Sedimentation model based on particle classes for urban wastewater systems

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Overview

- Objective of the study
- Modelling approach
- Application to wastewater systems
- Simulation results
- Conclusion

Objective

Sedimentation model based on particle classes applied to:

- Stormwater basin (Vallet *et al.*, 2011)
- Combined sewer retention tank (Maruejouls *et al.*, 2011)

- Primary clarifier

Objective

Why using particle classes?

- Settling velocity is not the same for all the particles → Distribution
- Better description of real wastewater systems!

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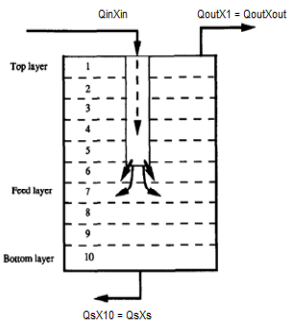
Modelling approach

- Dynamic and 1-D model
- Set of ordinary differential equations
- Vertical heterogeneity

  → layers
- Settling velocity distribution

  → set of 3 particle classes (ViCAs)



Modelling approach

Definition of 3 classes – ViCAs experiment

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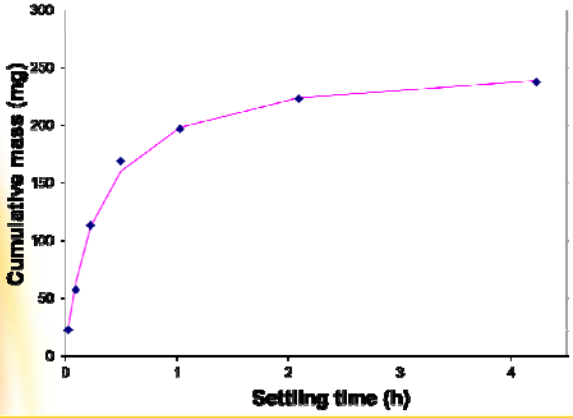
Modelling approach

Definition of 3 classes – ViCAs experiment



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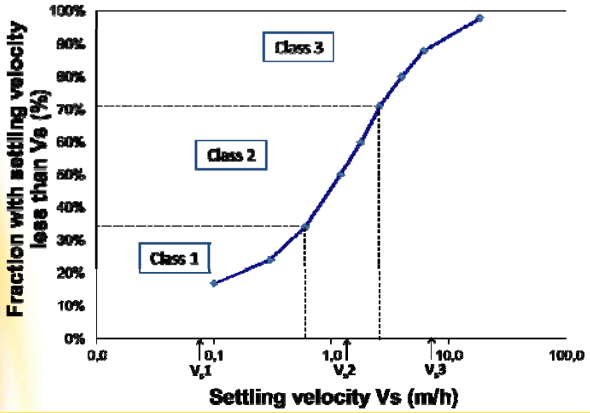
Modelling approach

Definition of 3 classes – ViCAs experiment



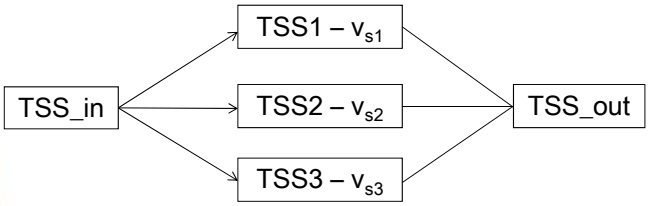
Modelling approach

Definition of 3 classes – ViCAs experiment

Poster from Maruejouls et al.: "Particle settling velocity distribution based wastewater characterisation: Generalisation of a single protocol"

Modelling approach

TSS fractionation:



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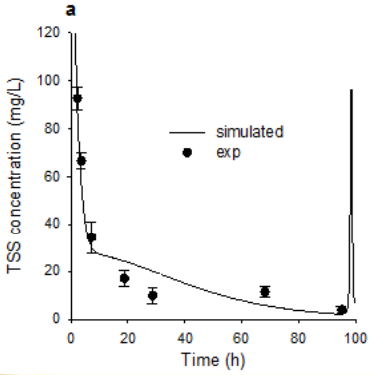
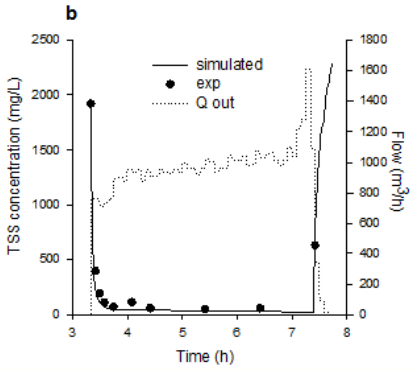
Model application

Stormtank
(Vallet *et al*., 2011)

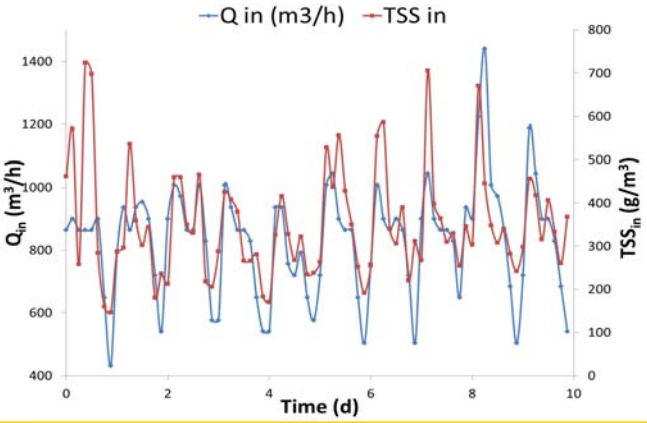


Combined sewer retention tank
(Maruejouls *et al*., 2011)



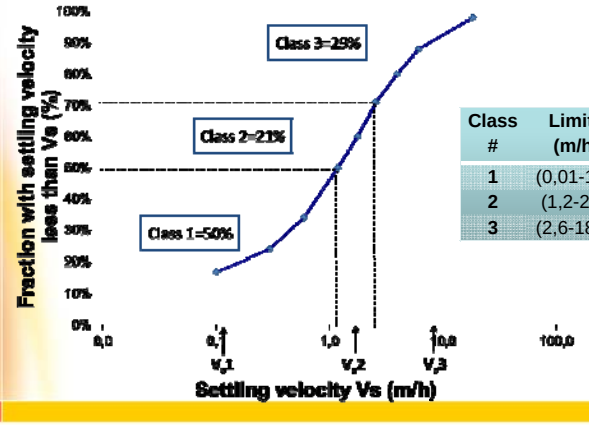
Model application

Experimental data: TSS Norwich WWTP



Model application

Calibration results



Class #	Limits (m/h)	V_s (m/h)	TSS fraction (%)
1	(0,01-1,2)	0,1	50
2	(1,2-2,6)	1,77	21
3	(2,6-18,5)	6,9	29

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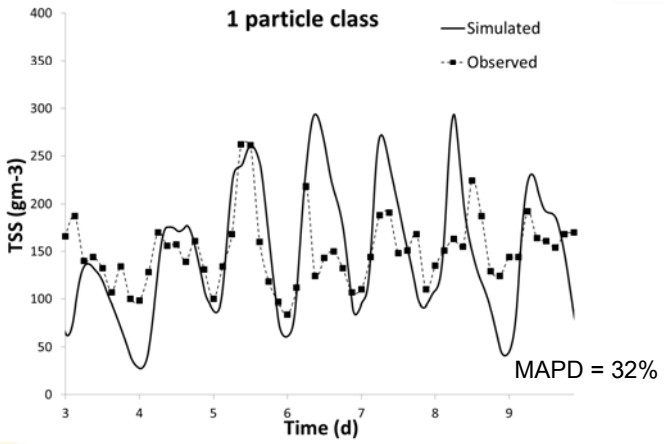
Simulation results

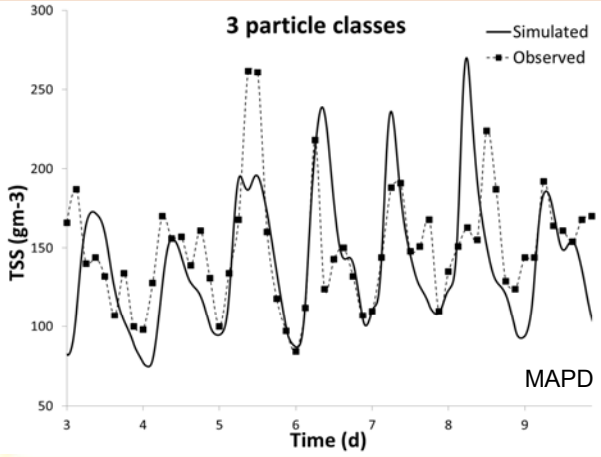
- Simulation software: WEST
- Effluent TSS
- Evaluation of the model performance:

$$\text{MAPD (\%)} = \frac{1}{n}\sum_{i=1}^{n}\left|\frac{X_{i\_obs} - X_{i\_sim}}{X_{i\_obs}}\right| \times 100$$

Simulation results



Simulation results



MAPD = 18,6%

Conclusion

- 3 particle classes are sufficient to describe the settling velocity distribution;
- Effluent TSS are well simulated;
- Better fit compared to 1-class model;
- Extension of the model with interaction of particle classes for simulation of coagulation/flocculation

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Thanks for your attention