

NON-DIFFUSIONAL DISSOLUTION BEHAVIOUR OF BENZOIC ACID

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Benzoic acid has been frequently used as a model solute for assessing geometric and hydrodynamic effects within dissolution systems (Prakongpan, Higuchi & others, 1976; Bisailon & Tawashi, 1971). Its use is based on the dissolution of benzoic acid being controlled by diffusion-convection, thus enabling application of the appropriate model equation.

The present work shows that the above assumption is not valid for all conditions. Dissolution rates of compressed disks of benzoic acid have been determined in 0.01N HCl and in caffeine complexing medium at 25° and 37° at various rotational speeds by means of a rotating-disk dissolution apparatus. Samples were analysed by gas-chromatography. In Table 1, the experimental dissolution rates (DR) were compared with the rates predicted (J) by Levich theory (Levich, 1962).

Table 1. Dissolution rates of benzoic acid under different conditions

Temp. °C	Dissol. medium	ω rad s ⁻¹	DR J		Slope of log-log plot	
			mg cm ⁻² s ⁻¹	$\times 10^3$	DR vs ω	J vs ω
25	0.01N HCl	9.2	4.98	6.14		
		11.1	5.24	6.74	0.40 (r 0.995)	0.50
		14.7	6.06	7.75		
		19.9	6.69	9.03		
	0.005M caffeine	15.9	6.73			
		26.6	8.57		0.45 (r 0.998)	
		32.6	9.19			
		0.03M caffeine	15.9	10.1		
	22.6		12.0			0.49 (r 0.995)
	26.6		12.6			
	32.6		14.4			
	37	0.01N HCl	10.2	10.1	11.2	
12.6			12.6	12.4	0.59 (r 0.996)	0.50
22.4			16.4	16.6		

At 25° and in 0.01N HCl the experimental rates at all rotational speeds were found to be significantly lower than those predicted for a diffusional process. The slope value of a log-log plot of DR vs angular velocity of rotation (ω) was also lower than theoretical for diffusion control in a laminar regime (Table 1). These show that an interfacial reaction is involved (Bircumshaw & Riddiford, 1952; Mitchell & Saville, 1969). With caffeine in the medium, which increases the DR, the slope of log DR vs log ω approaches the theoretical value. However, at 37° in 0.01N HCl, diffusion appears to be the rate controlling step, as indicated by the slope value and the agreement of DR and J values. The dissolution behaviour of benzoic acid thus appears to change gradually from being largely interfacially controlled at 25° in 0.01N HCl to being essentially diffusion-controlled at 25° in 0.03M caffeine and at 37° in 0.01N HCl.

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