Phthalate ester plasticizers in freshwater systems of Venda, South Africa and potential health effects

OS Fatoki[1]*, M Bornman[2], L Ravandhalala[3], L Chimuka[4], B Genthe[5] and A Adeniyi[6]

[1] Department of Chemistry, Faculty of Applied Sciences, Cape Peninsula University of Technology, PO Box 652, Cape Town 8000, South Africa

[2] Department of Andrology, University of Pretoria, South Africa

[3] Department of Environmental Resources Management, University of Venda, South Africa

[4] Department of Chemistry, University of the Witwatersrand, South Africa

[5] CSIR, Stellenbosch, South Africa

[6] Department of Chemistry, Lagos State University, Nigeria

Abstract

Phthalate ester plasticizers were determined in rivers and dams of the Venda region, South Africa. Liquid-liquid extraction, column chromatographic clean-up and capillary gas chromatography were the methods used for the quantitative analyses. Levels of phthalates in water samples from the rivers and dams ranged from 0.16 mg/ℓ to 10.17 mg/ℓ and varied between 0.02 mg/kg and 0.89 mg/kg in sediments. Generally, the highest concentrations of phthalates were found as DBP and DEHP, which is consistent with their common use in plastic materials and other industrial chemicals. The phthalate levels found in the water samples were much higher than the criterion of 3 µg/ℓ phthalates recommended by the United States Environmental Protection Agency (USEPA) for the protection of fish and other aquatic life, and higher than the Suggested No-Adverse Effect Levels (SNAEL) of 7.5 to 38.5 µg/ℓ for drinking water. The health risk-assessment studies on the phthalates found in the water systems suggested potential carcinogenic and other toxic effects they may pose to communities downstream which might be exposed either through drinking untreated water from the rivers, through dermal absorption or by using the freshwater sources to water their vegetable gardens. DEHP posed the highest risk potential of all the phthalates and the water use or exposure pathway that appeared to pose the highest potential health risk for carcinogenic as well as toxic effects was vegetable watering. The results for phthalates in the water samples give cause for environmental concern as people's health downstream is at stake if rural populations use this water.

Keywords: capillary GC, phthalates, freshwaters, potential carcinogens