

Table of Contents

List of Figures	ix
List of Tables	xi
Appendices	1
1 An introduction to suspension dynamics	1
1.1 Introduction	1
1.2 Sedimentation in vertical containers	2
1.3 Sedimentation in inclined containers	9
1.4 Dense granular flows	12
2 Particle organization after viscous sedimentation in tilted containers	15
2.1 Introduction	16
2.2 Materials and Methods	17
2.2.1 Experiments	17
2.2.2 Numerical simulations	20
2.3 Results and discussion	26
2.4 Conclusions	32
2.5 Appendix	34
2.5.1 Drag coefficient	34
2.5.2 Error analysis of ϕ	34
3 Characterization of a sediment layer in tilted ducts	36
3.1 Introduction	37
3.2 Governing equations	39
3.3 Results and discussion	43
3.4 Conclusions	51
4 Conclusions	53

5 Future work	57
Bibliography	60

List of Figures

1.1.1 Different types of granular media.	3
1.2.1 Hindered functions.	5
1.2.2 Regional sedimentation processes for the different types of particles.	7
1.2.3 Vertical fingers over a sedimentation process for various types of particles.	7
1.3.1 Different regions of a tilted sedimentation process in a container.	9
1.3.2 Instabilities (waves) in a settling particle process in a tilted container.	10
1.3.3 Comparison between experiment and theory of the stability of the suspension.	12
1.4.1 Rheology of dense granular flows.	13
2.2.1 Schematic of the experimental setup.	18
2.2.2 Experimental calibration curve.	21
2.2.3 Volume fraction of particles as a function of the vertical axis for various times.	21
2.2.4 Computational domain and Boundary conditions.	22
2.2.5 Convergence of free triangular mesh. θ_p as a function of number of mesh elements.	24
2.2.6 Particle concentration profile for $\phi_0 = 15.0 \pm 0.1\%$	25
2.2.7 Particle concentration field obtained from numerical simulations.	25
2.2.8 Accumulated particle mass, $\int \phi(x, z) dz$	26
2.3.1 Comparison between experimental and numerical results.	27
2.3.2 Evolution of the interface of the suspension, from 10 s to 25 s.	28
2.3.3 Time evolution of the height of the interface of the suspension.	29
2.3.4 Velocity of the interface of the suspension, $w_s = w_0(1 - \phi_0)^n$	29
2.3.5 Mean height of the sediment layer, h_{mean}	30
2.3.6 Final angle of the sediment layer, $\theta = \theta_s - \theta_p$	30
2.3.7 μ as a function of the dimensionless numbers.	32
2.5.1 Percentage error of the volume fraction of particles ($\Delta\phi/\phi$) %.	35
3.1.1 Schematic of the conceptual model.	37
3.2.1 Schematic of the numerical model.	41
3.2.2 Convergence of free triangular mesh.	43

3.3.1 Sedimentation process and particle concentration field.	45
3.3.2 Magnitude of the velocity field of the dispersed phase.	46
3.3.3 Maximum magnitude of the velocity of the dispersed phase at MP ₁ and MP ₂	47
3.3.4 Maximum magnitude of the velocity of the dispersed phase at MP ₃ and MP ₄	47
3.3.5 Accumulated particle mass and mass flux along the horizontal section.	48
3.3.6 Normalized height of the sediment layer.	49
3.3.7 Data fit for h_{SL}/L_0 as a function of the dimensionless group Π	51
5.0.1 Sedimentation process in a tilted duct as a function of the concentration particle.	57
5.0.2 Sedimentation process in a tilted duct as a function of time.	58
5.0.3 Resuspension process in a tilted duct as a function of time.	59

List of Tables

2.1	Set of experimental conditions.	19
2.2	Fit coefficients for light intensity function (3.2.1).	20
3.1	Set of parameters of numerical simulations.	42
3.2	Set of conditions for convergence analysis.	43
3.3	Duct obstruction conditions.	49