Ion Exchange Property of the Synthesized Ion Exchange Resins

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Abstract

We synthesized ion exchange resin that can remove NO_3^- selectively rather than SO_4^{2-}. Ion exchange property of the synthesized ion exchange resin occurred like the following process, $NO_3^- > SO_4^{2-}$, the efficiency of functional group to remove NO_3^- occurred in the process of $NPr_3 > NBu_3 > NEt_3 > NMe_3 > NPe_3 > N(EtOH)_3$, and the efficiency of functional group to remove SO_4^{2-} occurred in the process of $NMe_3 > NEt_3 > NPr_3 > NBu_3 > NPe_3 > N(EtOH)_3$

Introduction

There are organic-N, NH_4^+-N, NO_2^--N, NO_3^--N, N_2, as types of nitrogen compounds existing in the nature. Though these nitrogen compounds are necessary in growth of microorganisms, nitrate nitrogen(NO_3^--N) and ammonium nitrogen(NH_4^+-N) are increasing through human lives, industy activities, and large-scale livestock industry, etc.. Especially, the water polluted in nitrate nitrogen need the water purification treatment technique. The method to remove nitrate nitrogen in water is ion exchange that called the most practical and accessable technique when it comes to economical, technical and convenient way of handling. But the problems for removal the effective nitrate nitrogen by the method of ion exchange are how to remove the reproduced waste liquid exhausting by reproduction of anion exchange resin and the selection problem of ion by ion exchange resin. Water is including not only NO_3^- but also many other kinds of anions, SO_4^-, HCO_3^-, Cl^-, and they can remove by ion exchange resin. There exists much more qunatity of SO_4^- than NO_3^- and SO_4^- is more selection by ion exchange resin than NO_3^-, SO_4^- is removed earlier and this makes the efficiency of removal of nitrate nitrogen by ion exchange decrease. So we need synthesis of ion exchange resin that can remove NO_3^- more quickly than SO_4^-.

Materials and methods

1. Device - UV/vis spectrophotometer: shimadzu(UV-240), Ion Chromatography: Dionex(DX-300), Peristaltic pump: cole-parmer(H-07553-85), Water bath: Donyang science(0933), Water purification system: Millipore(Milli-Q).
2. Materials and Reagent - We used procursor of an anion exchange resin DIAION SA 10AP as chloromethylated stylene-divinylbenzene carrier of Cl-type made by domestic SAMYANG Co., Ltd., we bought NMe_3, NEt_3, NPr_3, NBu_3, NPe_3, $N(EtOH)_3$ from Aldrich. We used KNO_3 and a commercial reagents without refining. The first grade distilled water applied to ion exchange reaction was filtered out by microfilter, then we maked it as super pure state of 18MΩ by water purification system.
3. Synthesis and Experiment - We made use of nucleophilic substitution reaction of amine toward benzyl location. In other words, we synthesized chloromethylated stylene-divinyl carrier and ion exchange resin which has trialkylamine reacting from many varieties of tert-amine. Ion exchange property of the synthesized ion exchange resin performed by continous experiment.

Results and Discussion

We compared removal ability of NO_3^- and SO_4^{2-} by the synthesized resins with that of SA 10AP having nitrate nitrogen removal ability among the commercial anion exchange resins. According to the continuous experiment, we used a solution included the same equivalent for NO_3^-(124mg/l) and SO_4^{2-}(96mg/l) at 25□. We can make breakthrough curve appeared as the fucntion of BV(bond volume) to analyze concentration of NO_3^- and SO_4^{2-} in effluence periodically, to the column charged in each ion exchange resin(5g). In the Fig. 1, Fig. 2, and Fig. 3, unlike ion selected SO_4^{2-} after NO_3^- when it comes to SA 10AP being the commercial resin, ion selected NO_3^- after SO_4^{2-} when it comes to the synthesized resin (Et and EtOH.). In Fig. 4, Fig. 5, we can see the most efficient ion exchange action process to remove NO_3^- is like $NPr_3 > NBu_3 > NEt_3 > NMe_3 > NPe_3 > N(EtOH)_3$ and when it comes to SO_4^{2-}, the process is like following, $NMe_3 > NEt_3 > NPr_3 > NBu_3 > NPe_3 > N(EtOH)_3$ in the experimental condition of this study.

Conclusion

In this study, we synthesized ion exchange resin that can remove NO_3^- selectively rather than SO_4^{2-}, In the efficient of the functional group to remove $NO_3^-$and SO_4^{2-}, the efficiency of functional group to remove NO_3^- occurred in the process of $NPr_3 > NBu_3 > NEt_3 > NMe_3 > NPe_3 > N(EtOH)_3$, and the efficiency of functional group to remove SO_4^{2-} occurred in the process of $NMe_3 > NEt_3 > NPr_3 > NBu_3 > NPe_3 > N(EtOH)_3$

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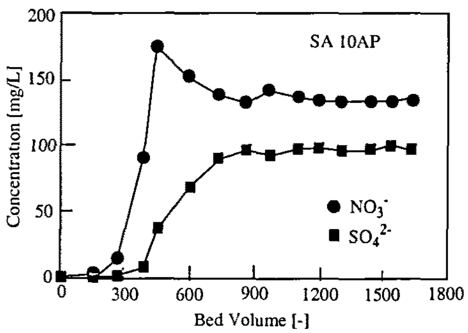

Fig. 1. Concentration profile with SA 10Ap resin in continuous column.
(Temp.=25, NO_3^-=124mg/L, SO_4^{2-}=96mg/L, resin=5g).

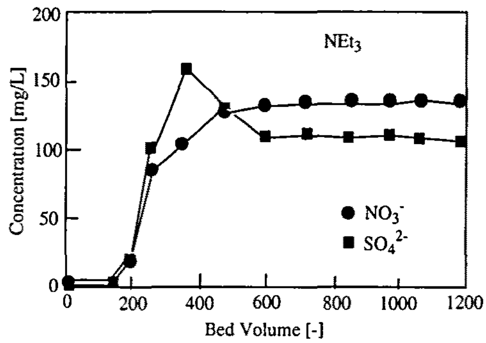

Fig. 2. Concentration profile synthesized resin in continuous column.
(Temp.=25, NO_3^-=124mg/L, SO_4^{2-}=96mg/L, resin=5g).

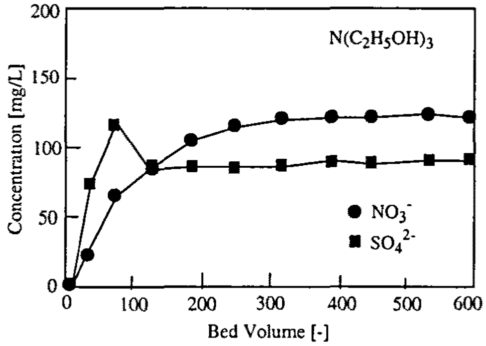

Fig. 3. Concentration profile synthesized resin in continuous column.
(Temp.=25, NO_3^-=124mg/L, SO_4^{2-}=96mg/L, resin=5g).

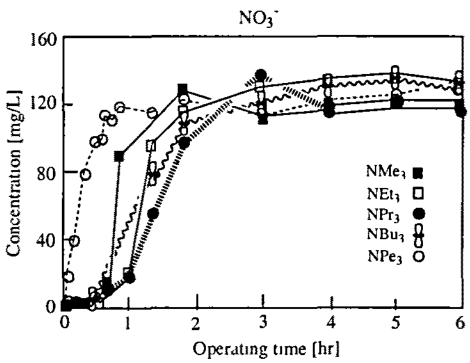

Fig. 4. NO_3^- concentration profile by using ion exchange resin.

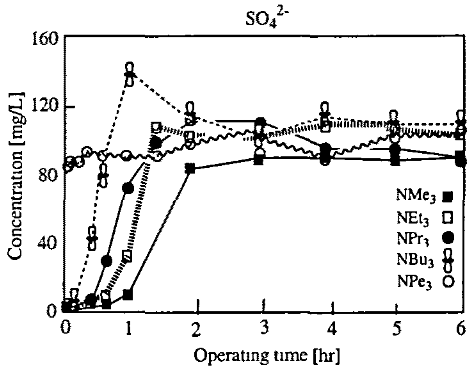

Fig. 5. SO_4^{2-}concentration profile by using ion exchange resin.