rheonics

# Self-cleaning sensors for automated continuous slurry viscosity and weight monitoring in-tank

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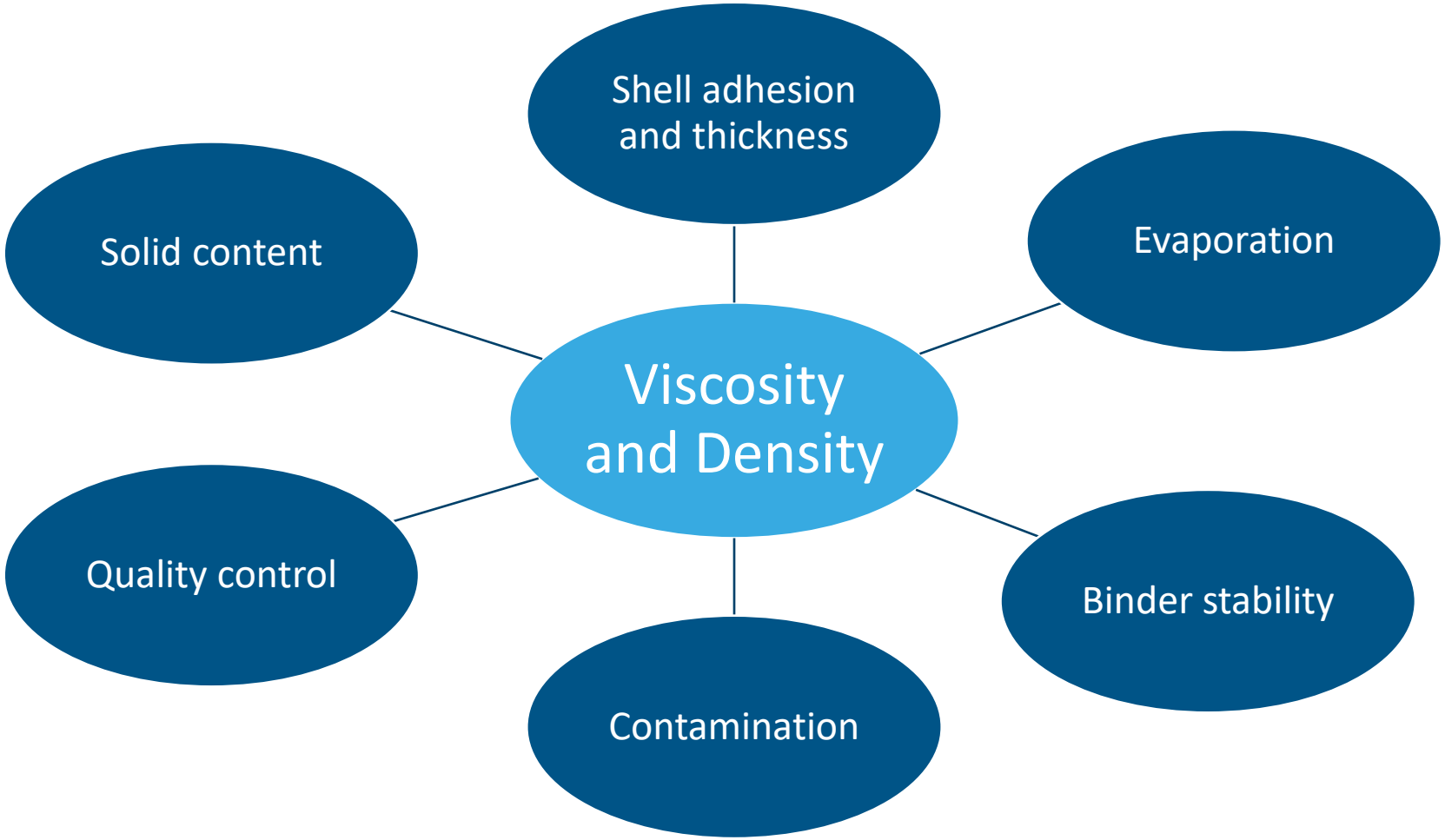
# Agenda

1. Background
2. Motivation
3. Design Principle
4. Proof of Concept
5. Field Trial
6. Outlook

# Background

# 1. Background

Slurry consistency measurements



# 1. Background

Current slurry monitoring options

1 **Manual measurements**

2 **Continuous in-tank viscosity and density measurements**

# 1. Background

Problems with existing systems: manual

1 **Manual measurements**

- Intermittent
- Operator variability
- Time consuming
- Frequent device cleaning
- Samples tested outside of process conditions
- Time delay

# 1. Background

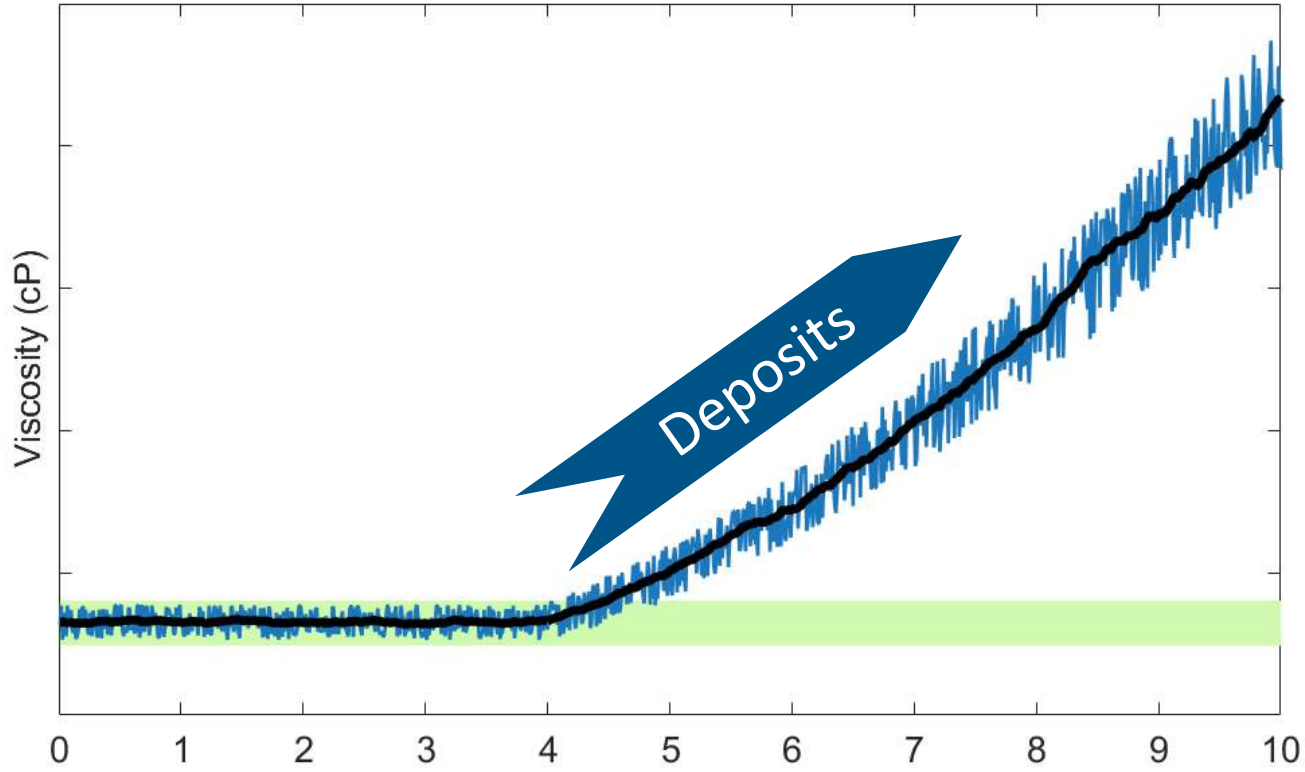
Problems with existing systems: in-tank

- Many slurries give continuous readings without issue.
- Slurries, by design, adhere to surfaces.
- Deposits formation can distort readings.
- Cleaning schedules/checks for sensor can be required.

# 1. Background

Problems with existing systems: in-tank

- Cleaning requirements differ by foundry and slurry.
- Observing readings over time is required to find necessary cleaning frequency
- Hurdle towards measurement use in process control




**Method for preventing deposition is desired.**

# Motivation

# 2. Motivation

## Desired outcomes

- Uninterrupted reading
- Built-in cleaning mechanism:
  - Prevent deposit formation
  - Remove deposits after formation
- Reduce maintenance
- Increase shell room operator trust

**Is this even possible?**

# 2. Motivation

Deposit-free sensor

- Standardize cleaning timeline? → **Too much variation between slurries**
- Cleaning robots? → **Not fast enough for some deposits**
- Non-stick coatings? → **Slurries are abrasive**
- Self-cleaning?

# 2. Motivation

Requirements

- Self-cleaning
- Prevents deposition
- Compatible with existing sensor technology
- Does not interfere with measurements
- Does not interfere with tree dipping

# Design Principle

# 3. Design Principle

Inspiration

# 3. Design Principle

Features

Mount for adjustable length

Built-in Vibrator

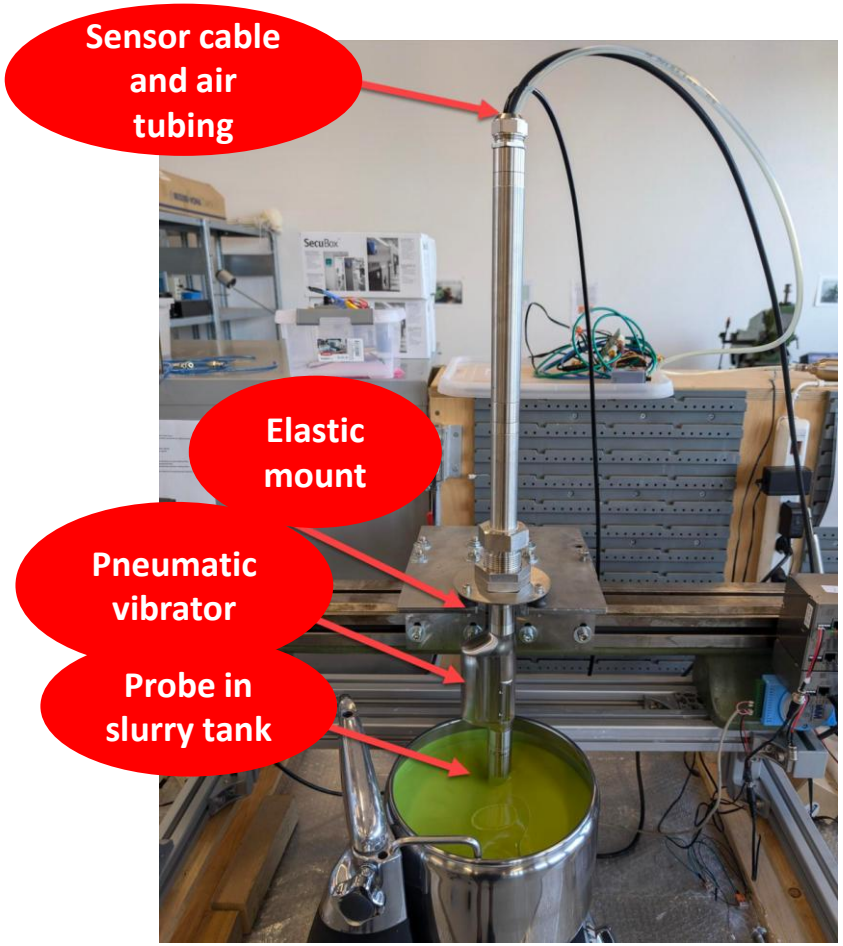
- High amplitude
- Low frequency

Rheonics SRD sensor

# Proof of Concept

# 4. Proof of Concept

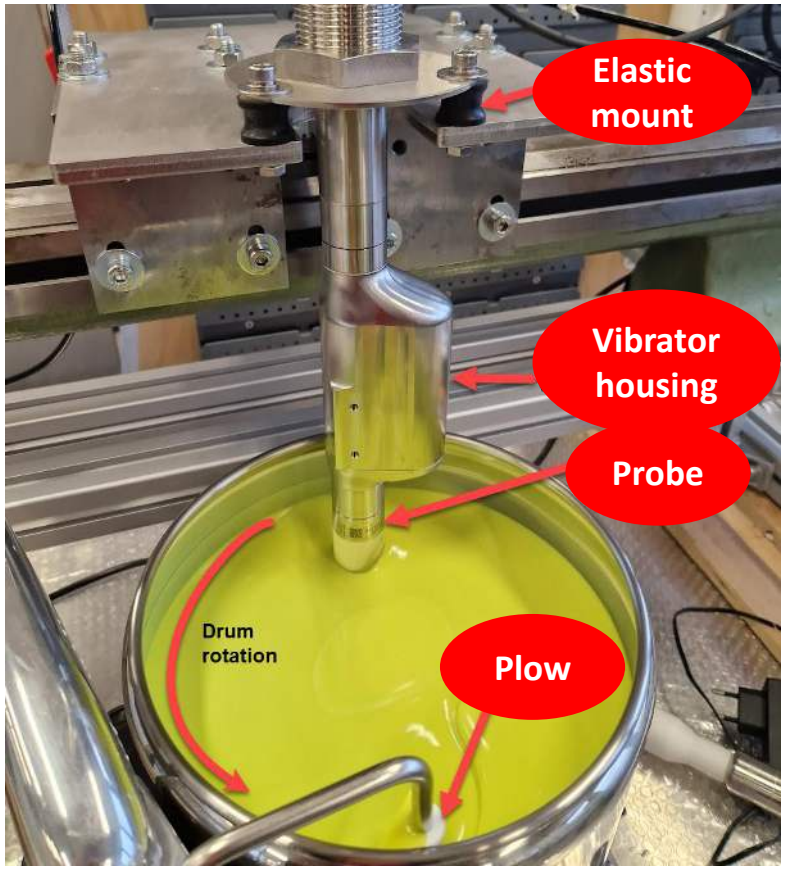
## Validation




- Kitchen mixer with rotating bowl and plow blade
- Ransom & Randolph SuspendaSlurry
- Rheonics SRD for viscosity and density measurements
- Pneumatically-actuated vibrator

# 4. Proof of Concept

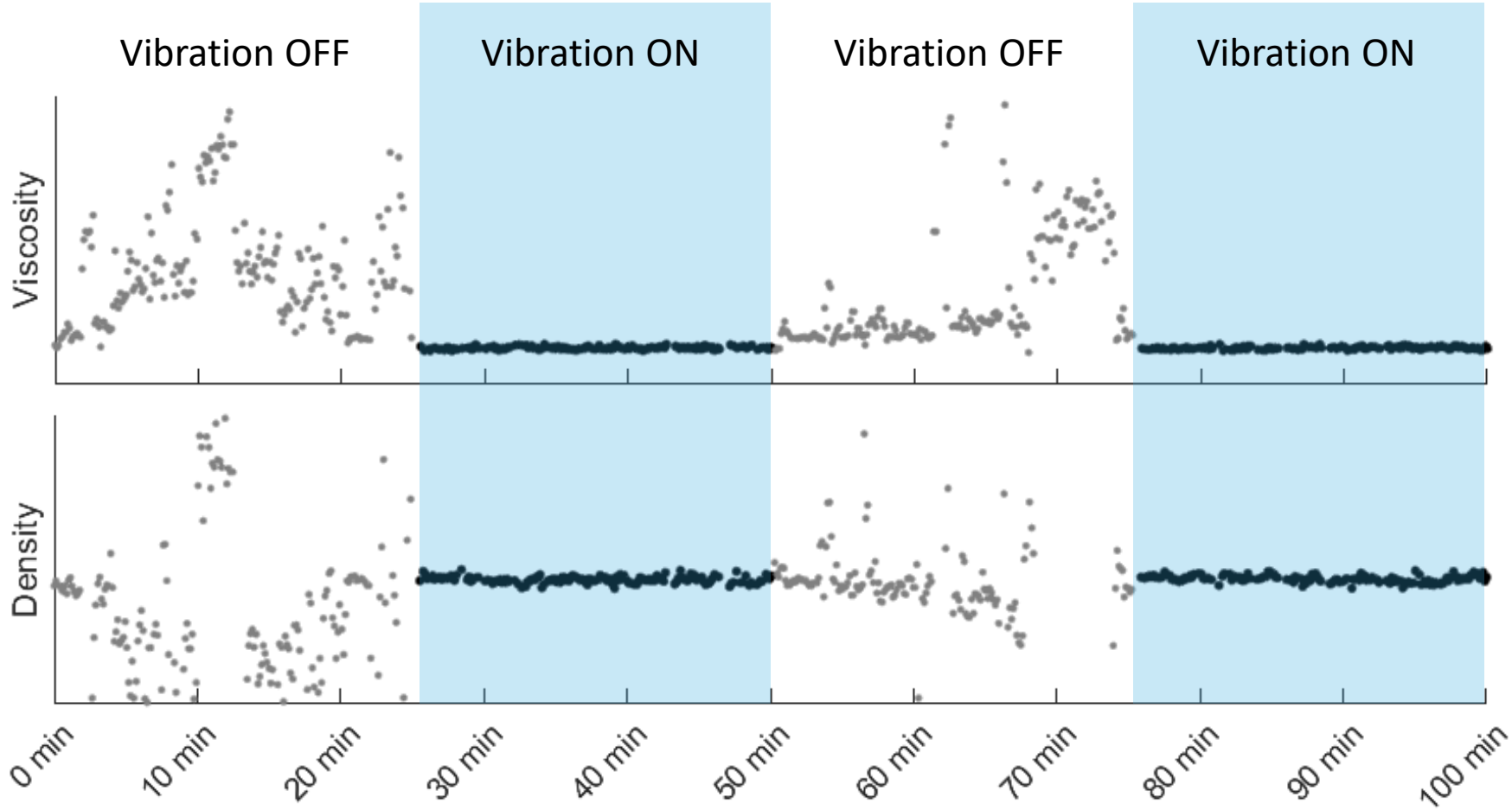
## Experimental procedure




- Drum was rotated at a constant speed
- Viscosity and density recorded as a function of time
- Cleaning vibration alternated:
  - 25 minutes off
  - 25 minutes on

# 4. Proof of Concept

Results



# 4. Proof of Concept

## Manual density check

- Agrees well with conventional density measurement

# Field Trial

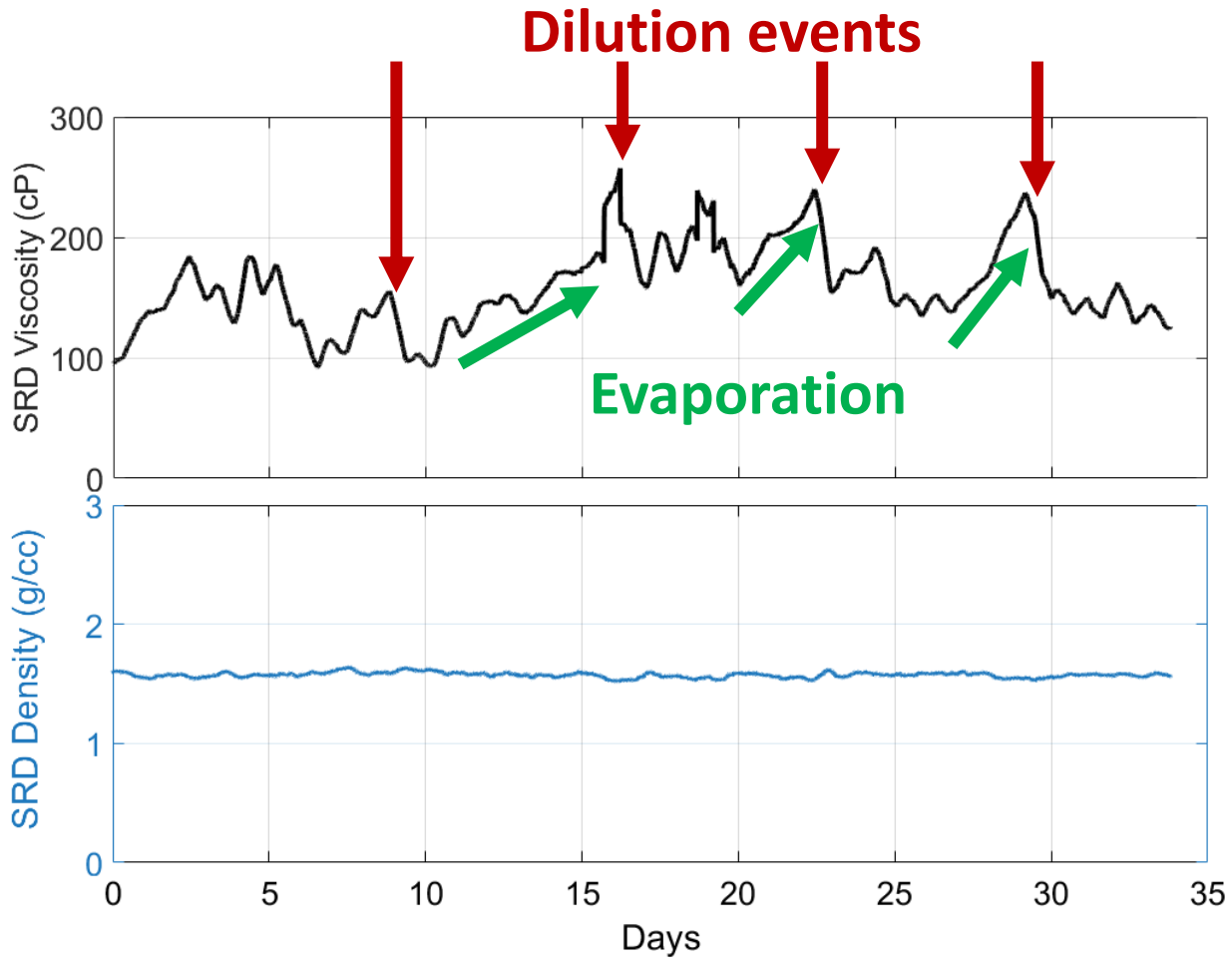
# 5. Field Trial

Validation in industrial shell room

- Prime slurry
- Slurry previously known to form deposits on sensor in-tank
- Plant operation continues normally
- Data acquired in parallel from:
  - Efflux cup
  - Rheonics SRD with vibration
- Continuous operation
  - 5 months so far !

# 5. Field Trial

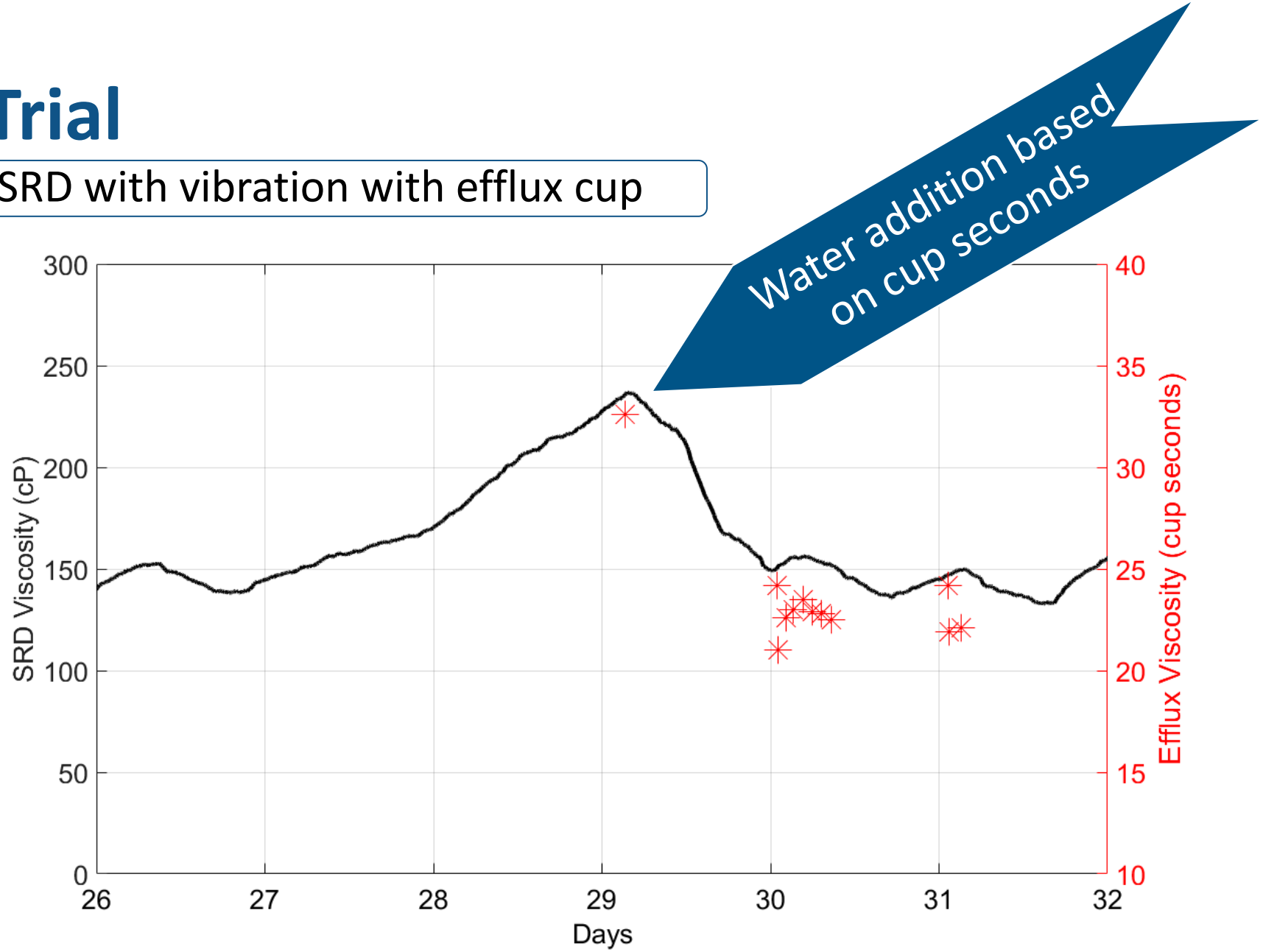
Results from SRD with vibration




- No cleaning or inspection for period shown
- 1 month of operation
- Vibration run continuously
- Density remains constant

# 5. Field Trial

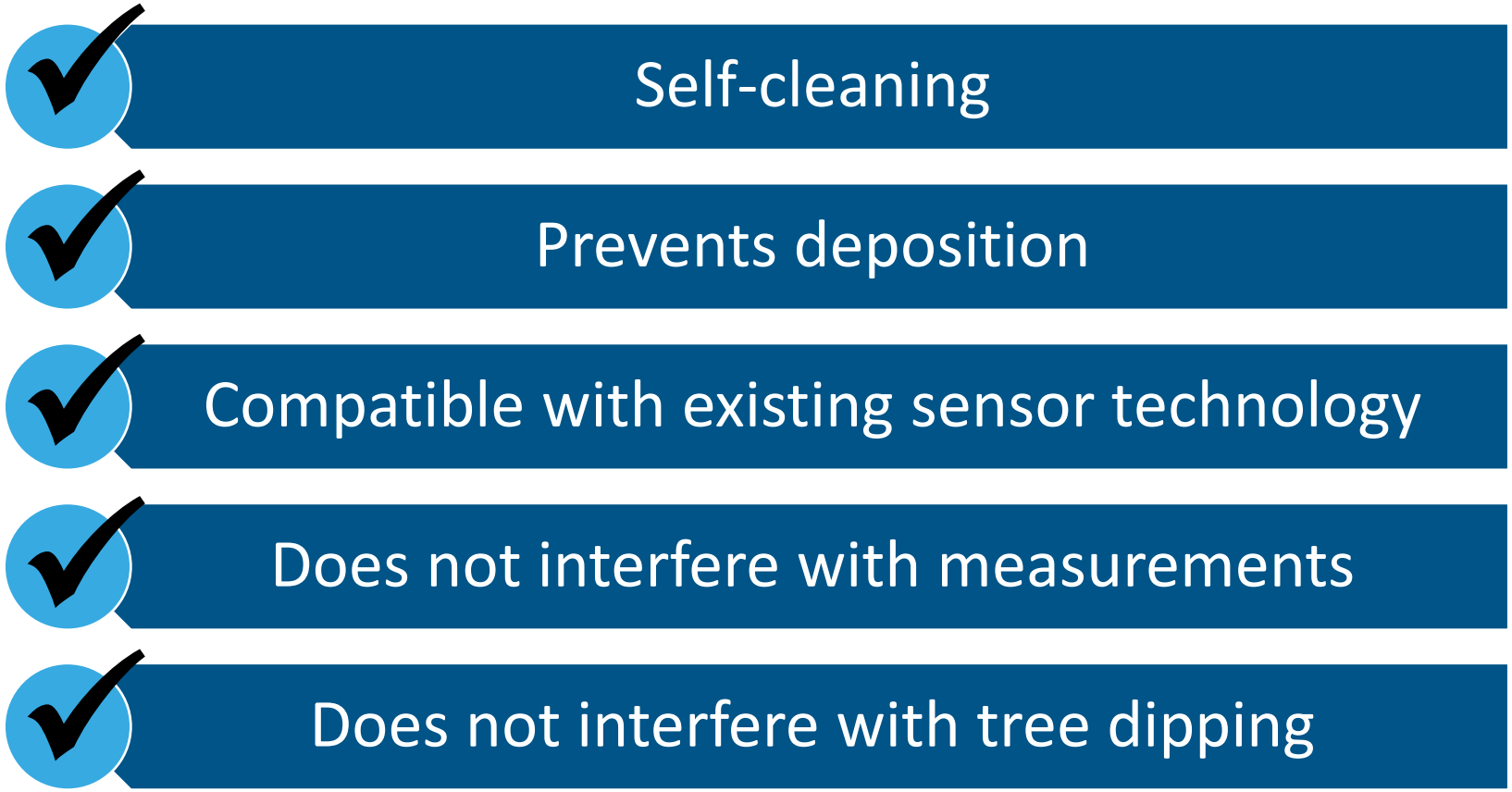
Results from SRD with vibration with efflux cup



# Outlook

# 6. Outlook

Requirements fulfilled



# 6. Outlook

## Shell room automation

- Extends application of SRD viscosity and density measurements to **deposit prone slurries**
- Reduces reliance on **manual measurements**
- **Saves cleaning time**
- **Increases trust** of in-tank measurements
- **Reduces measurement reliability** concerns
- Step towards **Industry 4.0**

# Questions?

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