

Research Update

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Today's Topics

- Regional research
 - North Central Superpave Center (NCSC)
- National level research
 - RAP ETG
 - FHWA Turner-Fairbank
 - ARC
- Brief Overviews



NCSC Research Focus Areas

- Recycling
 - High RAP Mixes
- Surface Characteristics
 - Use of Local Materials and RAP
 - Quiet Pavements
- Pavement Performance
 - Porous Friction Course Performance
 - Low Void Mixes



National Interest in RAP

- ❑ Strong incentives to increase RAP use
 - Material and energy costs
 - Binder costs rose over 300% in 2007 & 2008
 - Material supply issues
 - Environmental concerns
- ❑ Growing demand
 - RAP in more mixes (i.e. surfaces)
 - Higher RAP quantities
- ❑ Major research efforts nationwide



HMA Recycling ETG

- FHWA initiated in May 2007
- Managed by NCAT
- Purpose – Coordinate, develop national guidance and recommendations on RAP use
- Demo projects, document performance, share info, best practices, research
- Meeting 12/16-17 in Seattle

Removing/Lowering Barriers

- Nationwide specs vary widely
- Several states allow up to 50% RAP
- Some still do not allow RAP
 - Goal – all states allow RAP; encourage use of 25-30%
- Potential for WMA plus RAP

RAP mixes can perform as well as or better than virgin mixes.

RAP ETG wants to show states how to successfully use 25% RAP and more.

NCSC Study on RAP Plant Mixes

	Reclaimed Asphalt Pavement			
Binder Grade	0%	15%	25%	40%
PG 58-28			X	X
PG 64-22	X	X	X	X



2006 Results

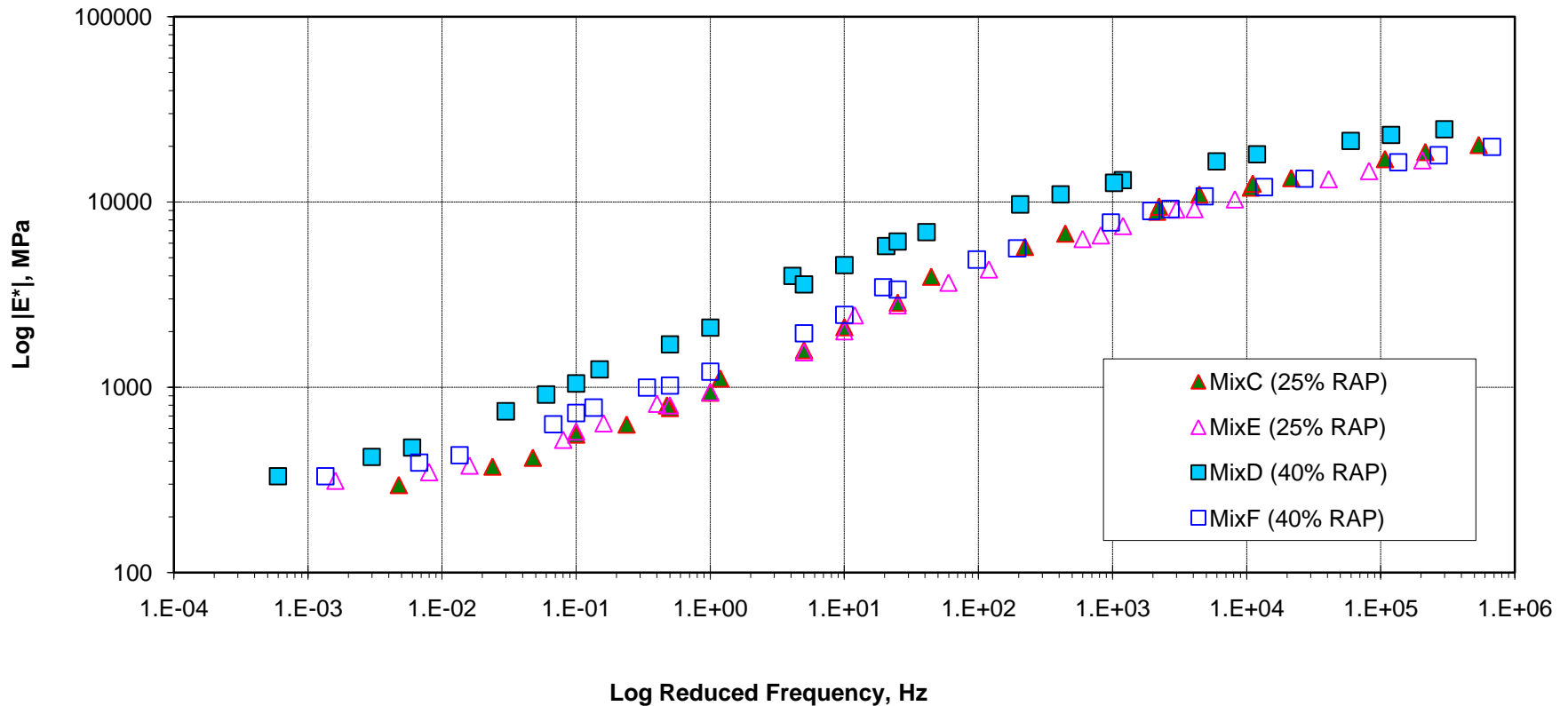
- One plant and one set of materials studied.
- The RAP mixes were not as stiff as expected.
 - High, intermediate and low temperatures
- The binder did not stiffen linearly with increasing RAP content.
- In this case, dropping the virgin grade to PG58-28 for 25% RAP was not necessary.

2007 Experiment

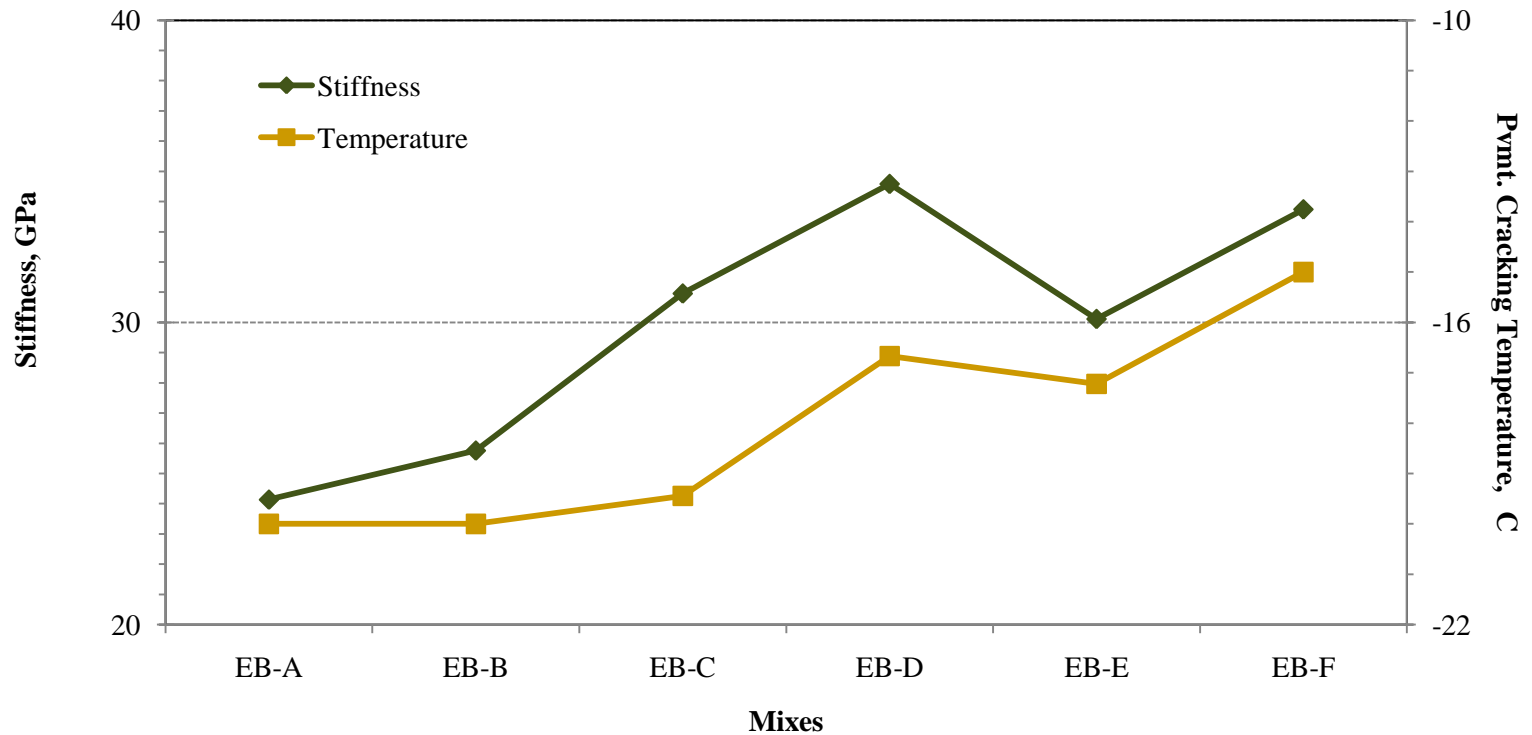
- Four more contractors (IN and MI)
 - Dynamic Modulus $|E^*|$
 - High and intermediate modulus, blending
 - Indirect Tension
 - Low temperature stiffness, strength and cracking
 - Binder extraction/recovery and PG grade
 - Blending analysis
- Fatigue Testing – at FHWA TFHRC

One Example

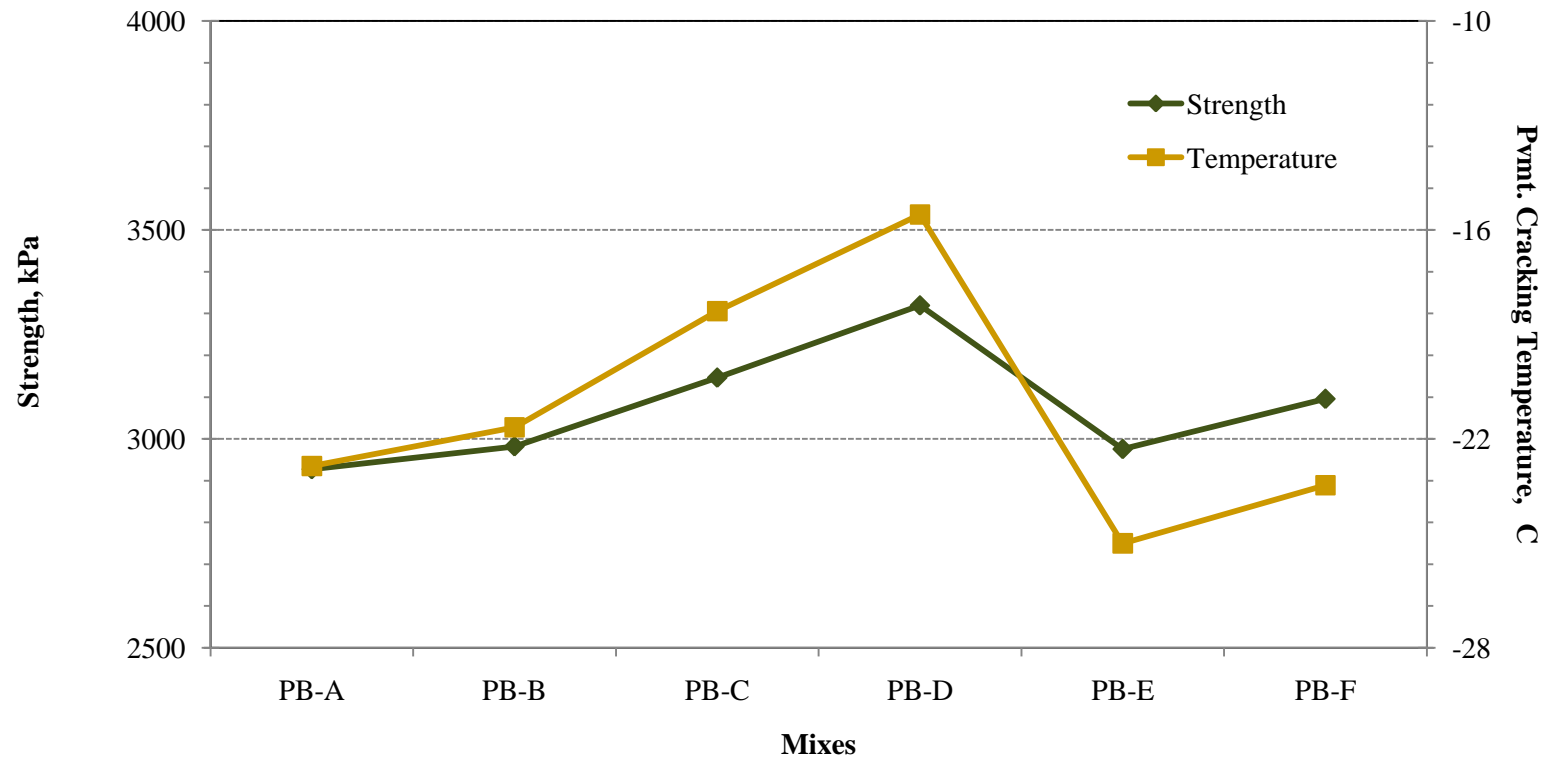
PG64-22 versus PG58-28



Low Temperature Behavior



Low Temperature Behavior





For these materials

- Grade change at 15% not necessary
- Low, intermediate and high temperature properties acceptable to 25%
- Pretty good blending of RAP and virgin binders to 25% RAP



Current Status

- Draft report on Phase 2 done by end of year
- Specification change underway in Indiana
- States should evaluate their own materials



RAP in Surface Courses

- Evaluate effect of poor quality RAP on friction
- Lab study of crummy RAP blended with steel slag, ACBF slag, crushed gravel
- Field evaluation of RAP surfaces on low volume roads
- Data analysis underway; report by Spring



Other NCSC Recycling Efforts

- Assistance with CIR mix design
- Field evaluation of RAP mix performance
- Evaluation of RAP plus shingles (pending funding)
- High RAP content study with NCAT, UNH

Surface Characteristics





Surface Characteristics/Performance

- RAP in Surface Courses
- Friction – NMAS, aggregate type, gradation
- Use of Local Aggregates in Surfaces
- Friction in Pavement Management System
- Thermoplastic Pavement Marking Material
- Evaluation of new aggregate sources

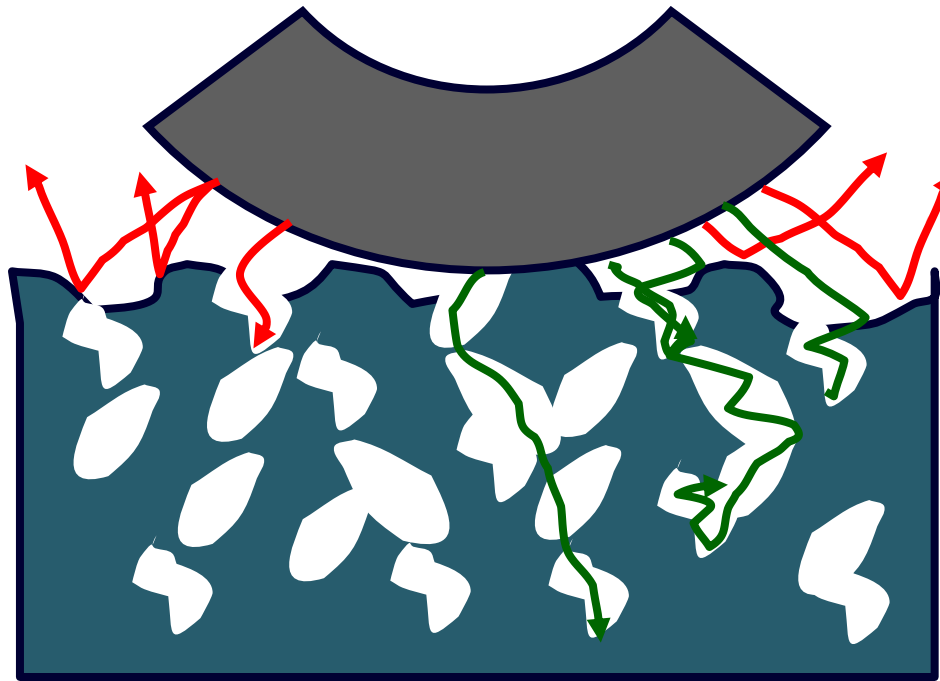


Porous Asphalt Surfaces

- New Generation Open Graded Friction Courses
- Porous European Mix
- Porous Friction Course

- For noise control and safety
 - Reduced splash and spray
 - High friction (macrotexture)

Pavement Porosity





Long Term Field Evaluation

- I74 Eastbound East of Indianapolis
- Constructed August 2003

- Comparison of SMA, PFC and HMA
 - Texture
 - Friction
 - Noise
 - Performance

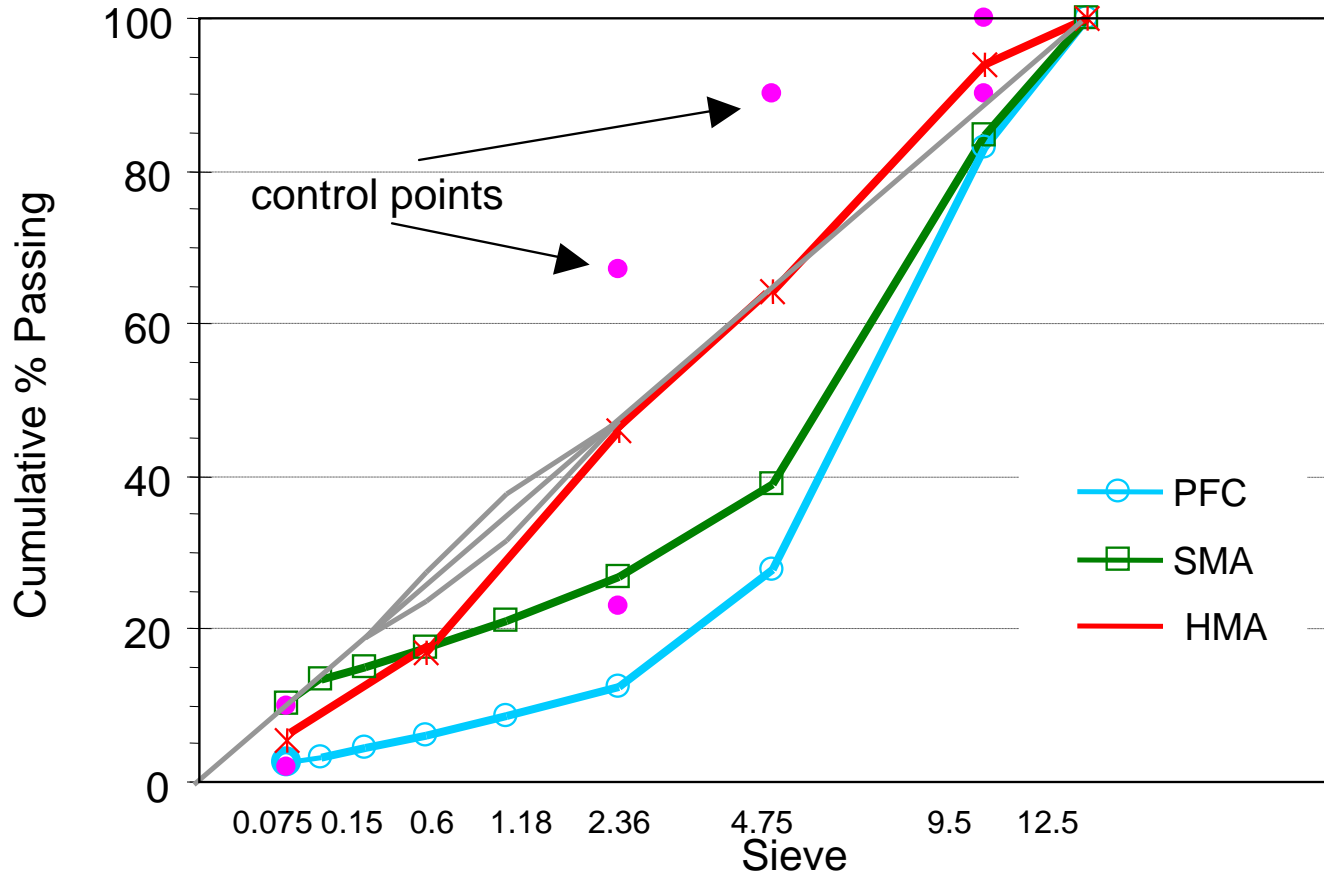


The Materials

- 9.5mm mixtures, Steel Slag and PG76-22

- PFC designed at 18-22% air voids
 - Old OGFC designed at 12-15% voids
 - Polymer modified binder and fiber

Design Gradations







SMA vs. PFC

Conventional HMA





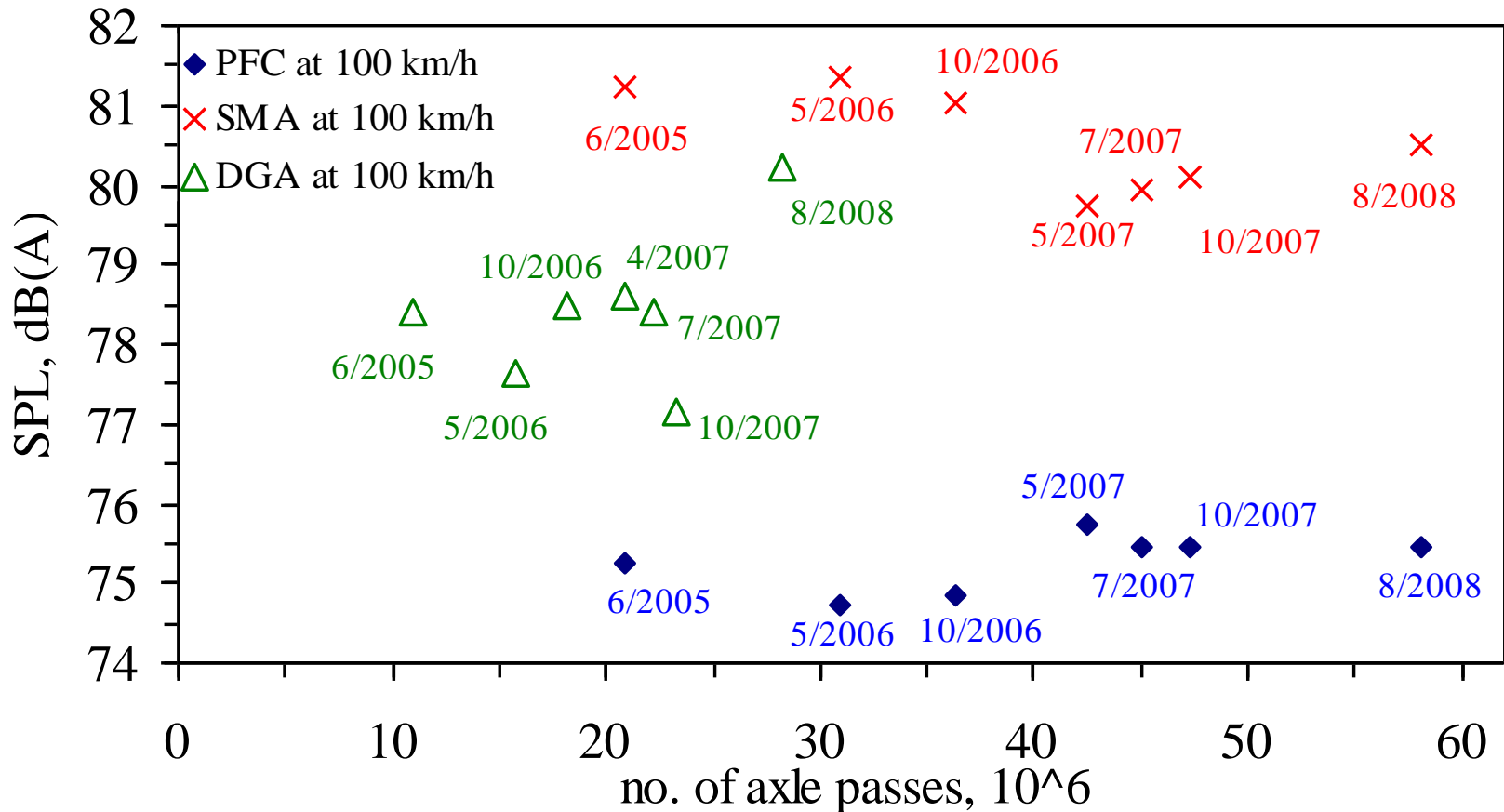
After One Year

- PFC significantly quieter than SMA or HMA
– CPX and sideline
- In car noise significantly lower on PFC
- PFC -- higher macrotexture than SMA and much higher than HMA
- Friction higher for PFC and SMA than HMA
- PFC significantly reduced splash and spray

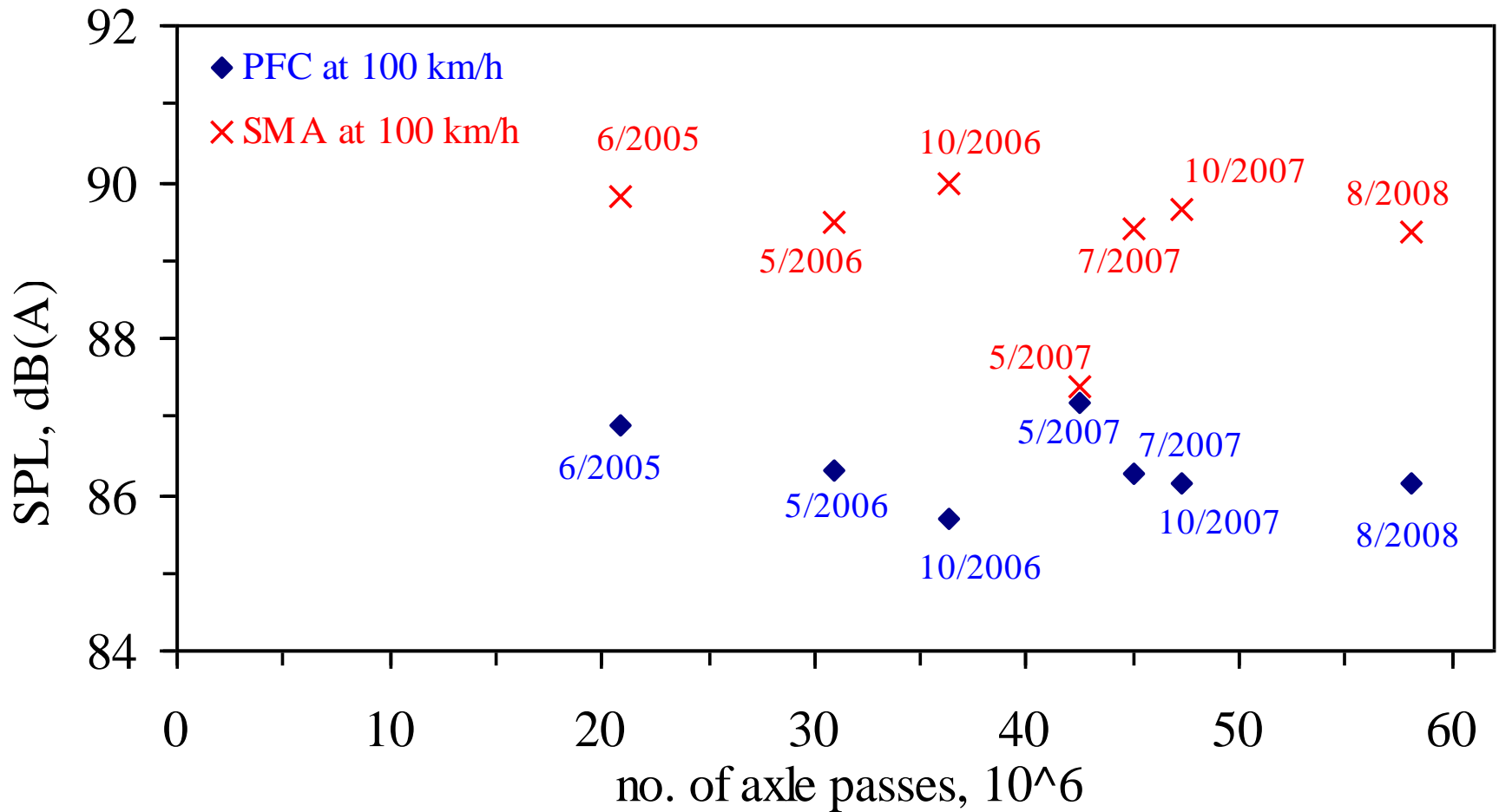
Long Term Performance

- Questions remained -- how long will these effects persist?
 - Does the PFC clog and lose effectiveness?
 - High permeability is supposed to help prevent that, but
 - Will traffic wear off film and increase IFI on PFC and SMA?
 - Will PFC lose macrotexture and friction?

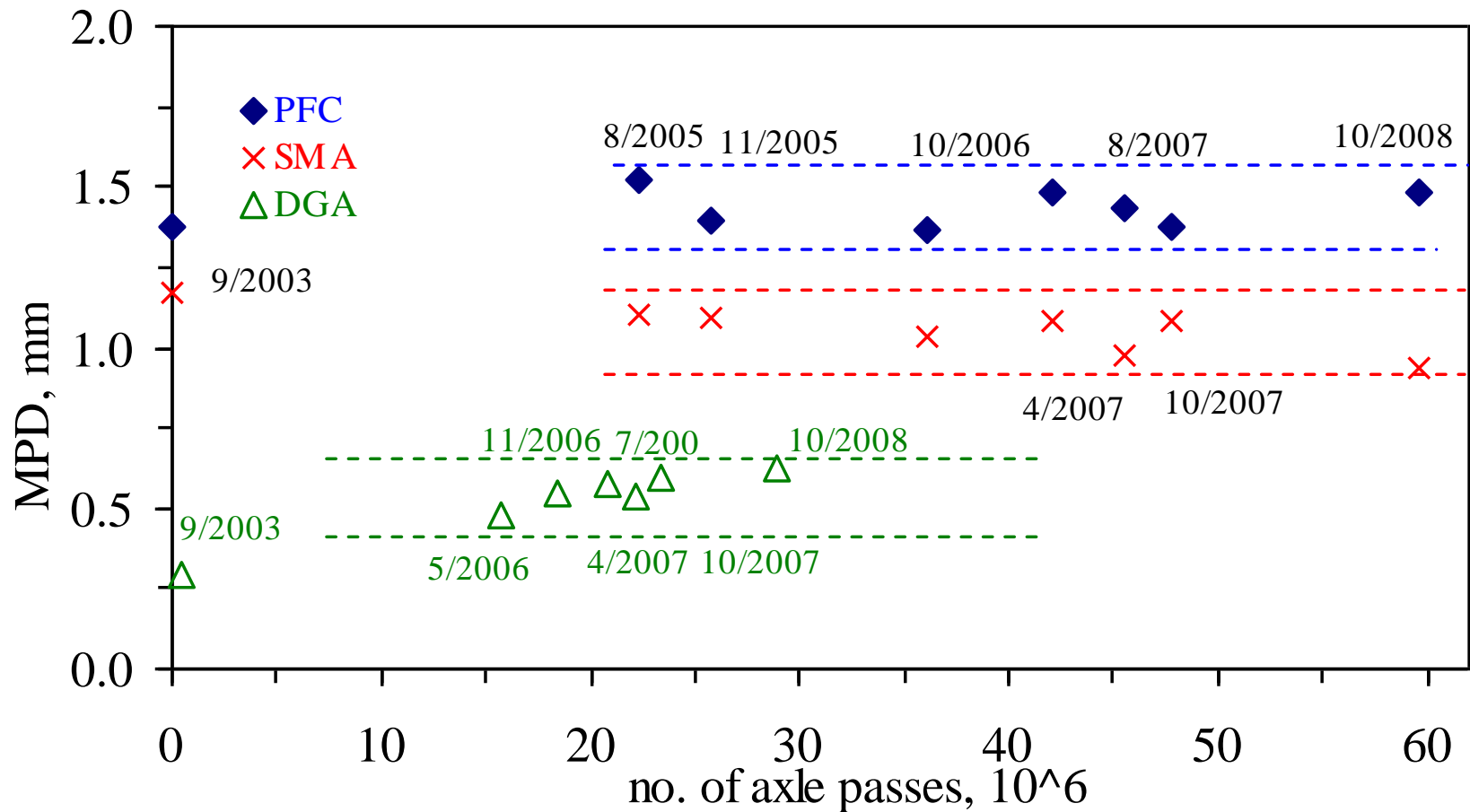
Changes in Noise vs. Traffic



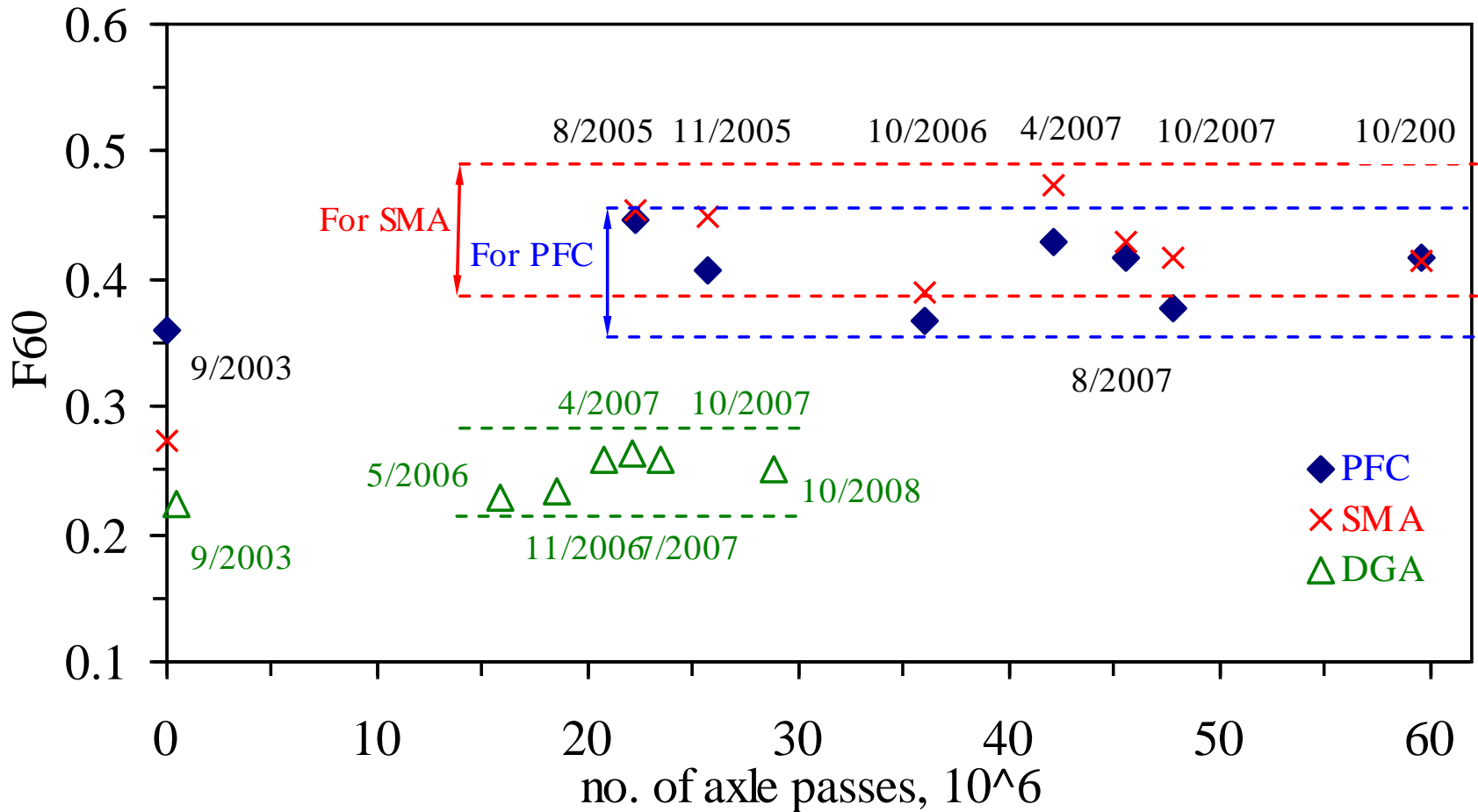
Heavy Vehicle Noise



Changes in Texture



Changes in Friction (F60)





After Five Years

- Texture decreased slightly after two years then stabilized
- Noise increased slightly, now steady
- PFC significantly quieter
- PFC and SMA friction the same
- PFC reduced splash and spray
- PFCs can hold up in Midwestern applications (when used properly)
- Did require somewhat more salt



Other Studies

□ Quiet Pavements

- European style surfaces in American terms
- Extensive lab study

□ Low Void Mixes

- How low is too low?
- NCAT Track performance, Accelerated Pavement Testing and lab testing



FHWA Research

- Polyphosphoric Acid Modification
- Improved Asphalt Binders
- Locking Point
- Fatigue – Endurance Limit
- RAP Binder Co-Mingling
- Virtual Mix Design
- Forensic Evaluations



Asphalt Research Consortium

- Western Research Institute, Advanced Asphalt, UW Madison, UNR, Texas A&M, FHWA
- Moisture Damage
- Fatigue
- RAP
- Engineered Materials



Asphalt Research

- Lots of exciting work on all levels
- Major advancements on the way

- Aimed at better performance, better environmental stewardship and more economical construction



Plug

North Central Asphalt User Producer Group
HMA Technical Conference

Overland Park, Kansas

February 3-4, 2009

*Stretching Pavement Dollars -
Sustainability – Constructability*



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