

Contents

1	Introduction	1
2	What Kinds of Artificial Hearts Are Available?	3
2.1	Population of Heart Patients	3
2.2	Total-Replacement Artificial Hearts and Ventricular Assist Devices	3
2.3	Generation Progress of Implantable Ventricular Assist Devices	4
2.4	Practical Artificial Hearts: 1st to 3rd Generation	7
	References	12
3	How Do We Select Pump Types?	13
3.1	Pulsatile Flow Pumps (Reciprocating Pumps and Rotary Displacement Pumps)	13
3.2	Continuous Flow Pumps (Rotary Pumps or Turbo Pumps)	13
3.2.1	Pump Output	16
3.2.2	Volute and Diffuser	18
3.2.3	Force Balance of a Centrifugal Impeller	19
3.2.4	Open, Semi-Open, and Closed Type Impellers	20
3.2.5	Force Balance of an Axial-Flow Impeller	20
	References	21
4	Selection of Bearing Types: A Key to Durability	23
4.1	Pivot Bearing	23
4.2	Magnetic Bearing and Hydrodynamic Bearing	23
4.3	Analysis of Hydrodynamic Bearing	26
	References	31
5	Motor, Battery, and Magnetic Suspension	33
5.1	Motor Mechanism	33
5.2	Battery and Cable	33
5.3	Magnetic Suspension	34
	Reference	35

6	Flow Visualization and Computational Fluid Dynamic Analysis . . .	37
6.1	Particle Image Velocimetry (PIV)	37
6.1.1	Visualization of a Centrifugal Blood Pump	37
6.1.2	Visualization Regarding Washout Hole Flow	41
6.1.3	Visualization of a Gap Flow in a Centrifugal Blood Pump	42
6.2	Computational Fluid Dynamic (CFD) Analysis	45
6.3	Similarity Laws: Development Tool	47
6.3.1	Similarity Law 1: <i>Reynolds Number</i>	47
6.3.2	Similarity Law 2: <i>Specific Speed</i>	47
6.3.3	Meaning of the Variation of the Two Similarity Parameters for a Pump	48
	References	49
7	How Do We Select Materials?	51
7.1	Pump Material	51
7.2	Coating Material	51
7.3	Bearing Material	52
7.4	Durability Testing	54
	References	55
8	Enhancement of Hemocompatibility	57
8.1	What Kinds of Hemocompatibility Should be Considered	57
8.2	What Is Hemolysis and Its Criterion	57
8.3	What Is Thrombus Formation and Its Criterion	59
8.4	What Is vWF Damage	60
8.5	Testing Methods	61
8.5.1	In Vitro Hemolysis Testing	61
8.5.2	In Vitro Anti-throbogenicity Testing	63
8.5.3	Animal Testing (In Vivo Evaluation)	64
	References	66
9	System Evaluation	69
9.1	Clinical Trial	69
9.2	Regulatory Science	70
9.2.1	Standard and Guidance	70
	References	75
10	Remarks and Future Aspect	77

Mechanism of Artificial Heart

Yamane, T.

2016, X, 77 p. 59 illus., 22 illus. in color., Hardcover

ISBN: 978-4-431-55829-3