

Contents

1.	General Introduction into the Determination of Heat Flow Components	1
1.1	Why is Determination of Heat Flow Components Important?	2
1.2	The Key Role of Radiative Transfer	5
1.3	Definition of Extinction Coefficient, Optical Thickness and Nontransparency	6
1.4	Definition of a Dispersed Medium	12
1.5	Definition of Thermal Conductivity	15
1.6	Conservation of Energy Defines Temperature Profile	22
1.7	Three Independent Methods to Determine Extinction Coefficients	26
1.8	Radiative Contribution to Heat Flow at Low Temperature	27
2.	Quantities Needed to Formulate the Equations of Energy Conservation and Radiative Transfer	29
2.1	Parameters and Functions, Cell and Continuum Models	29
2.1.1	Cell and Continuum Models	30
2.2	Heat Flow Through a Gas in a Two-Phase System	33
2.2.1	Basic Relations for Calculating Gaseous Conductivity	33
2.2.2	Temperature Dependence of the Accommodation Coefficient	40
2.2.3	Conclusions for the Temperature Dependence of Gaseous Conductivity	42
2.2.4	Convection as a Conduction Process	43
2.2.5	Free Molecular Conduction	44
2.2.6	Two-Phase Thermal Conductivity	46
2.3	Contact Heat Flow Through Solid Phase	47
2.3.1	The Thermal Resistor Concept	47
2.3.2	Contact Conductivity of Spheres and Fibres	51
2.3.3	Temperature Dependence of Contact Conductivity	55
2.4	Radiative Flow	70
2.4.1	Survey: How Do Single Radiation-Particle Interactions Enter the Equation of Transfer?	70

2.4.2	The Rigorous Mie Theory of Scattering	72
2.4.3	Dependent Scattering	80
2.4.4	Measurements of and Approximations for Single Scattering Phase Functions	85
2.4.5	Refractive Indices	89
3.	Approximate Solutions of the Equation of Transfer	96
3.1	Applications of the Two-Flux Model	97
3.2	Discrete Ordinates	104
3.3	Formal Solution, its Numerical Calculation and its Consequences for Nontransparent Media	107
3.3.1	Derivation of Radiative Flow and Temperature Profile	107
3.3.2	Viskanta's Solutions for a Grey Medium, for Isotropic Scattering and Temperature-Independent Parameters	112
3.3.3	Inclusion of Anisotropic Scattering by LAS Models; Importance of Wall Emissivity	116
3.3.4	Transient Temperature Profiles from Finite Element Calculations	119
3.3.5	Comments on "Linearization of the Temperature Profile" in Coupled Radiation-Conduction Problems	121
3.4	The Diffusion Model	123
3.4.1	Derivation of Original Formulation	123
3.4.2	Additive Approximation, Temperature Slip	126
3.4.3	Inclusion of Anisotropic Scattering	129
3.4.4	Temperature Profiles Calculated with Temperature-Dependent Parameters	131
3.4.5	Experimental Determination of Thermal Conductivity Components	132
3.4.6	The "Effective Index of Refraction"	136
4.	Comparison Between Measured (Calorimetric or Spectroscopic) and Calculated Extinction Coefficients	139
4.1	Materials Used in Calorimetric and Spectroscopic Experiments	139
4.2	Calorimetric Measurements	143
4.3	Spectroscopic Measurements	149
4.4	Calculated Extinction Coefficients	155
4.5	Comparison of Extinction Coefficients Obtained from the Three Independent Methods	157
4.6	Translucence in a Nontransparent Medium	158
4.7	Conclusion	158
5.	Measurement of Temperature-Dependent Thermal Conductivity and Extinction Coefficient	160
5.1	Expected Temperature Dependence of Extinction Coefficients of Real Materials	160

5.2	Predictions of the Diffusion Model for Local Values of Heat Flow Components	162
5.3	Experimental Procedure and Results	165
5.4	Can Calorimetric Measurements of Extinction Coefficients Reveal Dependent Scattering?	169
5.5	Inhomogeneous Media; Outlook for a Completion of the Method	170
6.	Optimum Radiation Extinction	171
6.1	Formulation of the Complete Optimization Concept	171
6.2	Optimum Particle Diameters for Spheres and Cylinders	173
6.3	Thin Metallic Fibres	176
7.	Conclusion	178
	References	181
	Subject Index	199