

Coalescence Modelling for Settler Design

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agenda

- motivation
- basic understanding
- coalescence modelling
- settler simulation

gravity settler



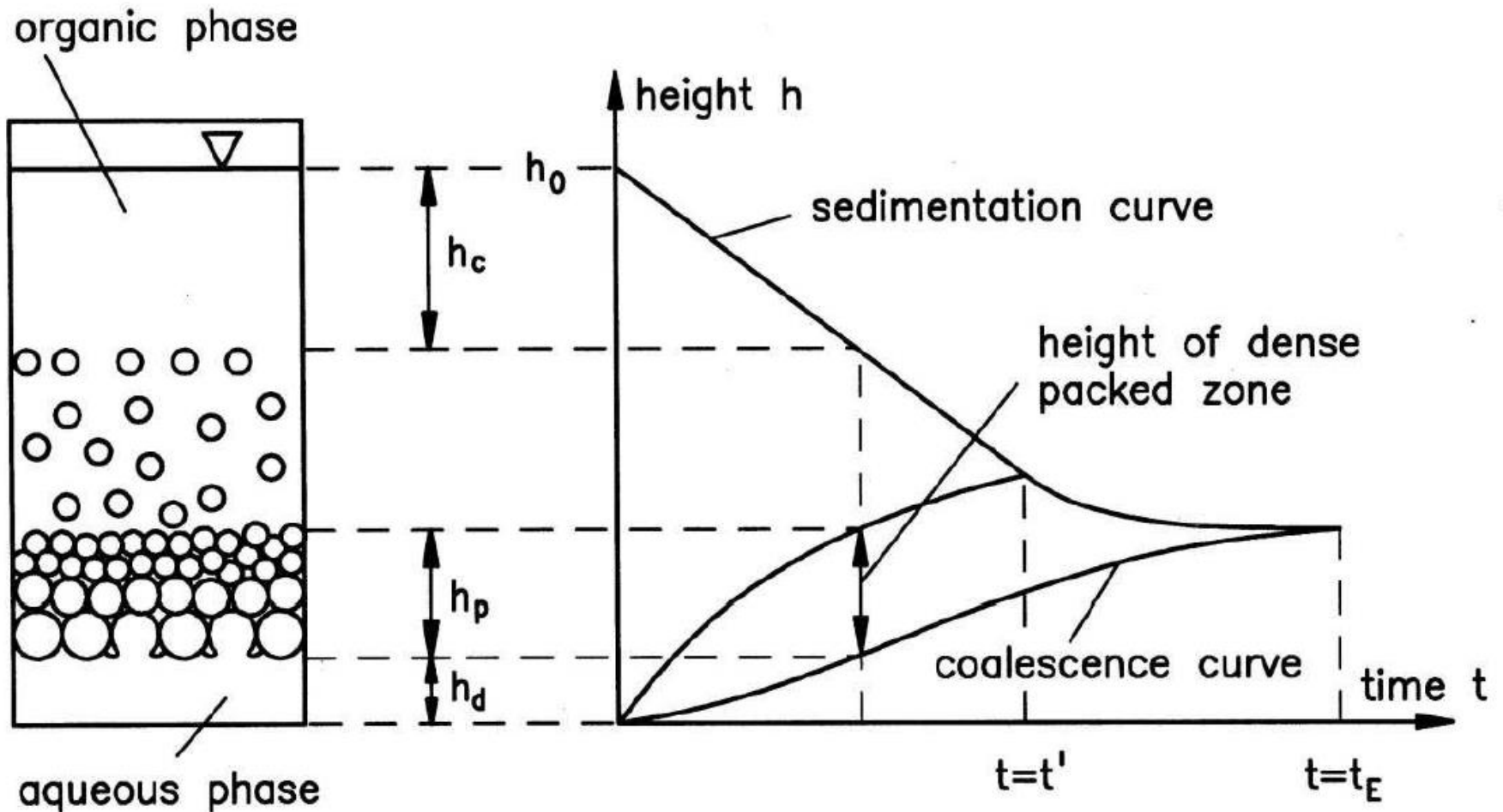
pilot-plant settler with internals



stirring cell

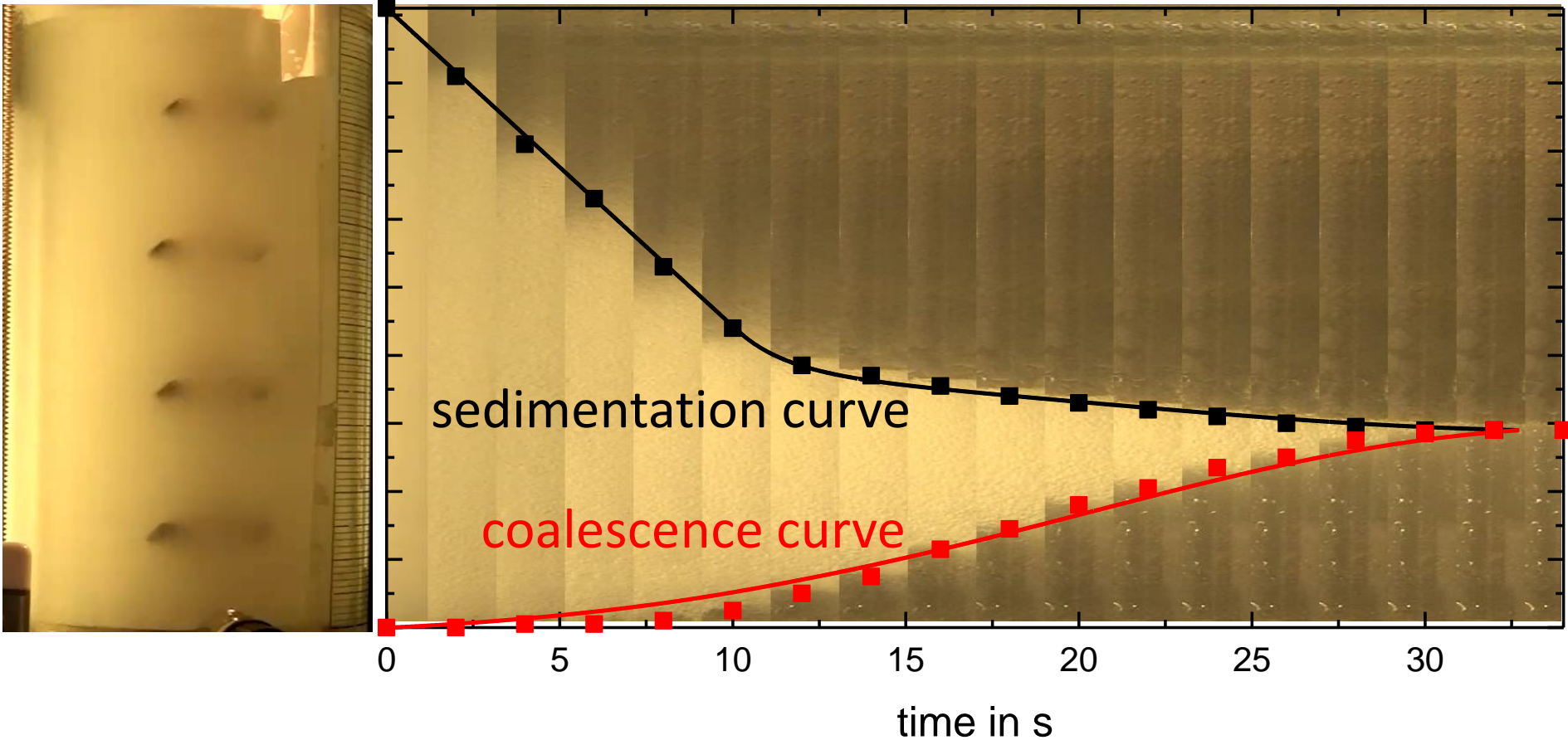


settling of dispersion

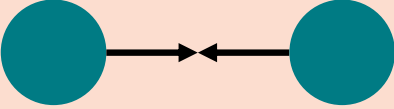
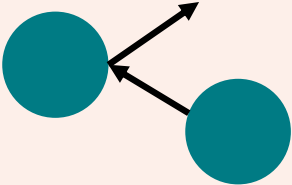
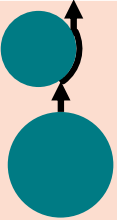
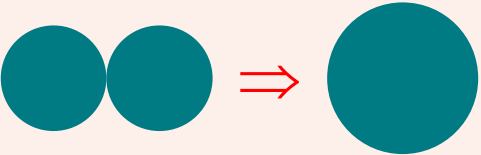


Henschke, 2002

stirring-cell experiment



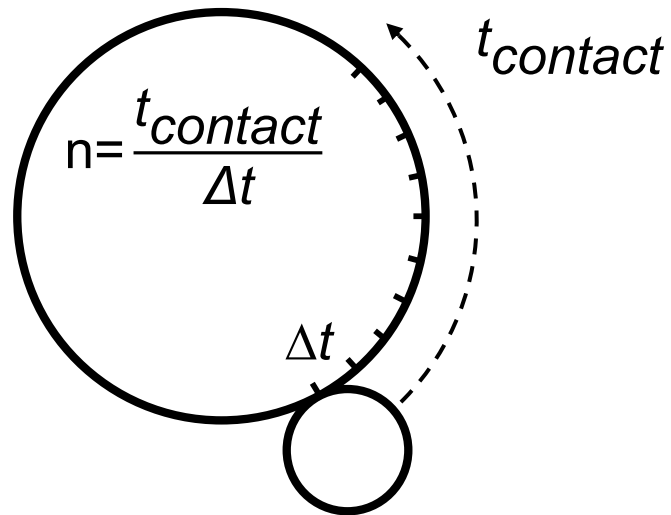
modelling coalescence of drops

effect	description	influenced by
	frequency at which drops meet	equipment type, fluid dynamics, holdup
	drops bounce at high relative velocity	equipment type, fluid dynamics, operating conditions
	time drops stay in contact, t_{contact}	equipment type, fluid dynamics, operating conditions
	characteristic time drops need to coalesce, $t_{\text{coalescence}}$	material system, drop size

coalescence probability: fundamental

$$p_{\text{coalescence, Coualoglou\&Tavlarides}} = \exp\left(-\frac{t_{\text{coalescence}}}{t_{\text{contact}}}\right)$$

coalescence probability: fundamental



$$\rho_{\text{non-coal}, n\Delta t} = \rho_{\text{non-coal}, \Delta t}^n$$

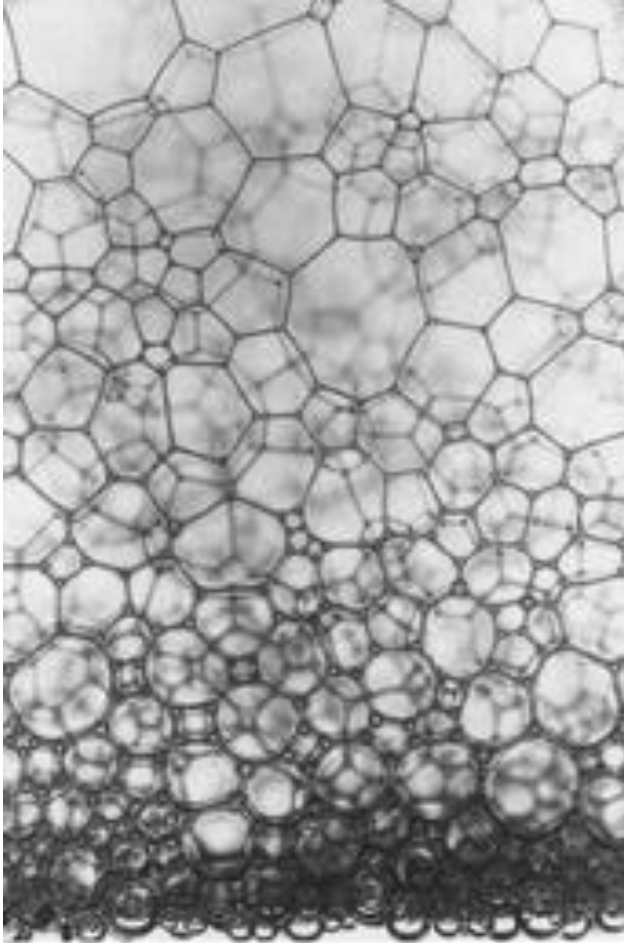
$$\rho_{\text{non-coal}, \Delta t} = \exp\left(-\frac{\Delta t}{t_{\text{coal}}}\right)$$

$$\rho_{\text{non-coal}, n\Delta t} = \exp\left(-\frac{n\Delta t}{t_{\text{coal}}}\right)$$

$$\rho_{\text{non-coal}} = \exp\left(-\frac{t_{\text{contact}}}{t_{\text{coal}}}\right)$$

$$\rho_{\text{coal}} = 1 - \exp\left(-\frac{t_{\text{contact}}}{t_{\text{coal}}}\right)$$

close-packed zone

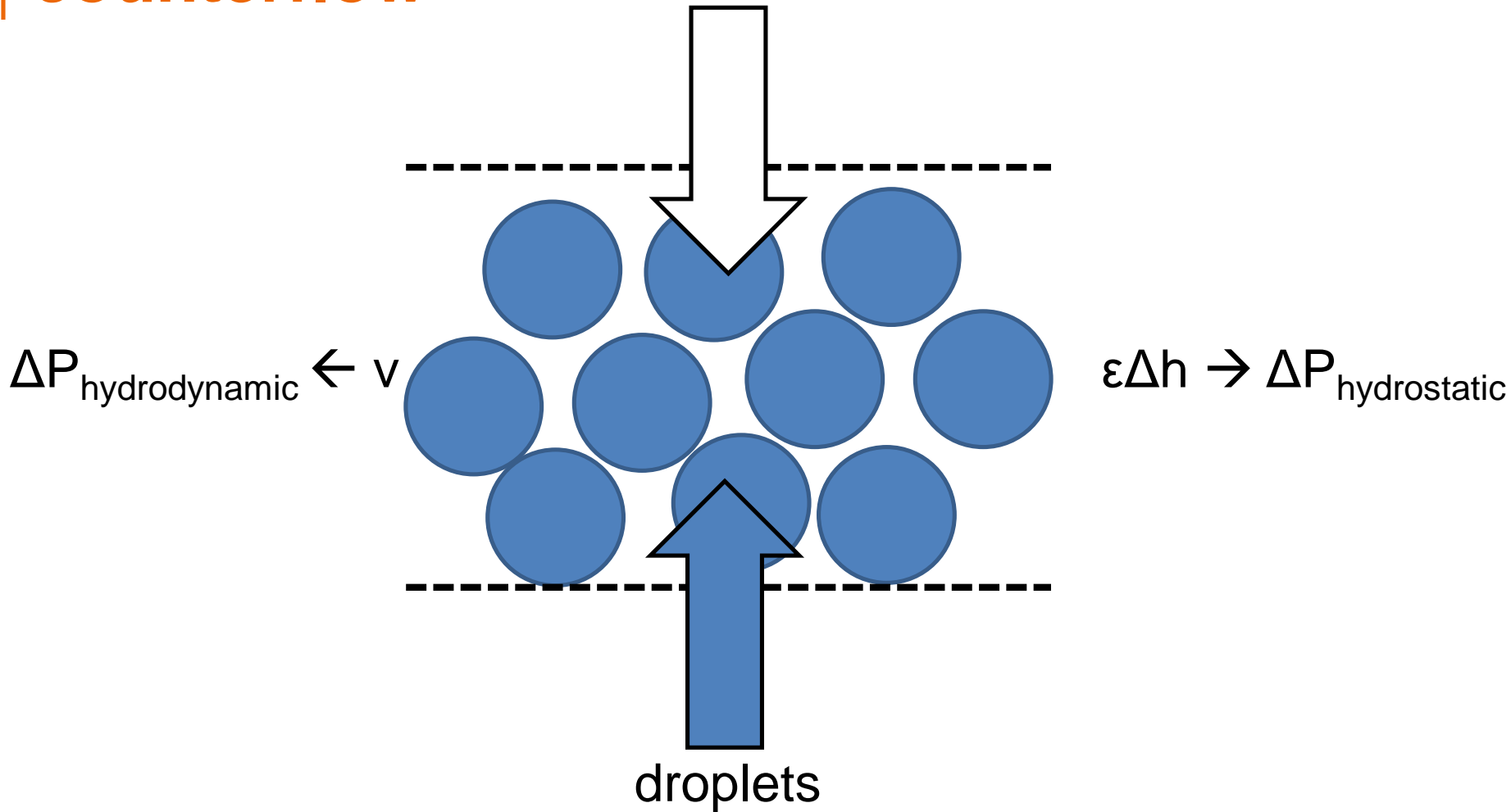


Arnaud Saint-Jalmes, 2006

- drops deformation
- film drainage

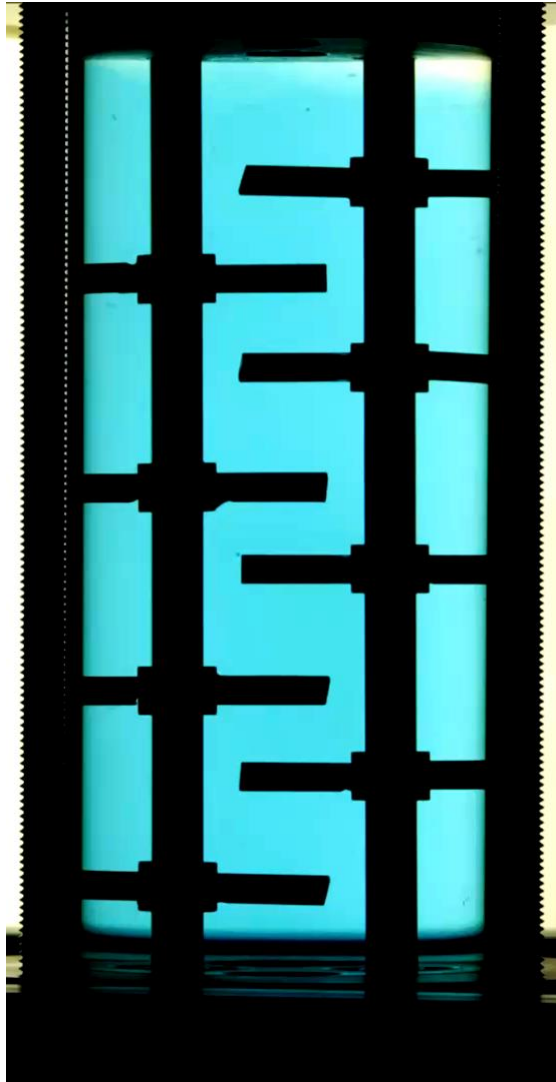
counterflow

continuous flow

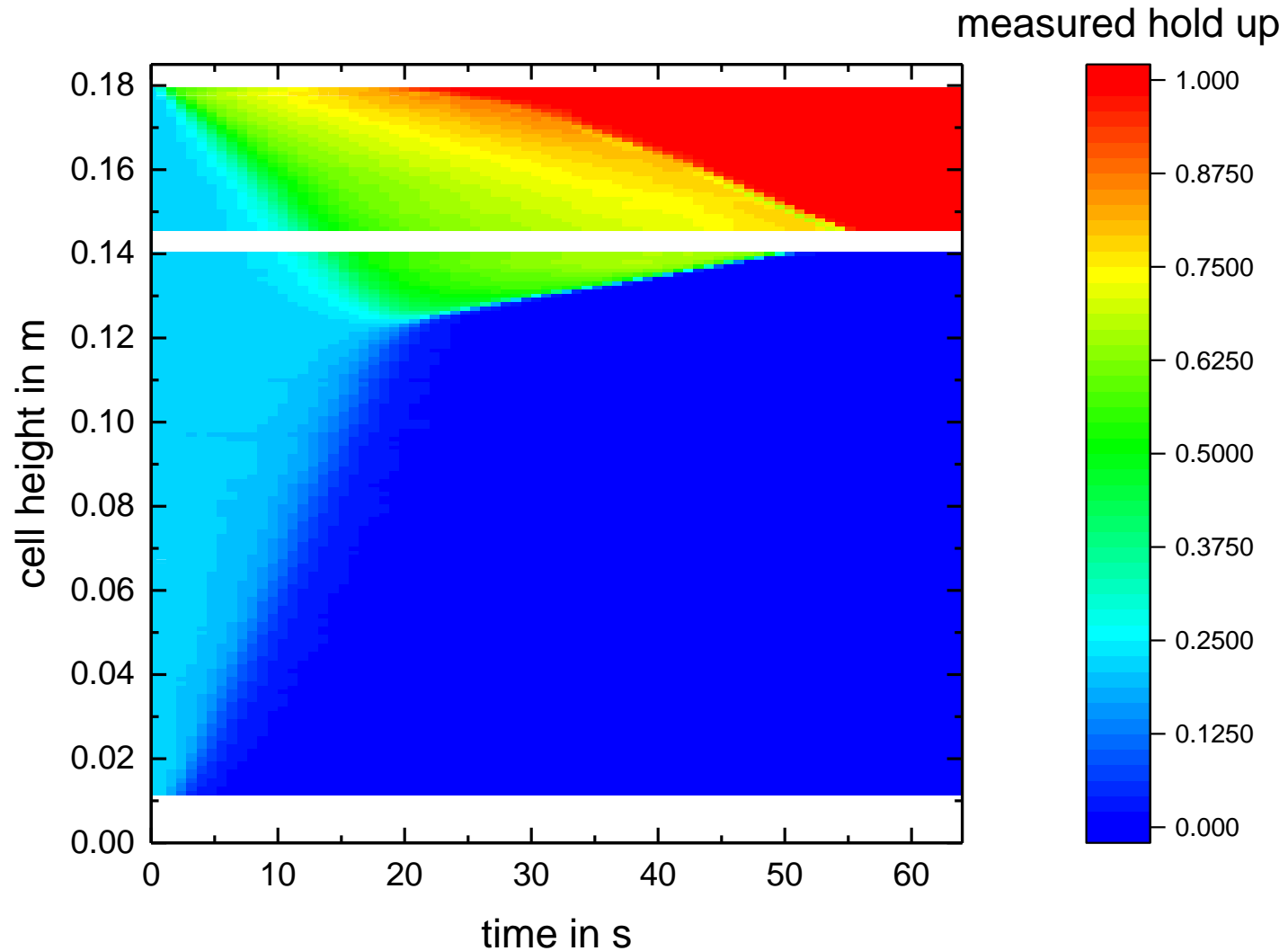


$$\Delta P_{\text{total}} = \Delta p_{\text{hydrostatic}} - \Delta P_{\text{hydrodynamic}}$$

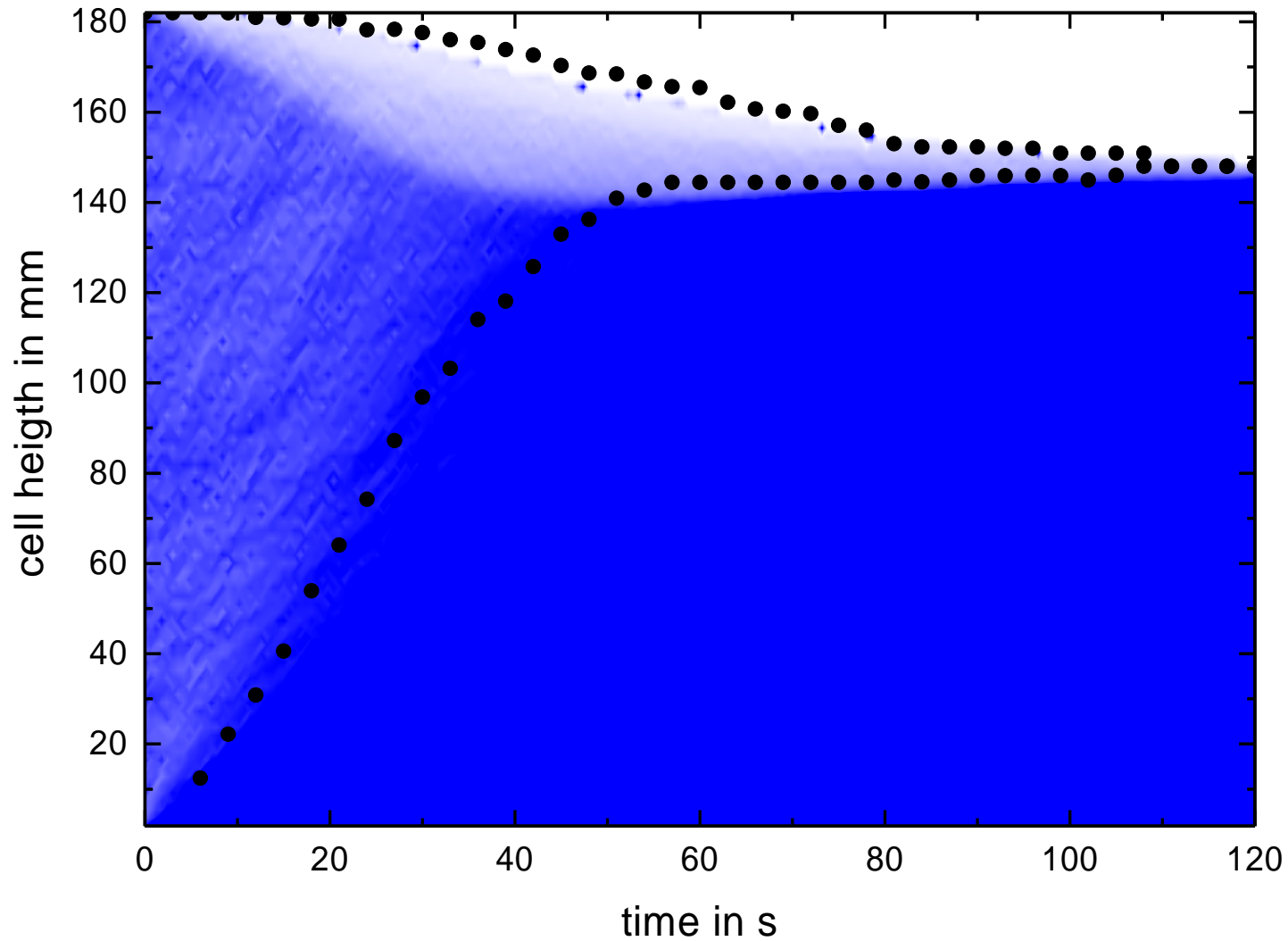
iso-optical settling experiment



experimental measurement of the holdup



settling simulation



summary

- consistent coalescence model
- calibrated setup for model validation purposes
- model able to characterize settling behavior for any system

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