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Removal of urea from an aqueous solution using brick powder

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Abstract:

Urine is the main source of Nitrogen in household waste water, which causes eutrophication in water bodies. More than 80% of Nitrogen in waste water comes from urine. But, the volumetric contribution of urine to domestic wastewater is less than 1%. Therefore, to treat urine at the source of generation is more convenient than to treat after dilution with the waste water in the derange system. Urea is the main nitrogen containing compound in human urine. Its concentration is approximately 12,000 ppm. Adsorbing urea into various sorbents has been studied extensively during past two decades. But adsorption is very rarely used for treating the waste water containing higher urea concentrations due to higher cost of the adsorbent such as activated carbon. Recently it has been found that brick powder also shows good adsorption characteristics as other commercially available adsorbents.

In this study brick powder was evaluated for its ability to remove urea from an aqueous solution in a batch process. Equilibrium studies were conducted for a range of initial urea concentrations (300, 600, 900, 3000, 6000, 9000, 12000 and 15000 mg/l). The experimental data were analyzed by the Langmuir, Freundlich, Temkin and Dubinin–Radushkevich isotherm models. Langmuir isotherm model was best fitted with the urea adsorption. The Langmuir constants Q_0 and b were found to be 1667 and 0.000638 respectively. The pseudo first-order and second-order kinetic models were used to describe resulting kinetic data for the same range of urea concentrations, and the rate constants were calculated. Pseudo second-order kinetic model best described the adsorption kinetics of urea onto brick powder. The maximum urea adsorption capacity of 1750 mg/Kg was reported for an initial urea concentration of 12,000 mg/L.

Keywords: Urea, brick powder, source separated urine, waste water, isotherm models, kinetic models, adsorption characteristics