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3.7 Conservation of energy equation for a rotating component 3.8 Conservation of mass in a pipe; 3.9 Conservation of energy in a pipe; 3.10 Conservation of momentum in a pipe; 3.11 Bibliography; Chapter 4. Steady-state incompressible flow; 4.1 Introduction; 4.2 The energy equation for general steady-state flow; 4.3 Incompressible flow; 4.4 Magnitude of the Fanning friction factor,  $f$ ; 4.5 Frictionally resisted, incompressible flow through a real pipe; 4.6 Pressure drop due to level difference; 4.7 Frictional pressure drop; 4.8 Pressure drop due to bends and fittings 4.9 Pressure drop at pipe outlet 4.10 Pressure drop at pipe inlet; 4.11 Overall relationship between mass flow and pressure difference; 4.12 Bibliography; Chapter 5. Flow through ideal nozzles; 5.1 Introduction; 5.2 Steady-state flow in a nozzle; 5.3 Maximum mass flow for a polytropic expansion; 5.4 Sonic flow; 5.5 Comparison between flow formulae; 5.6 Bibliography; Chapter 6. Steady-state compressible flow; 6.1 Introduction; 6.2 General overview of compressible pipe-flow; 6.3 Frictionally resisted, adiabatic flow inside the pipe; 6.4 Solution sequence for compressible flow through a pipe 6.5 Determination of the friction factor,  $f$  6.6 Determination of the effective length of the pipe; 6.7 Sample calculation; 6.8 Explicit calculation of compressible flow; 6.9 Example using the long-pipe approximation; 6.10 Bibliography; Chapter 7. Control valve liquid flow; 7.1 Introduction; 7.2 Types of control valve; 7.3 Pressure distribution through the valve; 7.4 Liquid flow through the valve; 7.5 Cavitation and choking in liquid flow; 7.6 Relationship between valve capacity at part open and capacity at full open; 7.7 The valve characteristic; 7.8 Velocity-head loss across the valve 7.9 Bibliography

## Sommario/riassunto

Computer simulation is the key to comprehending and controlling the full-scale industrial plant used in the chemical, oil, gas and electrical power industries. Simulation of Industrial Processes for Control Engineers shows how to use the laws of physics and chemistry to produce the equations to simulate dynamically all the most important unit operations found in process and power plant. The book explains how to model chemical reactors, nuclear reactors, distillation columns, boilers, deaerators, refrigeration vessels, storage vessels for liquids and gases, liquid and gas flow t