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新型螯合型表面活性剂增溶菲的热力学和动力学研究

Thermodynamics and kinetics of phenanthrene solubilization by novel chelating surfactant

关键词：螯合型表面活性剂 菲 增溶作用 热力学 动力学

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摘要：采用批平衡试验法，研究了新型螯合型表面活性剂N-十二酰基乙二胺三乙酸钠（N-LED3A）增溶菲的性能，并探讨了其增溶热力学和动力学特征.结果表明：N-LED3A可有效增溶菲，菲的表观溶解度S_w^*及其在表面活性剂单体和胶束相的分配系数K_{mn}和K_{mc}均随温度升高而增大；N-LED3A的临界胶束浓度（CMC）随温度的升高（15、25、35、45 ℃）呈现先减小后增大的趋势；菲在N-LED3A单体/水、胶束/水的表观摩尔分配焓变ΔH_{mm}^*、ΔH_{mc}^*分别为18.30、13.12 kJ·mol^{-1}，菲在水、N-LED3A单体和胶束中的表观摩尔溶解热分别为18.87、37.17和31.99 kJ·mol^{-1}，均为吸热过程，故温度升高有利于菲在N-LED3A单体和胶束中的分配作用，菲在水、N-LED3A单体和胶束中的溶解量随温度升高而增大。动力学方程拟合结果表明，一级动力学方程最适合描述N-LED3A对菲的增溶过程.

Abstract：The performance of a novel chelating surfactant sodium N-lauroylethylenediaminetetriacetate (N-LED3A) for phenanthrene (PHE) solubilization and the characteristics of its thermodynamics and kinetics were investigated using the batch equilibrium experimental method. It was observed that the solubility of PHE could be enhanced by N-LED3A solution. The apparent solubility and the partition coefficients, K_{mn} and K_{mc}, of PHE in monomer/water or micelle/water system increased with temperature. Given the experimental temperature at 15, 25, 35 and 45 ℃, the critical micelle concentration (CMC) of N-LED3A decreased when the temperature was less than 35 ℃ and then increased at 45 ℃. It was also found that the enthalpy changes of distribution, ΔH^*_{mm} and ΔH^*_{mc}, of PHE in N-LED3A monomer/water or micelle/water system were 18.30 kJ·mol^{-1} and 13.12 kJ·mol^{-1}, respectively. The apparent enthalpy changes of solubilization of PHE in water, N-LED3A monomer and micelle were 18.87, 37.17 and 31.99 kJ·mol^{-1}, respectively, which implied that the solubilization of PHE were endothermic processes. As a result, increasing temperature favored partitioning aqueous PHE into N-LED3A monomer or micelle as well as dissolving PHE solid into aqueous solution, N-LED3A monomer and micelle. The data showed that solubilization of PHE in N-LED3A solution fitted a pseudo-first-order kinetic equation well.

Key words：chelating surfactant phenanthrene solubility enhancement thermodynamics kinetics

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