

A yellow tracked bulldozer is shown in the foreground, working on a large pile of dark asphalt material. In the background, there are several large white cylindrical storage tanks and other industrial structures under a clear blue sky. The text "RAP Research Activities At AAT" is overlaid in orange on the image.

# RAP Research Activities At AAT

Ramon Bonaquist, Ph.D., P.E.  
Chief Operating Officer  
Advanced Asphalt Technologies, LLC

# Acknowledgements

- NCHRP
- Agencies
  - Maryland State Highway Administration
  - Pennsylvania Department of Transportation
- Maryland Producers
  - Aggregate Industries
  - F.O. Day Company, Inc.
  - Independence Construction Materials
  - Reliable Contracting Company, Inc.
  - Edgemoor Materials of Maryland, Inc.

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# Guiding Principals

- RAP Mixtures Must Be Homogeneous
  - High Degree of Mixing of RAP and New Materials
- RAP Mixtures Must Meet Same Performance and Quality Standards
  - Same Strength and Durability
  - Produced with Same Variability



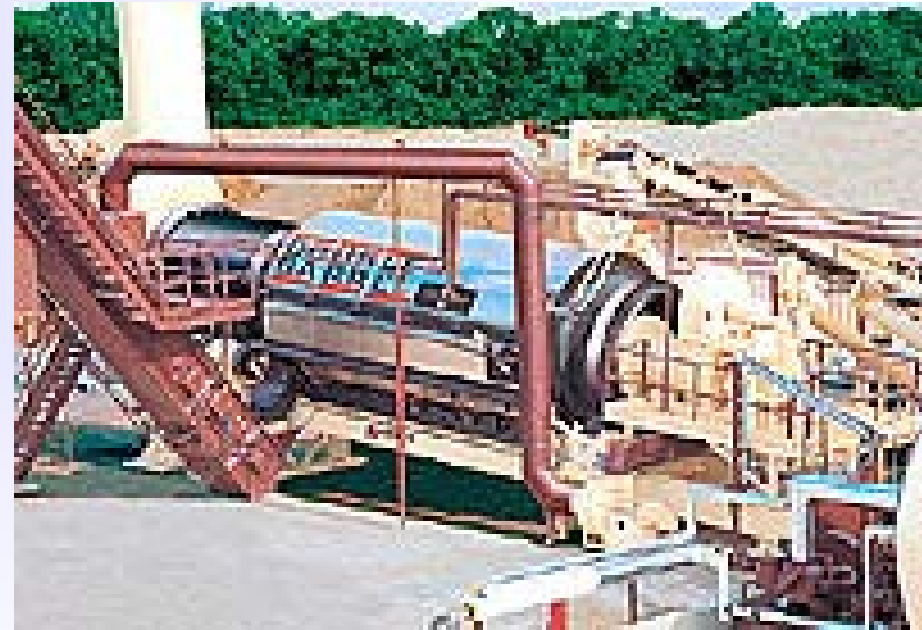
# Major RAP Related Projects

- Method for Evaluating Plant Mixing
  - MSHA, PennDOT, Maryland Producers
- Method of Estimating Allowable RAP Stockpile Variability
  - NCHRP Project 9-33, A Mix Design Manual for Hot Mix Asphalt
- Effect of RAP on Polymer Modified Binder
  - MSHA
- RAP in Warm Mix Asphalt
  - NCHRP 9-43, Mix Design Practices for Warm Mix Asphalt



# Mixture Homogeneity

- How Well Does the RAP/RAS Binder Mix with the New Binder?
  - Black Rock
  - Complete Mixing
- Process Specific
  - Plant Type
  - Plant Operations
  - RAP/RAS Processing



# One Tool

- Dynamic Modulus
  - Test Is Highly Sensitive to Binder Stiffness
    - Assess Degree of Mixing of New and Recycled Binders
  - Relatively Easy to Perform with the Simple Performance Test System



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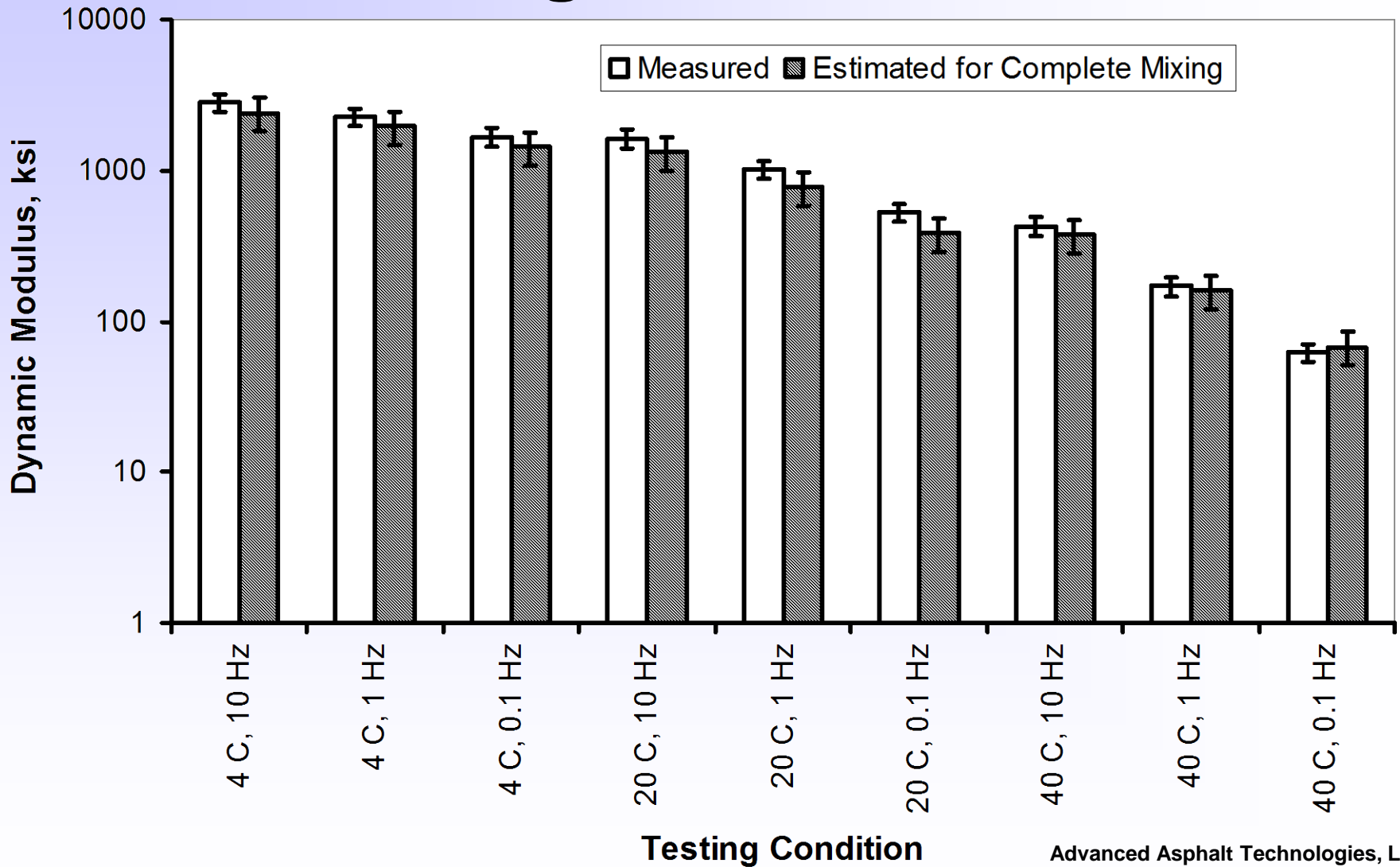
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# How?

- Perform Dynamic Modulus Tests on Plant Produced Mixture
  - Plant Mixed Condition
- Recover Binder, Test and Estimate Dynamic Modulus Using Predictive Model
  - Fully Blended Condition
- Compare Measured and Estimated



# Good Mixing



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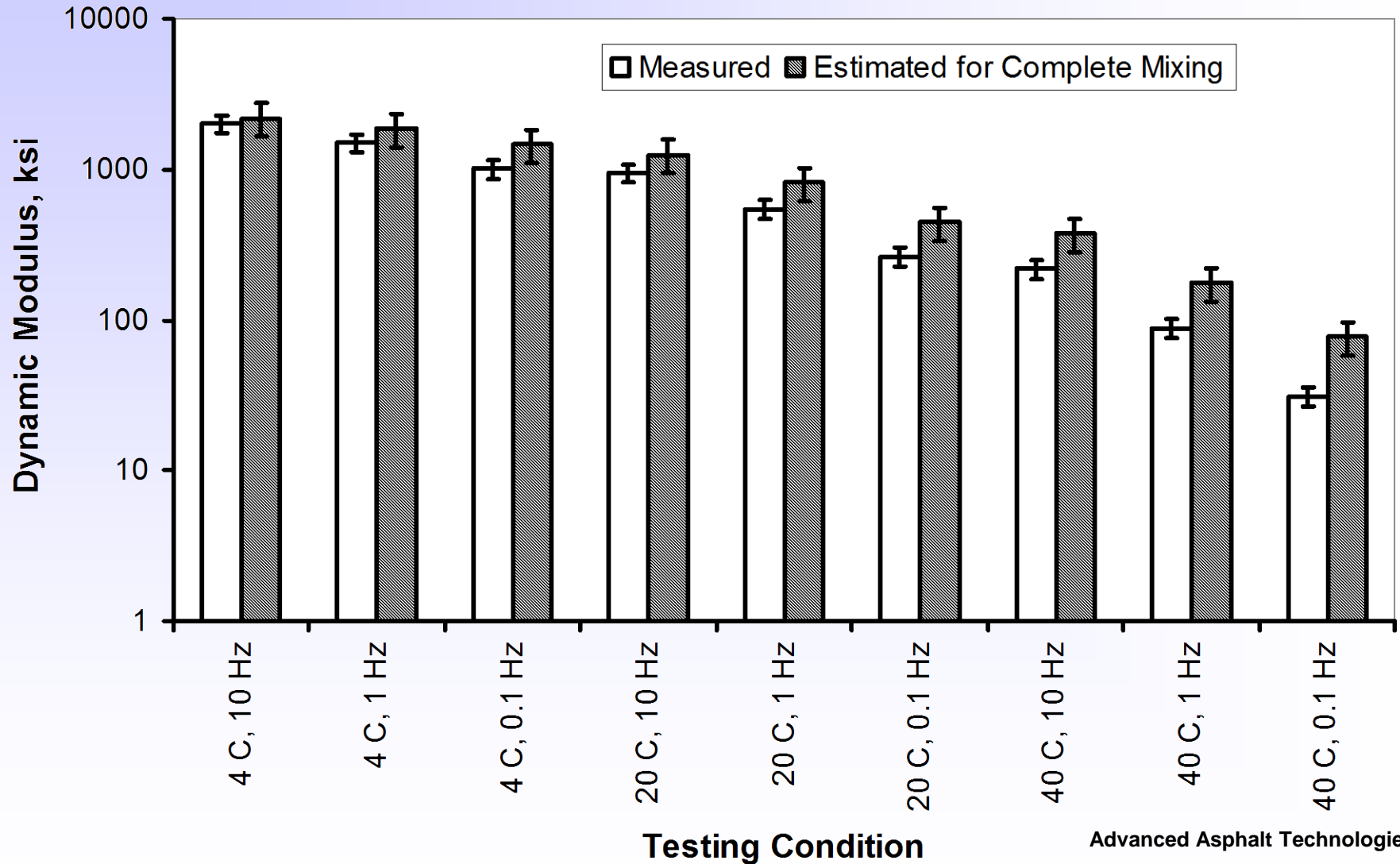
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# Poor Mixing



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# Recommended Work

- Improved Dynamic Modulus Predictive Models
- Reduce Width of Confidence Interval



# RAP Stockpile Variability

- NCHRP Project 9-33 “Mix Design Manual for HMA”
  - Developed a Tool to Estimate Allowable RAP Stockpile Variability to Meet Selected Production Variability
  - Earlier Presentation
- Needs Field Verification



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# Effect of RAP on PMA

- MSHA and MAA RAP Task Force
- Use Low Percentage of RAP in Mixtures Where RAP is Not Permitted
  - SMA
  - Mixtures Requiring PMA
- Effect of RAP on PMA?



# 2007 Field Project

- SMA With 10 % RAP
- I-270 Near Washington Beltway
- Laboratory Testing
  - Binder Blending Study
    - PG Grade
    - MSCR
    - Elastic Recovery
  - Mixture Performance Properties
    - Modulus
    - Flow Number
    - Continuum Damage Fatigue



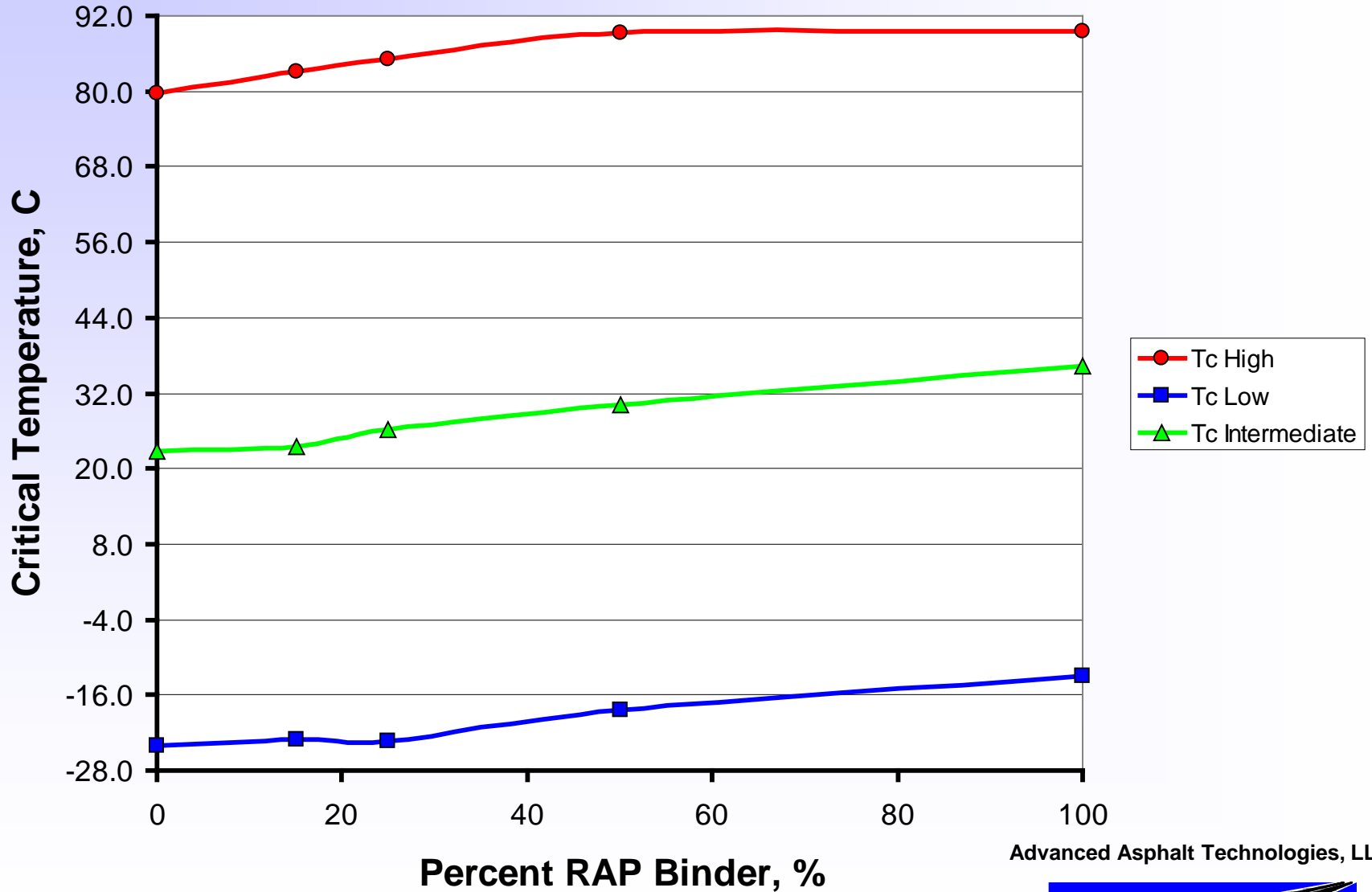
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# RAP Binder Blending PG Grade



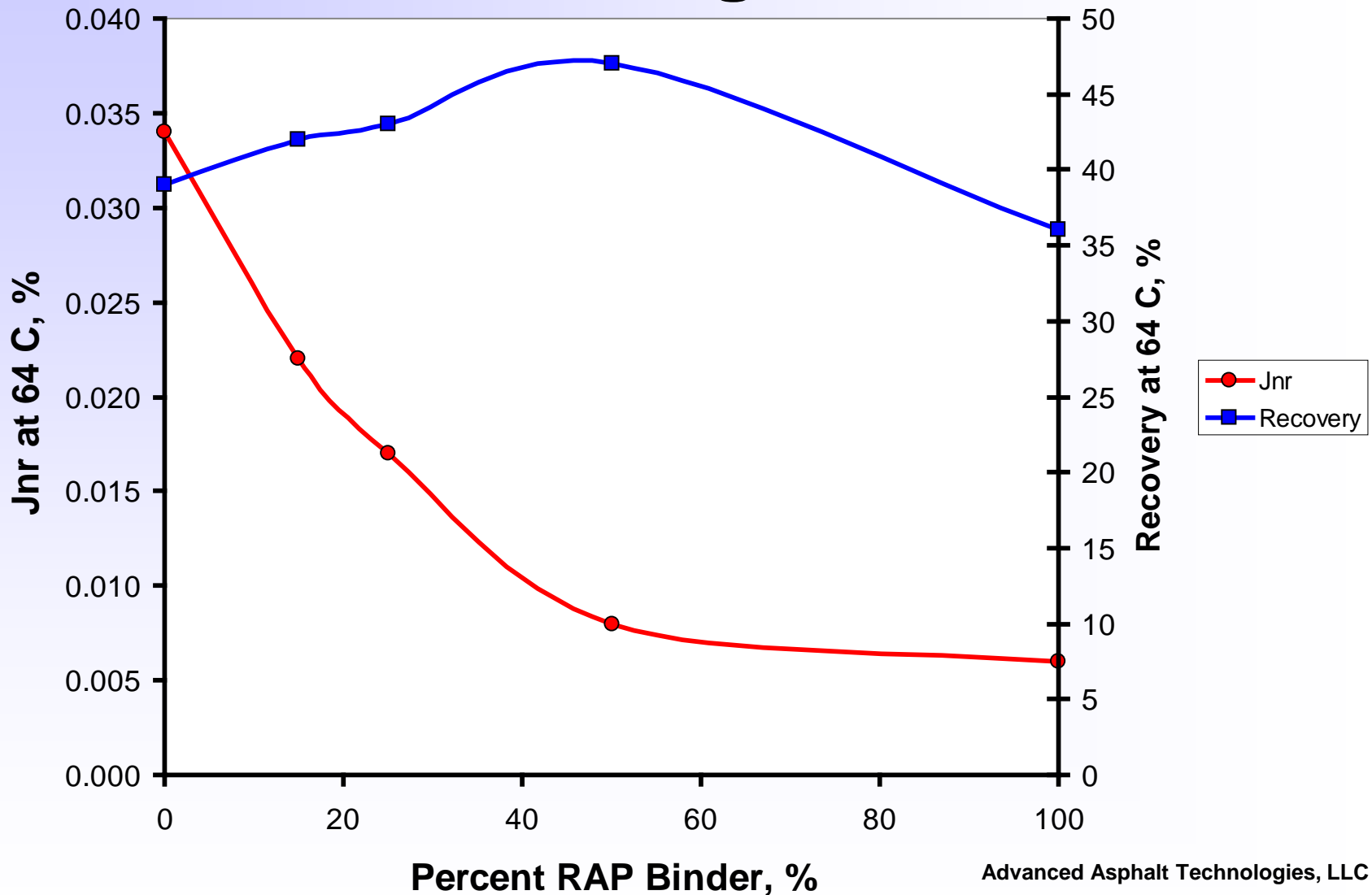
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# RAP Binder Blending MSCR Test



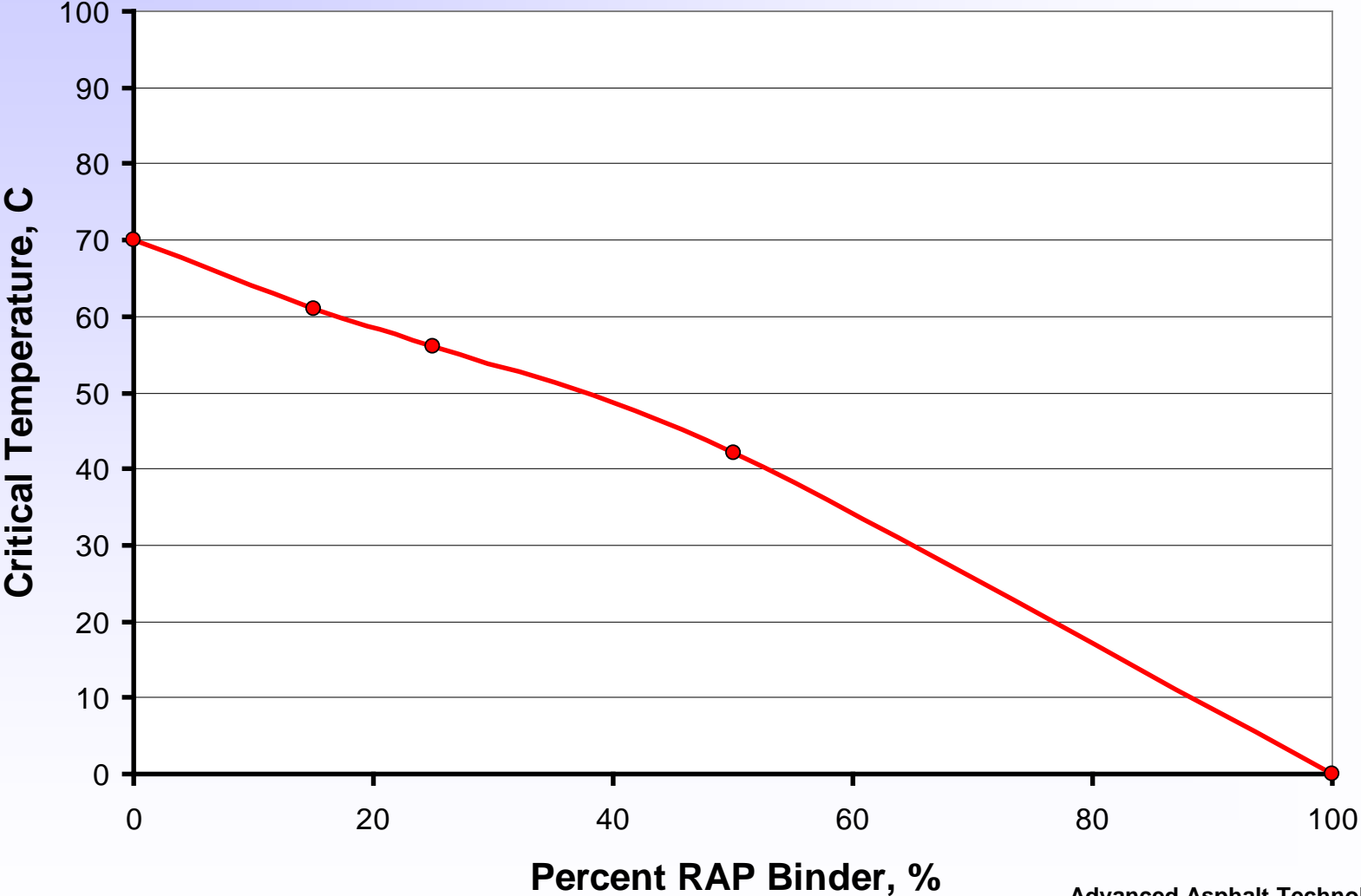
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# RAP Binder Blending Elastic Recovery



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# Recommended Work

- Continue With Mixture Performance Testing From Field Project
  - 10 % RAP
- Mixture Performance Testing on Lab Blends
  - 25 to 50 % RAP



# RAP in Warm Mix Asphalt

- One Task in NCHRP Project 9-43
- Should RAP be Limited in WMA
- Collaborative Effort Between AAT and WRI
  - WRI Evaluating Effect of Time, Temperature, and Compatibility on Wetting Versus Mixing
  - AAT Will Verify Using Mixture Modulus Analysis



# Summary AAT RAP Research

- Method for Evaluating Plant Mixing
  - Improved Dynamic Modulus Predictive Models
- Method of Estimating Allowable RAP Stockpile Variability
  - Field Verification
- Effect of RAP on Polymer Modified Binder
  - In Progress
  - Require Additional Mixture Performance Tests in 25 - 50 % RAP Range
- RAP in Warm Mix Asphalt
  - In Progress
  - Field Verification

