거대망상형 수지 입자에 의한 피리딘류의 흡착

김형준, 이성식, 손진언, 에이지후루야*
동아대학교 화학공학과, *메이지대학 공업화학과

Adsorption of Pyridines onto Macroreticular Resin Particles

Hyoung-Jun KIM, Sung-Sik LEE, Jin-Eon SOHN, Eiji FURUYA*
Dept. of Chem. Eng., Dong-A Univ., Pusan 604-714 KOREA
* Dept. of Ind. Chem., Meiji Univ., Tama-Ku, Kawasaki 214 JAPAN

Introduction

It was reported that amount of phenols adsorbed onto the MR resin particles from aqueous solution was dependent on the fluid concentration, adsorption systems, the adsorption temperature and so on.[1] For liquid phase adsorption, interaction force must take place at between adsorbate-adsorbent, adsorbate-solvent, and solvent-adsorbent, while only the affinity of adsorbate molecules for adsorbent surface is considered in generally.

In this study, adsorption equilibrium and kinetic parameters of pyridines onto MR resin particles were experimentally determined by shallow bed technique and effects of functional groups on the parameters were investigated.

Experimental

Kinetic data were collected by the following manner[2]

(1) The resin particles were packed in a glass column. Both ends of the shallow resin bed was held by the Teflon screen and its dimensions were 8×10^{-3}m diameter and 1×10^{-2}m height.

(2) The solution of a known concentration was fed upward through the column for a predetermined time interval.

(3) After the solution held at bed void spacings was removed with very small volume of distilled water, the solute within particles was extracted to determine the mount adsorbed. The concentration of extracts were determined by ultra-violet absorbance.

(4) This procedure was repeated with changing contact time and hence the relationship of the degree of saturation and the contact time could be determined. Because of the large linear flow rate of the solution ($0.13\text{-}0.14 ms^{-1}$) and small bed length, the inlet and outlet concentrations are essentially the same.

The physical properties of MR resin particles are listed in Table 1.

Table 1. Physical Properties of MR resin particle

Material	Paticle radius [cm]	Surface area [m^2/s]	Pore volume [ml/g]	Pore Size [Å]	Particle Density [g/cm^3]
MR resin	0.0026	630	0.74	47	0.597

A schematic diagram of the experimental apparatus is shown in Figure 1.

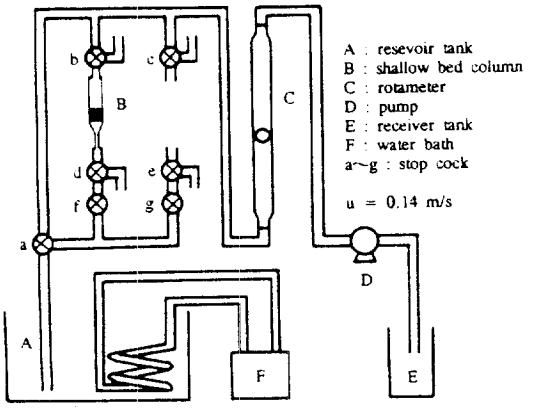

Fig. 1. Schematic diagram of experimental apparatus.

Analysis of experimental kinetic data

Numerical results of equations mainly depend on the equilibrium parameters, as shown in Figure 2. Experimental uptake curves were compared with the theoretical ones obtained by use of the respective equilibrium parameters under the experimental conditions. The effective intraparticle diffusivity, D_e', was obtained from the dimensional contact time, t_0, which corresponds to the dimensionless time=1, as shown elsewhere[3]

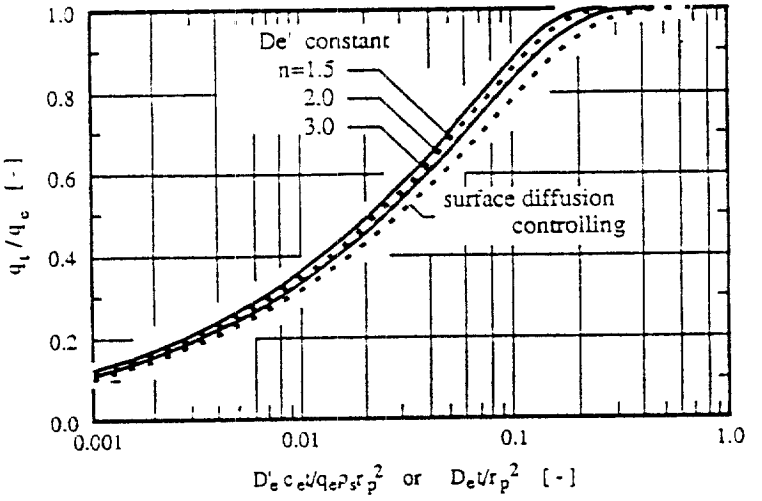

Fig. 2. Theoretical uptake curves.

Results and discussion

The experimental amounts adsorbed of pyridines onto MR resin and activated carbon was shown in Figures 3 and 4.

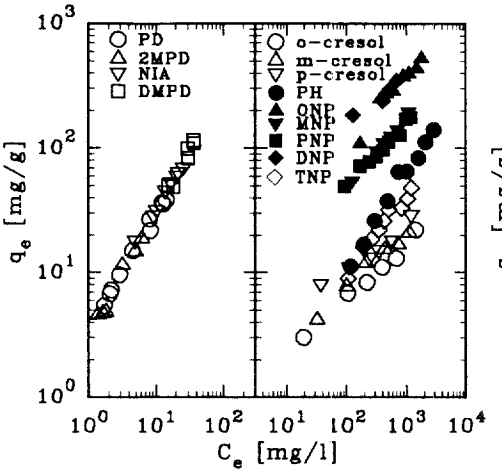

Fig. 3. Adsorption isotherms.

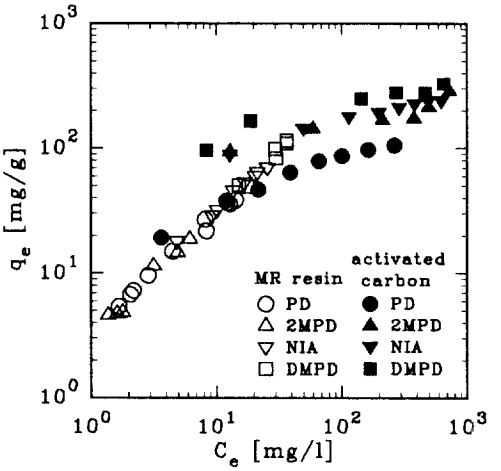

Fig. 4. Adsorption isotherms.

pyridine derivatives indicates lower amounts adsorbed than phenols, and the adsorption capacity of pyridine onto activated carbon is larger than that of MR resins, and adsorption of pyridine onto MR resin was independent on the adsorbate systems. Pyridines have nitrogen and substituted CH_3- group.

The macroreticular resin particles made of styrene-divinylbenzene copolymer as by hydrophobic adsorbent and activated carbon is non-polar system.

The CH_3- group cause the positive I effect, while the $OH-$, and $Cl-$ have the negative I effect, and NO_2- have the negative R effect.

The structure of MR resin particles which have multiple CH_3- groups is not affected with pyridines molecular by electro affinity.

The effective intra-particle diffusivity based on fluid concentration difference, De was determined by the comparison of experimental concentration uptake data with corresponding theoretical curve for pyridines systems.

Molecular diffusivities, D_{AB}, were estimated by Wilke's method[4] and the ratios of D_e' to D_{AB} were plotted against equilibrium amount adsorbed as shown in Figure 5.

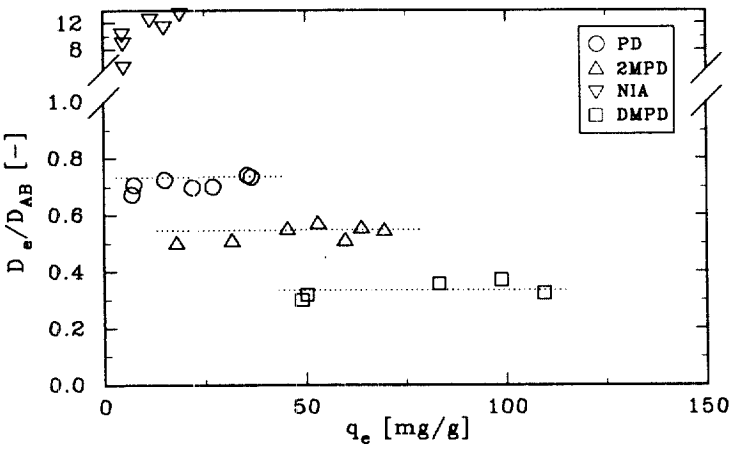

Fig. 5. Relationship of D_e'/D_{AB} with q_e for MR resin-pyridine system.

It became clear that the ratios of D_e'/D_{AB} were independent of the equilibrium amount adsorbed, qe, except nicotinamide.

Conclusion

Uptake curves of pyridines onto macroreticular resin particles were collected by a shallow bed technique at 298K. From the curves and equilibrium experimental data, equilibrium and kinetic parameters were determined.

Pyridine derivatives have been weaker adsorption capacity than phenols.

CH_3- functional groups of pyridines seemed to hider adsorption equilibria and kinetics to MR resin particles.

References

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