

## CONTENTS

<b>CHAPTER 1 Power consumption of mixing impellers</b>	
1.1 Flow model in a cylindrical mixing vessel	1
1.2 Method of measuring power consumption	12
1.3 Empirical equation of the power consumption of paddle agitators and their extended application to other impellers	24
1.4 Power consumption of impellers in heterogeneous liquids	59
1.5 Power consumption of impellers in highly viscous gingham plastic liquids	66
1.6 Power consumption of mixing impellers in pseudoplastic liquids	76
<b>CHAPTER 2 Heat transfer in agitated vessels</b>	
2.1 Heat transfer from the wall of a jacketed vessel in the turbulent flow region	85
2.2 Heat transfer from cooling in the turbulent flow region	91
2.3 Heat transfer in highly viscous liquids	98
<b>CHAPTER 3 flow patterns in agitated liquid</b>	
3.1 Methods of measuring liquid velocity	121
3.2 Flow pattern and the characteristic curve of impellers in an agitated vessel	124
3.3 Discharge efficiency of various impellers	136
3.4 Discharge of shear, turbulence and energy dissipation in agitation vessel	138
3.5 Transport phenomena and the rate of flow on the vessel wall	164
3.6 Flow pattern if the highly viscous liquids agitated with Helical impellers	167
Notation	167
Literature cited	168
<b>CHAPTER 4 Mixing of homogeneous liquids</b>	
4.1 Basic concepts of liquid mixing	171
4.2 Mixing model	185
4.3 Mixing in an agitated vessel	186
4.4 Mixing of high viscosity liquids	197
4.5 Mixing of low viscosity liquids	204
4.6 Blending in a large tank	207
4.7 Line mixer	211
<b>CHAPTER 5 Continuous flow reactors</b>	
5.1 Types of flow in continuous flow reactors	215

5.2 Exit age distribution function	217
5.3 Liquid flow in agitated vessels and its flow model	220
5.4 Rate processes superimposed on a flow having a residence time distribution	224
5.5 Approximation by a dispersion model	226
5.6 Approximation replaced by complete mixing reactors in series	232
5.7 Approximation by a hypothetical circulation flow	234
5.8 Approximation by combining a complete mixing flow and a piston flow	235
5.9 State of mixing for multiple – stage – impellers	241
<b>CHAPTER 6 Agitation in solid – liquid systems</b>	
6.1 Suspension of solid particles in agitated liquids	249
6.2 Mass transfer in solid – liquid agitation	254
6.3 Mass transfer from micro particles suspended in agitated liquids	266
6.4 Critical agitator speed for fluidization of solid particles	270
6.5 Suspension of solid particles by bubbling air	277
6.6 Dispersion of solid agglomerates	277
6.7 Rate of solution of solid particles followed by chemical reaction in agitated vessels	278
<b>CHAPTER 7 Agitation In liquid – liquid systems</b>	
7.1 Dispersion of a liquid into another immiscible liquid	298
7.2 Mixing index	300
7.3 Diminution of drop size of dispersed phases	301
7.4 Inverse dispersion	314
7.5 Mass transfer followed by a chemical reaction in liquid – liquid agitation systems	316
7.6 Effect of agitation on the dissolution of dispersed liquid – liquid agitation whose density is nearly equal to the continuous phase	318
7.7 Effect of agitation on the reaction systems of both the diffusion – and reaction –rate controlling, and of negligible difference in density	321
7.8 Effect of agitation on the mixing inside droplets	322
7.9 Coalescence and redispersion of droplets	323
7.10 Region of stabilization of emulsion	325
7.11 Flow mixer (Pope line mixer)	328
<b>CHAPTER 8 Agitation in gas – liquid systems</b>	
8.1 Agitation vessels under aeration	335
8.2 Dispersion of gas bubbles in liquids	341
8.3 Hold – up of gases in liquids and contact time	349
8.4 Coalescence of bubbles in dispersions	350
8.5 Capacity coefficient of mass transfer in agitated vessels under aeration	351
8.6 Design of gas – liquid contactors	353

8.7 Heat and mass transfer in continuous phase of gas dispersion	356
8.8 Agitation of liquids by gas sparring	359
<b>CHAPTER 9 Effect of agitation in heterogeneous reactions</b>	
9.1 Example of liquid – liquid reaction – nitration of benzene	369
9.2 Influence of agitator speed on the rate of heterogeneous reactions	371
9.3 Hydrogenation of & - methylstyrene	372
9.4 Selectivity in a consecutive gas – liquid reaction under agitation	376
9.5 Selectivity of an intermediate products from the oxidation reaction of cyclohexane	381
9.6 Relation between selectivity and agitator speed in heterogeneous hydrogenation reaction of fatty oils	386
<b>CHAPTER 10 Applications</b>	
10.1 Liquid – solid contacting	391
10.2 Gas – liquid processes	405
10.3 Liquid – liquid contacting	417
10.4 Blending	429
10.5 Pumping applications	437
10.6 Characteristics of continuous flow	442
10.7 Scale – Up and pilot planting	444
Acknowledgements	450
Index	452