

Contents

Vorwort	V
Nomenclature	VIII
1 Introduction	1
1.1 Circulating Fluidized Bed Systems Today and Tomorrow	2
1.2 Temperature Distributions in Circulating Fluidized Beds	6
1.3 Aim of the Work	8
2 State of the Art Understanding in CFB Modeling	10
2.1 Circulating Fluidized Bed Modeling with Focus on the Fluid Dynamics	10
2.2 Circulating Fluidized Bed Modeling Including the Enthalpy Balance .	14
3 The Three-Dimensional CFBC Model	17
3.1 Fluid Dynamics	20
3.1.1 Fluid Dynamics in the Bottom Zone	21
3.1.2 Fluid Dynamics in the Splash and Upper Dilute Zone	22
3.1.3 Fluid Dynamics in the Exit Zone	28
3.1.4 Horizontal Solids and Gas Velocities	28
3.2 Dispersion	32
3.3 Fuel Spreading	34
3.3.1 Drying, Devolatilization and Fragmentation	34
3.3.2 Fuel Distribution Balance	36
3.4 Reactions	39
3.5 Mass Balances	42
3.5.1 Char Population Balance	42
3.5.2 Gas Balance	44
3.6 Enthalpy Balance	46
3.6.1 Heat Sources due to Combustion	49
3.6.2 Evaporation Enthalpy	50
3.6.3 Heat Exchangers in the Combustion Chamber	50
3.7 Modeling of the Cyclone	51
3.7.1 Modeling the Separation Performance	51
3.7.2 Gas Balances in the Cyclone	54
3.8 Solution Procedure	55

4	Model Validation	57
4.1	The CFB-FGD in Pilsen/Czech Republic	57
4.1.1	Comparison between Model and Measured Data	61
4.1.2	Performance Prediction for the CFB FGD	71
4.2	The CFB Combustor in Turów/Poland	76
4.2.1	Comparison between Model and Measured Data	77
4.2.2	Performance Prediction for the Turów CFBC	99
4.3	The CFB Combustor in Duisburg/Germany	103
4.3.1	Comparison between Model and Measured Data	106
4.3.2	Performance Prediction for the Duisburg CFBC	123
5	Conclusions	128
A	Appendix / Complete Set of Equations	137
A.1	Fluid Dynamics in the Combustion Chamber	137
A.1.1	Fluid Dynamics in the Bottom zone	138
A.1.2	A Core-Annulus Model for the Fluid Dynamics in the Upper Dilute Zone	141
A.1.3	Fluid Dynamics in the Splash Zone	145
A.1.4	Distortion Factors for Rectangular Cross Sectional Areas	150
A.2	Modeling the Separation Performance in the Gas Cyclone	152
A.3	Compilation of the simulation input parameters	155
A.3.1	For the Pilsen CFB-FGD	155
A.3.2	For the Turów CFBC	157
A.3.3	For the Duisburg CFBC	162
	Curriculum Vitae	167