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Assessment of the Physicochemical and Heavy Metal Concentration from Effluents of Paint Industry in Addis Ababa, Ethiopia

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Abstract

Paint industry is one of the industries that cause the water pollution by generating Wastewater primarily due to cleaning operations of mixers, reactors, blenders, packing machines and floors. The present research work deals with the study of some of the important physico-chemical and heavy metal parameters of paint industrial waste water effluents which was aimed at the analysis of the untreated effluents from six paint factories in Addis Ababa and the surrounding area. Analysis physico-chemical and heavy metal parameters of selected paint factories samples in Kadisco (KA), Zemilli (ZE), Rainbow (RA), Gastor solar (GA), Nifas silk (NI) and Modern building industry (MBI) were performed to investigate the concentration of status of the parameter. In this study, like; physico-chemical and heavy metal parameters pH, EC, TDS, TSS, COD, Cd, Cr, Pb, and Zn of the nine wastewater samples were analyzed using, Dana multi-meter, Jenway Model 4510 Conductivity/Temp Meter (451 001), Gravimetric, Volumetric, Colorimetric, flame emission photometry, and Atomic Absorption spectrometry (AAS)analyses methods. In the investigation some parameters were found to be above the limit set by ES and WHO. Values obtained for pH at KA, ZE,RA,GA, NI and MBI were 7.95, 8.34, 7.68, 10.95, 7.85 and 8.41; E.C:-55.1, 3.149, 675.9, 2.417, 549.6 and 3.169. TSS:-63, 205, 80, 55, 1980 and 418 mg/l and TDS:-501, 1, 2.849, 615.2, 2.207 and 2.883mg/l and COD:-100, 340, 270, 140, 2190 and 2670 mg/l. On the other hand, results obtained from Atomic Absorption Spectrophotometer analysis (AAS) showed the average metal levels as Cd2+, Cr Pb2 and Zn2+ were all sites above the permissible limit set by ES and WHO (detected mg/L).

Industrialization is seen as a motor behind many of the processes usually termed “social transformation” and “modernization". Paint industry is one of the industries that cause the water pollution. Wastewater is generated primarily due to cleaning operations of mixers, reactors, blenders, packing machines and floors. Heavy metals have been found to be highly toxic especially when their natural concentrations are exceeded. At normal concentration, they promote the functions of the enzymes but could lead to a lot of adverse metabolic reaction when their concentration rises beyond tolerance limit. The untreated effluents contain a lot of pollutants that are harmful to human beings when they exceed the permissible limits. The Zemilli Paint Factory in Ethiopia produces maximum of 36,000 liters of paint per day and as a result it generates about 500 liters of liquid waste on average per day. This massive quantity of untreated effluent is disposed to the river side and cause considerable load on the water courses leading to widespread damage to aquatic life and to the environment. The problem is more severe in Addis Ababa, where most (More than 40% of large and medium scale manufacturing industries are located. Addis Ababa, like most developing cities, lacks the infrastructure, financial resources, and institutional capacity necessary to effectively manage industrial wastes and adequately control industrial pollution. Paint manufacturing sector in Addis Ababa localized in different part of the sub city, most of them were concentrated in the residential and commercial area such as Nifas silk lafto sub city and Akaki Kality sub city. However, some of them are found in regional state. They have no proper waste discharging mechanism and no modern treatment plant which can handle their effluents waste accordingly. This study was employ on the city of Addis Ababa. Addis Ababa (9°N, 38.5° E) is the capital city of the Federal Democratic Republic of Ethiopia situated in the high plateaus of central Ethiopia in the NorthSouth oriented mountain system neighboring the rift- valley. The city, established in 1986, has experienced several planning changes that have influenced its physical and social growth. Its population is 2.7 million (2007 estimate); and about 3.9% of the total population of Ethiopia. It also represents about 28% of the urban population of the country with a life expectancy of 48 years. The city has experienced rapid population growth with an annual rate of 3.8 percent per year. It has a total land area of 54,000 hectares, situated 1500-3100 meter above sea level, with an aggregate population density of 4,847.9 persons per square kilometer. For administrational purposes the city is divided into 10 subcities. It is also home to the African Union, the Economic Commission for Africa and other international organizations”. The city makes a significant role in the economic, social and political development of the country. A preliminary visit in the study area was undertaken using vehicles in order to select six sampling sites. The selection of these sampling sites was based on the location (residential and commercial) by considering the relative amount of wastewater discharging paint effluent of Pollutant to the nearby environment and accessibility of the sites to investigation. Primary data was obtained from the six selected sites. Kadisco Paint, Zemilli Paint Nifas Silk Paint, Rainbow Paint, Gast solar and modern building industry factory wastewater sampling is made on site by applying stratified random sampling technique. The wastewater sample collected is analyzed for the presence and amount of physicochemical and heavy metal concentration at Addis Ababa University, faculty of science environmental laboratory and chemistry department laboratory.

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From the results of the physico- chemical analyses, it is evident that all the analyzed parameters showed compliance with ES and WHO standards except pHin site Gast solar (GS); E.C in site Nifas silk (NS) and (Rain bow) RB; TSS in all sites Gast solar (GS), Kadisco (KA), Rainbow (RB), Zemilli (ZE) and Modern industry (MBI). However, TDS as per WHO in site Rainbow (RB), Gast solar (GS) and MBI beyond the limit. And also COD in site Rainbow (RB), Zemilli (ZE), Nifas silk (NS) and MBI are beyond the permissible limit set by ES (250 mg/l) and also GS beyond the permissible limit of WHO (120 mg/l). In view of the overall results obtained for heavy metals contents of the samples from the paint industry's environment, the paint industry effluent did seem to pose serious threat to the environment.

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