



CHARACTERISATION AND ADSORPTION OF HEAVY METALS IN INDUSTRIAL EFFLUENT FROM PAINT AND COATING INDUSTRIES IN NAIROBI, KENYA

Ahenda O. Stephen^{1,2}, Kithure G.N. Joyce¹, Njenga Hellen¹, Wangeci N Alex^{2,3} and Nyang'au O. Jared²

¹Department of Chemistry, College of Biological and Physical Sciences, University of Nairobi,
P.O Box 30197-00100, Nairobi, Kenya

²Analytical Chemistry Laboratory, Kenya Plant Health Inspectorate Service,
P.O Box 49592-00100, Nairobi, Kenya

³Faculty of Agriculture and Environment, University of Sydney,
NSW 2006, Australia

Abstract—A study was conducted to estimate current status of physico-chemical characteristics of effluents emanating from three paint factories within the main industrial area of Nairobi County. The effluents were analysed for temperature, pH, oil and grease, total suspended solids (TSS), chemical oxygen demand (COD), total phosphorus, total nitrogen, total sulphur and heavy metal ions and compared to Kenyan effluent discharge standards. The results were as follows: pH 6.48 - 6.89, temperature 28.07-28.30 °C, COD 916.77-1881.20 mg/L, total phosphorus 145.00-149.32 mg/L, TSS 6382.33-7395.33 mg/L, oil and grease 3525.00-6374.33 mg/L, total sulphur 72.62-73.41 mg/L, total nitrogen 1586.67-4442.67 mg/L. Heavy metal concentrations were 3.03-4.18 mg/L, 2.07-3.04 mg/L and 5.38-17.21 mg/L respectively for cadmium, chromium and lead. Adsorbent was made from waste rubber tyres and tested for its suitability in removing three heavy metal ions namely cadmium, lead and chromium from the effluent samples by varying adsorbent dosage, pH and contact time.

Keywords— Physico-chemical, Effluents, Adsorbent

I. INTRODUCTION

Industrial and population growth in developing countries have led to environmental degradation due to discharge of polluted wastewater directly to the environment without any or adequate treatment (Begam et al., 2009). Paint and other coating manufacturing industries are examples of effluents-releasing sources of metal contaminants (Vinod et al., 2012). Heavy metals have become a major environmental pollutant of late with even trace concentrations causing toxic impacts when exposed to terrestrial and aquatic ecology

(Begam et al., 2009) Albeit acute heavy metals exposure is uncommon through skin or ingestion, small amounts can be detrimental (Appenroth, 2010). Paint can be described as a distinctive homogenous formulation of four components namely binder, pigment, solvent and additives that produce a specific end product having a unique properties. When applied to a substrate, it gives an essential characteristic of adhesion, elasticity and durability when the paint dries (Talbert, 2008). The huge effluents discharged from these paint and coating industries play a major role in polluting Ngong and Nairobi rivers with untreated effluents especially loaded with heavy metals (Ogilo et al., 2017), which eventually get into the environment and bioaccumulate in the human system via ingestion or nutritional hierarchy since they are not biodegradable (Fu and Wang, 2011).

Many conventional methods employed in the treatment of domestic and industrial effluents include and are not limited to coagulation, ion exchange, electro-coagulation, membrane filtration and reverse osmosis. These methods however are expensive to set up and maintain, produce large volume of wastes which do not meet effluent standards (Akunwa et al., 2014, Fu and Wang, 2011). Therefore waste tyres based activated carbon has found its application in up taking of harmful trace contaminants from industrial and domestic effluents (Belgacem et al., 2013)

The objective of this study was therefore to determine the levels of contaminants in wastewater generated by paint manufacturing industries situated in Nairobi's industrial area and the use of waste tyre based adsorbent in metal pollution reduction.