PREPARATION OF MAGNETIZED BIOPOLYMER-CLAY ADSORBENTS

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Introduction

• Many water pollutants, that are either not biodegradable or that biodegrade very slowly, are causing numerous environmental problems and also tend to accumulate in aquatic organisms causing a range of diseases.
• The pollutants can be removed from contaminated waters by adsorption, electrodialysis, flocculation, ion exchange, precipitation, reverse osmosis, and other techniques.
• Adsorption is frequently the simplest to apply but is not always the most economic technique because of the price of synthetic adsorbents.
• Clays are inexpensive and relatively efficient adsorbents but are, due to their colloidal nature, rather hard to separate from water (1).
• However, magnetized clay adsorbents can easily be removed from water with either permanent magnet or electromagnet.
• The objectives of this work were: to study the magnetization of clay:biomaterial aggregates at different:
  • [clay]/[biomaterial],
  • [Fe³⁺]/[Fe²⁺] ratios, and
  • to develop a simple model for detection of optimal conditions for magnetization of aggregates.

Methods and Materials

• We prepared nano-size adsorbents from:
  • two clays (bentonite and kaolin), and
  • two biomaterials (humic acids and starch).
• Freshly prepared absorbents where then coated with magnetite (2).
• The absorbents were prepared at five clay/biomaterial weight ratios in the range 2.5 to 27.6 and then magnetized at five Fe³⁺/Fe²⁺ molar ratios in the range 0.60 to 3.90.
• Magnetite coated absorbents were separated from suspension using a low intensity magnet (7.69+0.80 mT).
• Adsorbents were tested in simultaneous adsorption on nitrate (NO₃⁻) and phosphate (PO₄³⁻).
• The Response Surface Methodology (RSM) was used to plan the experiments and analyze results.

CONCLUSIONS

Maximal concentration of magnetized absorbent in bentonite/starch and in kaolin/starch suspensions was detected at:
  • clay/starch weight ratio of 6.1 and Fe³⁺/Fe²⁺ molar ratio of 0.6 and 1.1.
Maximal concentration of magnetized absorbents in bentonite/humic acids and in kaolin/humic acids suspensions was also detected at:
  • a. clay/humic acid weight ratio of 6.1 and Fe³⁺/Fe²⁺ molar ratio of 0.6 and 1.1.
High concentration of magnetized absorbent in both kaolin/starch and kaolin/humic acids suspensions was detected at:
  • kaolin/biomaterial ratios of 2.5, 15 and 25 and Fe³⁺/Fe²⁺ molar ratio of 0.6, 1.1, 2.3 and 3.9
  • but not in bentonite/starch and bentonite/humic acids suspensions.

The model predicted and experimental results are in good agreement over entire ranges of variables tested.

Literature