

**Colour Removal from Wastewater of a Pulp and Paper Mill in
Kenya by a Combination of Electrochemical and Coagulation
Methods**

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ABSTRACT

This study was undertaken to develop a simple, efficient and economically viable method capable of reducing the colour of Pan African Paper Mill (PPM) effluent prior to its discharge to Nzoia River. The mill has a production capacity of 120,000 tonnes of paper per year and discharges, on average, 35,000 m³ per day of wastewater with an initial colour index of 1867.71^oH. The effluent treatment system, which includes two clarifiers, followed by four lagoons, has proved grossly inadequate for the reduction of PPM wastewater colour.

IR, GC and TLC analyses were carried out on wastewater samples collected from five sampling points along the effluent treatment system. There was a significant increase in the wastewater colour from the clarifier overflow to the discharge point, which was probably due to the oxidation or polymerisation of lignin by-products. The IR spectrum with peaks between 1800 cm⁻¹ and 1900 cm⁻¹ was an indication of the presence of aromatic compounds, suspected to cause colour. The GC results showed the presence of two major compounds with varying degree of concentration depending on the sampling point. The colour of the treated effluent increased from 1867.71 to 3263.33^oH as one of the compound concentration increased from sampling point one to sampling point five.

Two types of colour removal classes were tested in the study, namely: coagulation and electrochemical using sacrificial iron electrodes. Throughout the study the experiments were laid out in a stratified random sampling design. The analysis of data was carried out using a Statistical Package for Social Scientists (SPSS) computer programme version 10.0. Electrochemical colour removal method was the best compared with coagulation methods, but required higher power consumption. Further investigations that combined electrochemical method and three types of coagulants (alum, calcium oxide and wood ash leachate) were carried out to reduce electrical power consumption. Electrochemical method combined with wood ash leachate (ELCAS) proved to be the best and least expensive method with almost 100% colour removal at an estimated annual cost of between KShs. 227,285.60 and 714,498.20 (US\$2705.78-8505.93). Besides colour abatement, ELCAS also reduced other effluent physico-chemical parameters such as BOD, COD, TSS, TS and turbidity by 81.25%, 80.66, 94.90%, 97.26% and 92.14% respectively.

The analysis of ELCAS treated effluent showed that the mill can discharge effluent that meets local and international standards for colour requirements into River Nzoia. It will further be recommended that recycling of the treated water by ELCAS back to the mill be considered since the quality meets the requirement for use in Kraft paper manufacturing. It was also suggested that ELCAS be set up immediately as the effluent leaves the mill to take advantage of the high effluent temperature and save on the cost of its treatment.