



Adsorption and Desorption of Cobalt(II) by 2-(2'-thiazolyazo)-p-cresol Chelating Resin

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Abstract

2-(2'-thiazolyazo)-p-cresol is an azo dye which has ability to form complex with Co(II) in the pH range of 5-10. 2-(2'-thiazolyazo)-p-cresol was immobilized on chloromethylated polystyrene-divinylbenzene to give a chelating resin (P-TAC) which has ability to adsorb Co(II). The batch method was used to obtain the optimum condition for the sorption of Co(II) by P-TAC. It was found that the optimum pH was 7 and the optimum shaking time was 3 hours, which gave capacity of 0.159 mmol/g. The desorption of Co(II) from P-TAC by various concentration of hydrochloric acid had been investigated. Increasing in concentration of hydrochloric acid caused the increasing in the desorption of Co(II) from P-TAC.

Introduction

2-(2'-thiazolyazo)-p-cresol (TAC) is a thiazolyazo dye which can be synthesized by diazotisation and coupling reactions of 2-aminothiazole and p-cresol (Nobuyoshi, 1959).

TAC can form complex with many transition metal ions such as Cd(II), Pb(II) and Zn(II), etc (Gandhi, 1990). In the case of Co(II), it has ability to form complex with TAC in the pH range of 5-10 (Songsasen, 2545).

In this work, a chelating resin (P-TAC) was prepared from the adsorption of TAC in a mixture of 1:1 triethylamine and dimethylformamide on chloromethylated polystyrene-divinylbenzene. This chelating resin has ability to adsorb Co(II) from solution. The desorption of Co(II) from P-TAC by various concentration of hydrochloric acid was also studied.

Experimental Methods

Preparation of chelating resin (P-TAC)

0.50 g of chloromethylated polystyrene-divinylbenzene was preswollen in a mixture of 1:1 triethylamine and dimethylformamide at 50 °C for 1 hour. 0.10 g of TAC was added into the swollen-copolymer, then the mixture was shaken at room temperature for 72 hours. The P-TAC was filtered and washed thoroughly and successively. It was then extracted in a Soxhlet extractor with ethanol as a solvent until the solution was colorless. The chelating resin was air-dried.

Determination of capacity of P-TAC

1. Effect of pH

Capacities were determined in the pH range of 3-7, the appropriate pH being adjusted using sodium hydroxide and hydrochloric acid. 50.0 mg of P-TAC was equilibrated with 10.0 ml of 125 ppm of Co(II) solution which was adjusted to the appropriated pH. After shaking time of 3 hours, the mixture was filtered and washed with distilled water. The filtrate was analyzed for concentration of unextracted Co(II) by atomic absorption spectrophotometer (Perkin-Elmer 1100).

2. Effect of shaking time

50.0 mg of P-TAC was equilibrated with 10.0 ml of 125 ppm of Co(II) solution which had pH 7. After a shaking period of 15, 30, 60, 90, 120, 180, 240 and 270 minutes at room temperature, the mixture was filtered and washed with distilled water. The filtrate was analyzed by atomic absorption spectrophotometer (Perkin-Elmer 1100).

3. Effect of initial concentration of Co(II)

50.0 mg of P-TAC was equilibrated with 10.0 ml of various concentration of Co(II), 10, 25, 50, 75, 100, 125, 150 and 175 ppm, which had pH 7. After shaking time of 3 hours, the mixture was filtered and washed with distilled water. The filtrate was analyzed by atomic absorption spectrophotometer (Perkin-Elmer 1100).

Desorption of Co(II) from P-TAC

The adsorbed P-TAC was suspended individually in 10.0 ml. of 0.25, 0.50, 1.00, 2.00 and 3.00 molar hydrochloric acid. After shaking period of 12 hours, aliquots were analyzed by atomic absorption spectrophotometer (Perkin-Elmer 1100).

Results and Discussion

Determination of capacity of P-TAC

1. Effect of pH

The capacity of P-TAC at pH 3, 4, 5, 6 and 7 were 0.0292, 0.0357, 0.0456, 0.0878 and 0.1420 mmol/g respectively. The efficiency of P-TAC increase when the pH is increased and the highest capacity for Co(II) on P-TAC was obtained at pH 7. Due to the hydrolysis of Co(II) over pH 7, therefore the experiment could not be performed at the pH higher than 7.

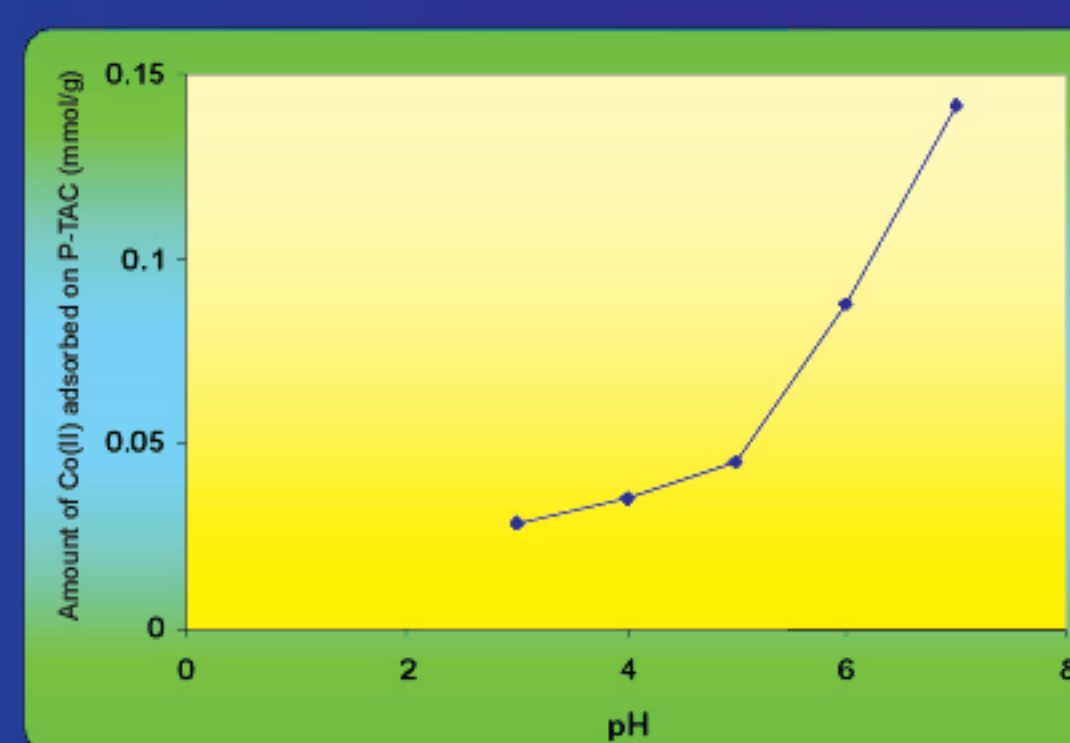


Figure 1 Adsorption of Co(II) by P-TAC at various pH

2. Effect of shaking time

The adsorption of Co(II) depend on shaking time were constant after 3 hours as shown in figure 2.

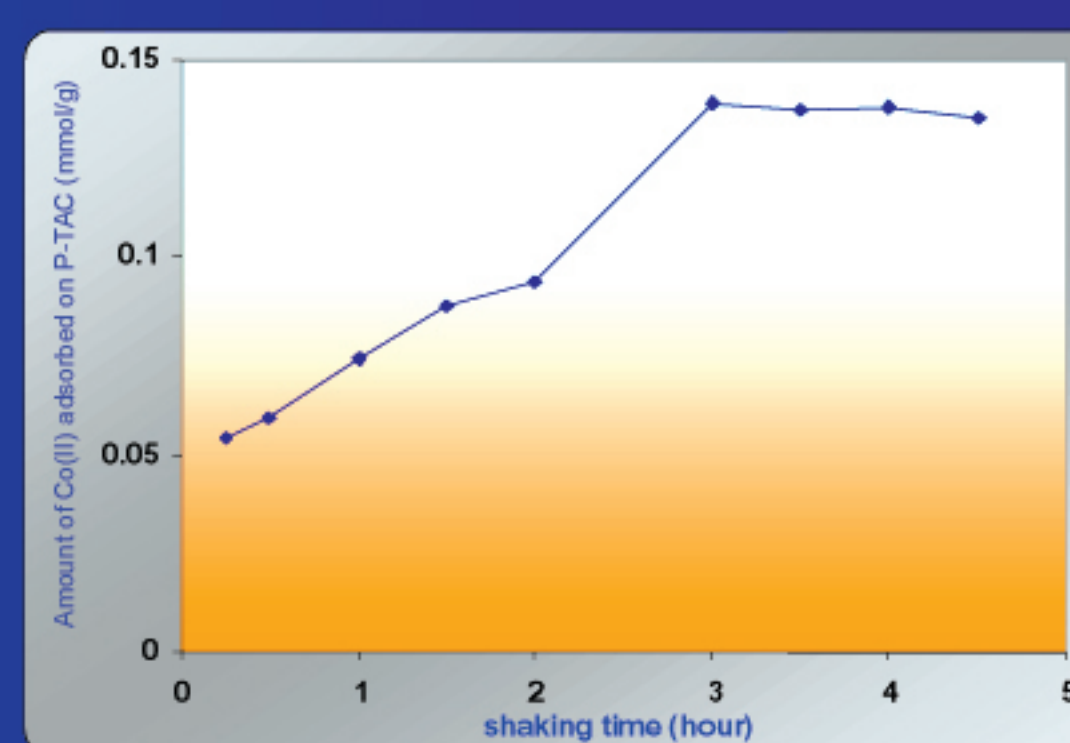


Figure 2 Adsorption of Co(II) by P-TAC at various shaking time

3. Effect of initial concentration of Co(II)

Figure 3 shows that the initial concentration has affect on the sorption of Co(II) by P-TAC. The capacity of P-TAC for Co(II) reached maximum when the concentration of Co(II) was 125 ppm.

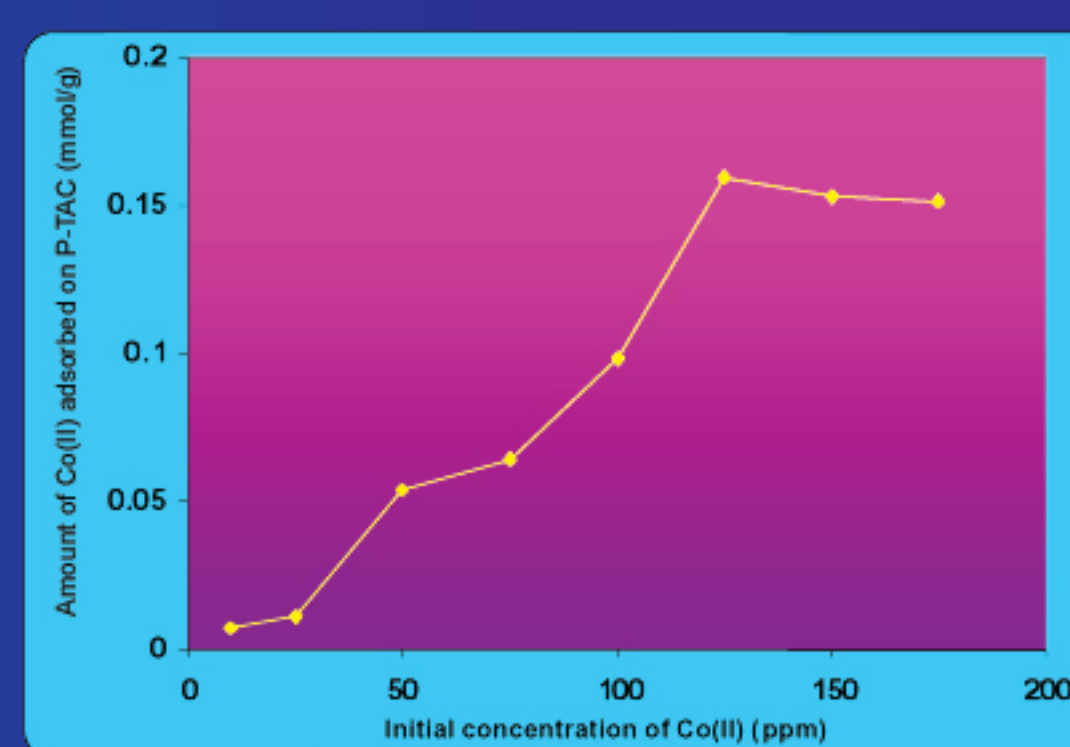


Figure 3 Adsorption of Co(II) by P-TAC at various initial concentration of Co(II)

From the results, the capacity of P-TAC for Co(II) at the optimum condition (pH 7, 3 hours of shaking time and 125 ppm of initial concentration of Co(II)) was 0.159 mmol/g.

Desorption of Co(II) from P-TAC

Table 1 The effect of concentration of hydrochloric acid on the desorption of Co(II) from P-TAC

Experiment	Concentration of HCl (M)	% desorption of Co(II) by P-TAC
1	0.25	8.59
2	0.50	9.40
3	1.00	11.52
4	2.00	18.70
5	3.00	25.53

The results from Table 1 suggested that hydrochloric acid can be used as eluent for desorption of Co(II) from P-TAC. The ability of desorption was related to concentration of hydrochloric acid. The desorption at the concentration of hydrochloric acid higher than 3 molar did not perform due to the lost in stability of P-TAC. However the search for others eluent which have higher efficiency need to be done.

Conclusion

2-(2'-thiazolyazo)-p-cresol chelating resin (P-TAC) which has ability to adsorbed Co(II) was prepared. The optimum condition to gave maximum capacity, 0.159 mmol/g, was pH 7, 3 hours of shaking time and 125 ppm of initial concentration of Co(II). Hydrochloric acid was used as eluent for the or desorption of Co(II) from P-TAC. The desorption efficiency was increased when the concentration of the hydrochloric acid increased.

Reference

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