

# Contents

<b>1</b>	<b>General Ideas of Mass Transfer Processes in Critical Regimes</b>	<b>1</b>
1.1	Granulometric Characteristics of Bulk Material	1
1.2	Distribution of Different Fractions in the Process of Separation	5
1.3	Fractional Separation Curves and Their Properties	7
1.3.1	Initial Composition	10
1.3.2	Solid Phase Concentration in the Flow	11
1.3.3	Process Stability	13
1.3.4	Flow Velocity and Particle Size	13
<b>2</b>	<b>Principles of Modeling Processes in Moving Media</b>	<b>19</b>
2.1	Correlation Between a Full-Scale Process and Its Model	19
2.2	Mathematical Models Construction	21
2.3	Similarity Criteria Determination	26
<b>3</b>	<b>System of Particles of the Same Size Class in a Critical Flow</b>	<b>33</b>
3.1	Dynamics of Mass Motion of Particles in a Flow	33
3.2	Definition of a Statistical System	38
3.3	Estimation of the State of a Statistical System	44
3.4	Principal Statistical Characteristics of the Separation Factor	53
<b>4</b>	<b>System of Particles of Several Size Classes</b>	<b>59</b>
4.1	Interaction of Particles in a Flow	59
4.2	Forces Caused by Interactions of Particles of Various Classes	64
4.3	Two-Phase Flow Entropy in Critical Flow Regimes	67
4.4	Main Features of Entropy in Critical Regimes	73
4.5	Mobility Factor	81
4.6	Statistical Identities	86

<b>5</b>	<b>Principal Statistical Relations of Mass Transfer in Critical Flow</b>	93
5.1	Mass Exchange Between the Zone and the Apparatus	93
5.2	Determination of Average Values	96
5.3	Cell and Apparatus, Entropy	98
5.4	Separation at Low Concentrations	100
5.5	General Regularities for the Zone	104
<b>6</b>	<b>Correlation Between the Apparatus and the Cell</b>	107
6.1	Coarse Particles Separation	107
6.2	Fine Particles Separation	108
6.3	Definition of Mass Transfer Parameters	109
6.4	Cellular Model of Separation	114
6.5	Physical Meaning of Separation Factors	118
6.5.1	Chaotizing Factor	118
6.5.2	Flow Mobility	118
6.5.3	Separation Factor	118
6.5.4	Concentration Effect	119
6.5.5	Potential Extraction	121
6.6	Extraction from a Cell Located in the Zone	122
<b>7</b>	<b>Structural Model of Mass Transfer in Critical Regimes of Two-Phase Flows</b>	125
7.1	Validation of the Distribution Coefficient	125
7.2	Physical Meaning of the Distribution Coefficient	127
7.2.1	Turbulent Overflow of Particles and Turbulent Regime of the Medium Motion in the Apparatus	132
7.2.2	Laminar Overflow Regime	134
7.2.3	Intermediate Regime of Overflow	135
7.3	Analysis of Distribution Coefficient	136
7.4	Analysis of Experimental Dependencies from the Standpoint of Structural Models	141
7.5	Check of the Structural Model Adequacy	147
7.6	Correlation Between the Structural and Cellular Models of the Process	151
<b>8</b>	<b>Correlation Between Statistical and Empirical Results</b>	153
8.1	Approximation of Universal Separation Curve	153
8.2	Principal Separation Parameters Depending on the Apparatus Height	156
8.3	Equal Extractability of Various Size Classes	160
<b>9</b>	<b>Entropy of Composition: Optimization Criterion</b>	169
9.1	Entropy and Particles Stratification	169
9.2	Evaluation of Heterogeneity of Powder Composition	173

9.3 Binary Separation .....	175
9.4 Multi-product Separation .....	176
9.5 Algorithms of Optimization of Separation into $n$ Components .....	177
9.5.1 Algorithm 1: Complete Sorting-Out .....	178
9.5.2 Algorithm 2: Greedy Algorithm .....	178
9.5.3 Optimization of Separation into Four Components .....	180
9.6 Mathematical Model of Separation into $n$ Components .....	186
9.7 Optimum Conditions for Binary Separation .....	187
9.8 Optimum Conditions for Multi-Product Separation .....	189
<b>10 Stability and Kinetic Aspects of Mass Distribution in Critical Regimes .....</b>	<b>197</b>
10.1 Entropy Stability .....	197
10.2 Particles Distribution over the Channel Height .....	204
10.3 Velocity Distribution of Particles of a Narrow Size Class .....	208
10.4 Kinetic Aspect of the Material Distribution .....	210
<b>11 Critical Regimes of Two-Phase Flows in Complicated Systems .....</b>	<b>215</b>
11.1 Problem Setting .....	215
11.2 Mathematical Model of a Duplex Cascade .....	216
11.3 Mathematical Model of a Cascade Process Allowing Control of the Effect of the Material Feed Site on Separation Results .....	220
11.4 Cascade Model with Two or More Material Inputs into the Apparatus .....	223
11.5 Combined Cascade Classifiers .....	225
11.5.1 Combined Cascades of $n(z)$ Type .....	225
11.5.2 Working Schemes for Combined Cascades of $n(z)$ Type .....	227
11.5.3 Connection Functions for Combined Cascades .....	229
11.5.4 Experimental Verification of the Adequacy of Mathematical Models of Combined Cascades .....	234
11.6 Quality Criterion for Combined Cascades .....	237
11.7 Fractal Principle of the Construction of Schemes of Combined Classifiers .....	241
11.7.1 Fractal Principle of Combination .....	241
11.7.2 Progressive Nature of Multi-element Apparatuses .....	244
11.7.3 Combined Scheme with Successive Recirculation of Both Products .....	246
11.7.4 Combined Cascade with an Alternating Bypass of Both Products .....	247
11.7.5 On the Potential of Fractal Combined Schemes .....	252

11.8	Some Methods of Combined Schemes Optimization .....	255
11.8.1	Multi-row Classifier .....	255
11.8.2	Method of Estimating a Multi-row Classifier .....	258
11.8.3	Optimal Scheme of a Multi-row Industrial Classifier ....	260
<b>12</b>	<b>Stochastic Model of Critical Regimes of Two-Phase Flows .....</b>	<b>265</b>
12.1	Principal Definitions .....	265
12.2	Statistical Description of Gravitational Separation in Turbulent Flows .....	267
12.3	Equations of Particles Motion Taking into Account Their Rotation Around the Center of Mass in a Turbulent Flow .....	271
12.4	Description of One-Dimensional Stationary Process of Gravitation Separation in a Turbulent Flow .....	274
12.5	One-Dimensional Model of a Non-stationary Process .....	278
12.6	Statistical Equations of a Random Process of Gravitational Separation .....	278
12.7	Computation of Fractional Separation of a Narrow Class .....	281
12.8	Approximate Computation Method .....	283
<b>13</b>	<b>Mass Transfer in Critical Regimes of Two-Phase Flows .....</b>	<b>287</b>
13.1	Mathematical Model of a Separating Cascade .....	287
13.2	Discrete Stationary Model of Critical Regimes of Vertical Two-Phase Flows .....	305
13.3	Optimization of Principal Parameters of Multi-stage Separation .....	319
<b>14</b>	<b>Universal Curves Criteria .....</b>	<b>333</b>
14.1	Substantiation of the Curves Universality .....	333
14.2	Generalizing Criteria .....	337
14.2.1	Turbulent Regimes of Particles Overflow .....	340
14.2.2	Laminar Regimes of Particles Overflow .....	342
14.3	Universal Curves .....	344
	<b>Bibliography .....</b>	<b>345</b>

Critical Regimes of Two-Phase Flows with a Polydisperse  
Solid Phase

Barsky, E.

2010, XVI, 348 p., Hardcover

ISBN: 978-90-481-8837-6