Prediction of the terminal settling velocity of natural particles applied in drinking water treatment processes (PPT)

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Publication date
2017

Document Version
Final published version

Citation (APA)
Kramer, O. (2017). *Prediction of the terminal settling velocity of natural particles applied in drinking water treatment processes (PPT).* 5th IWA Young Water Professionals BeNeLux conference, Ghent, Belgium.

YWP Benelux Conference

BENELUX Young Water Professionals Regional Conference GHENT 2017

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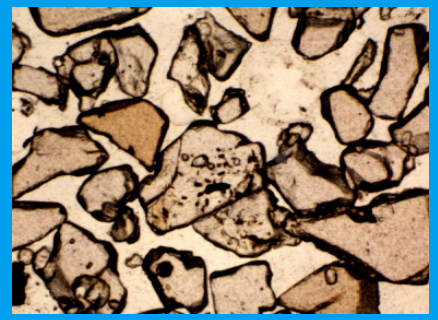

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Waternet

Amsterdam Water Cycle Company

- Drinking Water
- Waste Water
- Water Systems




Drinking water production processes

- Filtration
- Fluidisation
- Sedimentation

Natural granular particles

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Prediction of the terminal settling velocity of natural particles applied in drinking water treatment processes

Drinking water softening

Chemical $CaCO_3$ crystallisation (caustic soda)

Fluidisation reactors (Liquid-Solid)

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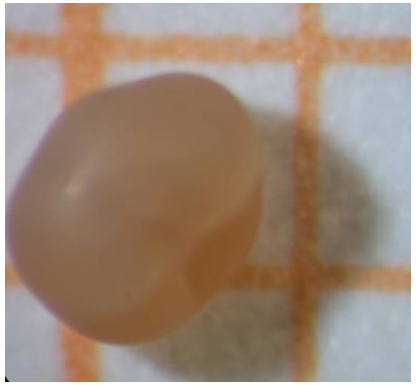
Prediction of the terminal settling velocity of natural particles applied in drinking water treatment processes

Drinking water softening (linear economy)

Seeding material ⟶ marble pellets

0,3 mm

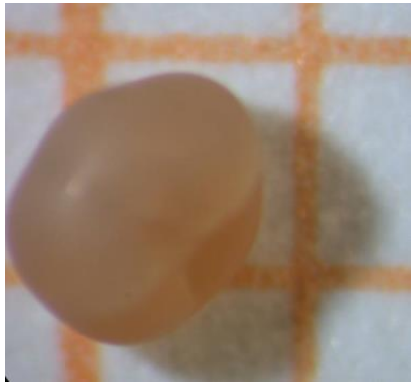


1.0 mm

Drinking water softening (linear economy)

Seeding material ⟶ marble pellets

0,3 mm



1.0 mm

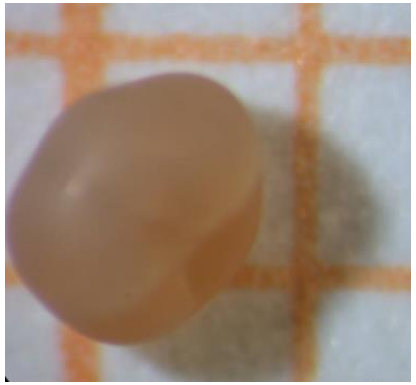
500 t/y raw material ⟶ 8000 t/y waste material

ıg velocity of natural particles applied in drinking water treatment processes

Drinking water softening (Waternet CO_2 neutral in 2020)

Seeding material ⟶ marble pellets

0.3 mm



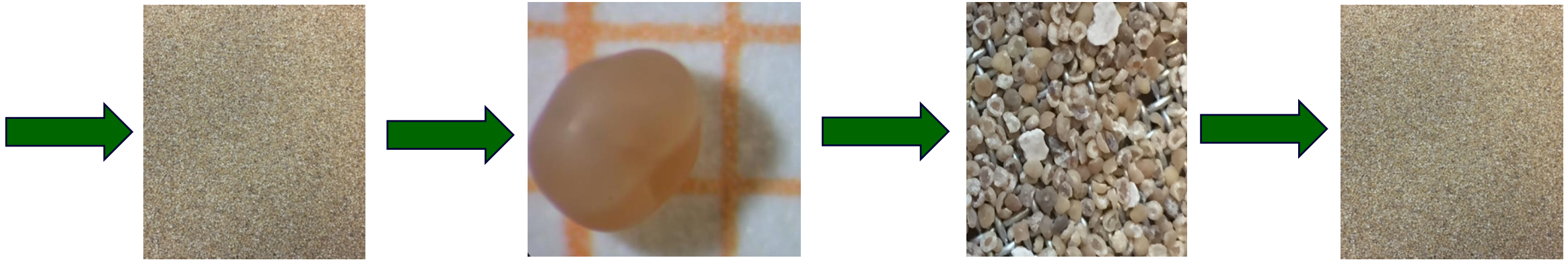
1.0 mm

500 t/y new material ⟶ 8000 t/y waste material

ng velocity of natural particles applied in drinking water treatment processes

Drinking water softening (circular economy)

Seeding material ⟶ marble pellets ⟶ grinding ⟶ sieving



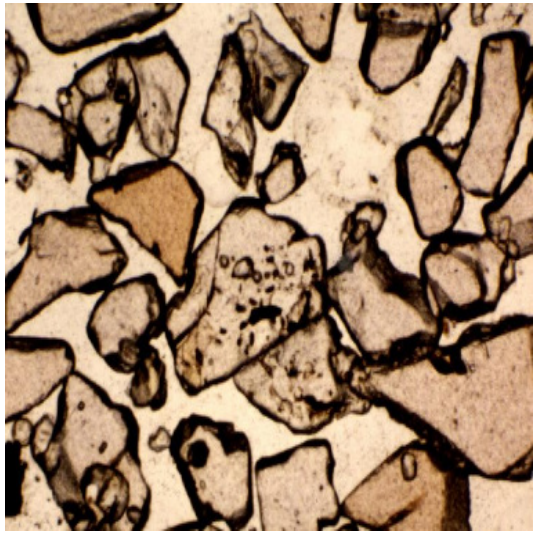
Re-using

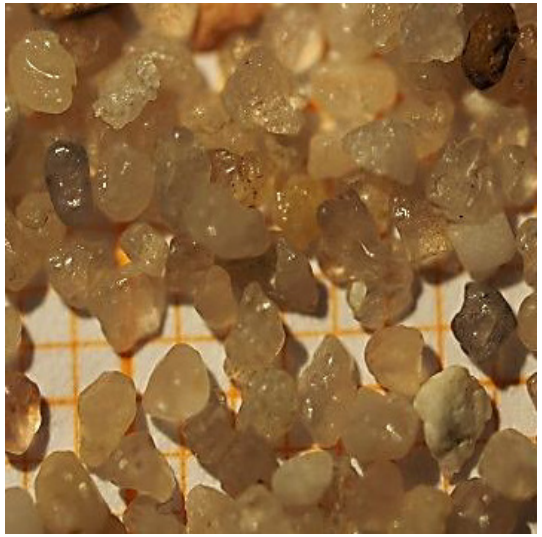
Valorisation

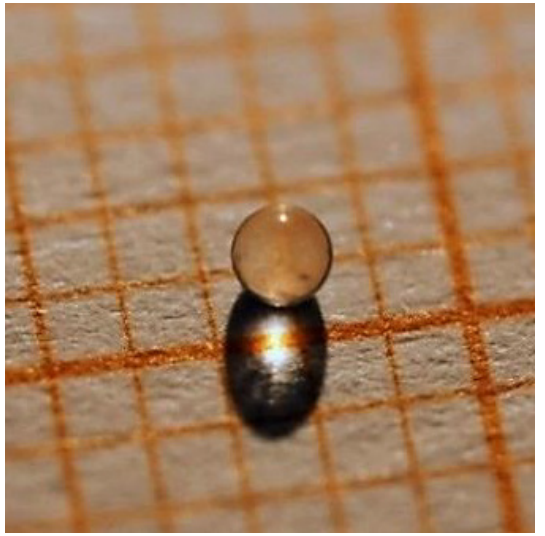
e.g. glass, paper, carpet etc.

Research aim (after process changes)

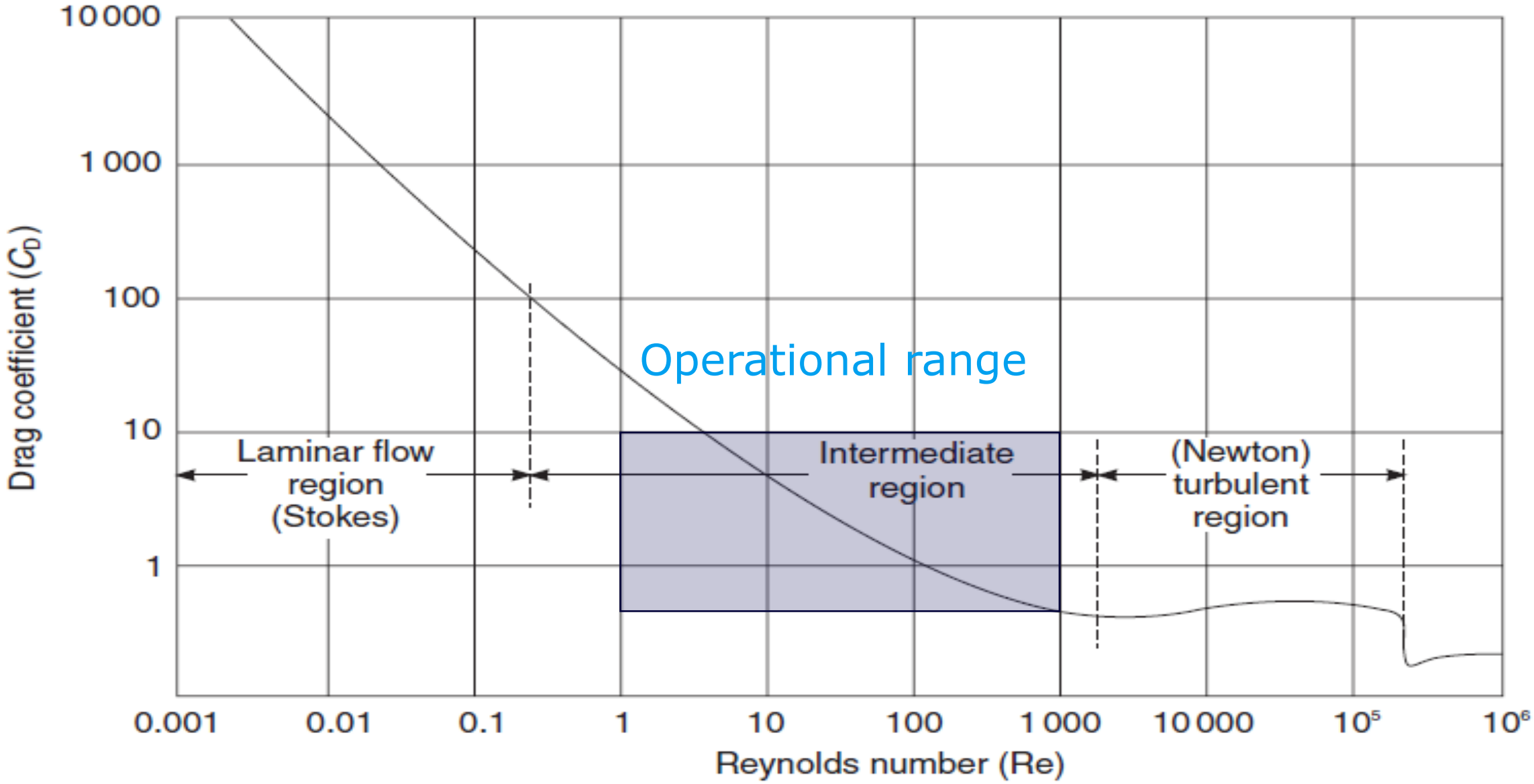
Investigating the hydraulic behaviour of imperfectly round spheres in drinking water treatment processes







(1/2) Literature study (drag versus Reynolds)



A.G. Jones (2002) Crystallization Process Systems

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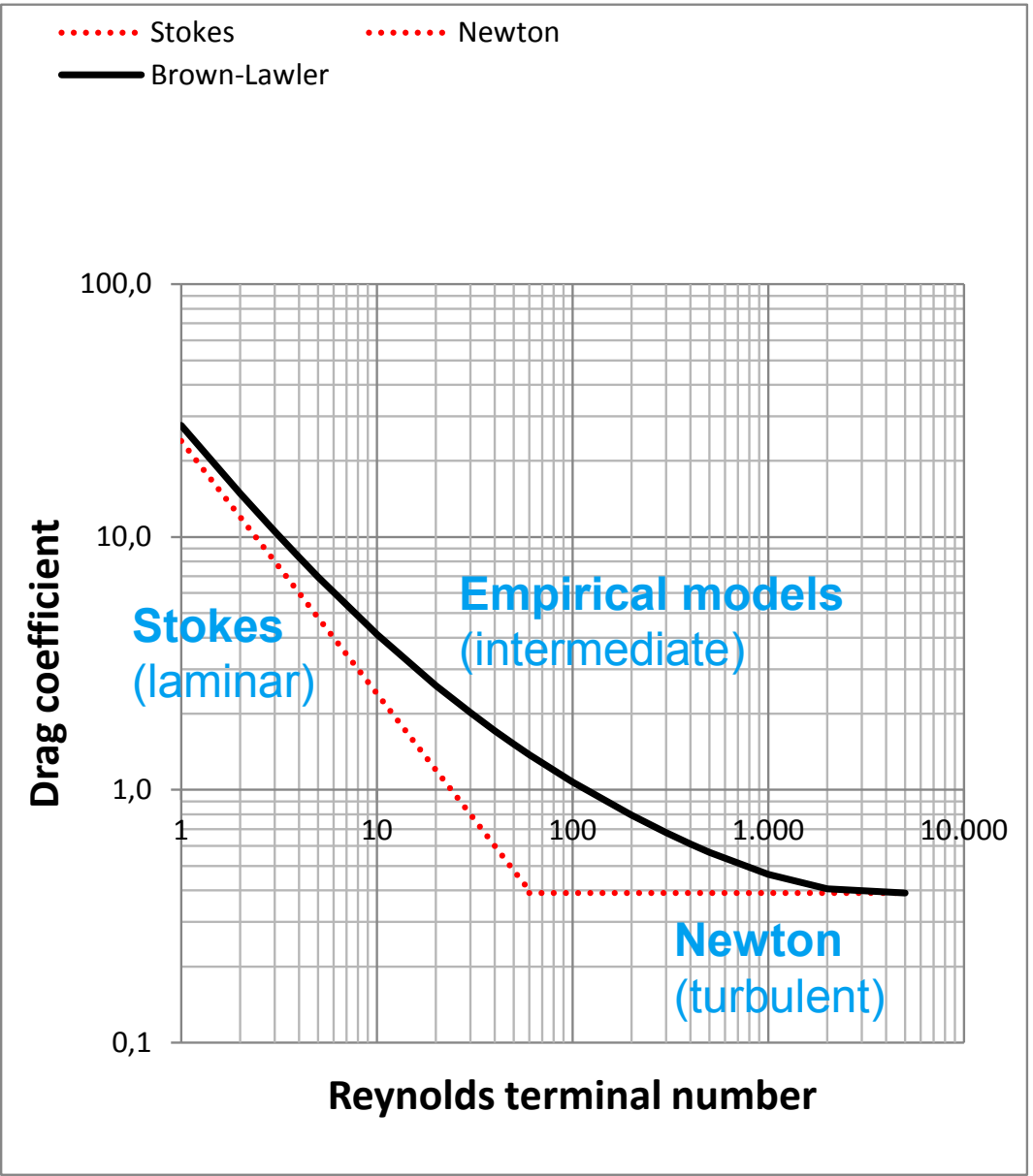
(1/2) Literature study (drag versus Reynolds)



- Terminal settling theory

  Laminar (Stokes)
  Turbulent (Newton)

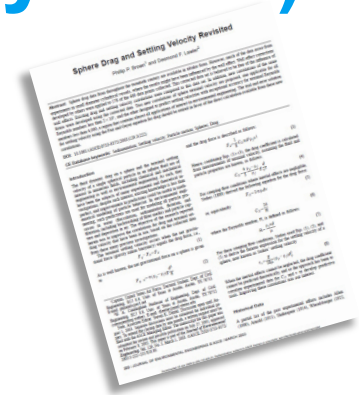
- Many prediction models

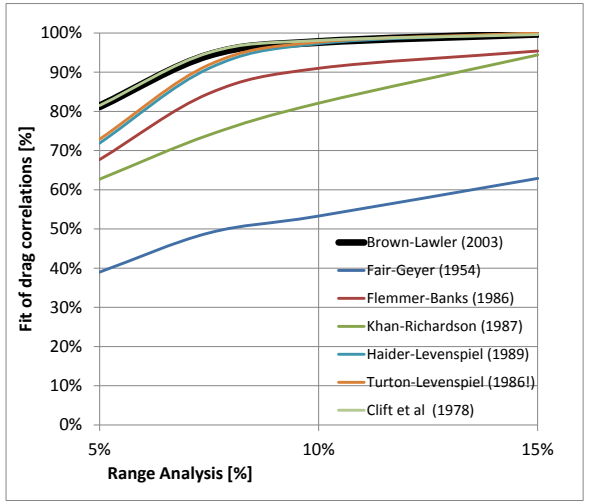
  Intermediate regime

- For prefect round spheres

- +/-5% accuracy

(1/2) Literature study (drag versus Reynolds)

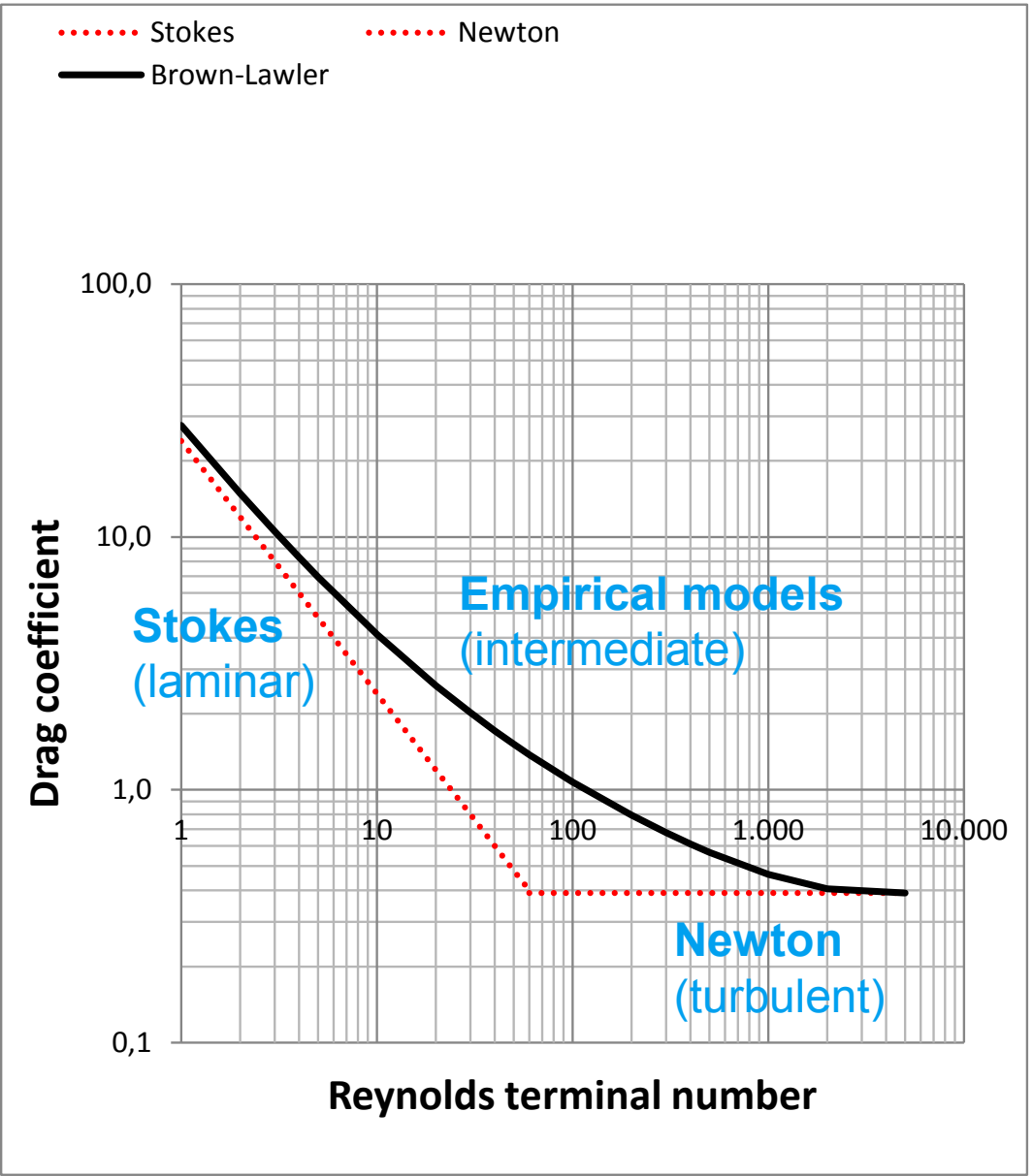


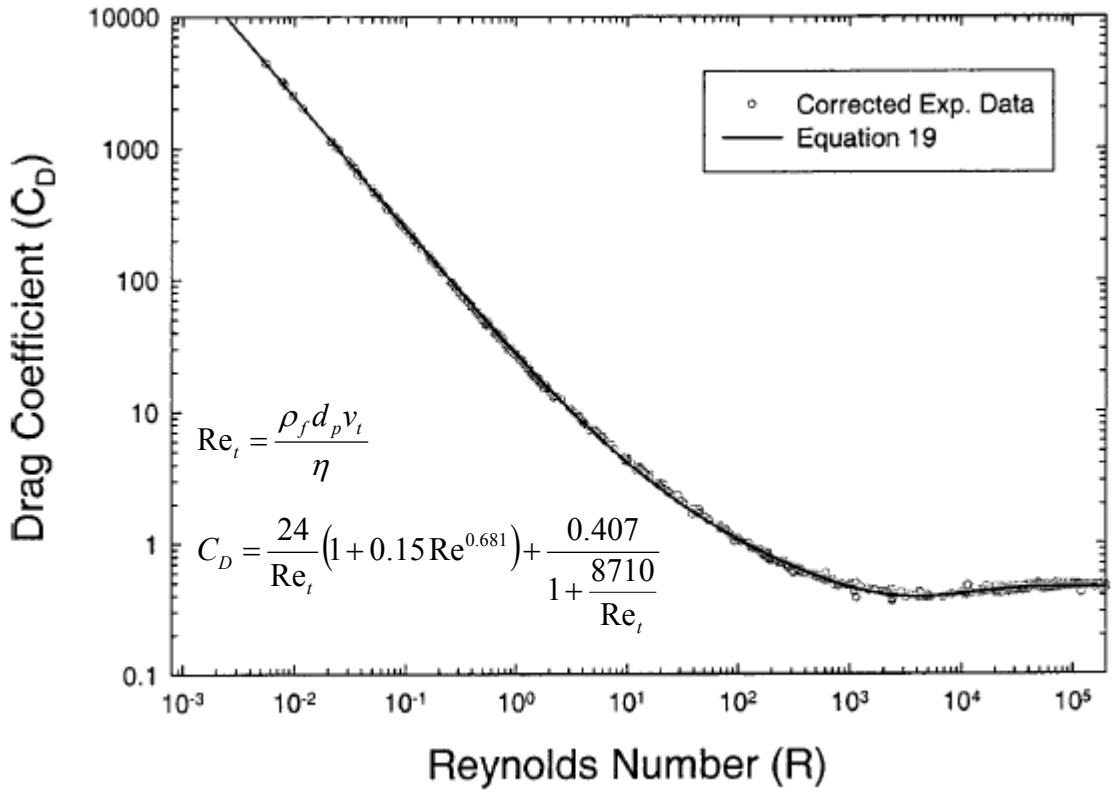


20%

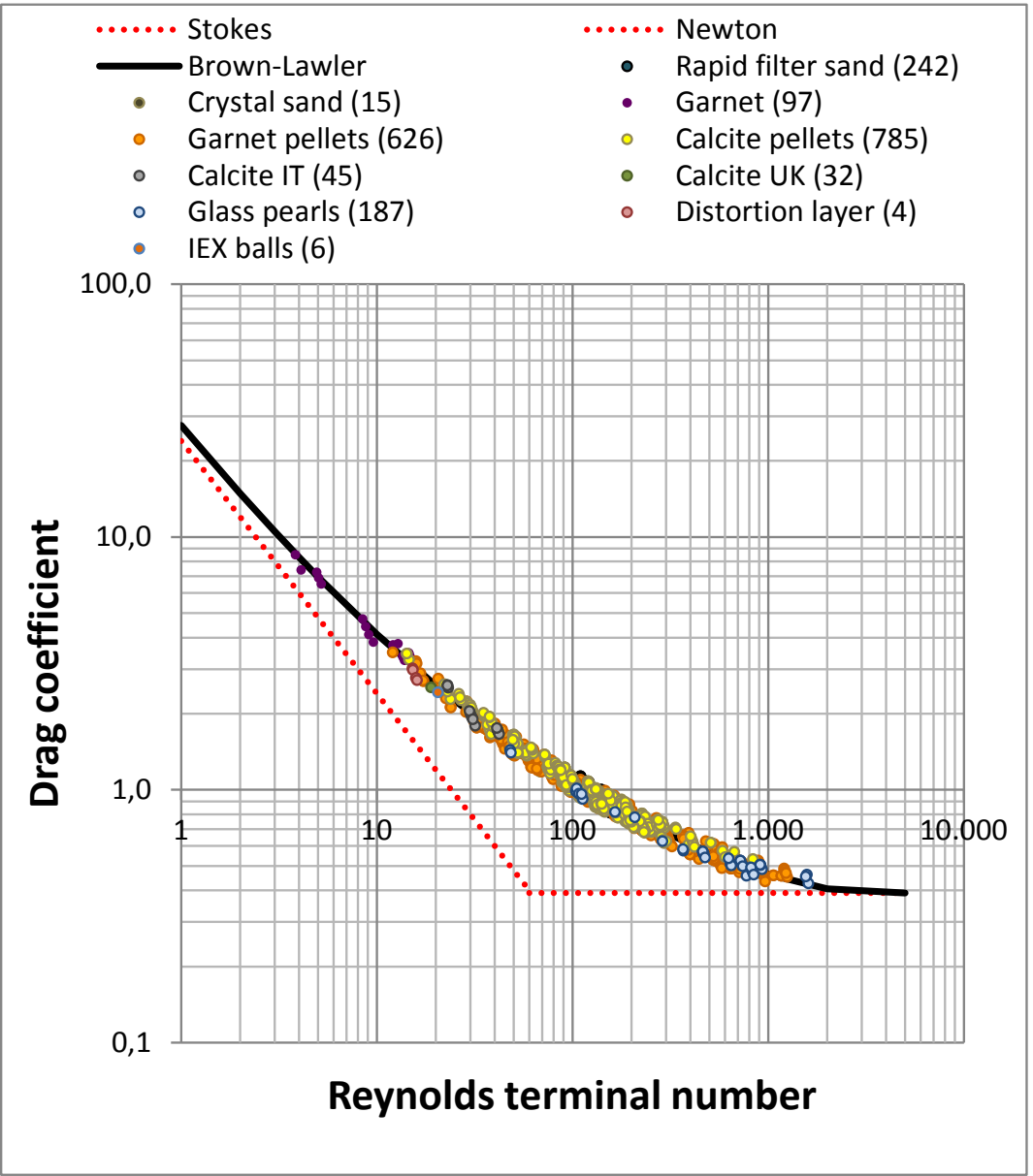
N = 480

- Brown-Lawler (2003)





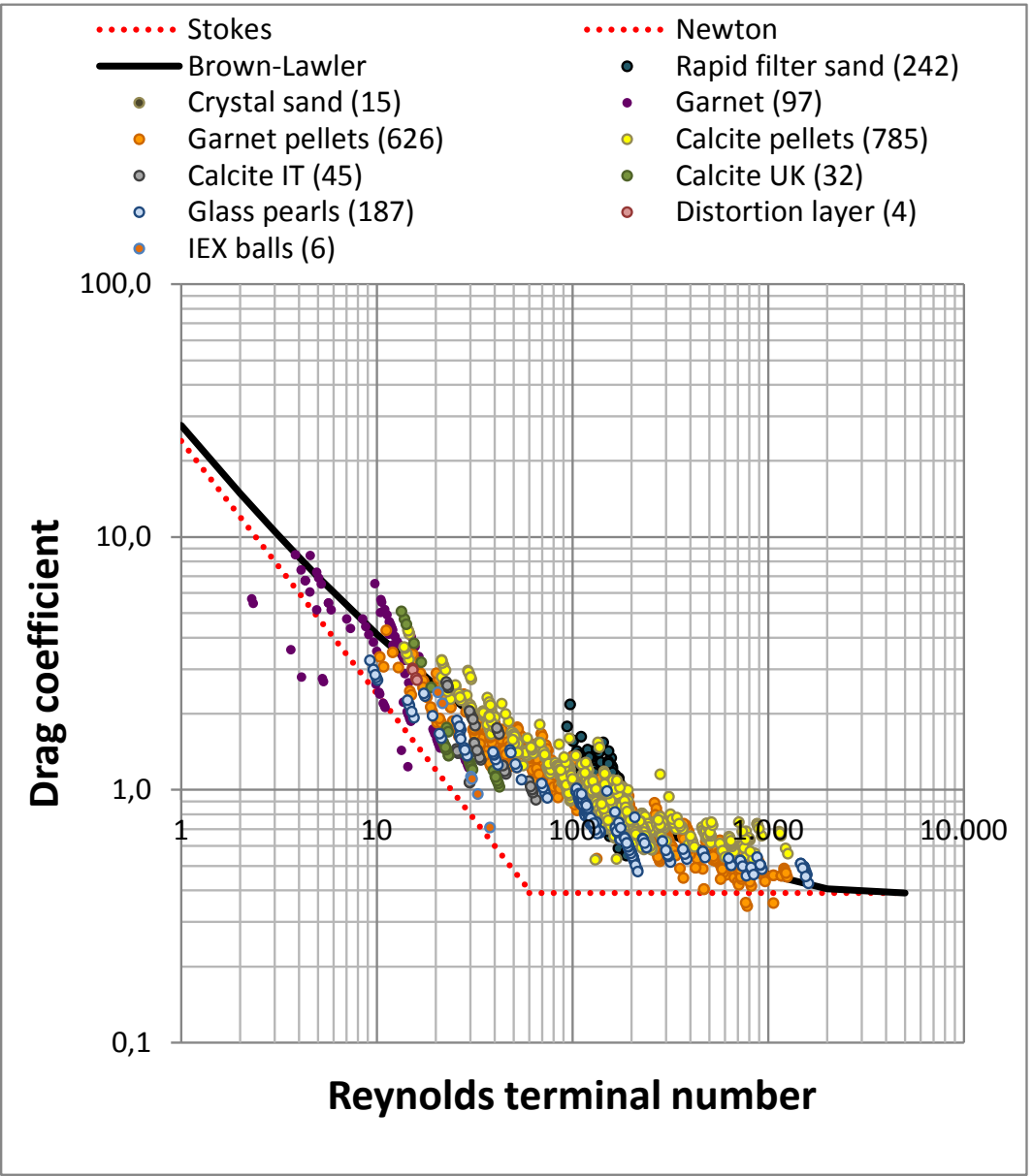
(2/2) Experimental data



10%

N = 1046

(2/2) Experimental data



0%

N = 2039

Explanation of deviation

Deviation caused by variation in:

• Gravitational acceleration	+/- 0.1%
• Specific particle density	+/- 0.4%
• Fluid viscosity and density (temperature)	+/- 1.0%
• Particle size (sieve diameter)	+/- 10%
• Particle dimension, (shape, properties and orientation)	+/- 15%

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Take home messages (optional)

Use all your data

- Be careful with filtering or eliminating less accurate data
- Before fitting your data, try to explain derivative deviation
- From deviation useful information can be retrieved
- Take deviation intro account when predicting or designing processes

Use proven models:

- *** Water treatment granular particles
- Hydraulic behaviour of round spheres can accurately be calculated
- Natural particles behave differently then perfectly round spheres
- The measured deviation can decisively be explained
- In particular particle shape causes distinguished hydraulic behaviour

Thank you for your attention

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