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Capacity and Kinetic Adsorption Calcium Metal Ion on Chitosan Nano Beads.

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ABSTRACT

Chitosan beads have been used as an adsorbent calcium metal ion from wastewater by using adsorption process. The effect of contact time and concentration initial of calcium metal ion were investigated. The experiment data were analysis with kinetic and isotherm adsorption. The results showed that the adsorption of calcium metal ion is followed kinetic model of first order sorption reaching equilibrium and Langmuir isotherm model. The Adsorption capacity of calcium ion on chitosan nanobeads was 90,23. 10^{-4} mol/g and on chitosan flake was 10,15. 10^{-4} mol/g.

Keywords: capacity and kinetic adsorption, calcium, chitosan nano beads

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INTRODUCTION

Clean amount of water required mount every year along with increase of population and awareness of human being to healthy life. Various constraint in is ready of healthy and clean water for example because height some mineral exist in in water. One of the most important problems is the accumulation of metal ion in food structures. As a result of accumulation, the concentrations of metals can be more than those in water. The contaminated food can cause poisoning in population. Although metal ions are necessary for the growth of plants, after certain concentrations metals become poisonous for both plants and the microorganisms [1]. Calsium metal ion is one of the matal can causing contamination of water. This water is improper consumed because influencing metabolism system, the core important kidney performance.

Some methods have been used to remove metal ion from water like precipitation, ion exchange [2], electro coagulation [3], filtration with membrane [4] reverse osmosis and adsorption in cleaning wastewater. Some research used adsorption for removed hazards from water like phosphate [5], metyl violete [6], bromate [7], arsenic, fluoride and cadmium[8] and nitrate. In this study, the calcium ion has been separated from water by adsorption method with chitosan beads as adsorbent. Chitosan is the deacetylated of chitin that isolated from crab, shrimp, lobster and microorganisms. Chitosan have some special characteristics include biocompatibility, biodegradability [11] , and non toxic. Thus chitosan could be applied on analytical chemistry, water treatment [12], biomedicine and pharmaceutical materials [13,14,15]. In this study, therefore we investigated the modified chitosan with sweeling on acetic acid medium for produce chitosan beads and this adsorbent was adsorpted calcium ion. The performances of adsorption capacity was investigated at based on the data effect concentration and adsorption kinetic at base on the data effect contaction time adsorbent with adsorbat.

MATERIALS AND METHODS

Chitosan from shrimp with 85% deacetylated was purchased from PT Chemindo Indonesia. The other materials were used analytical grade and purchased from Merck: Acetic acid, $CaCl_2$, NaOH, ethanol, demineral water and other materials. The equipments utilized in this experiment were Spectrophotometer Infra Red (FTIR Perkin Elmer Frontier-89485).

Preparation of chitosan beads

The chitosan beads were preparation with chitosan flake was solution in acetic acid solution followed method [11].

Study of batch adsorption system

Batch adsorption experiment was investigated at 30 ^{o}C for some variable i.e concentration initial of calcium solution and contact time calcium ion with chitosan nanobeads the removal of Ca(II) onto chitosan nanobeads. For each experimental run, 10 ml aqueous Ca(II) solution agitated with 100mg of chitosan nanobeads and at shaker at fixed speed of 100 rpm. The concentrations of calcium solution were varied at range of 50 -2500 mg/L. Whereas the time interaction was varied between 10- 150 min. The pH of each solution was controlled at 5.5 by adding buffer solution. The residual concentration of Ca(II) after adsorption was determined by Atomic absorption spectroscopy (AAS) Perkin Elmer. The data of effect concentration calcium solution were analysis with The Langmuir and Freuchlich isotherm adsorption model to determine the capacity (b) and equilibrium adsorption [16].

RESULTS AND DISCUSSION

The infra red spectra of adsorbent before and after interaction with calcium solution are shown in Fig. 1. The characteristic peaks of chitosan beads are at 1620 and 1416 cm^{-1} are assigned stretching of carbonyl groups. In addition, peaks at 1320 cm^{-1}, 1130 cm^{-1}, 1090 cm^{-1} , 1020 cm^{-1} (C–O–C stretching), and 950 cm^{-1} (C–O stretching) are attributed to its saccharide structure. The characteristic absorption bands at 1651 cm^{-1} amina, 1587 cm^{-1} amide . The spectra confirmed that the carbonyl groups of were dissociated to COO^{-} groups which complexed with protonated amino groups of chitosan through electrostatic interaction with calcium ion.

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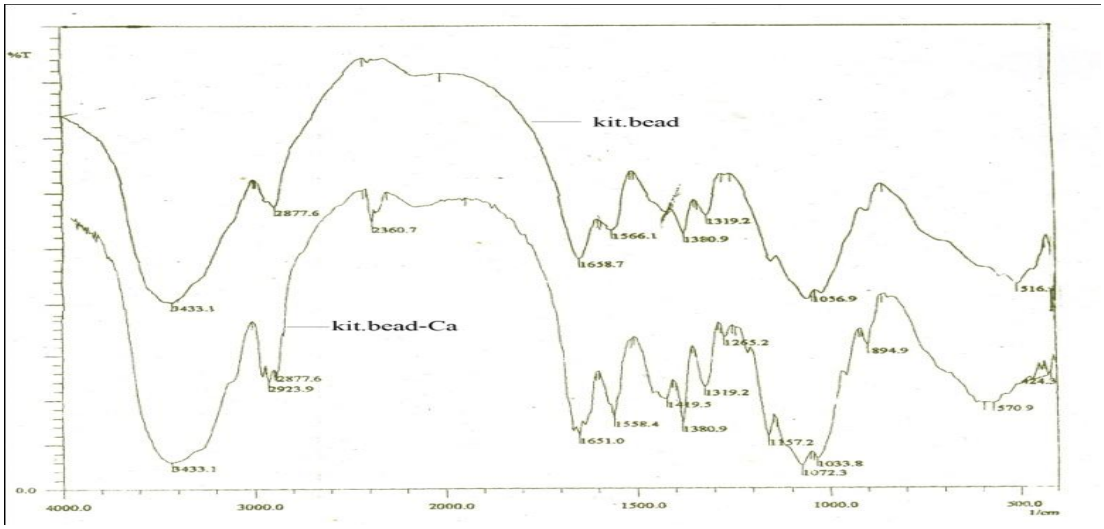

Figure 1: Spectra FTIR for Chitosan nano beads and chitosan nanobead-Ca

Results of adsorption batch system in some concentration of calcium solution after it analysis in Langmuir and Freundlich showed that adsorption Ca(II) on chitosan nanobeads have R= 0.994 for isotherm Langmuir and R= 0.965 for isotherm Freunclich, so that adsorption Ca(II) on chitosan nanobeads is followed isotherm Langmuir. Adsorption capacity of calcium ion on chitosan nanobeads was 90,23. 10^{-4} mol/g and on chitosan flake was 10,15. 10^{-4} mol/g

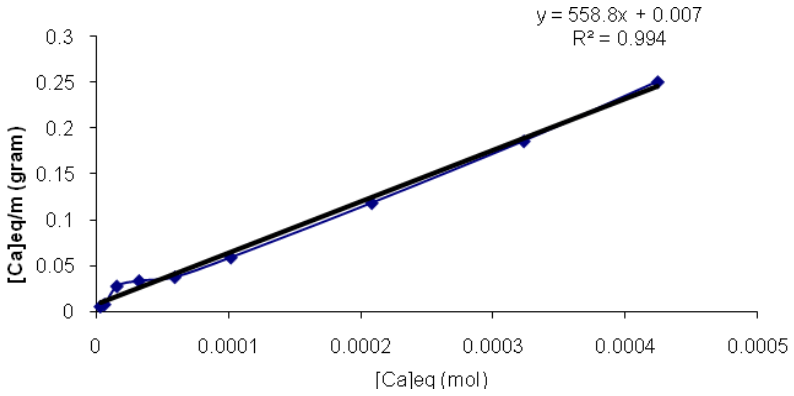

Figure 2: Linear it as Langmuir

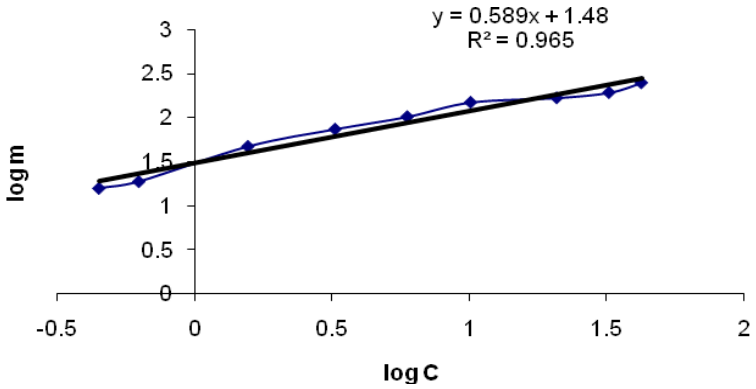

Figure 3: Linear it as Freunclich

The Freunlich isotherm was drawed that adsorption was multilayer system and Langmuir isotherm is designed for monolayer adsorption. It was draw that adsorbent have of a species on a homogeneous surface. The adsorption energy is the same for all active site regardless of the degree of coverage.

Study effect contact time adsorbent with calcium ion metal showed that adsorbent chitosan nanobeads have adsorption rate more faster than chitosan flake. Chitosan nanobeads more porous than chitosan flake so that it can adsorption calcium metal ion more faster than chitosan flake. When chitosan solute in acetic acid and it was dropped in NaOH solution, it constructed repolimerization and the layer more consctruction.

Table 1: Adsorption rate constant and correlation coefficient for the adsorption of Ca(II) on chitosan

Kation logam	Kinetic orde 1			Kinetic pseudo orde 2 Ho		
	k_1 10^{-3} (menit^{-1})	Q. (mol/L)$^{-1}$	R^2	h (mg g^{-1} menit^{-1})	k_2'. 10^{-4} (g mg^{-1}menit^{-1})	R^2
Ca(II) chi-flake	1,60	5.49	0.9874	0,029	9,058	0,9051
Ca(II) chi-nanobeads	8,00	166,37	0.9776	0,207	24,102	0,9921

CONCLUSION

The chitosan nanobeads was prepared with solution chitosan flake on acetic acid solution and was characterized by FTIR. The adsorption properties of calcium ion on chitosan flake and chitosan nanobeads were evaluated. Various factors affecting the adsorption process such as contact time, and initial concentration of the calcium ions were investigated. The adsorption data were analyzed using the Langmuir and Freundlich models. The equilibrium data were well fitted with Langmuir analysis and drawed that adsorption calcium ion on adsorbent followed monolayer model. The kinetic parameters were evaluated utilizing the pseudo-first-order and pseudo second- order. The kinetic study of calcium adsorption revealed that the first order model. It can be recommended that chitosan nanobeads were an effective and low cost adsorbent for the removal of calcium ions from waste water.

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