Bringing Smart Technology to Centrifugation

LK Industries

October 13, 2016

LK Industries

- History and Milestones
  - Founded in 1930 as LK Pump and Valve Company
  - Built first centrifuge in 1950 – "The Melton"
  - Launched Transport Series in late 80's
  - Built first Lab Centrifuge in 1999 in partnership with Exxon
  - Acquired Miller and Weber in 2016
  - Developed first SMART Transport Centrifuge: 2016+

- About Us
  - Located in Houston, TX
  - 25 Employees
  - Five Core Product Lines
    - Centrifuges, Heaters, Gaging Accessories
    - Glassware (tubes, thermom, hydrom), 17025 Calibrations
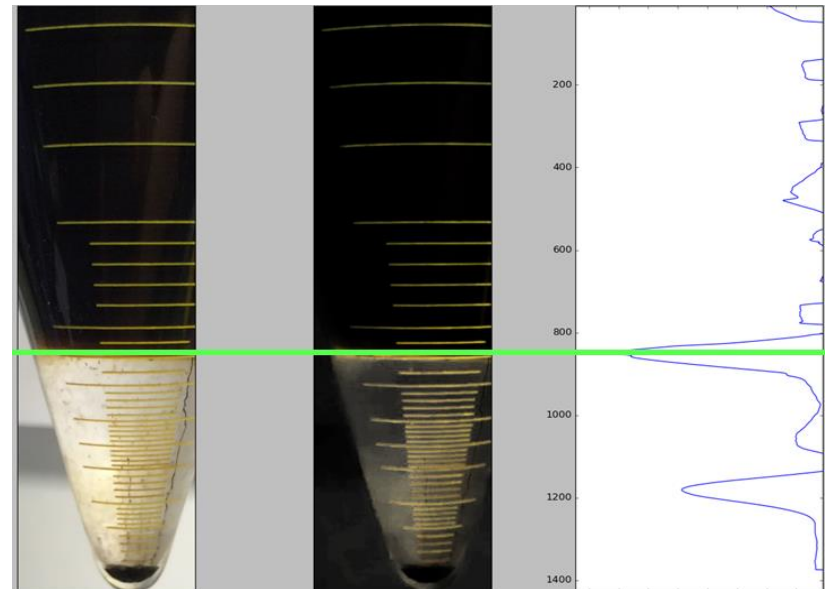
Field BS&W

- Current Approach:
  - Onsite centrifugation of sample by drivers
  - Suggested Method: API 10.4
    - Duration: 5 min test, RCF: => 500
    - Temperature: 140°F ± 5°F; samples within 15°F
    - Tolerance: one subdivision, minimum 2 tests, 2 samples
  - Results manually read and reported

- Limitations of Current Approach:
  - Visual inspection prone to subjectivity and error
  - Limited traceability of testing results
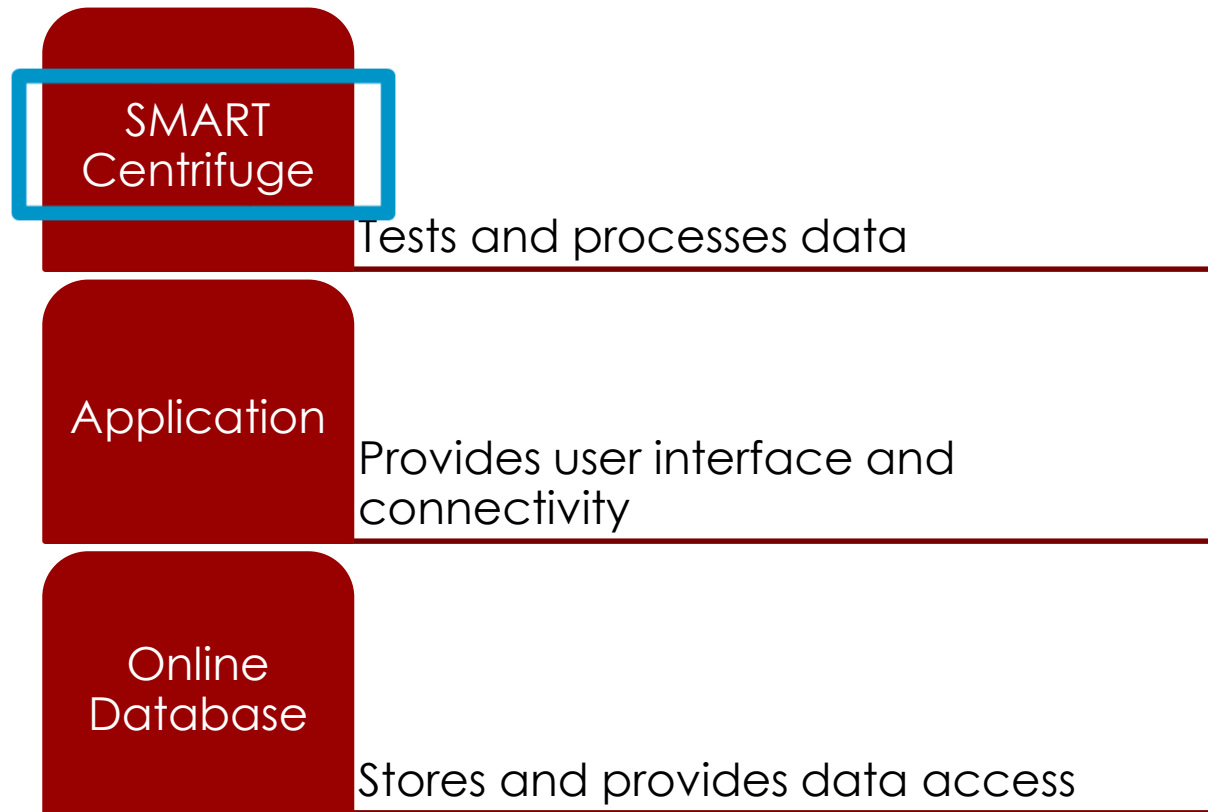 - Lack of conformance to test methods

What Must Be True?

- Business Case
  - Material consequence to inaccurate readings
  - Cost of solution must less than cost of issue

- Field Acceptance
  - Easily deployable
  - Must not impede efficiency

- Improve Outcomes
  - Testing traceability
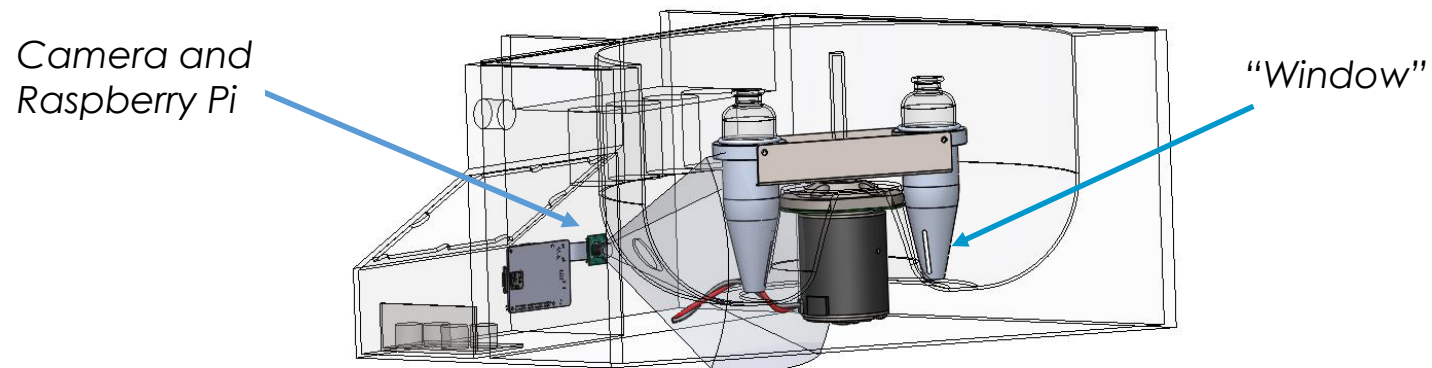 - Data analysis
  - Reduction in human error

A New Approach

SMART Centrifuge

Tests and processes data

Application

Provides user interface and connectivity

Online Database

Stores and provides data access
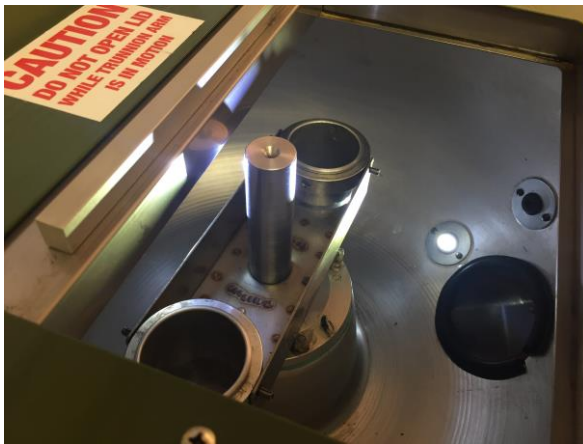
The SMART Centrifuge

- Utilize a camera and processor to read BS&W from field samples

- Transmit data from the unit to the app

- Confirm tests are being run onsite and in accordance with API standards
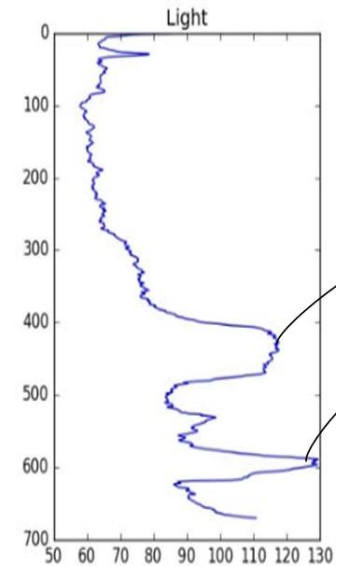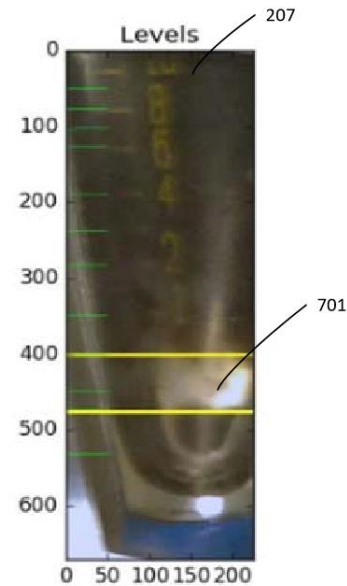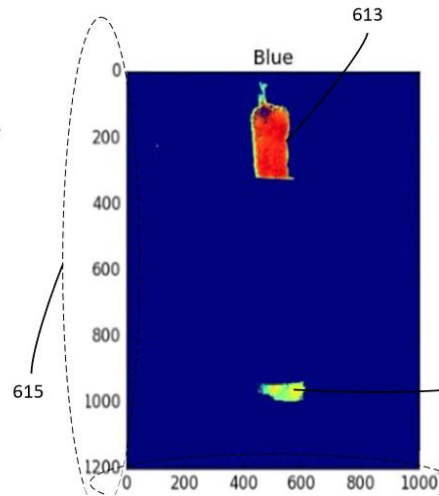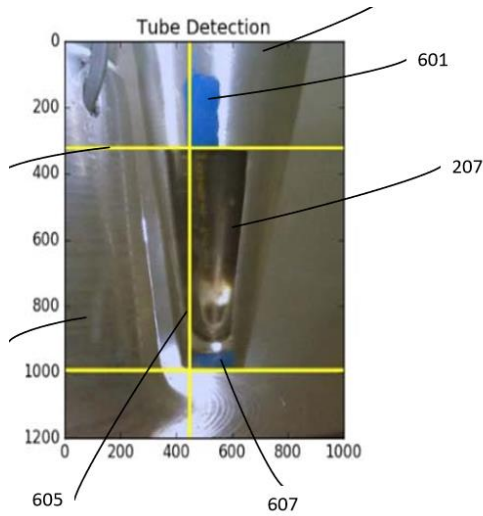
Camera and Raspberry Pi

"Window"

Patent Pending

Hardware

Detection Process

The System

SMART Centrifuge

Tests and processes data

Application

Provides user interface and connectivity

Online Database

Stores and provides data access

The App

Begin Testing

START TEST
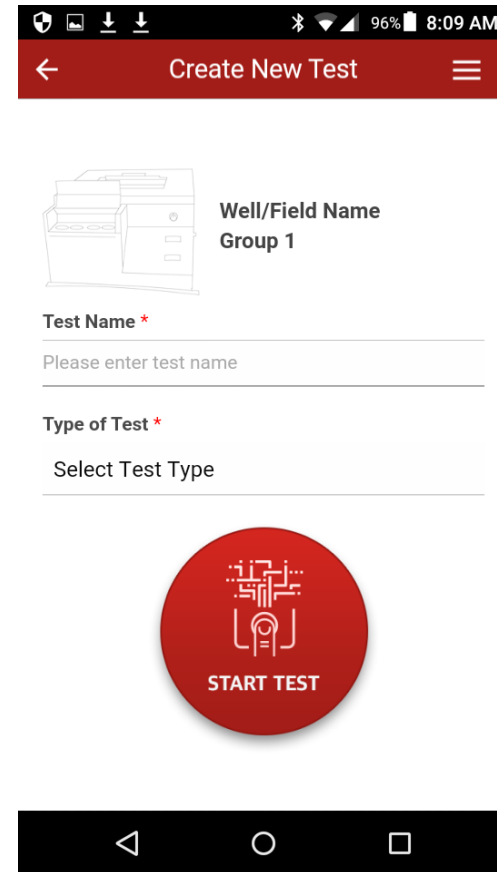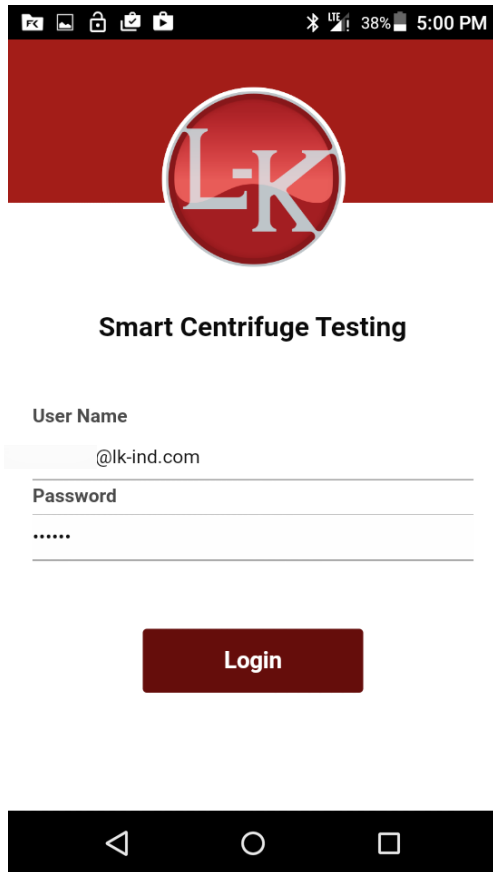
Testing

Centrifuge is Warming Up

🕐 9 mins, 27 secs.

🌡 120 F

⏱ 1,769.47 RPM

🔄 691.08 RCF

SMART Centrifuge is confirming proper testing conditions

Testing

Test in Progress

🕐 0 mins, 25 secs.

🌡 139 F

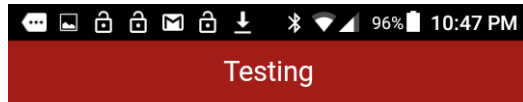⏱ 1,884.00 RPM

🔄 783.44 RCF

Stop Testing

Test is running in accordance with selected test method

View Results

The System

SMART Centrifuge

Tests and processes data

Application

Provides user interface and connectivity

Online Database

Stores and provides data access

Online Database

Test sets are presented in a summary view with the ability to export raw data

Online Database

Test Name : Test 3

						Water Content	Sed. Content		
Date & Time : 8/10/2016, 10:33:24 AM	**Test Duration** 5 Mins 35 Seconds	**Notes** :	**Speed** : 2,338.00 RPM	**Temperature** : 138.00 °F		: 0.78	: 0.04	**Latitude** : 29.6955027	**Longitude** : -95.3049004

Tube 1

Water Content: 0.94   Sed. Content: 0.07
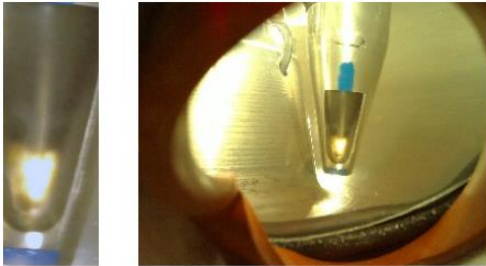
Tube 2

Water Content: 0.62   Sed. Content: 0.01
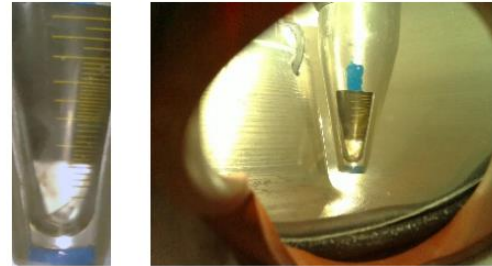
Select Type   Temperature ▾

Field Testing Overview

- Basics
  - Testing with 2 partnering companies in Southern US
  - Conducted 6 week trial beginning August 08, 2016
  - Established weekly check-ins with drivers and management
  - Monitored field testing live via website throughout testing period
  - Drivers recorded "traditional" readings during test to help validate accuracy.

- Goals
  - Proof of concept – demonstrate the idea
  - Test Design – field ruggedness and user acceptance
  - Accuracy – "smart readings" vs manual readings
  - Limitations – learn what needs improvement in next phase
  - Verification – confirm industry demand

Key Takeaways

- Areas for improvement
  - Crude Oil Type
    - Water levels difficult to detect in light crudes
    - Difficulty with "cloudy" samples
  - Convention vs Stated Method
    - Further investigation on which methods are preferred
    - Analyze if various/customized methods should be added
  - Equipment Limitations
    - Cushion staining → improper lighting
    - Positioning/process time → need to improve efficiency
    - Images → must ensure proper quality and clarity
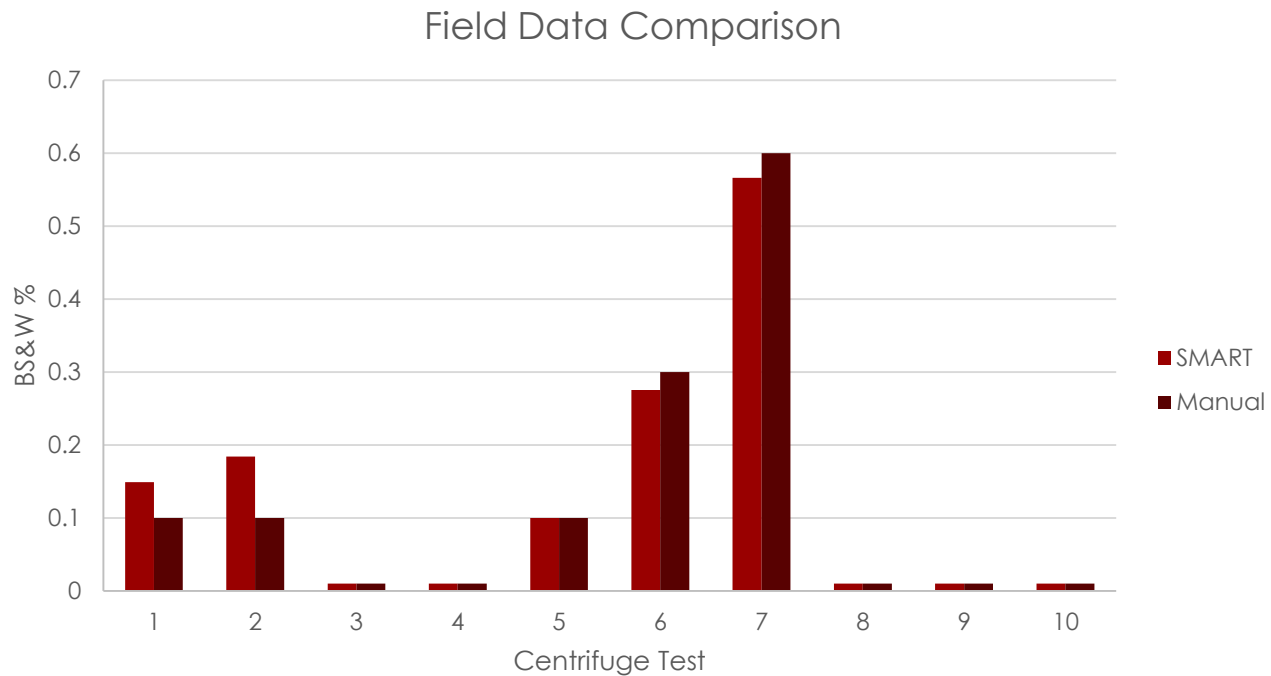
Key Takeaways

- What worked well?
  - User Interface – intuitive and well designed
  - Online Database - access is highly valued
    - Images, location, uniformity
  - Network Communication – worked as intended
  - Ruggedness – minimal failure
  - Kill Switch – valuable in the field

Field Test Results

Field Data Comparison

With correct crude type, results were reasonably accurate.

Moving Forward

- Focus Points
    - Evolve software for a broader range of crude types
        - lighting, shields, tubes…
    - Customize/Automated Verification
        - Correlate GPS coordinate to field/well name
        - Bridge software to connect with customer's ticketing system
    - Ensure database images are extremely high quality
    - Continue evaluating ruggedness - weather proofing, water hazards, etc
    - Investigate market interest in "manual" mode
    - Update temperature measurement (add density?)

- Commercialization in 2017

Thank you!

- A SPECIAL THANKS to our Testing Partners and COQA!

- LK Ind: Eric Calderon, Dwan Thomas, Frank Ragan

- Engineering Support: ErdosMiller

- Application Support: Saviance

- Questions?