
Contents

1 Introduction.....	1
1.1 Screw Machines.....	1
1.2 Calculation of Screw Machine Processes.....	3
1.3 Fluid Flow Calculation.....	3
2 Computational Fluid Dynamics in Screw Machines.....	7
2.1 Introduction.....	7
2.2 Continuum Model applied to Processes in Screw Machines.....	8
2.2.1 Governing Equations.....	9
2.2.2 Constitutive Relations.....	12
2.2.3 Multiphase Flow.....	14
2.2.4 Equation of State of Real Fluids.....	19
2.2.5 Turbulent Flow.....	22
2.2.6 Pressure Calculation.....	23
2.2.7 Boundary Conditions.....	23
2.3 Finite Volume Discretisation.....	27
2.3.1 Introduction.....	27
2.3.2 Space Discretisation.....	29
2.3.3 Time Discretisation.....	29
2.3.4 Discretisation of Equations.....	30
2.4 Solution of a Coupled System of Nonlinear Equations.....	32
2.5 Calculation of Screw Compressor Integral Parameters.....	33
3 Grid generation of Screw Machine Geometry.....	39
3.1 Introduction.....	39
3.1.1 Types of Grid Systems.....	42
3.1.2 Properties of a Computational Grid.....	44
3.1.3 Grid Topology.....	47
3.2 Decomposition of a Screw Machine Working Domain.....	48
3.3 Generation and Adaptation of Domain Boundaries.....	52
3.3.1 Adaptation Function.....	53
3.3.2 Adaptation Variables.....	55
3.3.3 Adaptation Based on Two Variables.....	55
3.3.4 Mapping the Outer Boundary.....	58
3.4 Algebraic Grid Generation for Complex Boundaries.....	62
3.4.1 Standard Transfinite Interpolation.....	63

XII Contents

3.4.2 Ortho transfinite interpolation.....	65
3.4.3 Simple Unidirectional Interpolation	73
3.4.4 Grid Orthogonalisation	75
3.4.5 Grid Smoothing.....	78
3.4.6 Moving Grid.....	79
3.5 Computer Program.....	81
4 Applications.....	83
4.1 Introduction	83
4.2 Flow in a Dry Screw Compressor	84
4.2.1 Grid Generation for a Dry Screw Compressor	86
4.2.2 Mathematical Model for a Dry Screw Compressor	87
4.2.3 Comparison of the Two Different Rotor Profiles	87
4.3 Flow in an Oil Injected Screw Compressor	94
4.3.1 Grid Generation for an Oil-Flooded Compressor	97
4.3.2 Mathematical Model for an Oil-Flooded Compressor	97
4.3.3 Comparison of the Numerical and Experimental results for an Oil-Flooded Compressor	98
4.3.4 Influence of Turbulence on Screw Compressor Flow.....	106
4.3.5 The Influence of the Mesh Size on Calculation Accuracy	114
4.4 A Refrigeration Compressor.....	118
4.4.1 Grid Generation for a Refrigeration Compressor	118
4.4.2 Mathematical Model of a Refrigeration Compressor.....	119
4.4.3 Three Dimensional Calculations for a Refrigeration Compressor.....	119
4.5 Fluid-Solid Interaction	123
4.5.1 Grid Generation for Fluid-Solid Interaction.....	123
4.5.2 Numerical Solution of the Fluid-Solid Interaction	124
4.5.3 Presentation and Discussion of the Results of Fluid-Solid Interaction.....	125
5 Conclusions.....	131
A Models of Turbulent Flow	133
B Wall Boundaries	139
C Finite Volume Discretisation	143
References	155