Quartz Crystal Microbalance with Dissipation Monitoring (QCM-D) Cleaning profile

Clever Characterisation for Smarter Formulation
Royal Society of Chemistry, Burlington House, Piccadilly, London

Friday 10th November 2017

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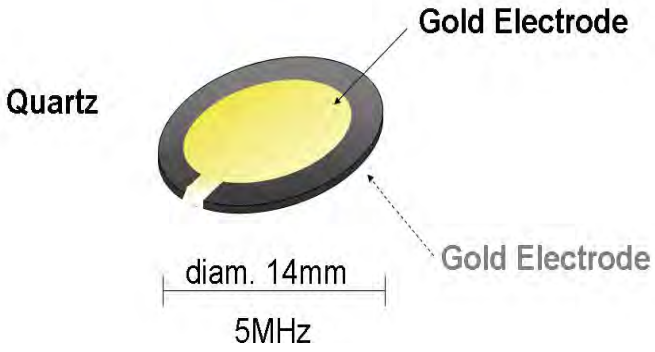
WHO WE ARE…

- **>70 employees** globally (~ 30% PhDs).
- Head office in **Gothenburg**, Sweden.
- **R&D and manufacturing** in Sweden and Finland.
- Direct sales in USA, UK and China, distributors in **>70 countries**
- Part of **Add Life**

MORE ABOUT WHO WE ARE…

- Surface science experts
- Widely adopted and accepted techniques and methods
- Thousands of publications
- Work with companies including Henkel, AkzoNobel, Clariant, BASF…

QSense QCM-D technology



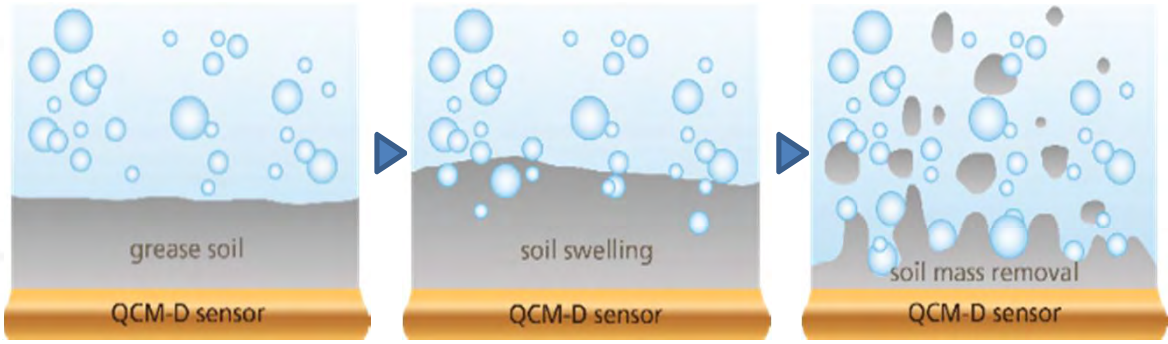


Illustration of cleaning steps to obtain the cleaning profile.

- Sensor can be coated with a suitable soil for your experiment

- QSense enables analysis of molecular interactions and surface properties.

What are your main challenges for cleaning efficiency?

- Constant development of more efficient and eco-friendly detergents and formulations
- Slow R&D test methods

Basic, analogue techniques, e.g.

Visual inspection
Foam height (Ross Miles test)
Wettability (Draves method)

One point measures

Need to do several analysis methods/tests

Non-automated, manual methods

A fast lane to the future

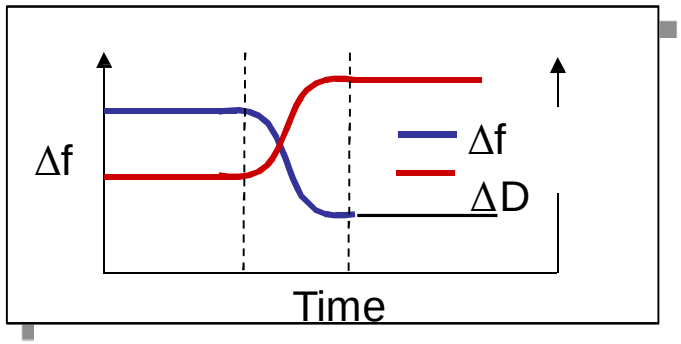
QSense offers a method for efficient screening and ranking of surfactant / formulation candidates

- Know HOW FAST your candidates clean.
- Know HOW CLEAN your candidates clean.
- Speed up the development of more efficient and ENVIRONMENTALLY-FRIENDLY products.

So that you can be FASTER. CLEANER. GREENER.

What makes QCM-D unique?

- Follow molecular events in REAL TIME
  - in liquid or in air
- Label free technique
- Measures frequency and dissipation changes
- ΔF a mass
  - Sauerbrey equation (uniform, rigid film)
  - Thickness



- Dissipation measurements – viscoelastic properties of the layer
  - How soft? How rigid?
- Measure mass 0.5 ng/cm2 and thickness of molecular layers (resolution: 1Å - 1µM)
- Frequency range of 1-70MHz and time resolution of 200 data points per second
- Analyse structural properties of molecular layers, reproducible data
- Wide array of sensor coatings for specific applications
- *Understand how QCM-D is a valuable technique for your formulation research*

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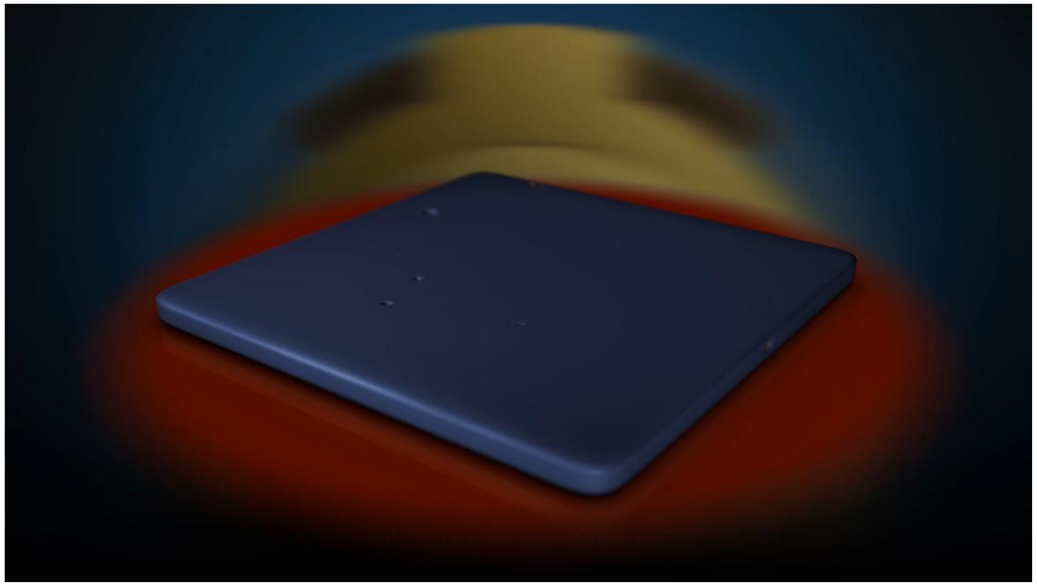
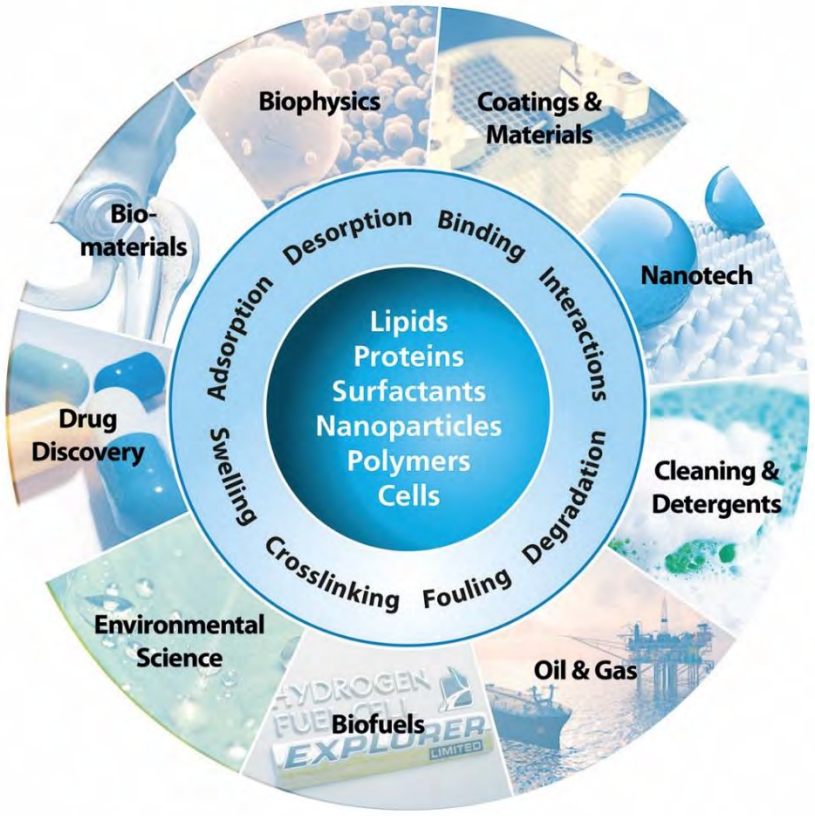
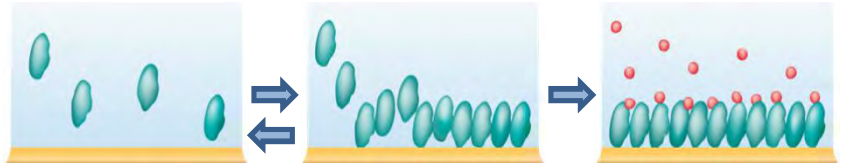
Soil removal is a chemical process

Sinners circle

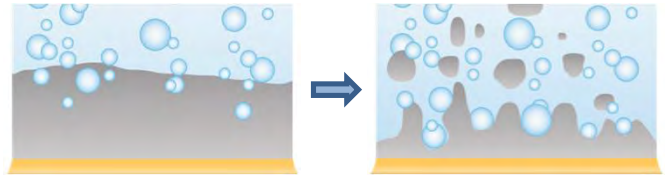


Application Areas

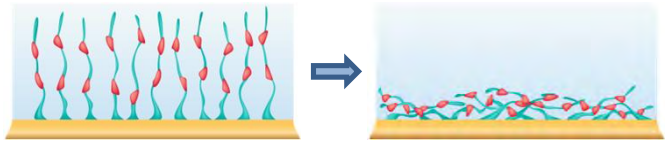




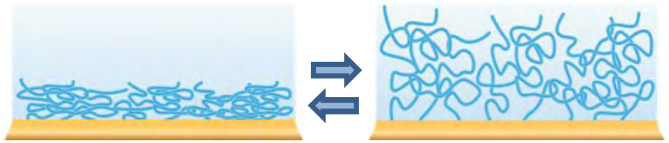
Absorption/Desorption/binding



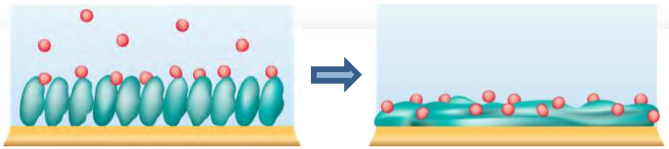
Degradation



Cross-linking



Swelling/collapse



Conformational changes

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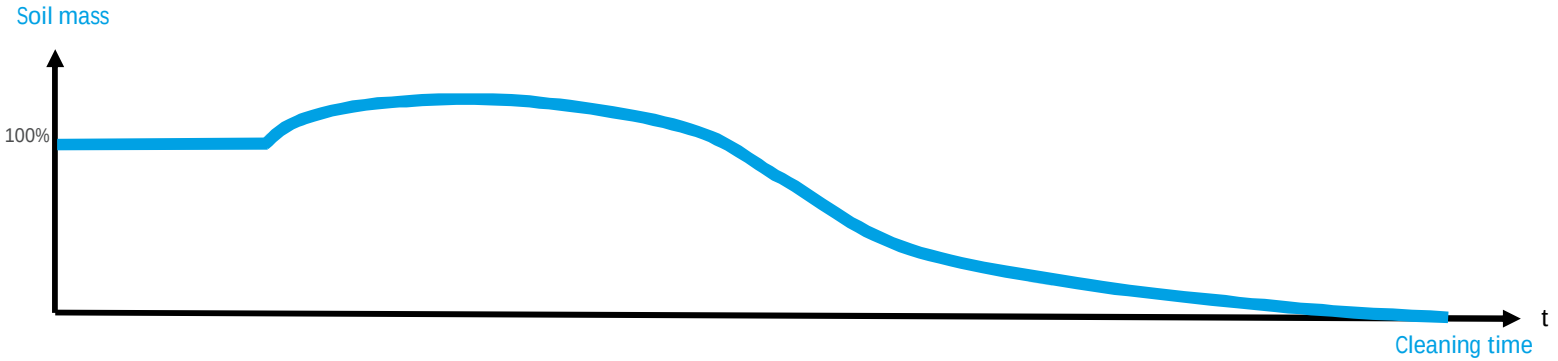
The QSense cleaning profile

The chemical cleaning process in real-time

- How fast?
- How much soil is removed?
- Good or bad? Fast or slow?



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Comparing different cleaning profiles

Cleaning profile A: SLOW

- 15% of the soil remains
- Cleaning process still ongoing
- Longer wash cycle required

Cleaning profile B: BAD

- 15% of the soil remains
- Cleaning process inactive
- Bad final result

Cleaning profile B: FAST

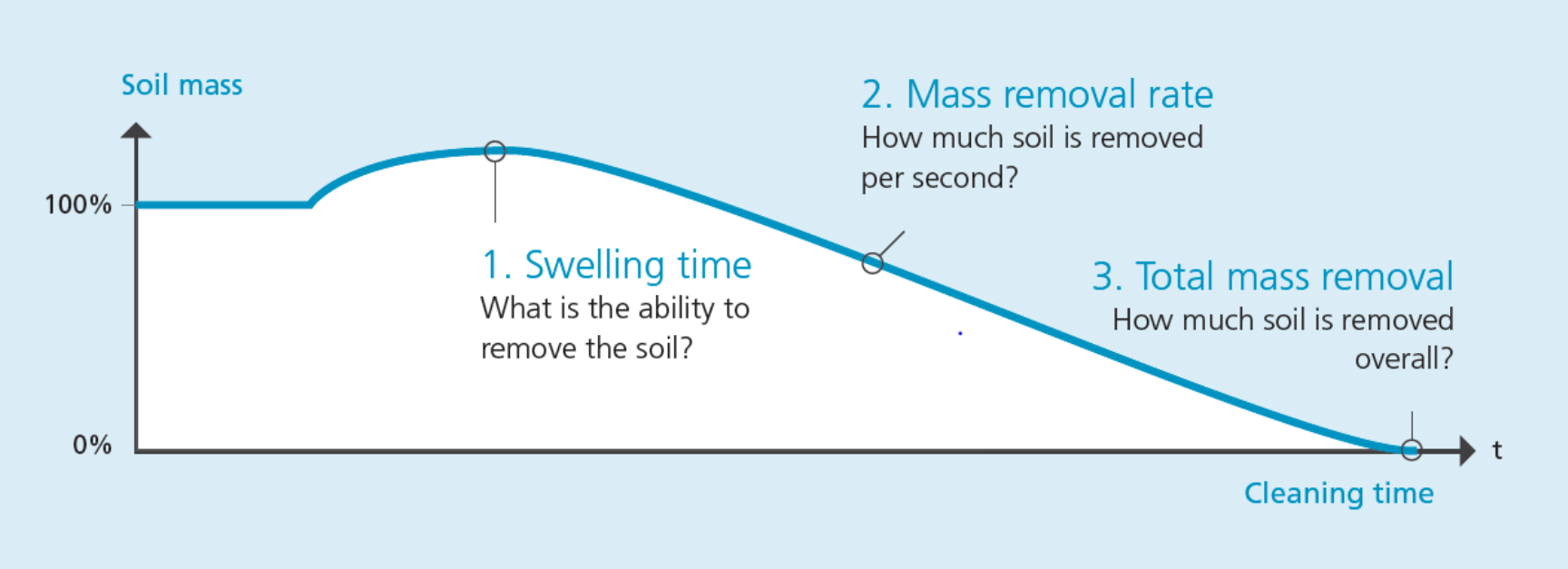
- 100% of the soil removed
- Cleaning process inactive
- Shorter wash cycle or less efficient candidate possible

Comparing candidates in varying conditions

- Composition
- Concentration
- Temperature dependence
- Water quality
- Wash cycle time

- Pre-program and run up to 8 samples in one go
- Get high precision, real-time reproducible data

Three key values

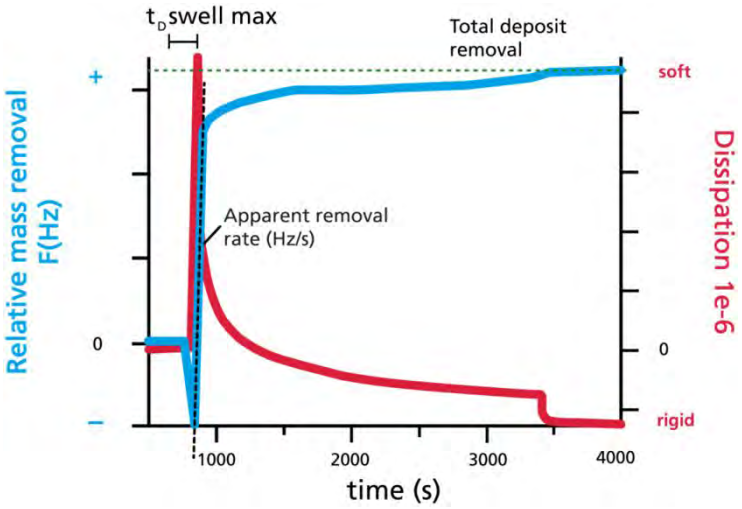


Data derived from changes in frequency and dissipation

1. Removal rate
   How much material is removed per second?

2. Total removal
   How much soil is removed overall?

3. t_D Swell Max
   How quickly does the soil swell?



Olesen, K, et al. Revealing detergent efficiency and mechanism by real-time measurement using a novel and tailored QCM-D methodology, Tenside Surfactants, 5, 2016

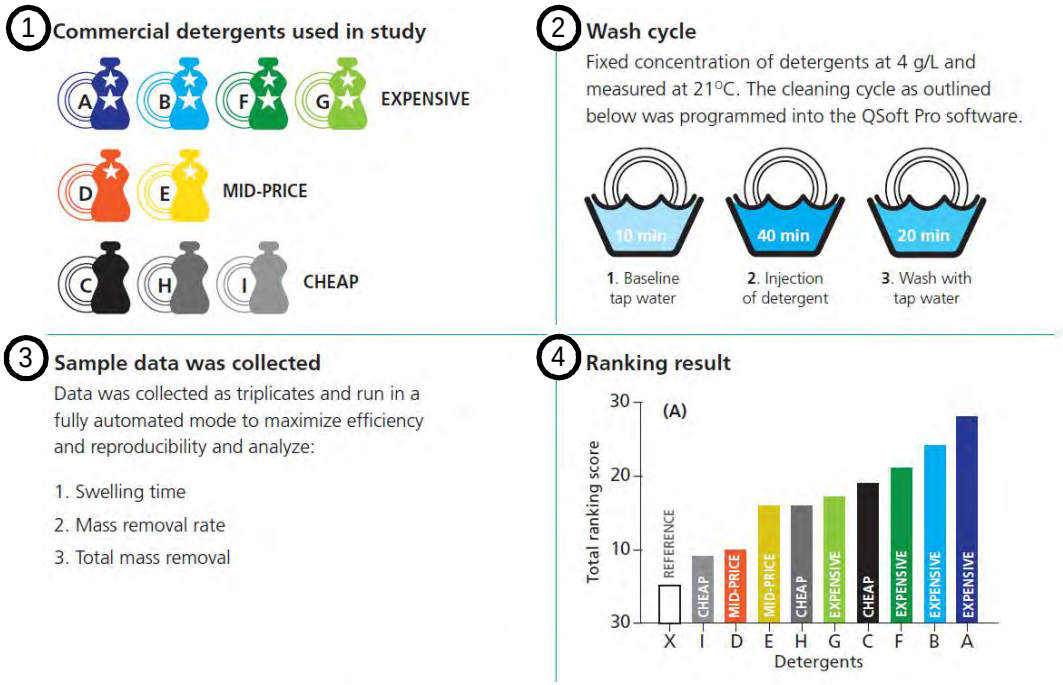
Evidence-based ranking of surfactants/formulations

Study by Biolin Scientific in collaboration with Center for Testmaterials BV(Netherlands)

- Swell time, mass removal rate and total mass removal tested for 9 commerically available formulations
- Rapid screening and ranking of the formulations was easily achieved
- Significant correlation found when comparing to Center for Testmaterials 'macro scale' set-up

http://www.hanser-elibrary.com/doi/pdf/10.3139/113.110445

Evidence-based ranking of surfactants/formulations



AkzoNobel – an application example

In Q2 2017 AkzoNobel revealed new results for their ELFAN AT 84 G surfactant based on QSense Cleaning Profile

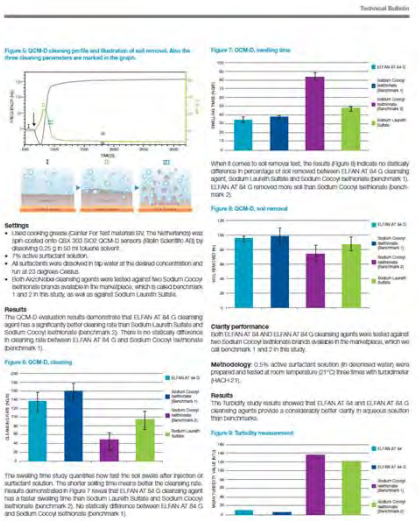
- Significantly better cleaning rate than competitor product
- Helps differentiate products
- Used both during and after the development phase
- QSense Cleaning Profile added to the ELFAN product data sheet


AkzoNobel Surface Chemistry

ELFAN® AT 84/ELFAN® AT 84 G

Mild anionic surfactant for cleansing systems

AkzoNobel

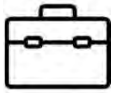


QSense Dfind analysis software

- A complete analysis toolbox in one intuitive software application
- Explore the full potential of your data
- Analyse all data in one go

QuickView and AutoPlotting to review and compare results

Material library and Model fit traffic lights



SmartTools analysis method toolbox

Batch mode and template tool

Report tool

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