

**Studies on the Degradation Kinetics and the Levels of Chlorothalonil and Chlorpyrifos in
the Water Systems Within the Coffee Growing Zones of Kiambu County, Kenya**

Elijah Kungu Ngumba

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ABSTRACT

The practice of using pesticides in coffee production in Kenya has been necessitated by high losses in production due to pest infestation. This has resulted to non-point contamination of surface water via runoff, spray drifts and leaching. Chlorothalonil (fungicide) and chlorpyrifos (insecticide) are some of the organic based pesticides that have over the years been used in Kenya and specifically within the major coffee growing zones of Kiambu County in Kenya. Given concerns related to both pest control efficacy and environmental risk, it is of concern that attention has not been focused on the fate of these pesticides in water within the coffee growing zones. The main objective of this study was to determine the degradation kinetics of these pesticides in both coffee pulping waste water and river water and ultimately determine their levels in the waters within these coffee growing zones using GC-MS. Samples of coffee pulping wastewater and river water were collected during the major coffee harvesting season from coffee processing factories and rivers in Kiambu County in the period between September 2009 and January 2010. The samples were analyzed for selected physico-chemical water parameters such as pH, chemical oxygen demand (COD) and conductivity. The COD, conductivity and pH for the river water ranged from 52.5-165 mg/L, 1585-1814 $\mu\text{S}/\text{cm}$ and 6.3-7.9 respectively. For coffee pulping wastewater the COD, conductivity and pH were in the range of 11125-33250 mg/L, 1859-2610 $\mu\text{S}/\text{cm}$ and 3.7-5.5 respectively. Pesticides were extracted from coffee pulping wastewater and river water by liquid-liquid extraction (LLE) and solid phase extraction (SPE), respectively. The two methods of extraction were optimized and their percentage recoveries calculated. The rate of degradation was found to follow first order kinetics and varied significantly with the nature of water, pH and exposure to light. The half-life of chlorothalonil ranged from 4.1 days to 165 days and for chlorpyrifos ranged from 5.739 days to 49.4 days. The

study showed that both chlorothalonil and chlorpyrifos at the normal water physico-chemical water parameters will not persist for a long time before they degrade to less toxic products. With regard to the pesticide levels, chlorothalonil ranged from below detection limit (BDL)-160.0 µg/L in coffee pulping wastewater and BDL-57.0 µg/L in the river water and chlorpyrifos levels ranged from BDL-70.2 µg/L in coffee pulping wastewater and BDL-9.2 µg/L in river water. The results from this study show that the levels are within the WHO maximum limits.