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The Dewaterability Estimation Test (DET) Apparatus

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Contents

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1. Background I

WATER & WASTEWATER TREATMENT FOR THE WHOLESALE MARKET
Volume 60 | Issue 7 | wwtonline.co.uk
JULY 2017

WWT

PIPES:
• Tests for corrosive water may need shake up for pipe health

PUMPS:
• WWT's round table discussion on pumps and their energy use

DROUGHT:
• Anglian Water directo Jean Spencer on building resilience

Sludge Showdown

How wastewater data could shape the new bioresources market

CHALLENGE

- Water and sewerage companies are reviewing their sludge treatment operations as a result of Ofwat's upstream reforms which will see a separate price control for PR19 around bioresources
- Information available on the volumes and quality of sludge produced will highlight opportunities for collaboration and new players in the market
- The reforms could assist the spread of new technologies, such as advanced anaerobic digestion and pyrolysis, as existing WASCs or new players could enjoy economies of scale for new installations

KWAN CHAN
MANAGING DIRECTOR
DEWLINK SLUDGE TREATMENT LTD

The Next Generation of Sludge Dewatering

The established equipment for dewatering sludge all comes with various pros and cons, but technology is now evolving for the better

Industry leader

Professor Dragan Savic, Exeter University

"If you can't measure, you can't manage

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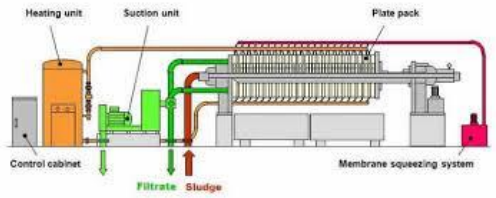
1. Background II

- **Dewatering** – removal of water from industrial process sludge.
- **Multiple industries**: mining, agriculture, breweries, paper and pulp manufacturers, and water and wastewater companies.
- **CapEx intensive**: Global market for dewatering equipment of about **$3.3bn p.a.**



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1. Background III

- Sludge filterability governs the output of **dewatering** (i.e. remove water from) **equipment** (drying beds, belt presses, vacuum filters, filter presses and centrifuges).

- **Capillary Suction Time (CST)** test is commonly used to assess filterability of sludge.

- The time taken for the water front to pass between two electrodes (solid electric conductor) constitutes the CST.

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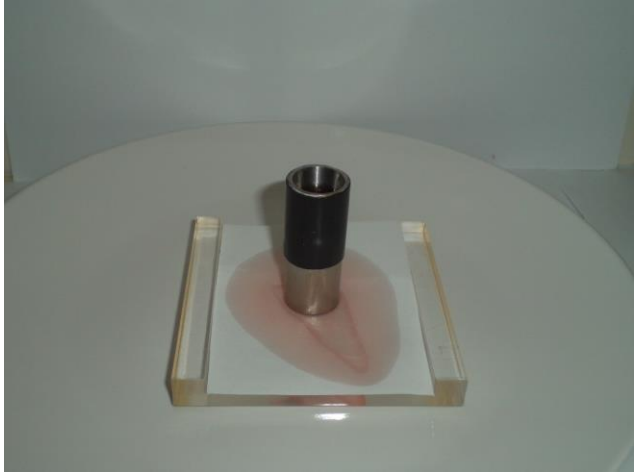

2. Problems with CST I

- The CST test has a **fundamentally flawed** design:
  - The test data are **difficult to reproduce** reliably.
  - **Tests take a very long time to generate results**.
  - The **waterfront advances radially** and not linearly, preventing accurate modelling of results.
  - The CST produces data of relative value.
  - Findings are not digitally captured and stored.

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2. Problems with CST II

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2. Problems with CST III

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3. Dewaterability Estimation Test (DET) I

- The new invention addressed the shortcomings of the CST device.
- The DET **results are stable** as long as the temperature is recorded and taken into consideration.
- Proof of Concept and prototype developments led to a **patent** application in autumn 2016.

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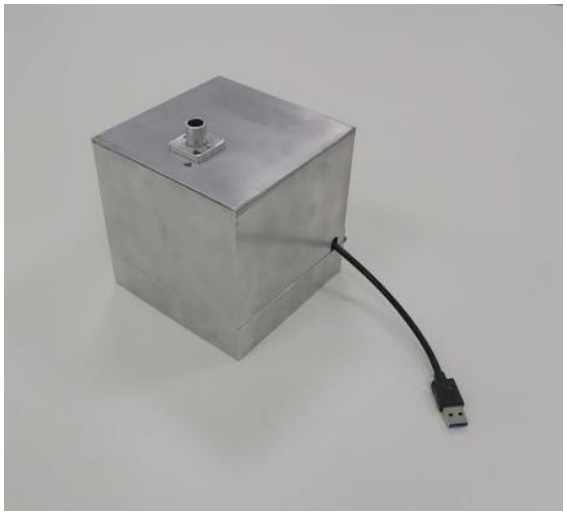
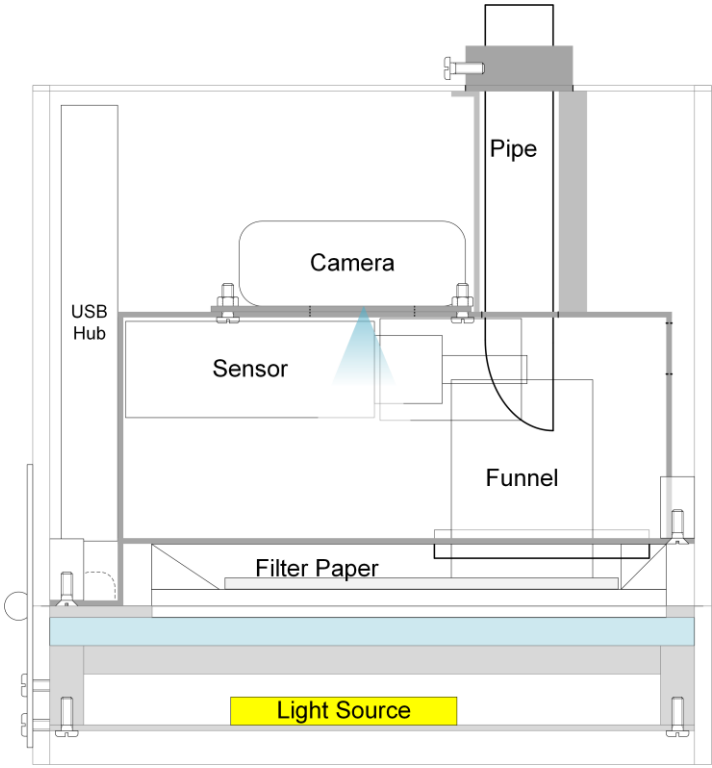
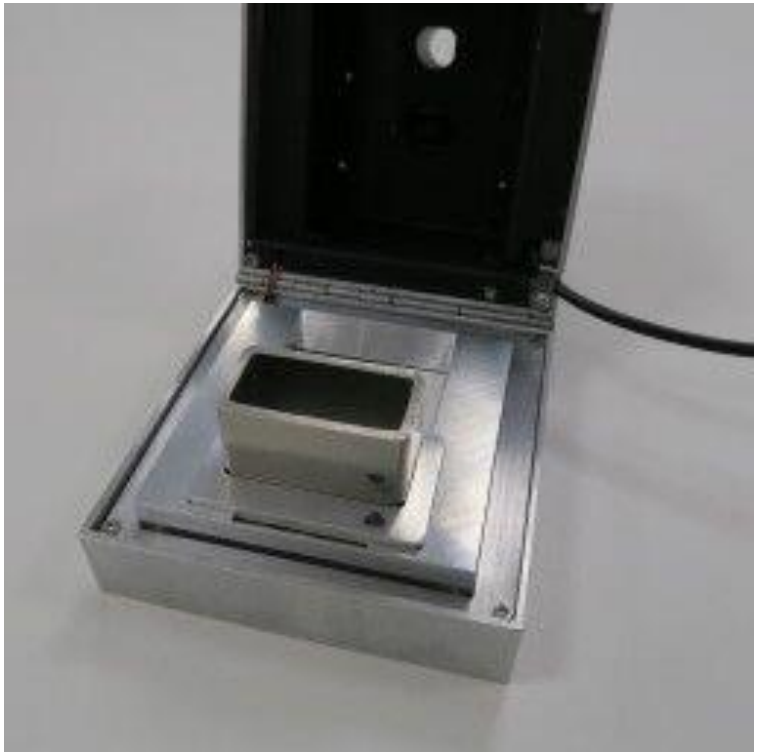
3. DET II







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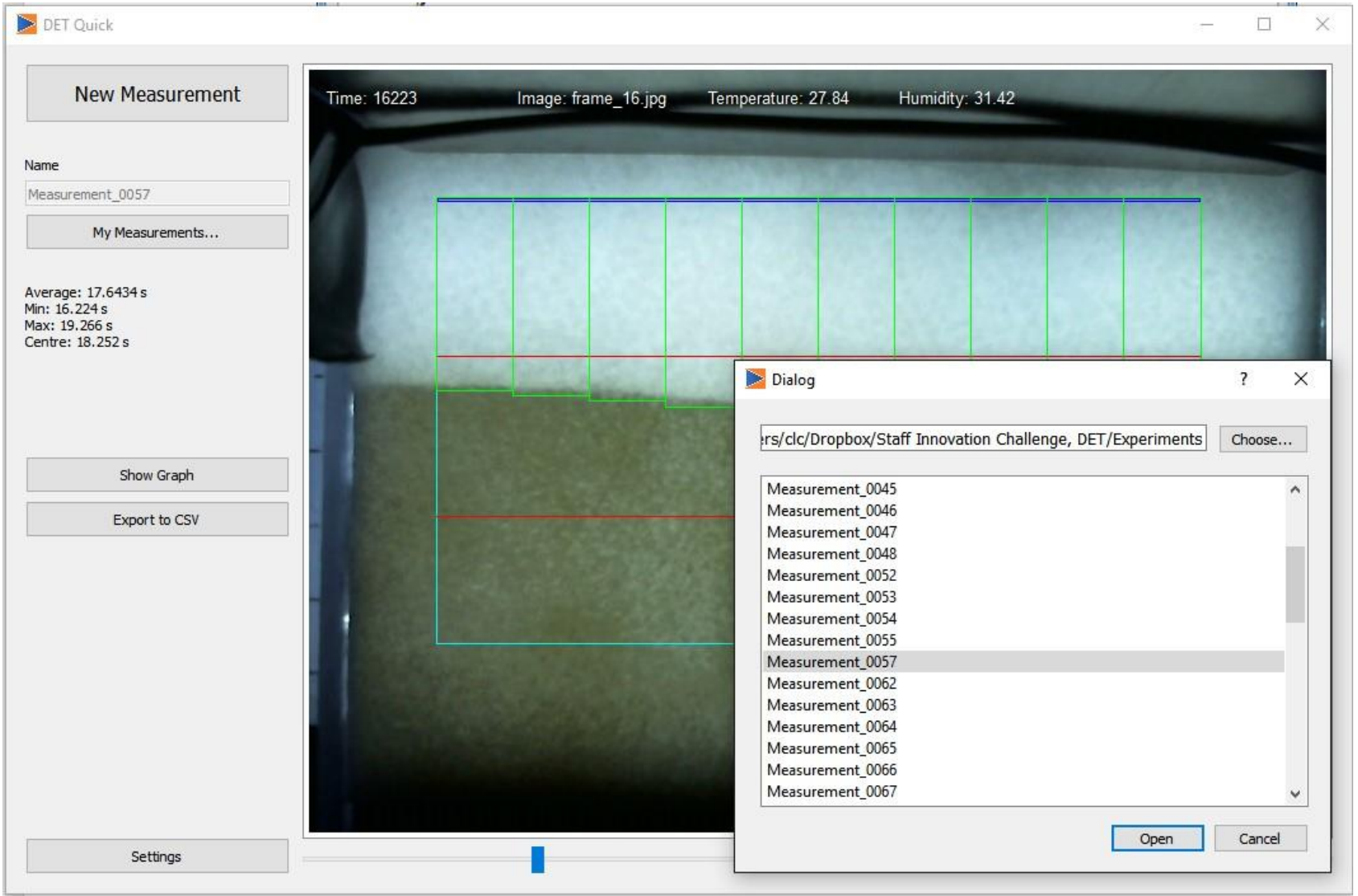
4. DET Software I



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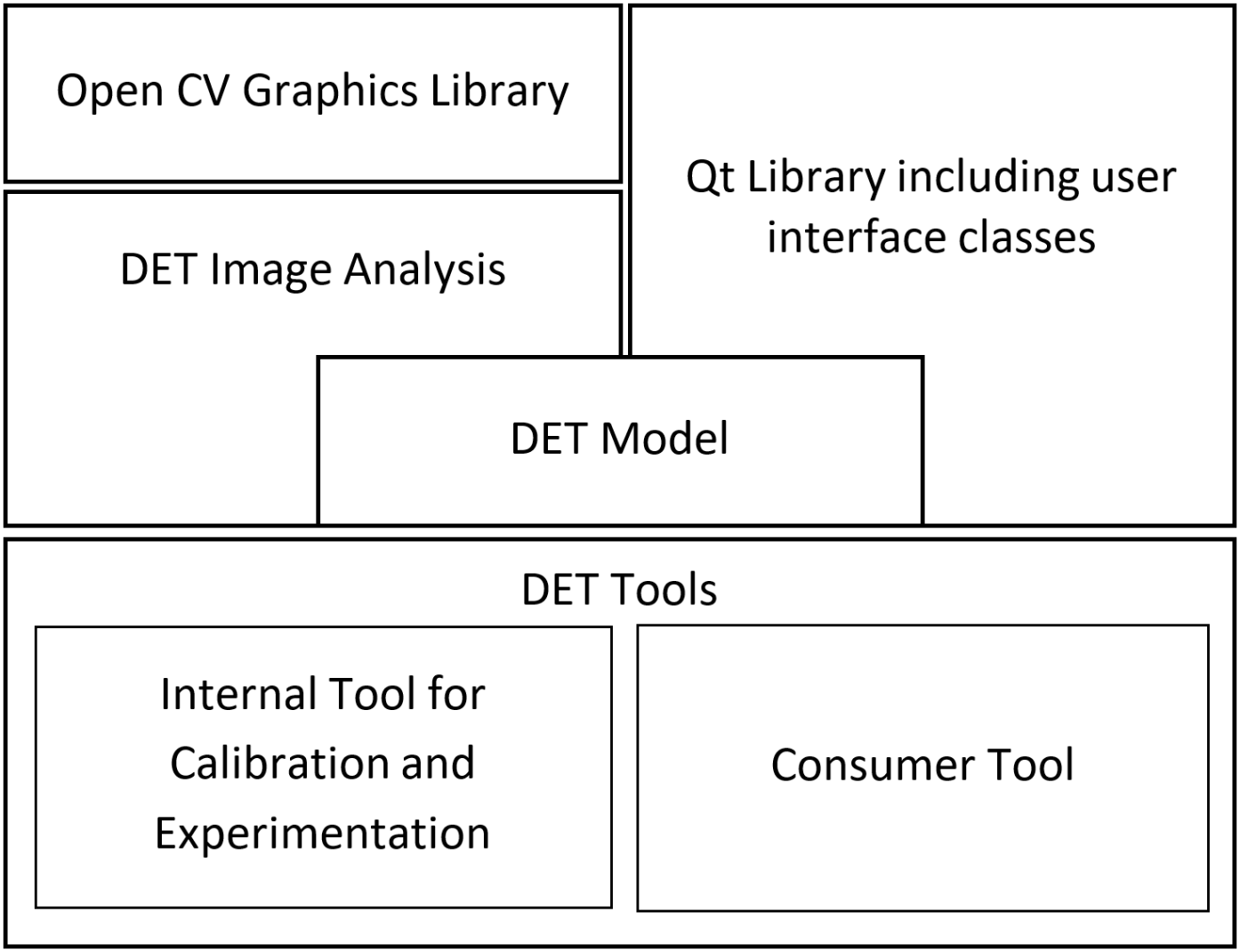
4. DET Software II



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5. Initial Results I

Synthetic sludge used for benchmarking purposes:

- Dextrin; low-molecular-weight carbohydrates (150 mg/l)
- Ammonium (130 mg/l)
- Yeast extract; eukaryotic and single-celled microorganisms (120 mg/l)
- Glucose 100 (mg/l)
- Soluble starch (100 mg/l)
- Sodium carbonate (150 mg/l);
- Detergent; commercial surfactant (10 mg/l)
- Sodium dihydrogen orthophosphate (100 mg/l)
- Potassium sulphate (8.3 mg/l);
- Kaolin; fine clay mineral (10000 mg/l)

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5. Initial Results II

Sludges used for testing in the past:

- Different raw and processed waters and wastewaters
- Various light and heavy synthetic sludges
- Primary water treatment sludge
- Various primary wastewater treatment sludges
- Various secondary wastewater treatment sludges
- Various tertiary wastewater treatment sludges
- Return/waste activated sludges
- Domestic septic tank sludge
- Ochre-based sludge from mining activities
- Paper and pulp sludge (Sweden)
- Sewage sludges (Evides, Belgium) – more later on
- Sewage sludges (United Utilities, UK) – more later on

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5. Initial Results III

Average measurement times in seconds for different filter papers

	CST B	BF3 B	EE 2.0H B	CST C	BF3 C	EE 2.0H C
DET	**163**	**110**	**177**	**24**	**20**	**16**
CST	709	577	1128	61	47	180

Relative standard deviations expressed in % for different filter papers

	CST B	BF3 B	EE 2.0H B	CST C	BF3 C	EE 2.0H C
DET	22	**12**	**19**	**16**	**8**	**36**
CST	**19**	24	50	54	25	52

References used: B: Synthetic sludge C: Synthetic domestic wastewater

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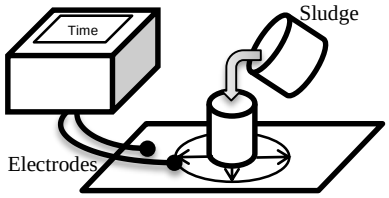
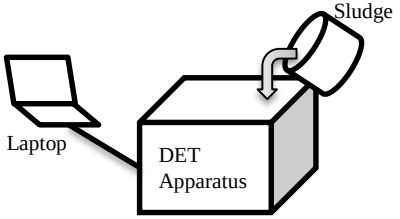
5. Initial Results IV





Variable	CST	DET
Range of Application	★☆☆	★★★
Simplicity	★★★	★★☆
Reliability	★☆☆	★★★
Measurement Time	★★☆	★★★
Flexibility	★☆☆	★★☆
Measurement Data	★☆☆	★★★

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6. Outcomes

- The DET apparatus is **more reliable** than the CST apparatus.
- It generates **results faster**.
- The device is flexible, **easy-to-use** and adjustable to new scenarios.
- The DET apparatus produces **more data;** multiple points of measurement and deceleration of dewatering throughout measurement.
- The invention offers a competitive solution for **all industries** where sludge is being produced.

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7. Testimonies I

"I was really ***impressed*** with the capabilities of the DET instrument; in a direct comparison to the CST, it appeared to not only provide ***a more detailed visual display*** of the dewaterability, but also we were able to ***run two full tests*** on the equipment, whilst the ***CST was unable to complete one***."

United Utilities
6 November 2017
Jenni Croft, Assistant Area Engineering Manager (Bioresources)
Bioresource Services

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7. Testimonies II

"**DET** turned out to be the **most effective sludge dewaterability testing method** because it is very user-friendly, simple to operate, provides high reliability results and need very little operational time for determination of sludge dewaterability."

Evides report on
"Sludge dewaterability estimation: determining the optimal testing method and improving operational performance "
October 2018

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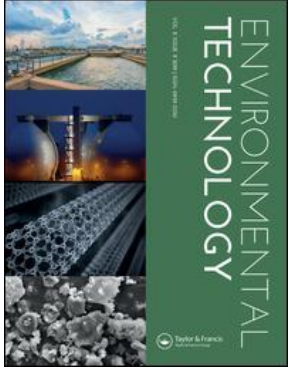
8. Further Reading



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ENVIRONMENTAL TECHNOLOGY
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Highlights of the novel dewaterability estimation test (DET) device

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ABSTRACT

Many industries, which are producing sludge in large quantities, depend on sludge dewatering technology to reduce the corresponding water content. A key design parameter for dewatering equipment is the capillary suction time (CST) test, which has, however, several scientific flaws, despite that the test is practical and easy-to-perform. The standard CST test has a few considerable drawbacks: its lack of reliability and difficulties in obtaining results for heavy sludge types. Furthermore, it is not designed for long experiments (e.g. >30 min), and has only two measurement points (its two electrodes). In comparison, the novel dewaterability estimation test (DET) test is almost as simple as the CST, but considerably more reliable, faster, flexible and informative in terms of the wealth of visual measurement data collected with modern image analysis software. The standard deviations associated with repeated measurements for the same sludge is lower for the DET than for the CST test. In contrast to the CST device, capillary suction in the DET test is linear and not radial, allowing for a straightforward interpretation of findings. The new DET device may replace the CST test in the sludge-producing industries in the future.

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KEYWORDS
Capillary suction time; filter paper property; image processing technology; resistance to filtration; sludge treatment; water technology

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9. Next Steps

- Continued development of DET device through **field trials** with end users to develop it as de facto test protocol.

- **Commercial prototype** units are available to use from now on.

- Would like to work with you to use the **DET in real world situations**:

    - Offer to travel to your premises with a DET device and work with your teams to evaluate the device on your problems.
    - Please get in touch after the presentation!

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