An assessment of the quality of liquid effluents from opaque beer-brewing plants in Bulawayo, Zimbabwe

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Abstract

The quality of liquid effluents from two opaque sorghum beer-brewing plants in Bulawayo, Zimbabwe were studied by analysing snap and composite samples collected manually from the plants' effluent discharge points over a period of six months. Both plants generate effluents that could negatively impact on the municipal treatment system if no efforts are made to significantly reduce their pollution load in terms of both quality and quantity. The results from both plants for the main pollution indicators showed high values of chemical oxygen demand (COD) (in excess of 30 000 mg/ℓ in some instances), biological oxygen demand (BOD) and suspended solids (SS), indicating high organic load. Analysis of BOD values indicates that the effluents are biologically degradable. No significant heavy metals were found in the effluents, as these are food-processing plants. The effluent treatment plants in both plants were not only inadequate but also poorly operated thereby rendering them ineffective in reducing the pollution loads of the effluents. Simple good housekeeping and operational practices and well as design modifications are suggested to reduce the pollution load of the effluents.

Keywords: industrial effluents, opaque beer-brewery, pollution load, quality, quantity

Introduction

In recent years, a number of environmental pollution incidents have led to a renewed drive to monitor and control the quality and quantity of liquid effluents being discharged especially by industries into the municipal treatment systems and natural watercourses in Zimbabwe. Recent examples of contamination of water-bodies include eutrophication of Lake Chivero due the presence of inorganic nutrients such as nitrogen and phosphorus compounds in excessive amounts, most of which originated from industrial activities (Marshal, 1997) and the case of the contamination of Ncema Dam with cyanide washed from a gold mine as a result of heavy rainfall (*The Chronicle*, 2000). The result of this drive is that a number of industries and some municipal authorities have been fined by the Zimbabwe National Water Authority (ZINWA) for discharging effluents whose qualities were not compliant with its standards for the discharge of such effluents into natural watercourses.

The discharge of poor quality effluents especially by industries into the municipal wastewater treatment works has the effect of reducing the performance of these treatment facilities over time due to hydraulic overloading and corrosion of the sewer pipe system (Nyoni, 1999; Norplan, Stewart Scott Zimbabwe and CNM and Partners, 2001). This problem has been worsened by the fact that industries within the jurisdiction of the city of Bulawayo were permitted to dispose of effluents into the municipal sewers, provided the quality of such effluents was within the regulatory standards as set out in the City Council By-Laws of 1980 (Bulawayo By-Laws, 1980). Consequently, most industrial establishments within the city do not have effluent pretreatment plants and on sites where they exist, their performance is not up to standard. The situation has further been compounded by the council's inability to effectively monitor compliance with and implement its by-laws (Ikhu-Omoregbe et al., 2001). However, as a result of the New Act of 1998 and the guidelines thereof most urban councils, including Bulawayo, in Zimbabwe are in the process of adopting the "polluter pays principle" in managing industrial pollution. Here the producer of any pollution would be made to pay the full cost of treatment to reduce the pollution loads to levels, which will not cause environmental damage or loss of beneficial use to others together with the cost of monitoring and management. Thus a factory that generates substantial effluents must take steps to reduce its pollution load before ultimate discharge into the municipal sewerage system.

It is well known that in most developing countries, industries dispose of their effluents without adequate characterisation, quantification and pretreatment due to economic and technological constraints (Sweeney, 1995). The main objective of this study was to characterise and quantify the liquid effluent pollution load from these two plants thereby generating reliable data for planning and cleaner production practices for both the industries and the local authority. The paper also discusses the current liquid effluent disposal/treatment practices and offers suggestions on possible remediation. Furthermore, it assesses the level of compliance to the local legislative guidelines for effluent disposal.

Effluent generation and treatment in the two breweries

The two breweries studied in this paper produce African traditional sorghum malt beer. The plants will be referred to as Plant A and Plant B respectively. Plant A has a production capacity of 100 x 10^6 ℓ of beer per year while Plant B has a capacity of 23 x 10^6 ℓ of beer per year. Both breweries use municipal water for their process water.

Plant A carries out its milling and malt preparation on the same premises as the brewing process while for Plant B these two initial stages in sorghum beer-brewing are done outside of the plant

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