

The Effect of pH and Initial Concentration on the Degradation Kinetics of Glyphosate in Biotic and Abiotic waters

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Glyphosate is one of the most commonly used herbicides globally. Microorganisms degrade Glyphosate into small molecules during its biodegradation. Biodegradation lowers its toxicity and reduces persistence in aquatic environments. The degradation kinetics of a pollutant is an important factor influencing its environmental fate. Therefore, in this study, the degradation kinetics of Glyphosate in waters was evaluated with respect to the zeroth and first-order models. Deionized water and well water samples were buffered to prepare abiotic and biotic waters at pH 4.5, 7.0 and 8.5, respectively, to cover the typical pH range of inland waters in Sri Lanka. pH-modified well water samples were separately spiked at 2, 10, and 100 mg L⁻¹ with Glyphosate reference standard and glyphosate-based formulation. In low spiked levels in well water samples, the rates of degradation are given by the first-order rate constants with the same order of magnitude for both reference standard and commercial formulation. However, the 50% (DT 50) and the 90% (DT 90) degradation kinetics of formulation are comparatively higher than that of the reference standard. Although the microbial composition of the identical biotic well water samples is supposed to be constant; different microbial reactions may take place depending on the concentration. Therefore, different rate constants may be observed. Further, in the absence of microbes, significantly lower degradation rates were observed in the control study and all spiked levels followed the zeroth order. Moreover, the degradation of Glyphosate in water is independent of the pH in both abiotic and biotic waters. Further, the degradation rate depends on the initial concentration of Glyphosate in higher concentrations with no impact of the inert surfactant. However, the DT 50 and DT 90 are affected by the inert surfactant.

Keywords: Biodegradation, Glyphosate, Kinetics, Microorganisms, Pollutant

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