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Protocol Article

Adsorptive removal of noxious cadmium from aqueous solutions using poly urea-formaldehyde : A novel polymer adsorbent



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ABSTRACT

Cadmium is a heavy metal toxic that enters water resources through industrial, household, agricultural waste and non-sanitary landfill of urban and industrial wastes. Pollution of water resources by cadmium increases incidence of diseases including Itai-Itai, kidney disorders, cancer, chromosome effects and kidney tubular damages in low exposures. The aim of this study is to study the efficiency of a new poly urea-formaldehyde adsorbent in the removal cadmium ions from aqueous solutions. The effect of different variables such as initial pH, contact time, initial concentration of cadmium and test of real wastewater samples were evaluated. In addition, laboratory data of cadmium adsorption by urea-formaldehyde adsorbent were matched to Langmuir, Freundlich and Temkin isotherm models. The results of the study showed that maximum adsorption capacity obtained by Langmuir model was 76.3 mg/g at pH = 5.5. Laboratory adsorption data matched mostly by Freundlich isotherm model ($R^2 = 0.999$) which indicates that adsorption of cadmium ions on heterogenic surfaces of poly urea-formaldehyde happens by chemical adsorption mechanism. Generally, the results of the study showed that new poly urea-formaldehyde adsorbent can be efficiently used to remove highly concentrated cadmium ions from aqueous solutions.

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Specifications Table

Subject area	Environmental Chemical Engineering
<ul style="list-style-type: none"> • More specific subject area 	<ul style="list-style-type: none"> • Adsorption
<ul style="list-style-type: none"> • Protocol name 	<ul style="list-style-type: none"> • Application of new urea formaldehyde adsorbent in the removal of cadmium from aqueous solutions.
<ul style="list-style-type: none"> • Reagents/tools 	<ul style="list-style-type: none"> • The Cd⁺² concentration measurement was performed by an Atomic Absorption Spectrophotometer (Shimadzu AA-670 model). • A digital pH meter (Basic 20 Crison) was used for solution pH measurement.
<ul style="list-style-type: none"> • Experimental design 	<ul style="list-style-type: none"> • Measuring of Cd⁺² concentrations under various levels of initial Cd⁺² concentration, solution pH, and contact time to obtain optimal Cd⁺² removal from aqueous solution using a novel adsorbent provided from Urea Formaldehyde.
<ul style="list-style-type: none"> • Trial registration 	<ul style="list-style-type: none"> • No applicable
<ul style="list-style-type: none"> • Ethics 	<ul style="list-style-type: none"> • No applicable

Protocol data

- Preparation a new highly efficient polymer urea-formaldehyde for the removal of cadmium ions from aqueous solutions.
- Maximum adsorption capacity of cadmium was 76.3 mg/g.
- Suitable application of urea-formaldehyde adsorbent in removing cadmium ions from wastewater is shown.

Description of protocol

Chemicals and materials

All chemical materials used in the present research were in analytical grade. Chemicals including cadmium nitrate, urea, formaldehyde, acetic acid (CH₃COOH) (purity degree of 100%), nitric acid (purity degree of 65%), acetate sodium (C₂H₃NaO₂), sodium dihydrogen phosphate (NaH₂PO₄), di-sodium hydrogen phosphate (Na₂HPO₄) and sodium hydroxide (NaOH) were provided from Merck company, Germany. A stock solution of 500 mg/L of cadmium was prepared by dissolving a certain amount of cadmium nitrate salt in de-ionized water. Different concentrations of cadmium solution were prepared by diluting the stock solution.

Urea-formaldehyde preparation

In order to prepare urea-formaldehyde adsorbent, firstly, 6 mL of formaldehyde was poured into volumetric flask and NaOH 0.1 M was added to it drop by drop by pH of the solution reach to 8. Then,

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