Biosorption of organic dyes using spent brewery grains and polylactide (PLA) blend films in batch and continuous systems

Chanzu, Harry Amugani
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Abstract:

Biosorption of Malachite green and Congo red dyes currently used in textile and dyeing industries was investigated using Spent Brewery Grains (SBGs) from a local brewery. The results showed that as the amount of the adsorbent increased, the percentage of dye removal increased accordingly. Optimum pH value for Malachite green dye adsorption was 6.85 and for Congo red was 1.84. Observations made regarding the effect of temperature led to the conclusion that the adsorption process was exothermic since increase in incubation temperature reduced adsorption of both dyes. The adsorption of both malachite green and Congo red followed the pseudo-second-order rate equation with R2 values of 0.999 and 0.998 respectively. Both processes fitted Freundlich isotherm with slopes between 0 and 1 indicating chemisorptions process. In column studies using Spent Brewery Grains, adsorption tests were conducted for both Malachite green and Congo red dyes. The breakthrough was fast with decrease in depth, increase in concentration, increase in particle size and increase in flow rate. Batch experiments were also conducted to study the biosorption of Malachite Green on PLA blend films. Films were prepared by solvent-casting method using dichloromethane. Above pH 4 and low salt concentration, Malachite Green was removed effectively. The isotherm data fitted the Freundlich model with 0.969 R2 value and 0.738 slope implying chemisorptions process. The biosorption process followed pseudo-second order kinetics with calculated adsorption capacity at equilibrium (qe) of 0.5718 mg/g.