Degradation of Bisphenol-A (BPA) in Drinking Water Using a Newly Synthesized Graphene-Based Photocatalyst

T.A.K.A. Thennakoon[1], B.E.P. Mendis[1]*, M. Gunawardena[2] and R. De Silva[2]

[1]Department of Food Science and Technology, Faculty of Agriculture, University of Peradeniya, Peradeniya 20400, Sri Lanka
[2]Sri Lanka Institute of Nanotechnology, Pitipana, Homagama 10206, Sri Lanka
**ereshamendis@yahoo.com*

Drinking water sources contain various types of micro-pollutants leading to significant health conditions in humans and animals. Bisphenol-A (BPA) is one of the micro-pollutants present in drinking water sources due to leaching from polycarbonate sources. Different mechanisms have been used to remove BPA from water and photocatalytic degradation is one of the methods. A photocatalytic material incorporated graphene has been developed to study its effectiveness in removing BPA from drinking water under different conditions as pH of the water (5.4, 6.5, 7.3 and 8.2), initial BPA concentration (5 mg/L, 10 mg/L, 20 mg/L and 25 mg/L), photocatalytic material concentration (0.8 g/L, 1.0 g/L and 2.0 g/L) and the light source (halogen light, UV light and 11.00 a.m.-2.00 p.m. sunlight). Photocatalytic material was added to drinking water samples with BPA, stirred to ensure even dispersion of material and the unit was exposed to the light source. Degradation of BPA was analysed with irradiation time. The absorbance of BPA was measured using a UV-VIS-NIR spectrophotometer for the calculation of concentration reduction over time. A simple kinetic study was performed using pseudo 1st order kinetic model to study the relationship between degradation and irradiation time of BPA. The highest degradation efficiency for BPA was achieved with 2.0 g/L catalyst concentration, 10 mg/L initial BPA concentration, pH 8.2 and visible light sources. The degradation efficiencies are 95.5±0.20 %, 95.70±0.73 %, 92.60±2.85 % and 95.7±0.73 %, respectively. Degradation of BPA with time showed a linear relationship under UV light and pH conditions 5.4, 7.3, and 8.2 resulting in squared correlation as 0.9523, 0.9797, 0.9515, and 0.9358 respectively. Based on the kinetics, degradation of BPA does not follow 1st order kinetics when resulting in the higher degradation efficiencies. The material is effective in degrading BPA in drinking water sources under visible light compared to UV light and above 95 % degradation efficiency was achieved.

Keywords: Bisphenol-A, Photocatalytic degradation, Drinking water, Graphene-based photocatalyst, Irradiation time

Financial support from Sri Lanka Institute of Nanotechnology and the guidance and support from Dr. Sanjeewa Wijesinghe and Mrs. Nadeesha Tharangani at Sri Lanka Institute of Nanotechnology are acknowledged.