

Table of content

Table of content	i
Nomenclature	iii
Abstract	vii
Zusammenfassung	ix
1. Introduction	1
2. State of the art	3
2.1 Mechanically stirred vessels	3
2.1.1 Equipment for stirred tank reactors.....	3
2.1.2 Basic fluid dynamic parameters	6
2.2 Aerated systems	11
2.2.1 Fundamentals of single bubbles	11
2.2.2 Fundamentals of bubble swarms	14
2.2.3 Gas hold-up and specific surface area.....	16
2.3 Gas dispersion in agitated tanks.....	18
2.3.1 Cavities behind impeller blades	19
2.3.2 Specific surface area, gas hold-up and flow regime in aerated stirred tank reactors....	21
2.3.3 Power input in aerated agitated tanks.....	27
2.4 Mixing time in stirred tank reactors	29
2.4.1 Single phase mixing	30
2.4.2 Two phase mixing	33
2.5 Mass transfer in aerated stirred tank reactors	36
2.5.1 Mass transfer in two phase systems	37
2.5.2 Mass transfer correlations	41
2.6 Conclusion	44
3. Experimental setup and measurement procedure	45
3.1 Facilities	45
3.1.1 Laboratory scale – 3 L glass reactor	45
3.1.2 Industrial scale – 12 kL acrylic glass reactor	47
3.2 Determination of the energy input	49
3.3 Determination of the bubble size distribution and gas hold-up.....	51
3.3.1 Measurement technique to determine the bubble size distribution in small and large scale system	51
3.3.2 Evaluation of the bubble size distribution.....	53
3.3.3 Evaluation of the gas hold-up	54

Table of content

3.4	Determination of the mixing time	54
3.5	Measurement of the volumetric oxygen mass transfer.....	57
3.5.1	Oxygen probes (location, devices and calibration)	57
3.5.2	Measurement of mass transfer performance	58
4.	Results and discussion	63
4.1	Energy input.....	63
4.1.1	Energy input in single phase flow	63
4.1.2	Energy input in two phase flow	67
4.2	Bubble size distribution, gas hold-up and specific surface area in small and large scale system	73
4.2.1	Investigation of bubble size distribution	73
4.2.2	Investigation of the gas hold-up and specific surface area.....	80
4.2.3	Influence of the bubbly flow on the flow pattern.....	83
4.3	Influence of flow pattern on mixing time	86
4.3.1	Mixing time for single phase stirring	86
4.3.2	Mixing time for aerated stirring	90
4.4	Mass transfer coefficient on lab scale and in industrial scale	94
4.4.1	Mass transfer coefficient in small scale system	95
4.4.2	Mass transfer coefficient in large scale system.....	98
4.4.3	Discussion	100
5.	Modelling	107
5.1	Mixing time	107
5.2	Mass transfer.....	114
6.	Conclusion	117
	Bibliography	119