deposition. A study of feed and manure heavy metals conducted in England and Wales indicated that a range of heavy metals were present in animal feeds and manure [5]. Thus, it is important to study the removal of those heavy metals in animal waste treatment systems.

Oxidation ponds are common domestic and animal farm waste treatment systems in developing countries due to its low cost and maintenance and simple operation [6, 7]. Though they are mainly designed for the removal of solids, they also contribute to the removal of nutrients

and bacteria. Many studies have been conducted on the effectiveness of such system in reducing organic solids, nutrients and bacteria [6, 8, 9]. Studies on their effectiveness in treating heavy metals have been reported and the results were mixed. Furthermore, most of the studies were conducted on industrial, domestic wastewater or sewage [10- 15]. Juanico *et al.* [14] reported the removal of 20-75% of heavy metals (Cu, Zn, Cr, Pb, Al) in two reservoirs in series used for seasonal storage of wastewater effluents for irrigation. High removal of heavy metals (Cu, Zn and Pb) in waste stabilization ponds and high rate ponds for domestic waste treatment system in Morocco was reported by Toumi *et al.* [13]. Studies of sediment heavy metals at retention ponds inlet and outlet draining retail and residential areas indicated a mixture of decrease and increase in concentrations [12]. Achoka [11] reported insignificant decrease in Cr, Cu and Ni in pulp and paper mill effluent oxidation pond treatment system. A study on the sewage treatment oxidation pond in Nigeria showed that it is capable of reducing some of the metals studied to some extent but not at desirable levels for discharge [10].