Reclaimed Asphalt Pavement Mixing and Compatibility

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Approach

- **Alternative methods for determining the degree of mixing found in asphalt-RAP mixtures**

- **Determining compatibility of asphalt-RAP mixtures**

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Materials

- **RAP samples and materials from 4 different sources**
  - **Iowa: 1 sample**
  - **Palm Dale, CA: 1 sample**
  - **South Carolina: 3samples**
    - **Fine, int, and coarse**
  - **Manitoba:**
    - **RAP**
    - **2 binders; 150/200 and 200/300**
    - **15% RAP + 150/200**
    - **50% RAP + 200/300**
    - **50% RAP + 150/200**

RAP Mixing

- **Solvent study combined with characterization**
  - **Toluene/EtOH vs. Cyclohexane**
- **Characterization**
  - **% Recovered**
  - **Compositional**
    - **SARA**
    - **AD/WD**
  - **Rheological**

RAP Mixing

- **Does initial mixing of RAP and virgin aggregate occur with any selectivity in the mix plant?**
  - **Add RAP sample to heated/superheated virgin aggregate while mixing.**
    - **RAP and virgin aggregates sized differently**
    - **Characterize the difference between resultant materials on RAP and virgin aggregates: SARA, AD, % recovery**

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RAP Mixing

- **Add virgin binder into the mix….Do the RAP aggregates and the virgin aggregates end up as different materials at high RAP concentration?**

- **Using RAP and virgin aggregates of different size**
  - **Extract each with Toluene/EtOH**
  - **Compositional analysis (AD, SARA, and % recovery) and rheological if possible/needed**
- **What affect does this have on material performance?**

Compatibility

- **Related to NCHRP 9-43**
- **Reversible Automated Flocculation Titrimetry**
  - **Colloidal stability ~ Rheological properties**
  - **Heithaus Solubility Parameters**
    - **The mixing of RAP and Virgin binders will have profound affects on the colloidal stability of the virgin binder at high RAP concentrations.**
- **Automated testing for performance prediction**

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Compatibility - Blending

		Neat			TFOT + PAV, 60°C, 144 hours		
Mix #	Components of Mixture	Vis., Pa•s 25°C, 1 r/s	Tan ∂ 25°C, 1 r/s	R. S. Visc. 25°C, 1 r/s	Vis., Pa•s 25°C, 1 r/s	Tan ∂ 25°C, 1 r/s	Aging Index 60°C, 1 r/s
I (A)	AAD Maltenes (79%) AAD Asphaltenes (21%)	49,011	3.2	705	550,650	1.5	15.4
VII (B)	AAG Maltenes (94%) AAG Asphaltenes (6%)	389,100	6.3	64	1,086,400	1.6	4.2
	Cross Blends						
V (C)	AAG Maltenes (79%) AAD Asphaltenes (21%)	4,970,900	1.5	287 (?)*	20,662,000	0.8	15.5
III (A) (C)	AAD Maltenes (79%) AAG Asphaltenes (21%)	62, 908	3.7	906	552,310	1.8	9.0
II (D)	AAD Maltenes (94%) AAG Asphaltenes (6%)	1,023	>10	35	7,108	<10	3.7
VI (B) (D)	AAG Maltenes (94%) AAD Asphaltenes (6%)	337,190	6.0	54	2,125,400	2.3	5.3

Data from: "Fundamental Properties of Asphalts and Modified Asphalts", Vol. 1: Interpretive Report FHWA-RD-99-212, Oct. 2001.

(JCP, 09/08)

*Value is suspect. Reduced specific viscosity at 60°C is reported as 393.

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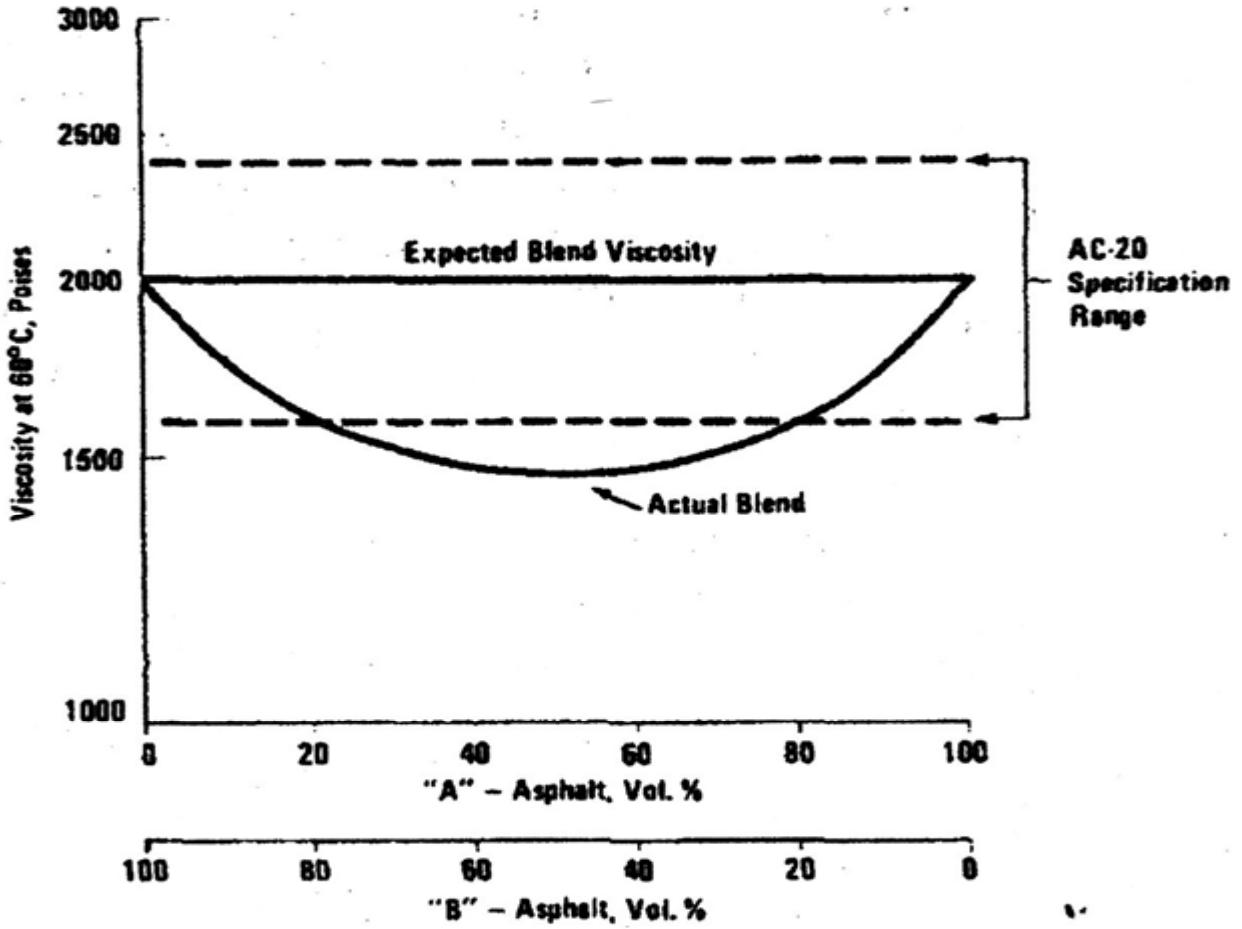
Compatibility – Blending



Reference: W. J. Kari. "Effects of Construction Practices on the Asphalt Properties in the Mix", *Proc. Canadian Tech. Asphalt Assn.*, vol. XXVII (1982), pp. 321-334. (cited in AAPT, Anderson, Petersen and Christensen, v. 55 (1986), pp. 250-268.

Compatibility and Blending

- **Blending of characterized RAP and virgin asphalts to determine effects of mixing.**
  - **BI0001 and BI0002 (Venezuelan and San Juaquin)**
  - **Use of AFT as a tool for material selection in respect to compatibility/colloidal stability**
  - **Compositional (AFT, AD/WD, SARA) and rheological analyses will be used to further characterize the changes in material properties as a result of blending**

Plan

- **Solvent extraction and material comparison studies underway**
  - **Rheological, AD/WD, SARA, and % recovery determinations of resultant materials.**
- **AFT testing of virgin binder and Manitoba RAP mixtures underway**
- **Physical RAP mixing study has not started**