

Equilibrium, kinetic and thermodynamic studies on the adsorption of atrazine in soils of the water fluctuation zone in the Three-Gorges Reservoir

CURRENT STATUS: ACCEPTED

Environmental Sciences Europe  Springer

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DOI:

10.21203/rs.2.18668/v1

SUBJECT AREAS

Environmental Policy

KEYWORDS

Soil, Atrazine, Water fluctuation zone, Kinetics, Sorption, Thermodynamics

Abstract

Background: Environmental behavior of pesticide in soils is a key current research focus. Studying the adsorption characteristics of pesticides in soils as a parameter for evaluating the risk of groundwater pollution by pesticides, is commonly applied in agriculture.

Results: In order to provide a theoretical basis for environment risk assessment and pollution remediation, the thermodynamics and kinetics of the equilibrium of atrazine adsorption in the Three Gorges Reservoir area were assessed and analyzed via batch experiments. Results showed that the sorption of atrazine was exothermic and spontaneous process at the temperatures (298–318K), and the atrazine was more easily adsorbed by soils at a concentration of 0–30 mg L⁻¹, with low temperature adsorption effects better than high temperature adsorption. The adsorption of atrazine to the two assessed soils was well fitted by Freundlich and Langmuir models. The adsorption kinetics of atrazine on soils were consistent with the quasi-second order kinetic model and intraparticle diffusion was found not to be the only control step. Results showed that monolayer adsorption occurred with non-uniform energy distribution on the soil surface, indicating that the adsorption of atrazine on the two kinds of soil was controlled by internal diffusion surface adsorption and liquid film diffusion, leading to the complexity of its adsorption kinetics. The values of standard free energy <0, indicating that the adsorption of atrazine in the soils was spontaneous and dominated by physical adsorption. Changes in standard enthalpy () indicated that the adsorption was exothermic.

Conclusion: Atrazine exhibited a weak adsorption capacity in both soils, indicating it is highly mobile in the soil-water environment and could easily cause groundwater pollution. Therefore, much attention should be paid to the environmental behavior of pesticide soil moisture fluctuations, leading to broad spreading of pollution.

Full Text

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