The Effect of Temperature on the Cation-Exchange Separations in Ion Chromatography and the Mechanism of Zone Spreading

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The effect of column temperature on retention of alkali metal and alkaline earth metal cations, as well as some amines, has been studied using three commercially available cation-exchange columns of Dionex Ion Pac type (CS10, CS12 and CS12A). Each column was packed with the cation-exchange resin containing different functional groups: strongly acidic sulphonic acid groups in Ion Pac CS10, weakly acidic carboxylic acid groups in Ion Pac CS12, and a mixture of weakly acidic carboxylic acid and phosphonic acid groups in Ion Pac CS12A column. The temperature was being changed from 10°C up to 60°C, which caused selectivity changes of the cation exchangers towards the analyzed cations, as well as the changes of column efficiencies. The changes of thermodynamic functions (free energy, enthalpy and entropy) for the studied cation-exchange processes were calculated. The comparison of the temperature effect on the ion-exchange behaviour of several ions on three cation-exchange columns with pellicular-type resin beds has been made. It has been noticed, that in some cases the lowering of the column temperature down to 10°C was more advantageous to achieve complete and rapid separation of some cations than the increase of the column temperature. It has been found that in the case of ions of high retention factors the longitudinal diffusion within the resin phase may significantly contribute to the total plate height.