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The Retention Behaviors of Benzene and Its Alkyl Homologues in Microemulsion Electrokinetic Chromatography

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Abstract: The retention behaviors of benzene and its alkyl homologues in microemulsion electrokinetic chromatography were investigated in both anionic and cationic surfactant MEEKC systems. The effects of the composition of microemulsion on retention time and selectivity were studied. A good linear relationship was obtained between log k' and the carbon number of alkyl chain.

Keywords : Microemulsion, electrokinetic chromatography, alkyl benzene.

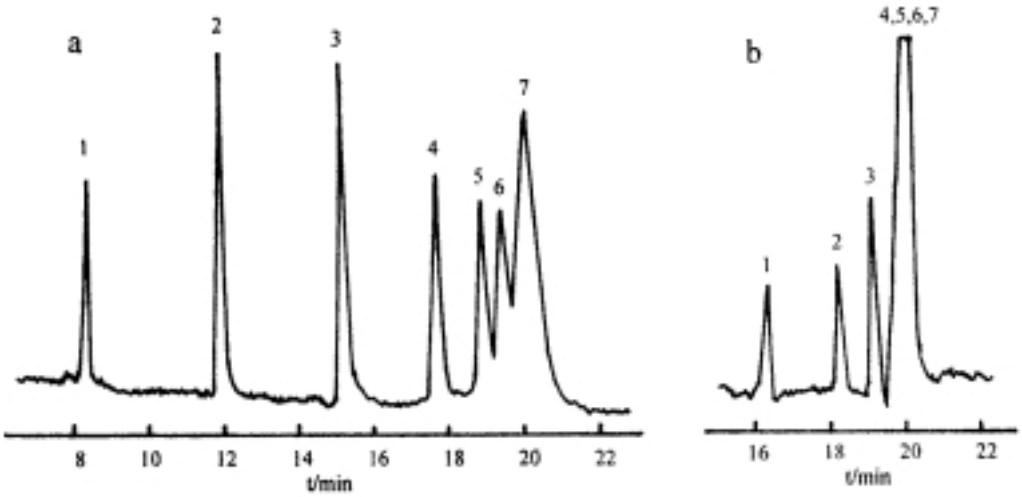
Microemulsion electrokinetic chromatography (MEEKC) is one kind of electrokinetic chromatography (EKC), whose separation principle is based on the different partition of solutes between the pseudostationary phase and the surrounding aqueous phase. Using microemulsion solution as the pseudostationary phase, MEEKC shows a high solubilization capacity and separation efficiency[1,2]. In this work, the retention behaviors of alkyl benzenes in both anionic and cationic surfactant MEEKC systems were investigated. The effects of co-surfactant and surfactant on separation were studied[3].

The separations were performed on Waters Quanta 4000 capillary electrophoresis system with UV detector monitoring at 214nm. A 50 μm I.D.x47cm (39cm to detector) uncoated fused-silica capillary was used. Formamide and n-dodecylbenzene were used as the electroosmotic flow (EOF) and microemulsion tracers respectively in both SDS- and CTAB- MEEKC systems. Benzene and its alkyl homologues were mixed as test sample.

Figure 1 shows the separation of the test sample in MEEKC system. From **Figure 1** we can see that the retention time of alkyl benzenes increased with the increase of the alkyl chain length. Under the selected condition, in SDS-MEEKC system a baseline resolution was achieved among benzene, methylbenzene and ethyl benzene. Propyl benzene, butyl benzene and pentyl benzene can be separated but not to the baseline. All the others were co-eluted with the microemulsion. However, in CTAB- system only the first three solutes can be separated, the propyl benzene and other homologues were co-eluted. This difference is mainly due to the bigger volume of the CTAB microemulsion compared with the SDS one, which indicates a higher solubilization capacity. The capacity factors (k') of alkyl benzenes were determined. A good linear relationship was obtained between log k' and the carbon number of alkyl chain in both systems under selected conditions. The correlation coefficients are more than 0.994. This result indicates that the hydrophobicity of alkyl benzenes has a direct influence on the partition of solutes between aqueous and microemulsion phases. The solute with higher hydrophobicity is easier to be solubilized into the microemulsion phase. So log k' increases with the carbon number.

The concentrations of surfactant and co-surfactant exert a strong effect not only on retention time but also on selectivity. In both SDS and CTAB-MEEKC systems, the retention time increased with increasing concentration of surfactant. In SDS system the retention time of low hydrophobic compounds was getting longer when the concentration of co-surfactant increased, whereas the high hydrophobic ones showed a shorter retention time. In CTAB system the retention time of all the compounds increased with the increasing concentration of co-surfactant. This difference may be explained by the different solubilization capacity of these two systems.

Figure 1 MEEKC separation of alkyl benzene mixture



Operating conditions: applied voltage, 20kV(-8kV); temperature, 30^{0}C; microemulsion, (a) 80 mmol/L n-heptane-120mmol/L SDS-8%(V/V) n-butanol-10mmol/L $Na_2B_4O_7$, pH 9.2, (b) 80 mmol/L n-heptane-120mmol/L CTAB-8%(V/V) n-butanol-10mmol/L $Na_2B_4O_7$, pH 9.2. Peaks: 1, benzene; 2, methylbenzene; 3, ethyl benzene; 4, propyl benzene; 5, butyl benzene; 6, pentyl benzene; 7, heptyl benzene, nonyl benzene, decyl benzene, dodecylbenzene and 1-phenyltridecane.

In conclusion, in both anionic and cationic surfactant MEEKC systems, a good linear correlation between the log k' and the carbon number of alkyl chain was obtained. It indicates that the hydrophobicity of the alkyl benzenes has a significant effect on their retention behaviors.

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