

ABSTRACT

The Study of Some Volatile Organic Compounds: Their Residual Levels in Water and Abiotic Transformation

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The conventional EPA method involving the use of purge and trap gas chromatography with mass selective detection was adopted to quantify the VOCs: MTBE (Methyl *tertiary* butyl ether), TBA (*tertiary* butyl alcohol) and BTEX (benzene, toluene, ethyl benzene and xylenes) in Jamaican waters. The linearity, analytical precision and the limit of detection were evaluated for each analyte. The method was employed in the analysis of water collected from rivers, wells (groundwater) and harbour surface. A total of 52 water samples (37 ground, 15 surface) were collected from Kingston, St. Andrew and St. Catherine; Jamaica. MTBE was detected in all water samples with concentrations ranging from 0.06 - 4.80 µg/L, however, its main degradation product TBA was not detected. BTEX was also detected with concentrations ranging from 0.01 – 0.48 µg/L.

The kinetics of the metal assisted acid hydrolysis of MTBE in aqueous solutions at various pH, temperature, ionic strength, metal ion concentration and metal ion were studied. The degradation of MTBE was first order with respect to the concentrations of MTBE, hydrogen ion and metal ion. The degradation follows an associative mechanism. The effect of some Group 1 cations on the hydrolysis showed a decrease down the group, that is; $\text{Li}^+ > \text{Na}^+ > \text{K}^+ > \text{Cs}^+$.

The mobility and distribution of the VOCs were evaluated using column leaching and batch equilibrium experiments on four different soil types. The order of leaching for the VOCs was $\text{TBA} > \text{MTBE} > \text{benzene} > \text{toluene} > \text{ethylbenzene} \geq \text{o-xylene}$. Leaching was dependent on the VOC's solubility with water, soil type and the percentage organic carbon/matter. Leaching potential was assessed using the GUS (groundwater ubiquity score) and all the VOCs were characterised as leachers. The presence of other gasoline components significantly affected the leaching behaviour of toluene, ethylbenzene and *o*-xylene, while MTBE and benzene were not affected.

Keywords: Nykieta James, Volatile Organic Compounds (VOCs), MTBE, TBA, BTEX, residual levels, acid hydrolysis, abiotic transformation, leaching, adsorption, volatilisation.