

Using Electrokinetic Methods to Rapidly Quantify Emulsion Stability



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WHAT STARTS HERE CHANGES THE WORLD



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Outline

1. Why measure emulsion stability?
2. Methodology and typical measurements
3. Other benefits
4. Concluding remarks

WHY MEASURE EMULSION STABILITY | 1



Balancing Act

› Timing emulsion breaking

- Emulsion is too unstable → break during transport
- Emulsion is too stable → prolonged breaking time after field application



Current methods

› Challenges in measuring stability

- Current method ASTM D6936 – time consuming, requires different solvents, and an elaborate set up
- Changing binder chemistry frequently requires stability measurement during formulation and quality control

METHODOLOGY AND MEASUREMENTS | 2

Goals

› Goal 1:

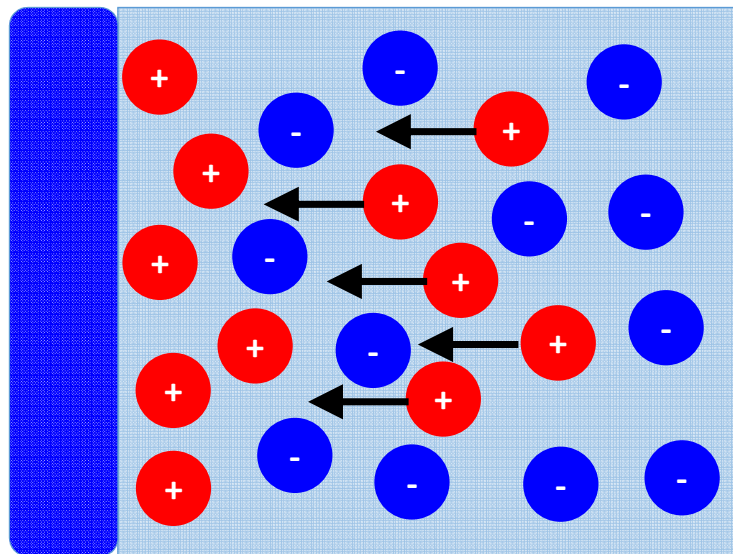
Develop a portable and rapid test method to quantify stability and breaking of asphalt emulsions.

› Goal 2:

Demonstrate the sensitivity of the test procedure to:

- type of emulsion,
- dilution ratios, and
- mechanical agitation.

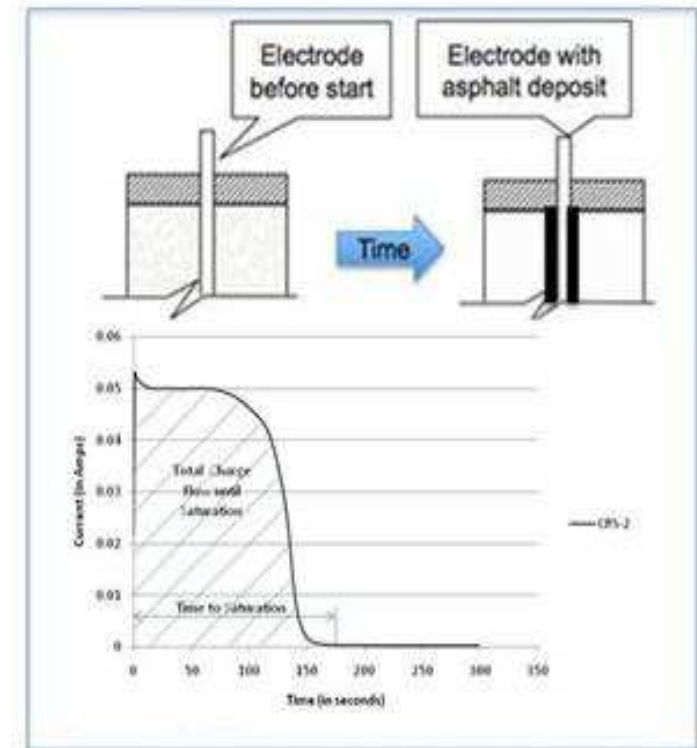
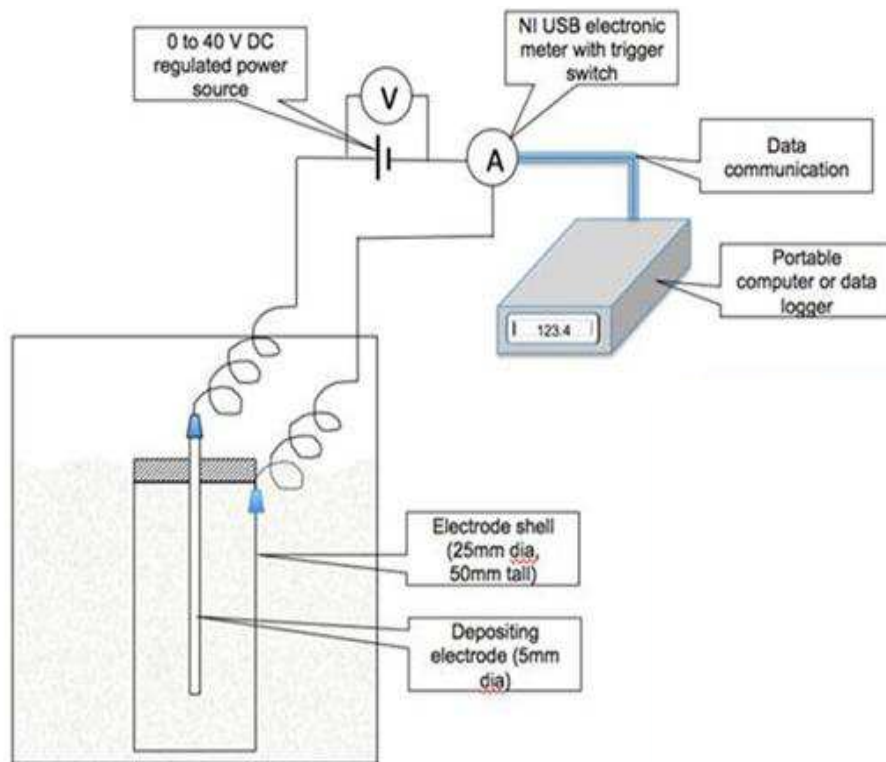
Theoretical Background



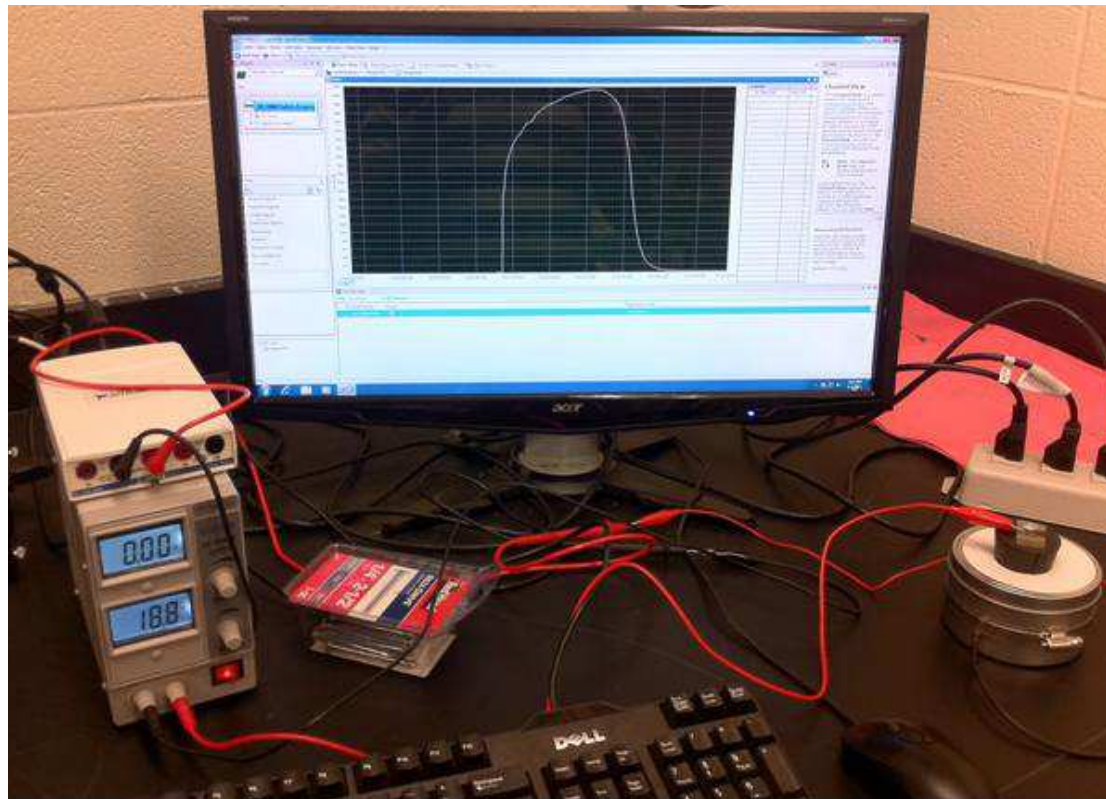
$$\text{Electrophoretic mobility} = \frac{\text{Zeta potential, particle radius, dielectric of medium}}{\text{Viscosity}}$$

Reference: Characterizing stability of asphalt emulsions using electrokinetic techniques. Journal of Materials in Civil Engineering (ASCE), 25(1), 78–85 (2013).

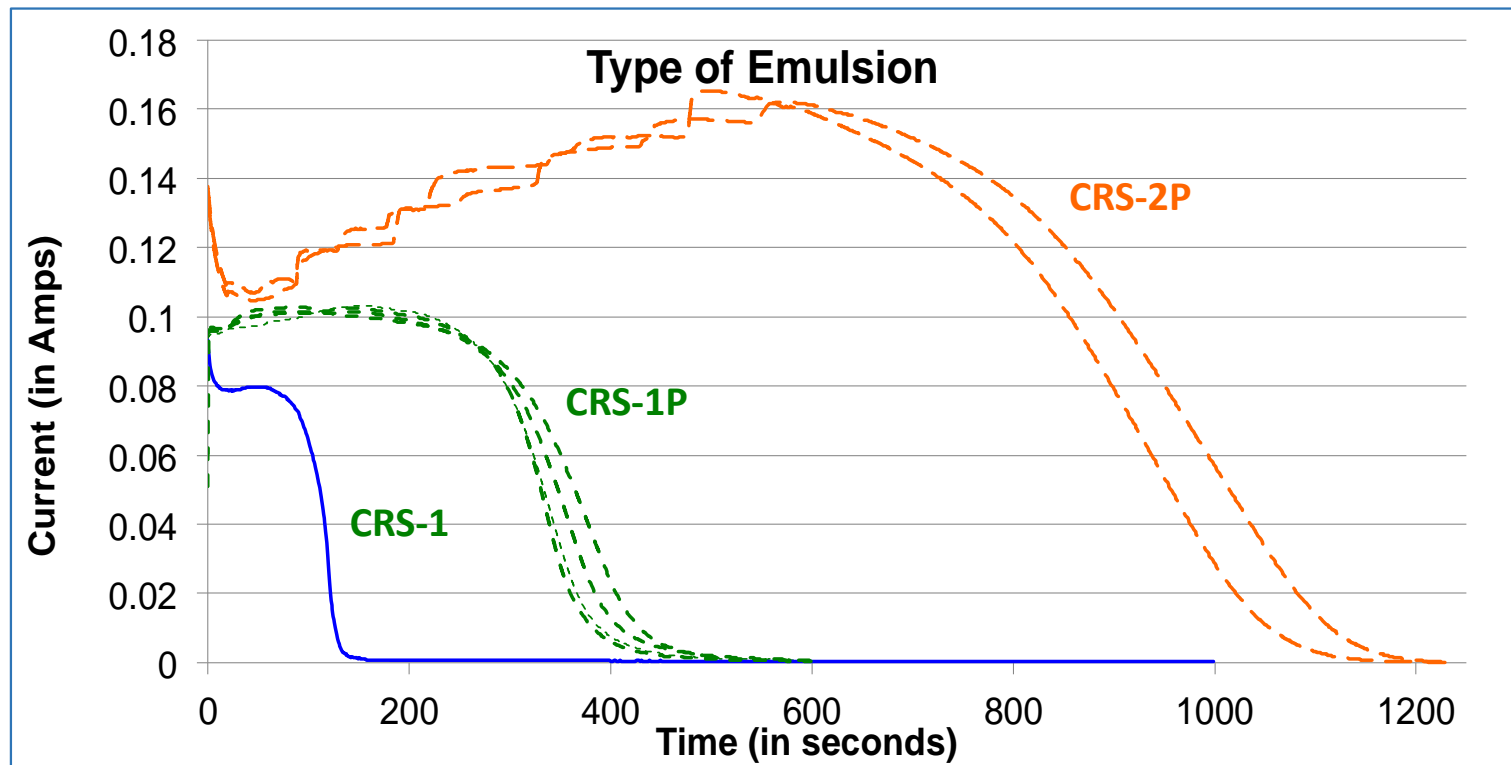
Methodology



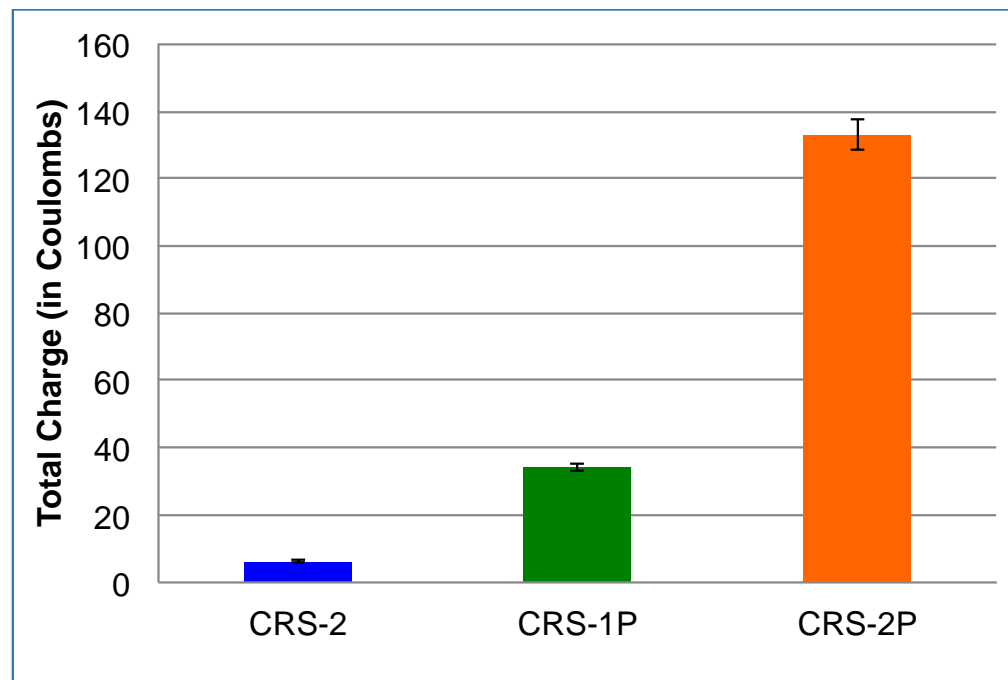
Methodology



Influence of Emulsion Type

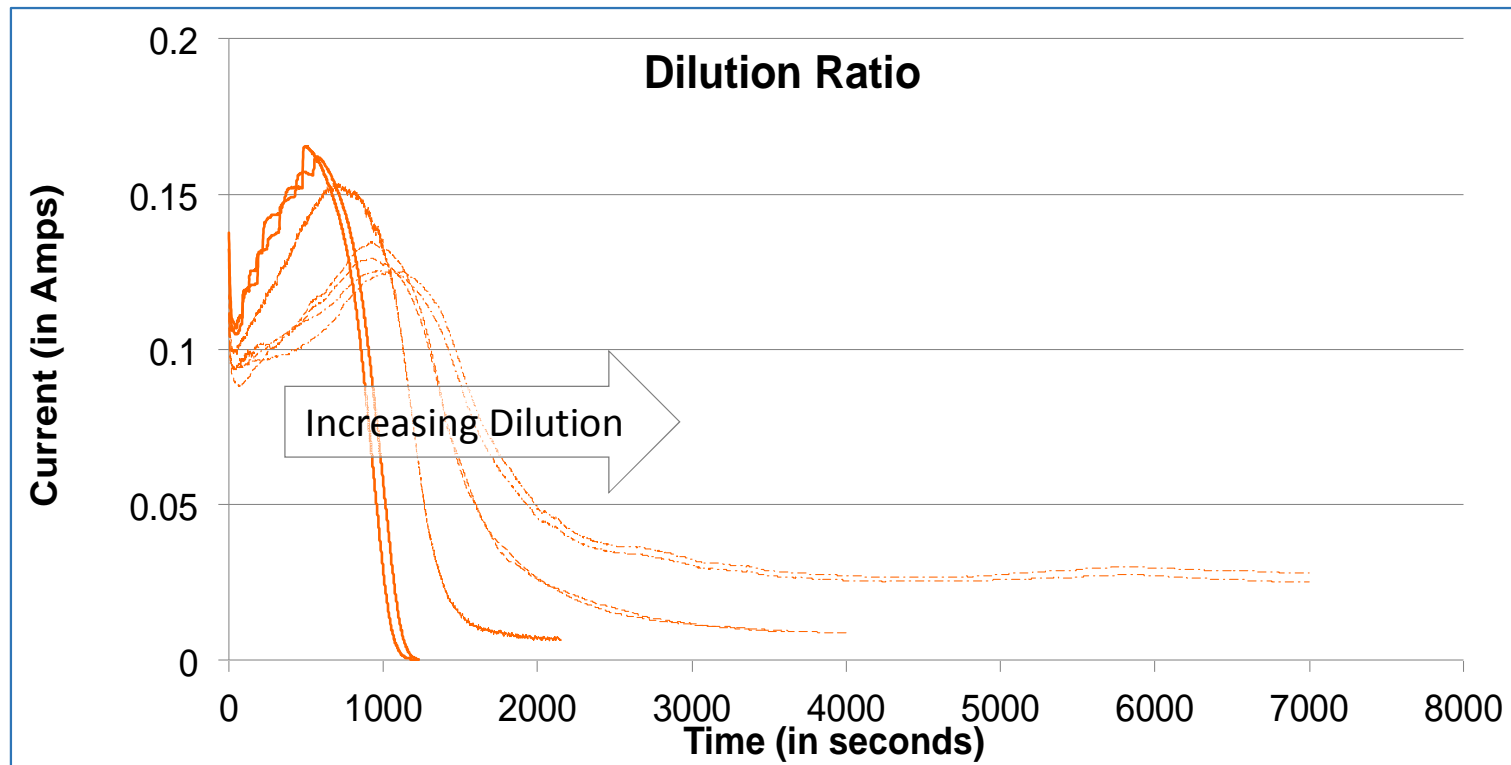


Influence of Emulsion Type



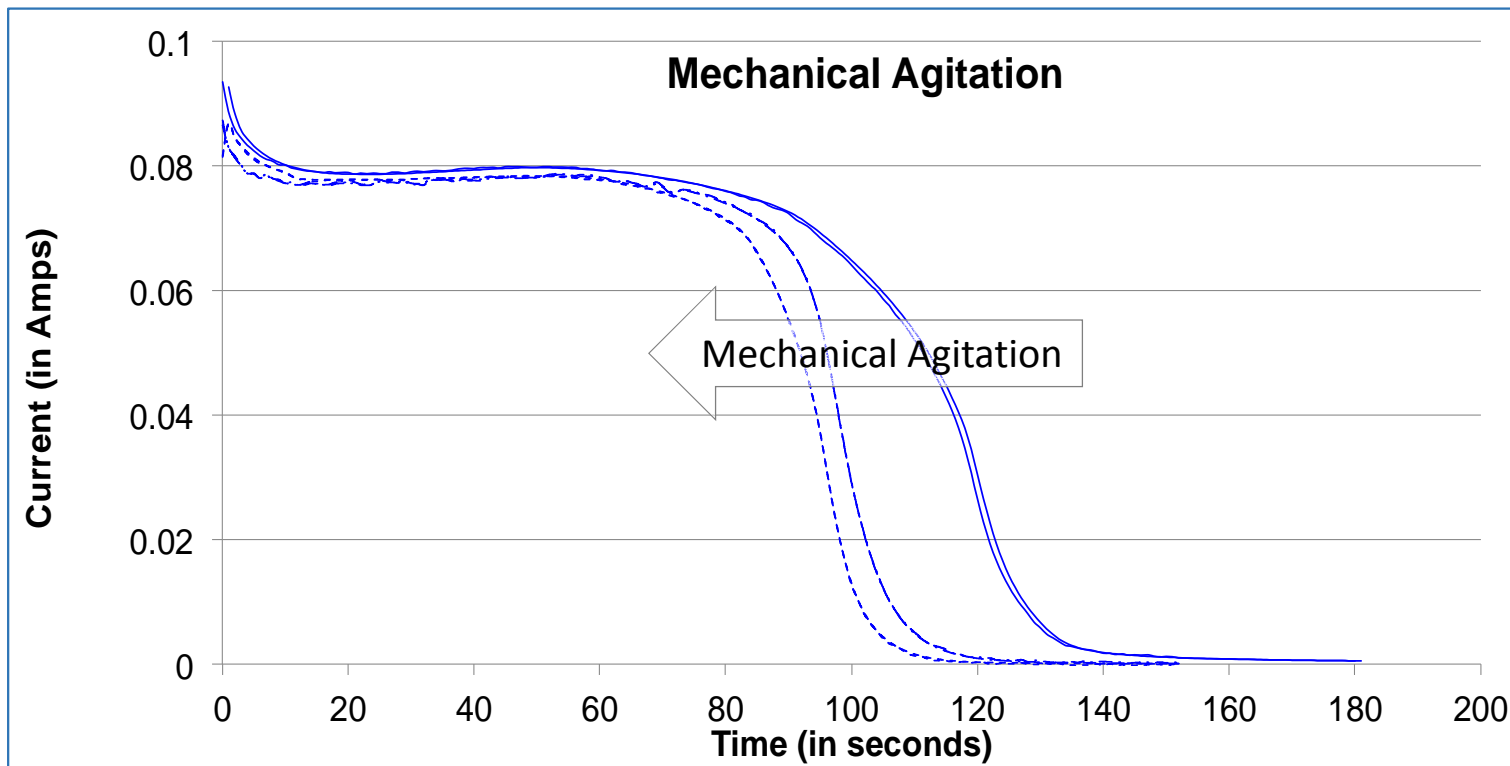


Influence of Dilution

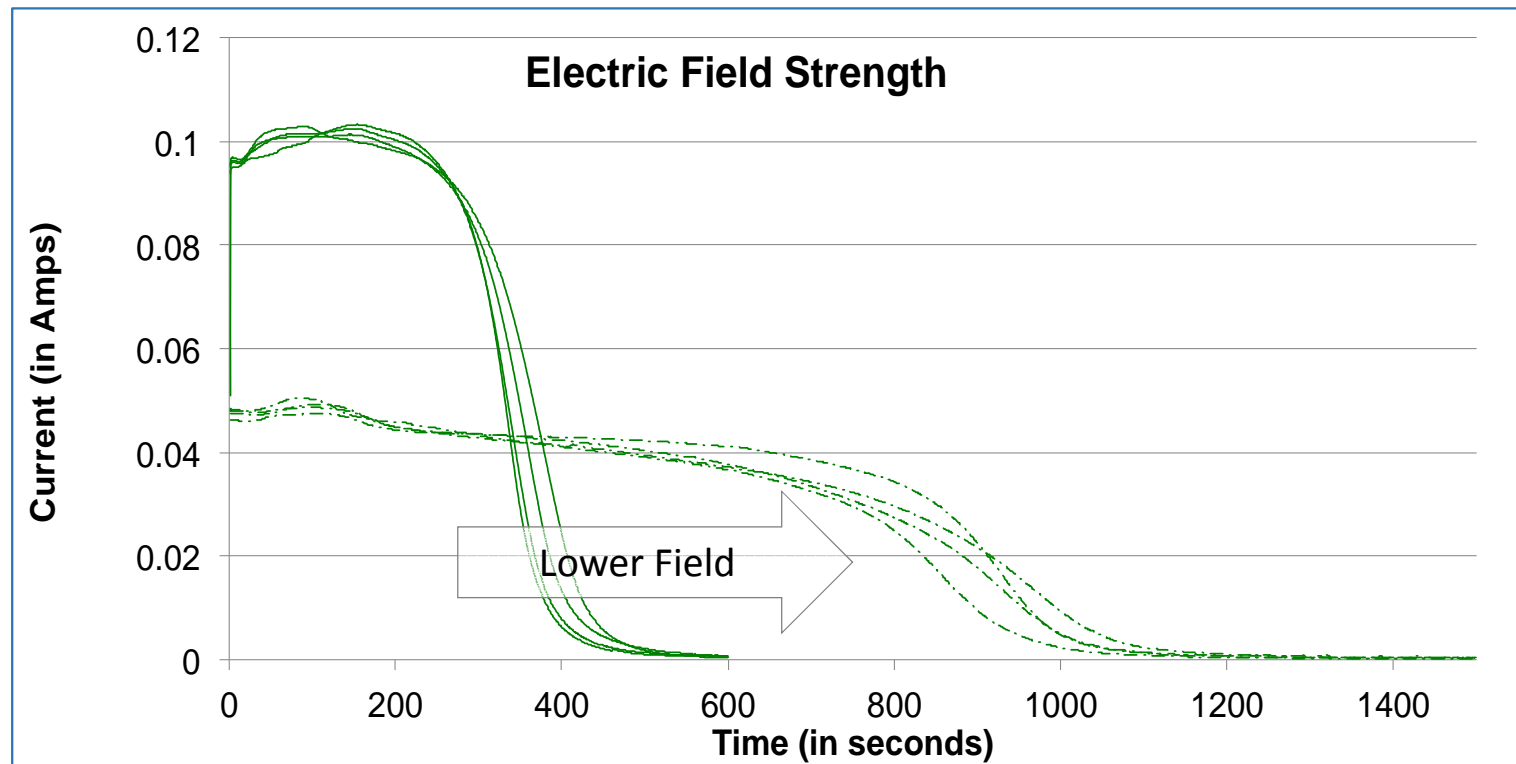




Influence of Mechanical Agitation



Influence of Field Strength



OTHER
BENEFITS | 3

Binder Residue from Electrokinetic Cell

- › Method can also be used to obtain binder residue for quality control and testing purposes



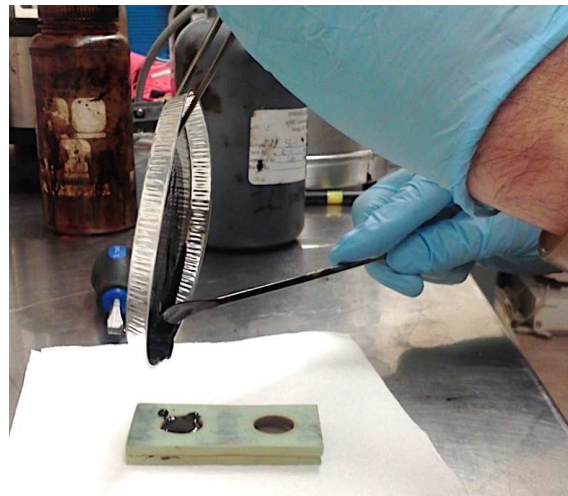
Binder Residue from Electrokinetic Cell

- › Method can also be used to obtain binder residue for quality control and testing purposes



Binder Residue – Other method

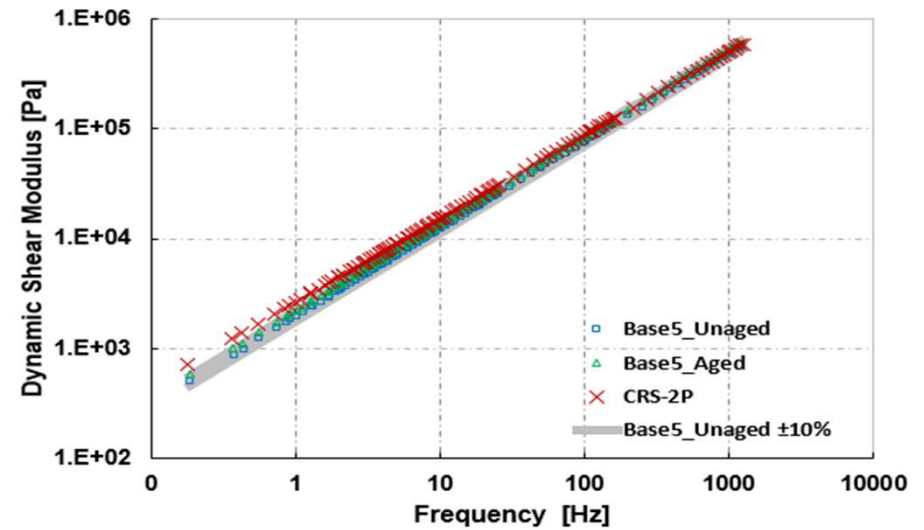
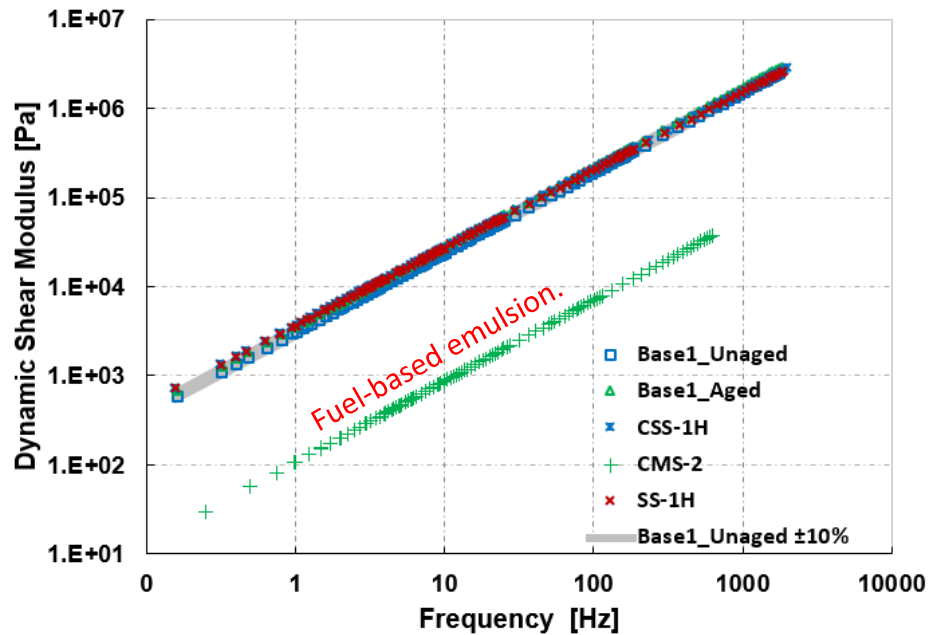
› Moisture Analyzer Balance



Reference: Motamed, A., Salomon, D., Sakib, N., & Bhasin, A. (2015). Emulsified asphalt residue recovery and characterization. Combined use of Moisture Analyzer Balance (MAB) and Dynamic Shear Rheometer (DSR). *Transportation Research Record*, 2444, 88–96.

Binder Residue – Other Method

› Moisture Analyzer Balance



CONCLUSION

- › Rapid stability test based on electrokinetic method with minimal hardware
- › Can be used for formulation and QC purposes
- › Test is repeatable and sensitive
- › Can also be used to extract binder for performance testing and QC testing

