

Contents

Introduction	v
1 The main asymptotic modes of suspension motion and associated model boundary-value problems	1
1.1 Microscopic model of suspension motion	1
1.2 A priori estimates for solution of the problem and main asymptotic modes of suspension motion	7
1.3 Method of particle fixation: Three main model problems	13
2 Homogenized equations of suspension motion in frozen particles mode .	19
2.1 Asymptotic behavior of the solution of model problem A	19
2.2 The resolvent convergence of model problem A	45
2.3 Uniform estimates of derivatives of the solution of the initial problem	50
2.4 Homogenized equations of perturbation of the carrier fluid by small solid particles moving in frozen particles mode	58
3 Suspension viscosity tensor	69
3.1 Calculation of viscosity tensors for structures close to periodic	69
3.2 Equivalent definition of the viscosity tensor	80
3.3 Asymptotics of viscosity tensors at weak concentrations	86
3.4 Mean value of the viscosity tensor with random distribution of diameters and orientations of particles	97
4 Closure of the homogenized system of equations for suspension motion in frozen particles mode	103
4.1 On the effect of viscous incompressible fluid flow on a particle	103
4.2 On the motion of a single particle in viscous incompressible fluid flow	109
4.3 Evolution equation of the mean orientation vector	111
4.4 Closed system of equations for suspension motion in frozen particles mode	116
4.5 On existence of generalized solutions of the initial–boundary-value problem for closed systems of homogenized equations of suspension motion of axisymmetric particles	119
5 Hydrodynamics of suspensions in strong external fields	135
5.1 Asymptotic behavior of the solution of model problem C	135

5.2	Asymptotic behavior of the solution of model problem A with external moments	150
5.3	Nonstandard model of hydrodynamics of suspension of oriented particles	154
6	Homogenized equations of suspension motion in filtering particles mode	161
6.1	Asymptotic behavior of the solution of model problem B	161
6.2	Probabilistic distribution of particles	179
6.3	Perturbation of viscous incompressible fluid by small solid particles moving in filtration mode	187
6.4	Closed system of equations of suspension motion in filtering particles mode	190
6.5	On existence of global generalized solutions of the initial–boundary-value problem for closed systems of equations of suspension motion in filtration mode	193
7	Homogenized model of a complex fluid with microstructure	197
7.1	Formulation of the problem	197
7.2	Mesoscopic characteristics of microstructure and statement of the main result	201
7.3	Variational statement of the problem and its homogenization	205
7.4	Analytical properties of the limiting tensor $\{a_{npqr}(x, \lambda)\}$	212
7.5	Analytical properties of solutions of boundary-value problems (7.3.1)–(7.3.5) and (7.3.18)–(7.3.19)	220
7.6	End of proof of Theorem 7.2.1	222
7.7	Periodic structure	225
8	Two-phase homogenized model of motion of a complex fluid with microstructure	235
8.1	Formulation of the problem	235
8.2	Local quantitative characteristics of the system of interacting particles and statement of the main result	237
8.3	Discrete analogue of the Korn inequality	239
8.4	Variational statement of the problem	242
8.5	Proof of the main theorem in the variational formulation	245
8.6	Analytical properties of solutions of boundary-value problems (8.4.1)–(8.4.5) and (8.4.10)–(8.4.12). End of proof of main theorem	261
8.7	Periodic structure	263
	References	265
	Index	273