PACWEST 2016
"EMBRACING TECHNOLOGY"

Auditing Your Lab to Insure Sensor Reliability

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TOPICS

- Why is the lab so important to sensor performance?
- What is Repeatability and how do we quantify it?
- The importance of a good sample valve
- Variability Makers in the lab
- How to conduct a lab audit?
- Real life challenges and solutions

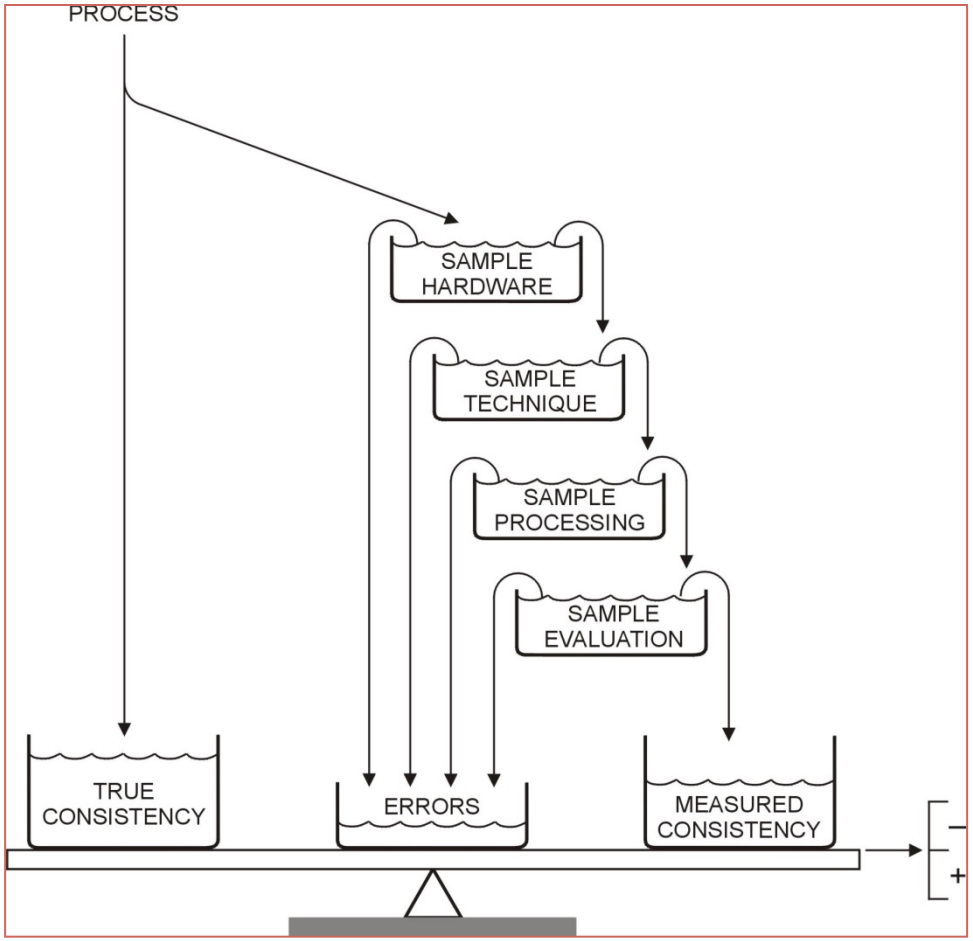
Why Should We be Concerned?

- We rely on well calibrated on-line sensors and analyzers
  - Rapid update to advanced control
  - The “eyes” for the operator
  - Reduce manual testing
- Sensors are calibrated to a lab test
- Every analyzer and sensor has “error” associated with it
- Each test has the following
  - $\text{Variance}_{(\text{total})} = \text{Variance}_{(\text{process})} + \text{Variance}_{(\text{measurement})}$

Measurement error

- **Repeatability** is a term used to describe a precision study for an individual operator's variation when the same sample is tested under the same conditions.
- **Reproducibility** is a component of precision associated with operator-to-operator differences when several operators run the same sample under identical conditions.

Accuracy of sample



- Sampling method
- Repeatable equipment
- Lab routine

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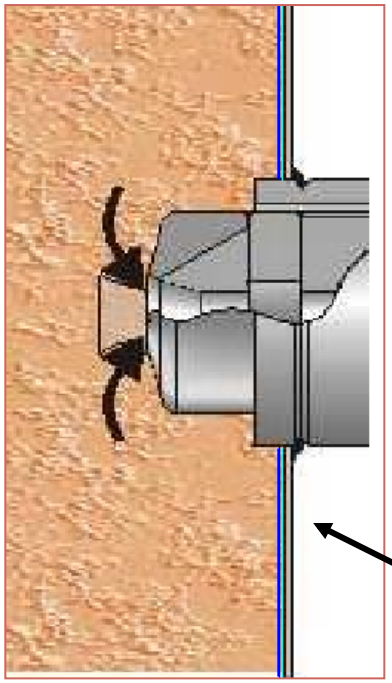
The ball valve – a reliable sampling valve?

- Sample is taken at pipe wall > **Bad sample**
- Dewaters pulp unless fully opened > **Bad sample**
- Different opening degrees at different occasions and for different operators > **Bad sample**
- Gives large volume and splashes at high line pressure. **Safety Concern**
- Often plugged at start > **Safety Concern**
- Low price – **Is the bad result worth it?**

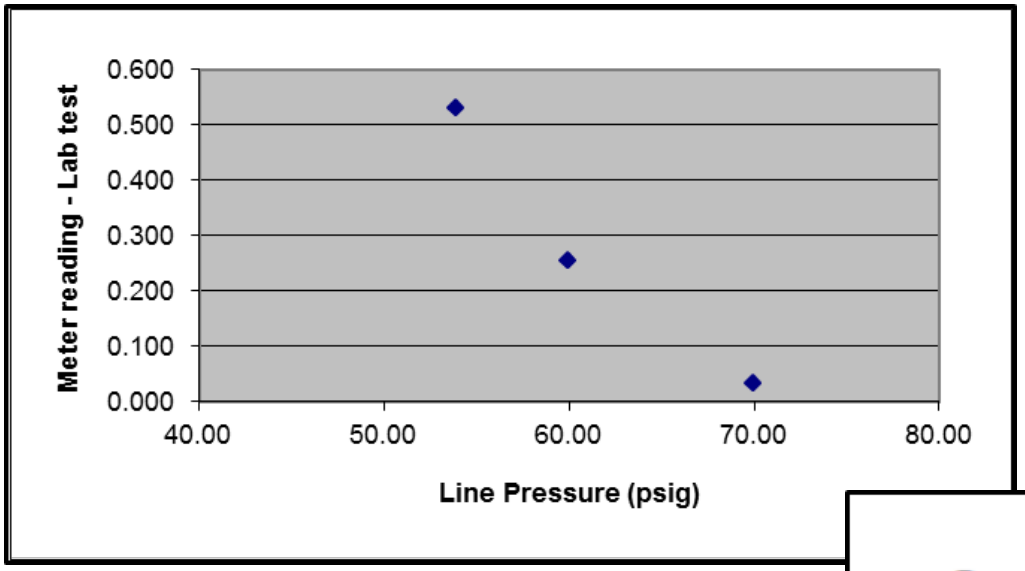
A Reliable Sampling Valve



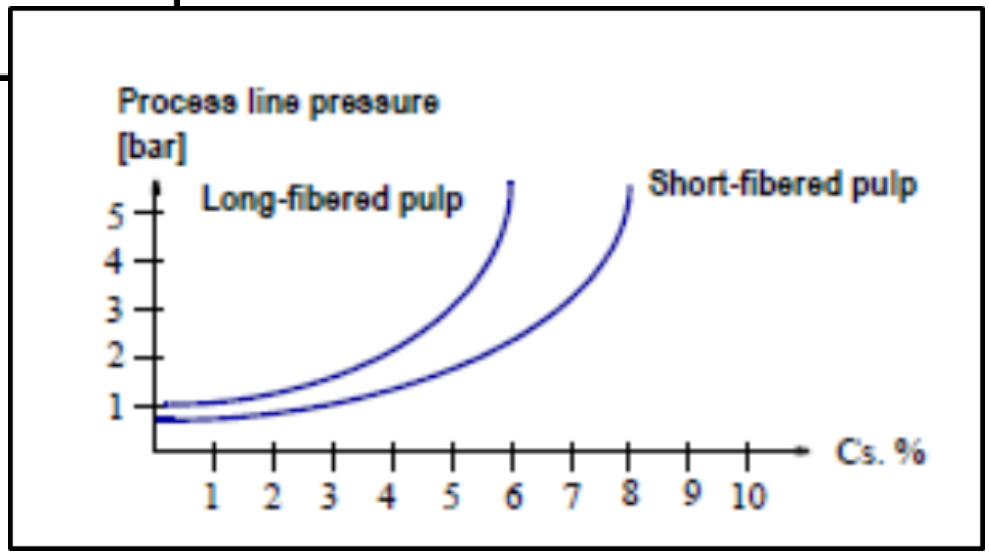
- Takes the sample well inside the pipe wall – inside the water film!
- Always fully open
- Not depending on operator
- Safe to operate under all conditions

The location of the sampling valve is important, it should extract the same sample as the consistency transmitter is measuring

The Importance of Knowing Your Application



Varying line pressure will effect the consistency test



Always select the appropriate sampling Valve for the species and process conditions

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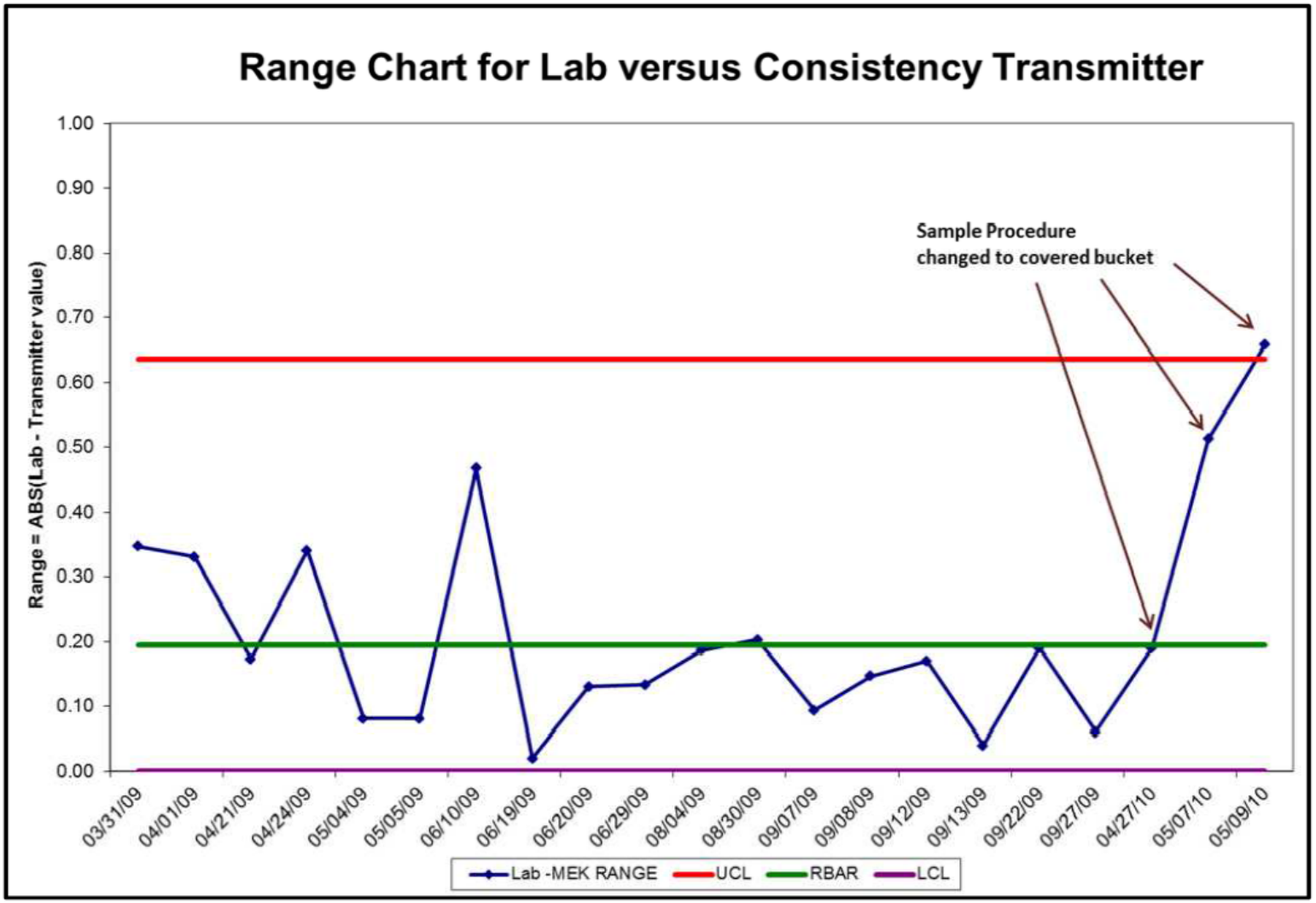
Variability Makers In The Lab

- Bucket versus separate containers
  - Covered or not?
- Weighing the sample
- Not using enough sample in the test
- Washing the sample
- Drying the sample (too hot?, scorched?)
- Lab cleanliness
- Testing chemicals
- Temperature compensation
- Testers

A Small Change Can Make A Big Difference



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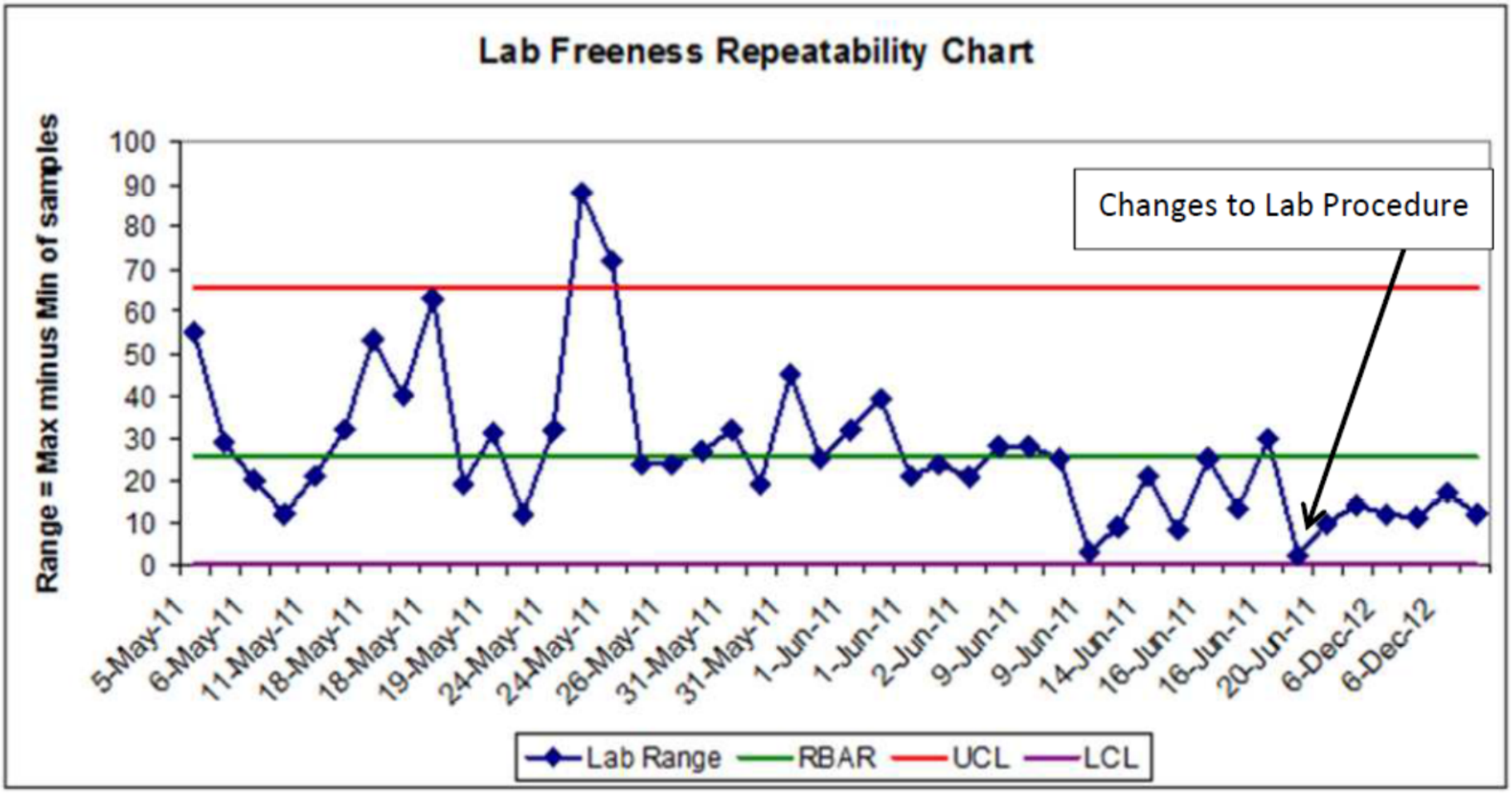
Identifying the Cause of the Variability



The Laboratory Audit

- Quantify laboratory variability BEFORE calibration starts
- Need 30 sets of repeated samples
- We are measuring:

Total Variance $_{(Total)}$ **= Process Variance +** **Measurement Variance**

% Measurement Variance = $Measurement\ Variance/Total\ Variance$ X 100

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Lab Audit Procedure

- Review current test procedure
- Involve all testers who will be involved in calibration
- Observe testers from sample collection through processing the sample without comment
- Report the results using a control chart and calculate statistics

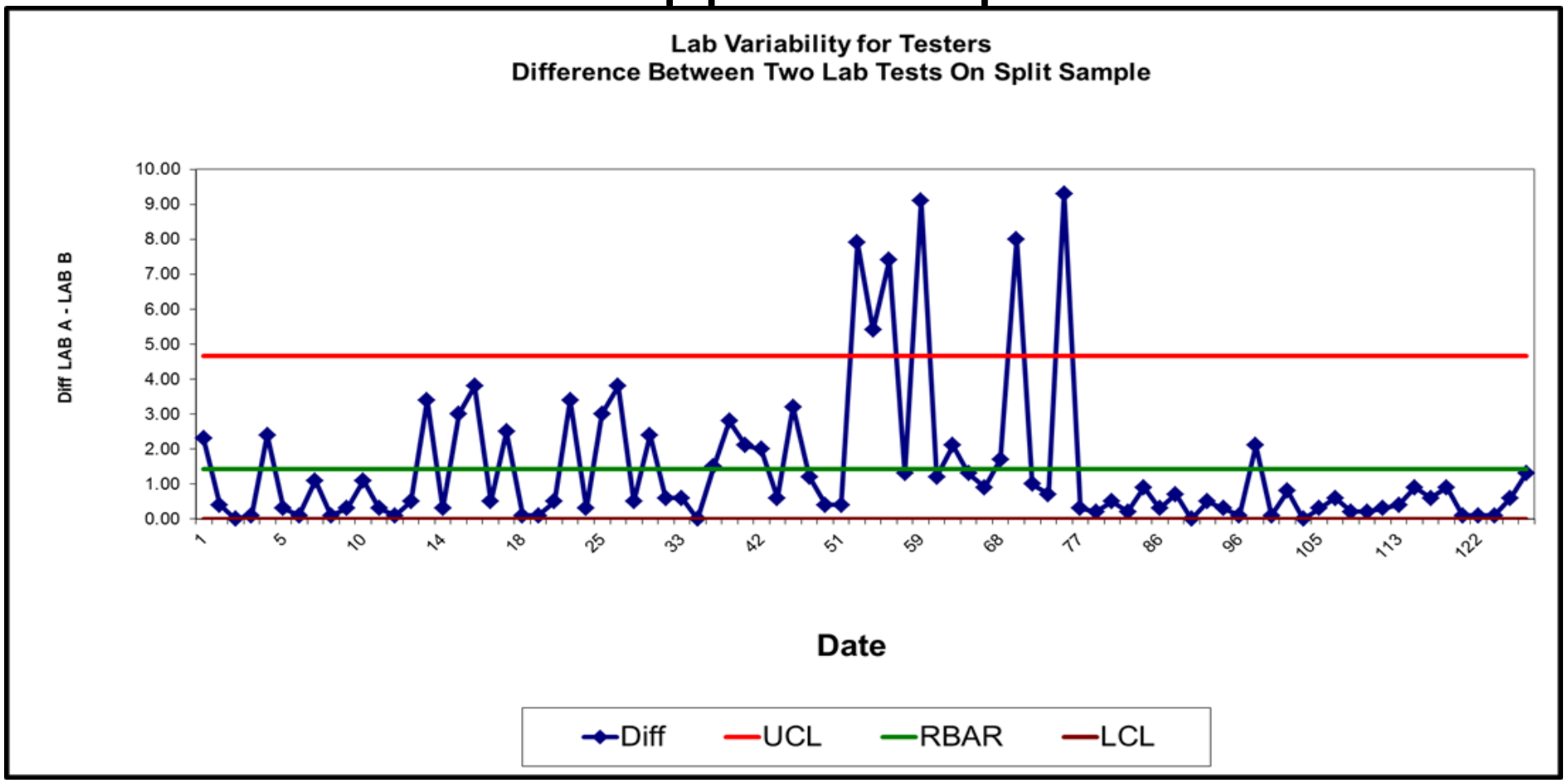
How Bad is Bad?

- Normal field testing is usually over 20% measurement error!
- "Central" labs are better @ below 10%
- A Kappa Example:

Source	Standard Deviation	Variance	Percent of total
Measurement	1.26	1.60	22.25
Total	2.68	7.18	

- This error is added to the measuring error associated with the analyzer or sensor

How can we reduce the measurement error: A Kappa Example



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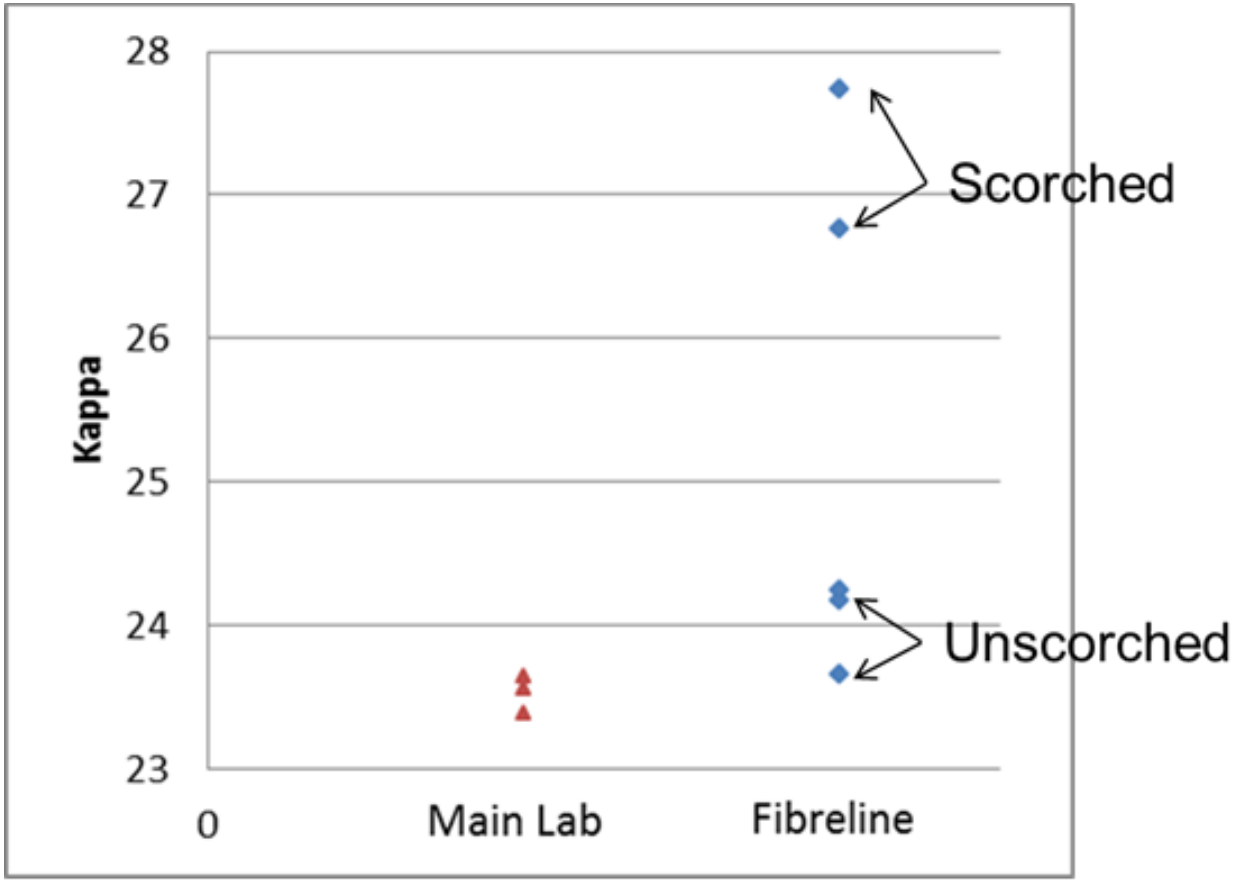
Uncovering the Variability Makers Leads to Improvement

Source	Standard Deviation	Variance	Percent of total
Measurement	0.90	0.82	11.37
Total	2.68	7.18	

Another Example: Improving Lab Kappa

- Zellstoff CELGAR
- Kappa tests processed at two locations
  - Main lab (used for calibration)
  - Field lab (used as a quick check)
- Methods varied
- Equipment differences
  - Main Lab: oven
  - Field lab: speed dryer
- Review of methods initiated when mill started to measure Bleach Load

Pad Drying Temperature Effects Kappa



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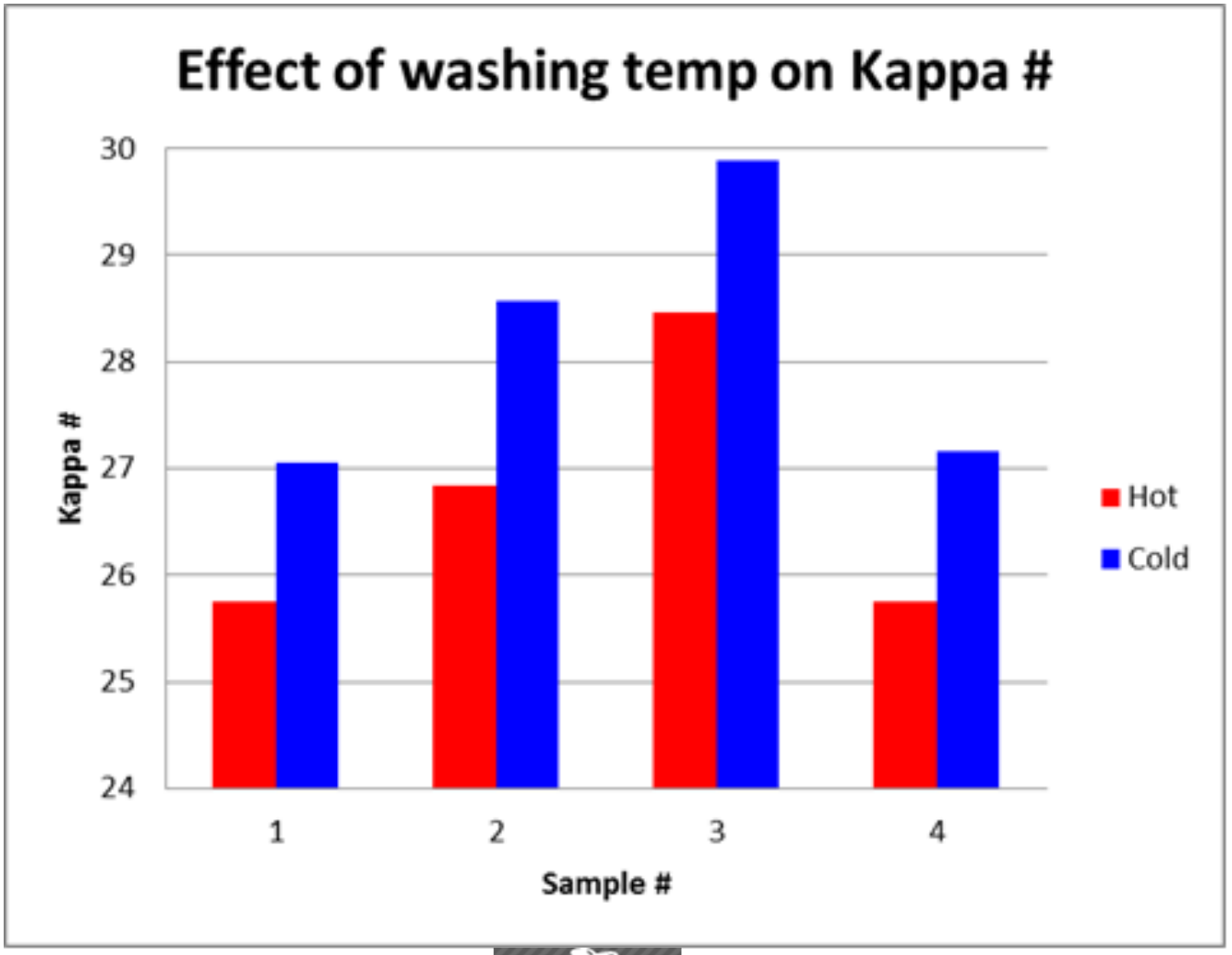
Washing Temperature Effects Kappa



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Other CELGAR Lab Improvements

- New titrators to add chemicals
- New chemical dispensers
- Color coding the dispensers, carboys so there were no mix ups.
- Ensuring the carboys got cleaned of crusty solids (read 100% chemical!!)

Summary

- Spend the time to audit your lab BEFORE undertaking a major calibration effort
- How you sample is critical
- Need for well written procedures and training
- Constantly work to reduce measurement error
- Measurement error will influence the overall error of your analyzer or sensor

Thank You For Listening!!

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