



Ground Tire Rubber and Trans-Polyoctenamer as Asphalt Binder Additives

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Presentation to the Western Research Institute 2004 Symposium on Additives
in Roadway Asphalts

Cheyenne, Wyoming

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Outline

- I. Further Studies of Asphalt Rubber/Rubber Aggregate for paving of paths and trails (non-motorized use); Vestenamer[®] effects.
- II. Asphalt-Rubber Binder viscosity: Field Measurement Standardization.
- III. Progress with Asphalt-Rubber Chip Seal instalments in Colorado – performance after one year and 2004 sites.
- IV. Tire-Roadway Noise Generation and the “Quiet Pavements Pilot Programs” (QP3).



What is

VESTENAMER[®] Polyoctenamer?

VESTENAMER[®] *trans*-polyoctenamer rubber (TOR) is a mixture of linear and macrocyclic polymers that exhibit four special structural features when added to rubberized asphalt concrete:

1. Low initial viscosity during the initial mixing operation
2. Increased viscosity after polymerization to prevent drain down
3. Chemical bonding of the GTR to the asphalt
4. Chemical bonding of the final rubberized asphalt to the aggregate to reduce stripping
5. Conversion of the thermoplastic asphalt to a thermoset polymer, which reduces cracking and rutting

COST CALCULATION *for 1 Mile, Dual Lanes, 22-foot Wide*

Case #1 *A 3-inch standard PG 76-28 modified asphalt overlay*

Material	Quantity	Cost
Aggregate	2,178 tons	\$12,306
76,-28 Asphalt	131 tons	\$38,551
Total	2,309 tons	\$50,857

Case #2 *A 3-inch 10% GTR + VESTENAMER modified (PG76,-28) asphalt overlay*

Material	Quantity	Cost
Aggregate	2,178 tons	\$12,306
64,-28 Asphalt	131 tons	\$24,235
10% GTR (14-)	13 tons	\$4,680
VESTENAMER 8012	0.6 ton	\$2,400
Total	2,322.6 tons	\$43,621

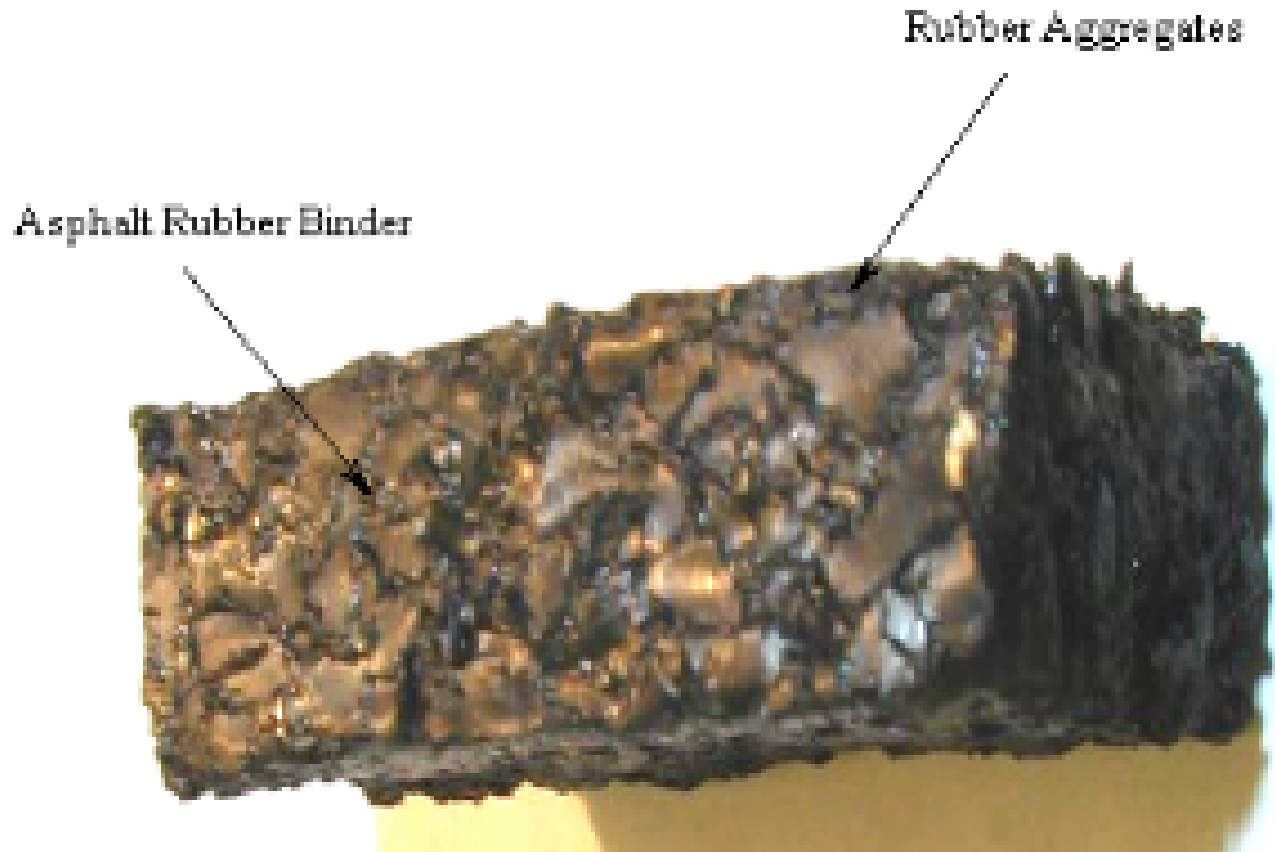


Penn State “NECEPT” Report (Jan. 24, 2003) “Evaluation of Vestenamer Reactive Modifier in Crumb Rubber Asphalt” –for Degussa Corp.

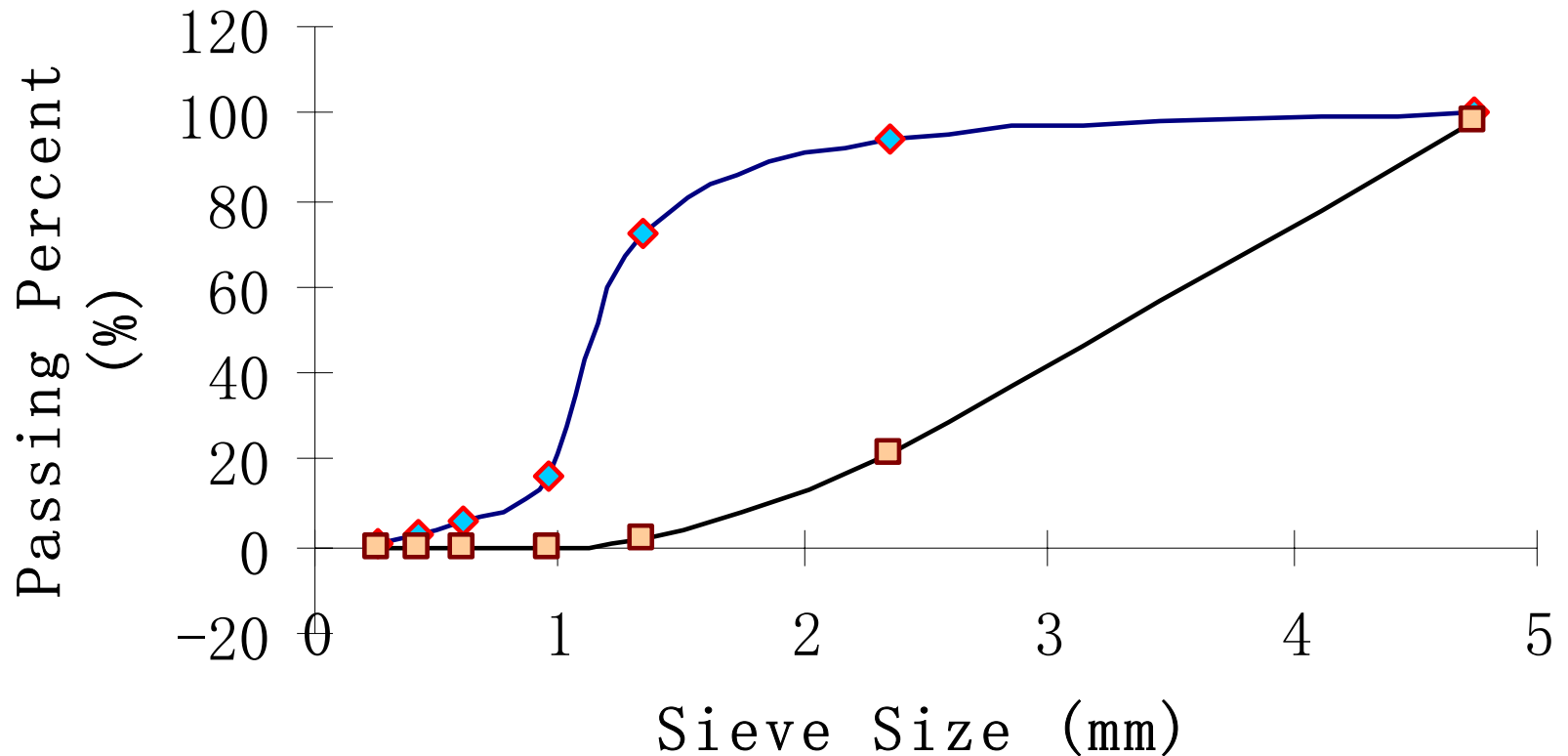
■ Conclusions:

1. Vestenamer[®] definitely reacts with the ground tire rubber, and has a significant effect on the appearance and workability of the modified binder.
2. Two increases in binder PG grade were observed for some blends; both GTR and GTR + Vestenamer provide higher rutting resistance compared to the control binder (PG58-28, Koch Pavement solutions).
3. Five percent GTR provides one grade bump in the performance grade (PG) of the binder.

Macrostructure of ARRA

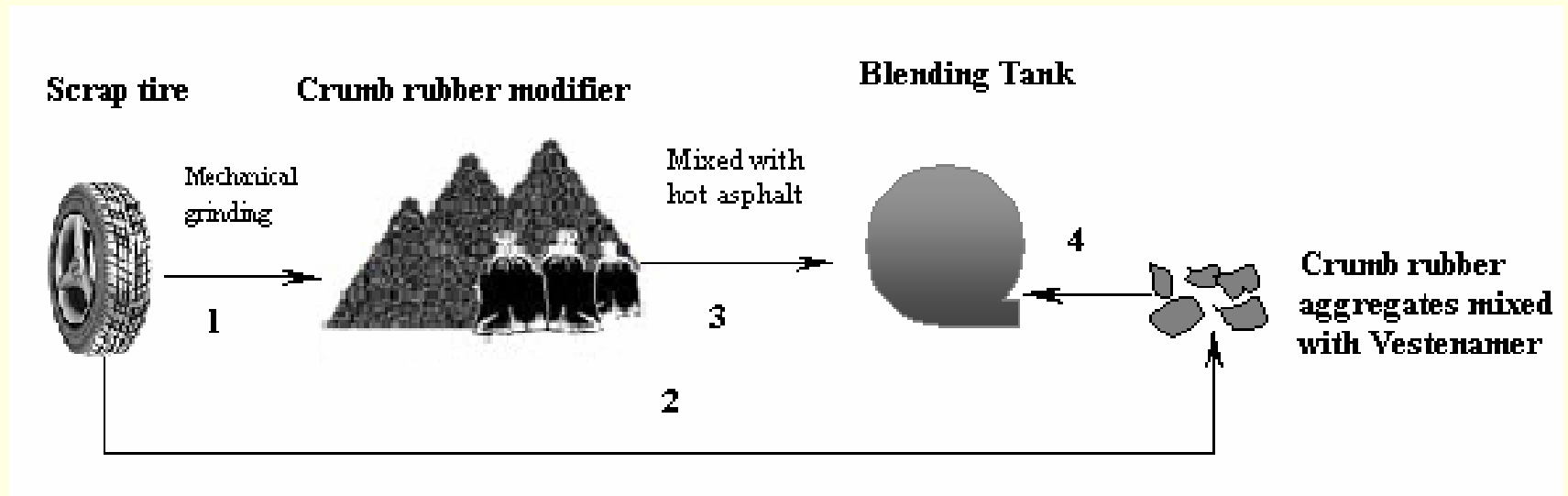


Size distribution of the crumb rubber particles

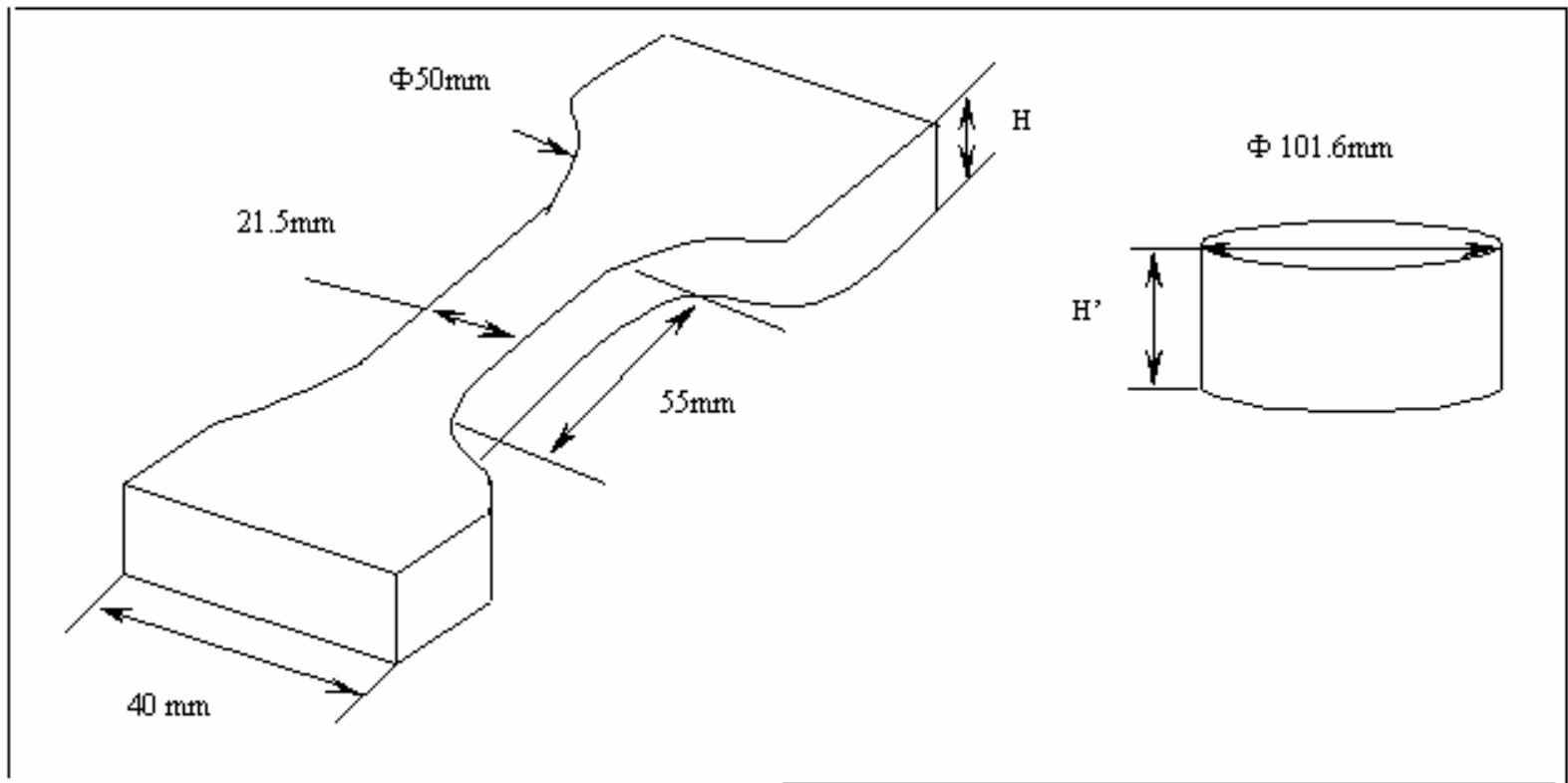


—◆— Rubber Modifier —■— Rubber Aggregates

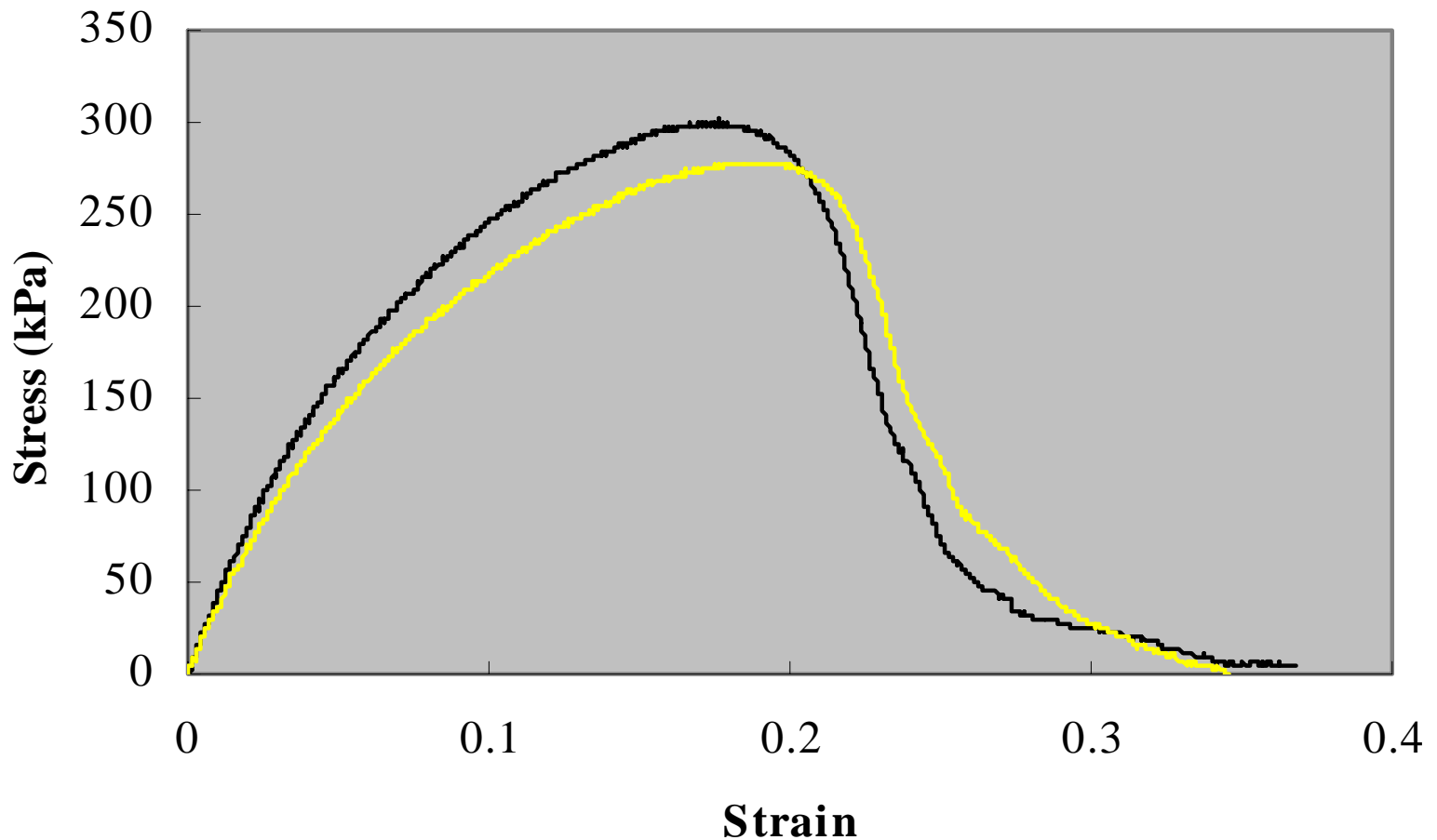
Dry Process for manufacturing ARRA



Dimensions of Tested Samples (compaction pressure: 140 kPa)



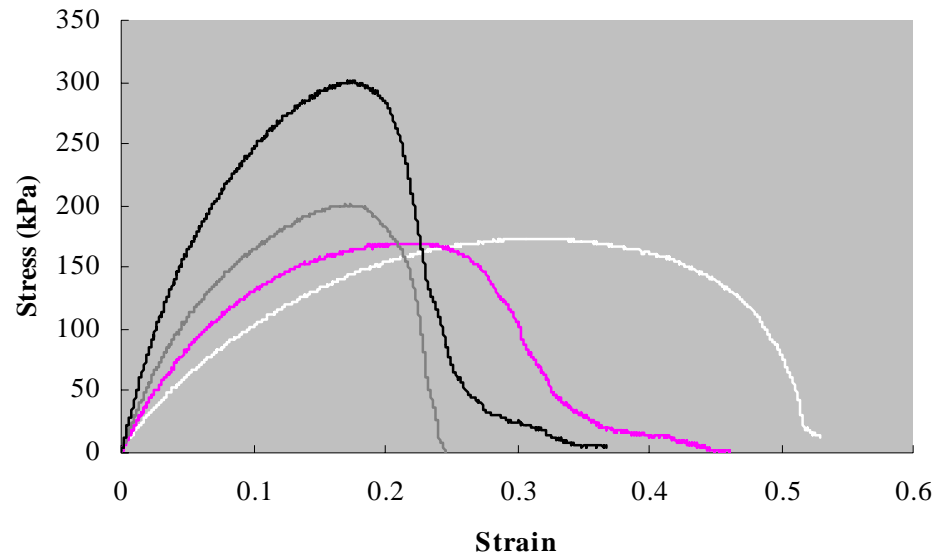
Blending effect on tension testing. (5% vestenamer modified ARRA 50-50, Testing temperature: 210C, compaction pressure: 140 kPa, Strain rate: 0.091 /min)



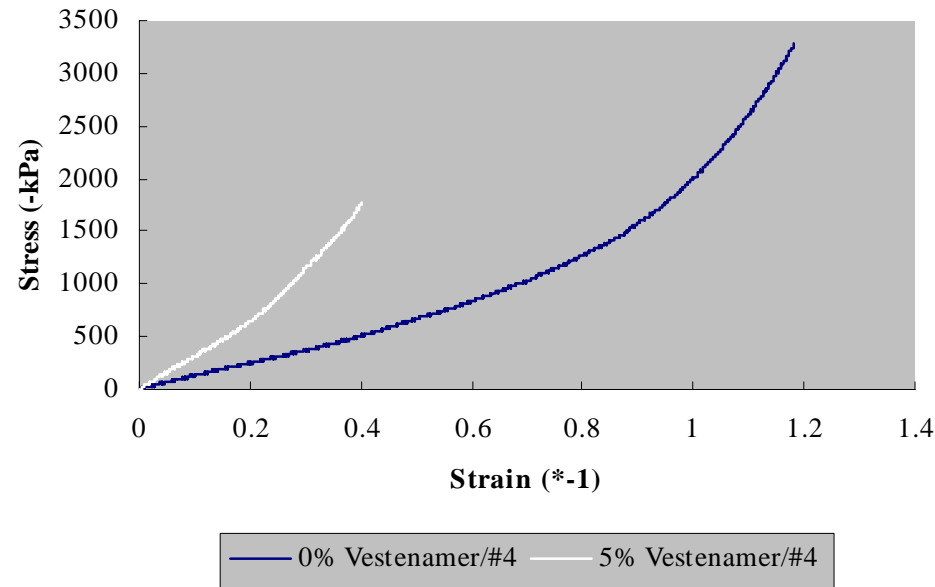
Smoother surface of vestenamer modified ARRA



Vestenamer Effect on Mechanical behavior of ARRA (Testing temperature: 21 ° C; Compaction pressure: 140 kPa)

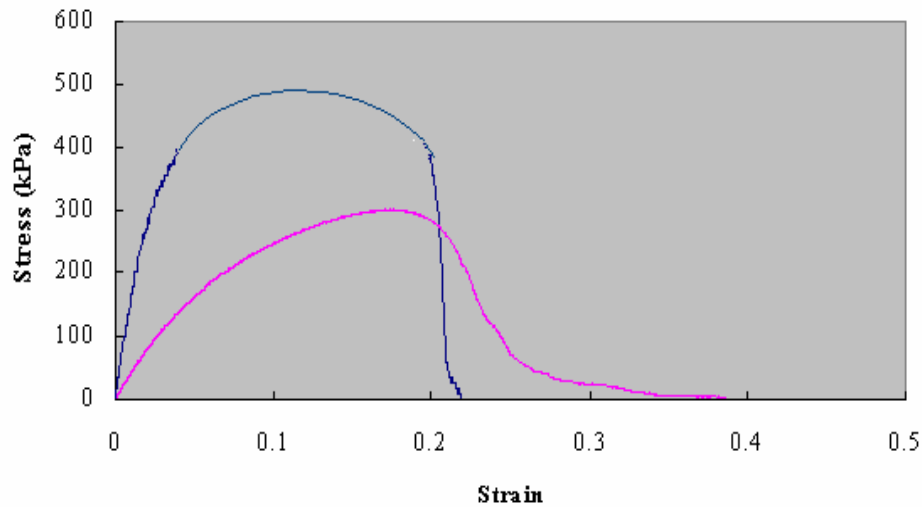


Vestenamer ratio effect on the tension behavior of ARRA,
Strain rate: 0.091 /min

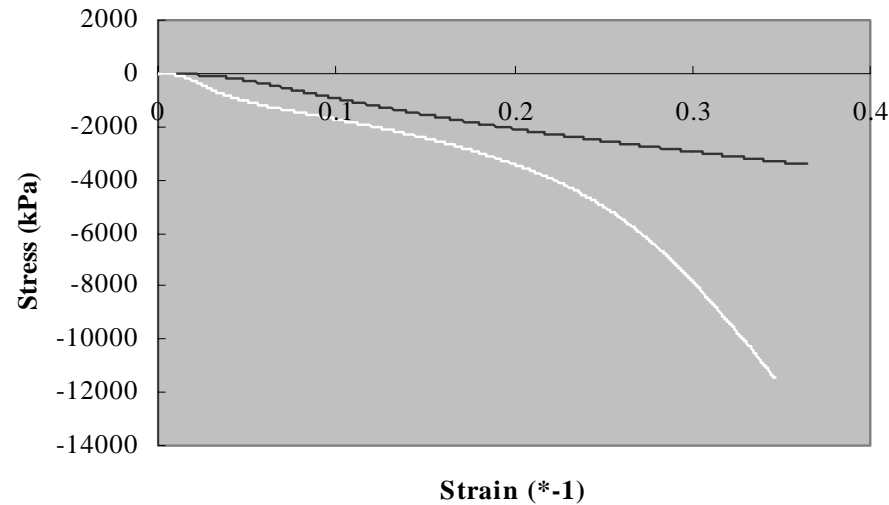


Vestenamer ratio effect on the compression behavior of ARRA,
Strain rate: -0.091 /min

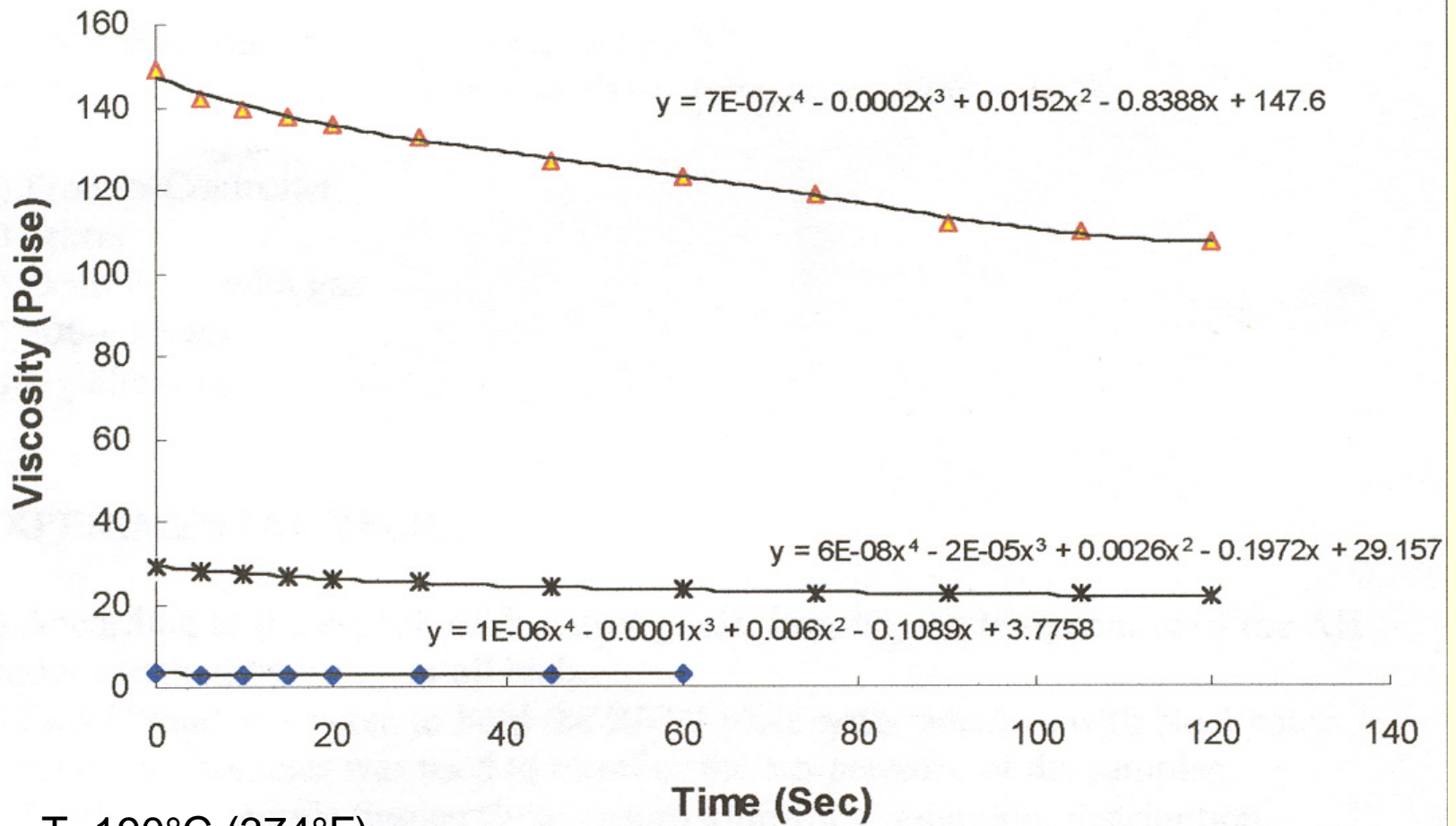
Low temperature behavior of ARRA (Compaction pressure: 140 kPa)



Low temperature effect on tension behavior
of 5%wt vestenamer modified ARRA,
Strain rate: 0.091 /min



Low temperature effect on compression behavior
of 5% wt vestenamer modified ARRA,
Strain rate: -0.091 /min



T=190°C (374°F)

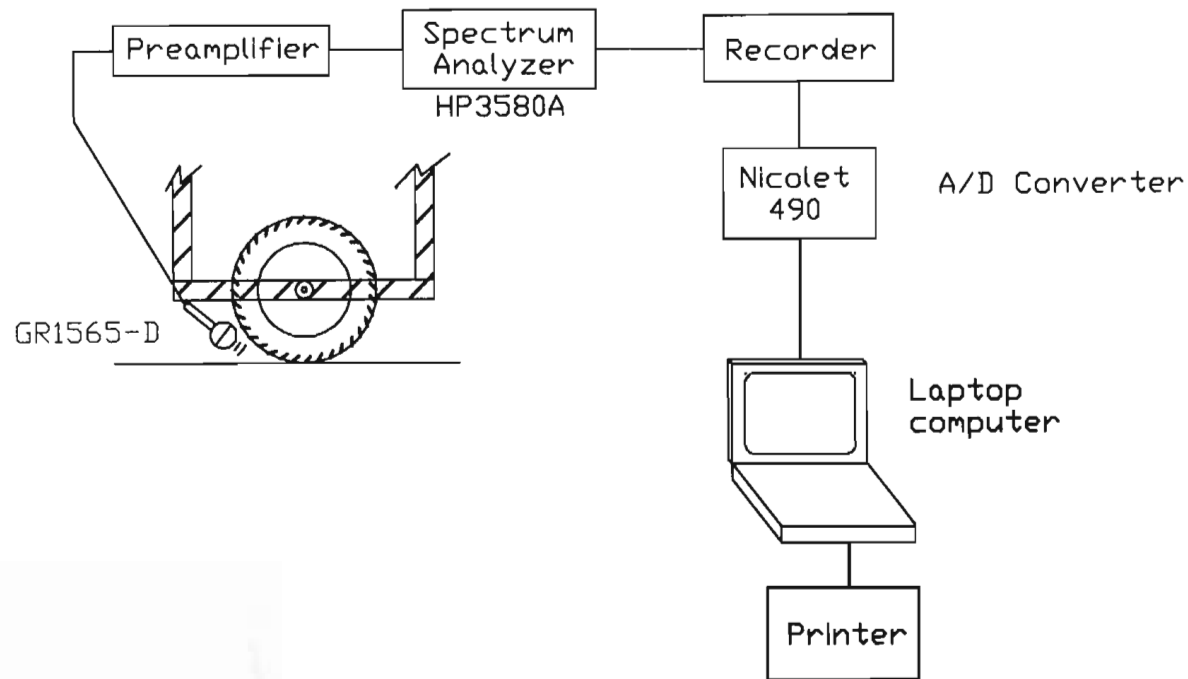
◆ 10% CRM * 15% CRM ▲ 20% CRM



Summer 2004 AR Projects

- Demonstrate an “ARRA” Trail for C-DOT and for state parks;
- Demonstrate 6 or 7 new Asphalt-Rubber Chip-Seal projects at sites with varying climates (one project may involve Vestenamer[®]) totaling ca. 700,000 yd²;
- Initiate sound level measurements for chip seals;
- Initiate skid resistance measurements on wet and dry AR chip-seal surfaces.

Portable Sound Pressure Level System



Rubber Modified Asphalt Binders

Blacklidge Emulsions, Inc. is the major producer of Rubber Modified Asphalt Binders in Florida, which is specifying Rubber Modified Asphalt Binders for use on all Department of Transportation friction courses (dense-graded and open-graded).

Blacklidge Emulsions, Inc. has participated in many of the SHRP demonstrations and research projects throughout the United States. Particularly in the Southeastern United States, the SHRP 76-22 performance graded asphalt binder has been selected by various Department of Transportations. Blacklidge Emulsions, Inc. has generally been able to meet this binder specification by the addition of 9-12% 40 mesh rubber using Blacklidge Emulsions' blending technique with the addition of special additives. Generally, Blacklidge Emulsions has found that using tire rubber instead of latex or SBS polymers is less expensive. The addition of tire rubber will improve the low and high end and temperature ranges of the SHRP specifications.

<http://www.blacklidgeemulsions.com/rubber.htm>

Streets to undergo rubbery facelift

Rubberized asphalt will help reduce road noise on busiest streets

By Rick Davis
The Desert Sun
March 8th, 2004

RANCHO MIRAGE -- A mid-valley street project is expected to reduce the sound of cars on roads by putting asphalt with car parts, specifically old tires, in the roads.

Sometime in July, Rancho Mirage will start another phase of its long-term project to deaden traffic noise by resurfacing all the city's streets with rubberized asphalt.

The latest phase will include resurfacing sections of Frank Sinatra Drive (1 1/4 miles), Gerald Ford Drive (1 1/2 miles) and Highway 111 (1 1/4 miles). The overall estimated cost is \$1.93 million.

In a staff report distributed last week, city Director of Public Works Bruce Harry noted that once the phase is completed, 40 percent of the city's main streets will be resurfaced with rubberized asphalt, including all of Highway 111 within the city limits.

The city's residential streets (about 49 miles) are surfaced and resurfaced with a product called rubberized emulsion aggregate slurry, by applying a coat that's 1/8 to 1/4 of an inch thick.

Harry noted that some municipalities aren't using the pricier product because of financial constraints. A city can resurface 4.2 miles of streets with non-rubberized asphalt for the same cost as resurfacing three miles with rubberized asphalt.

"It's more expensive, by about \$20 a ton," Harry said. "But it's supposed to be stronger by up to a 2-1 ratio. Added strength means it will last longer and you can put down a thinner coat."



New Mexico Wants Quiet Pavements

A New Mexico citizen concerned about traffic noise has prepared a point paper on the subject. He is attempting to get the local paving authority to explore asphalt rubber surface as part of a regular maintenance activity to take advantage of the material's noise reducing properties. The Tempe, AZ-based Rubber Pavements Association (RPA) reports the concerned citizen has made use of a Sacramento County noise study and recent Arizona Department of Transportation research to answer questions about the comparative noise reduction between Dense Graded Asphalt Concrete and Asphalt-Rubber mixes. Another resource for comparative noise reduction is the NCHRP synthesis 268 which was completed in 1998 and shows as much as a 9db reduction with open graded mixes. ♦

I-80 DAVIS OGAC PAVEMENT NOISE STUDY

TRAFFIC NOISE LEVELS ASSOCIATED WITH AN AGING OPEN GRADE ASPHALT CONCRETE OVERLAY



December 1, 2002



Prepared for:

California Department of Transportation
Environmental Program – Noise and Vibration Studies
1120 N St. 4th Floor
Sacramento, California 95814

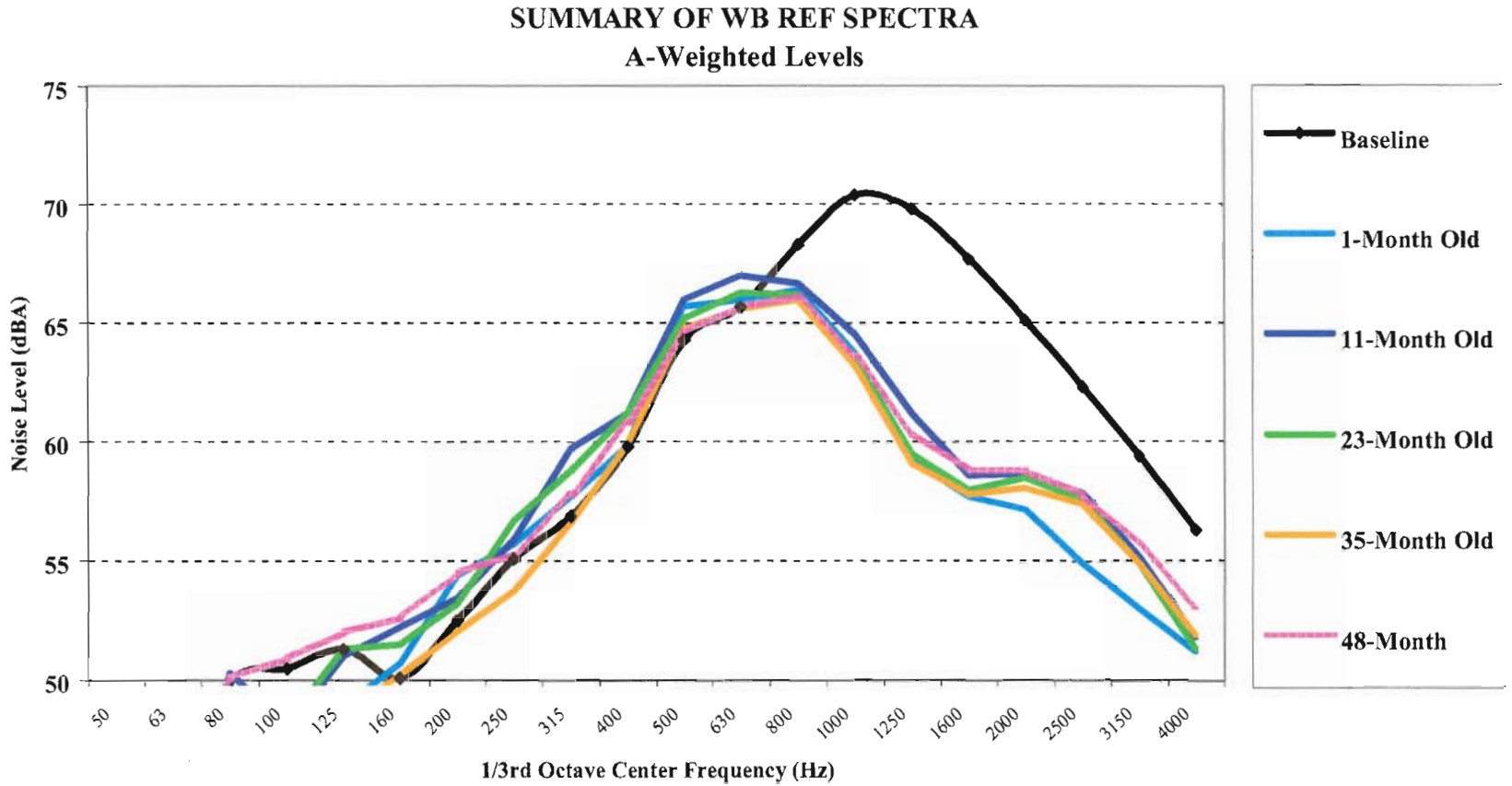


Prepared by:

ILLINGWORTH & RODKIN, INC.
Acoustics • Air Quality

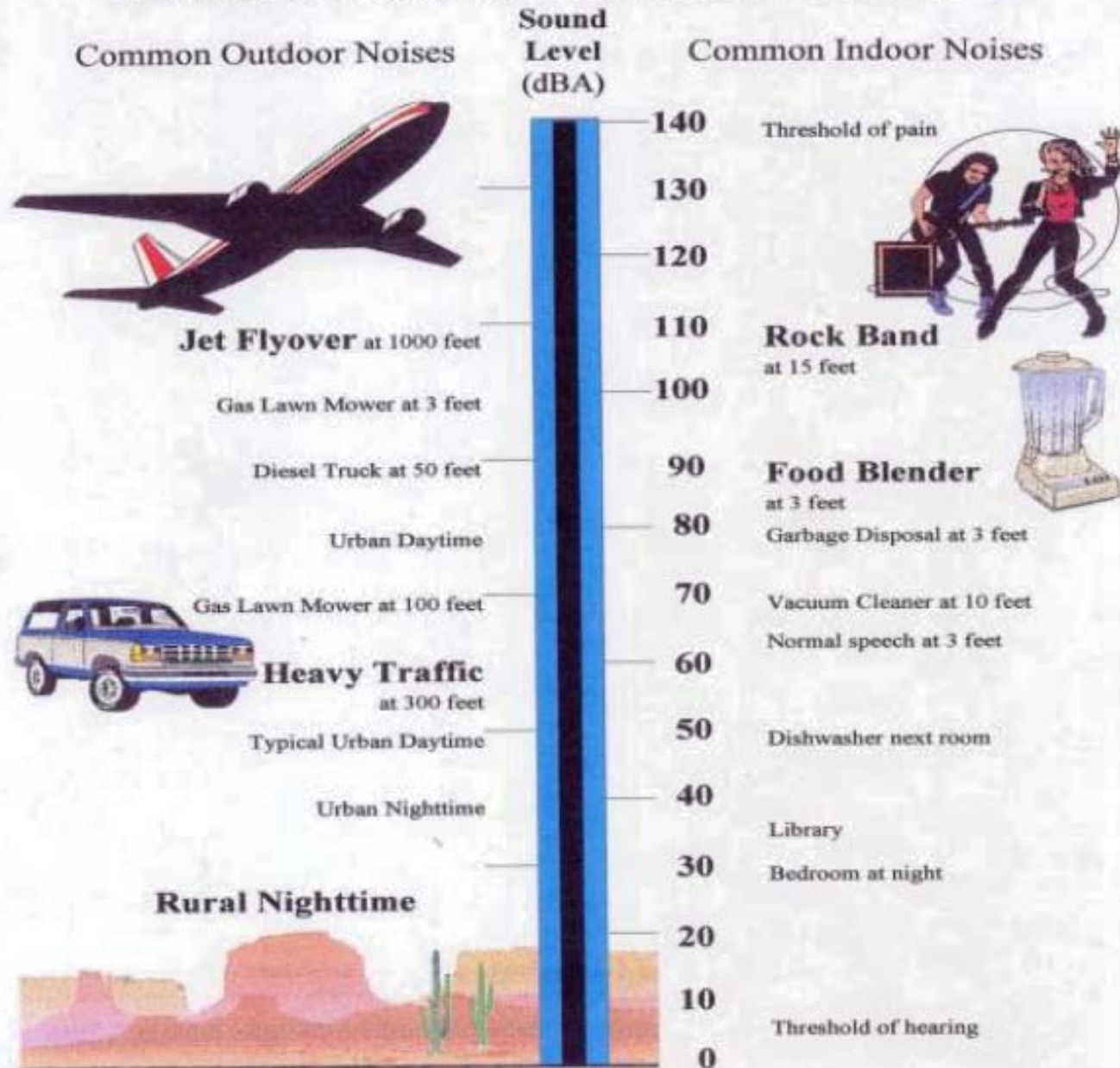
505 Petaluma Blvd South
Petaluma, CA 94952

Figure 4-2a Westbound Reference Traffic Noise Spectra



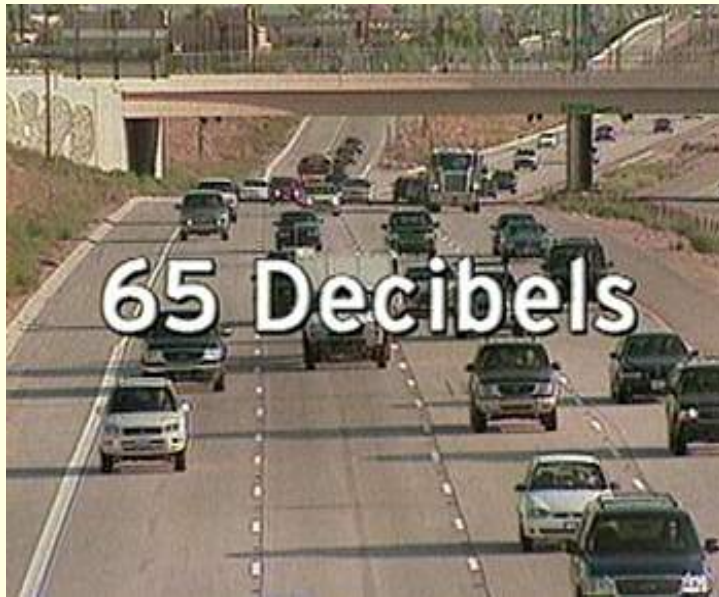
What is Noise, How is it Controlled, and How Does it Affect Our Lives

Common Indoor and Outdoor Noise Levels



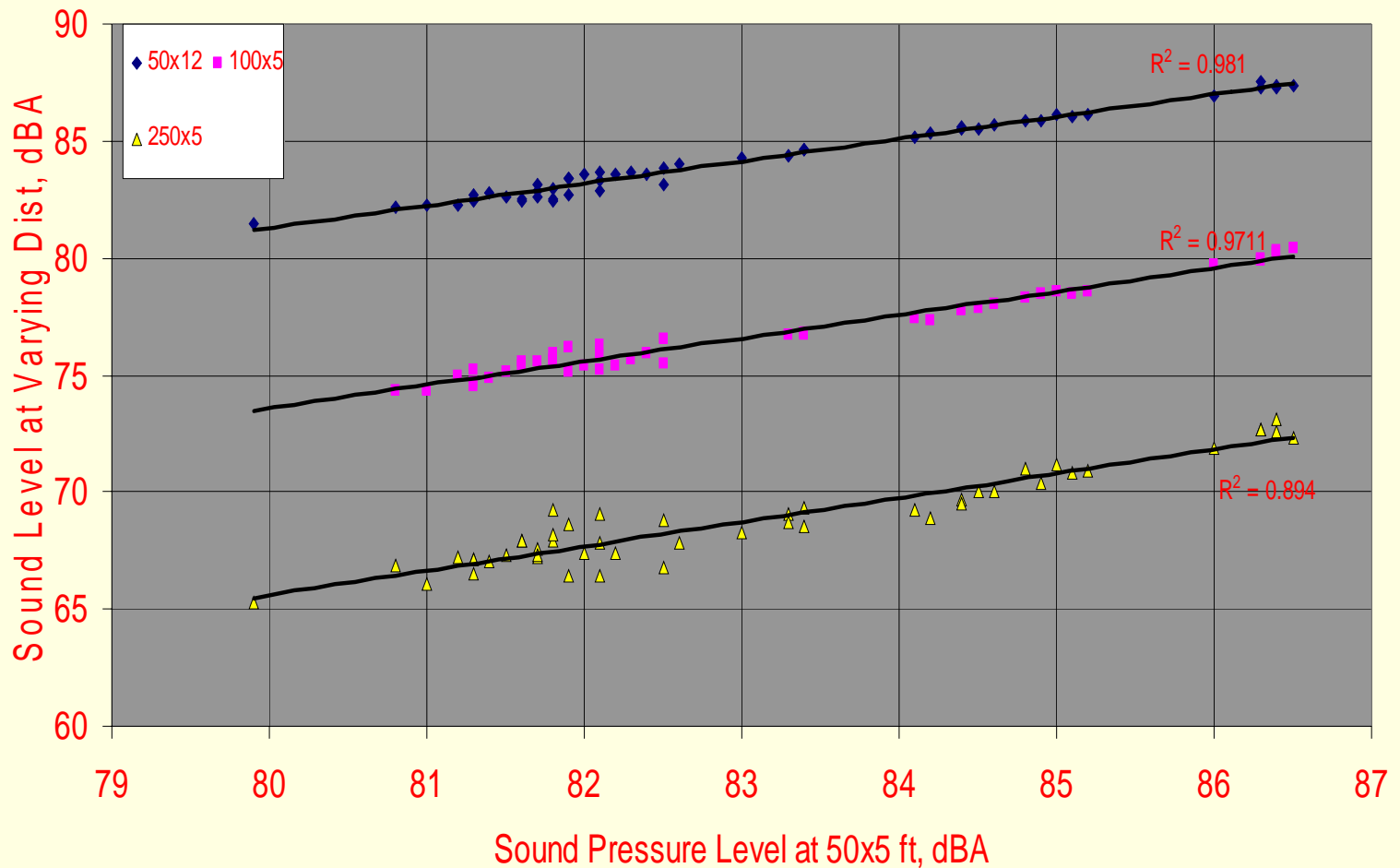
Note: *Sound is perceived differently by every individual*

Doubling Traffic adds 3dBA



Effect of Distance On Noise Levels for Site 3D

Comparison of the Leq Data Relative to 50 ft away, 5 ft high
AZ 202 Preproject PCCP



How Is It Controlled

- At the Source
 - Vehicle & Tire Emissions
- Through Distance
 - 3 dBA Reduction for Each Doubling of Distance
 - 25ft=70dBA, 50ft=67dBA, 100 ft=64
- Through Obstructions
 - Berms, Walls, And Combination of both

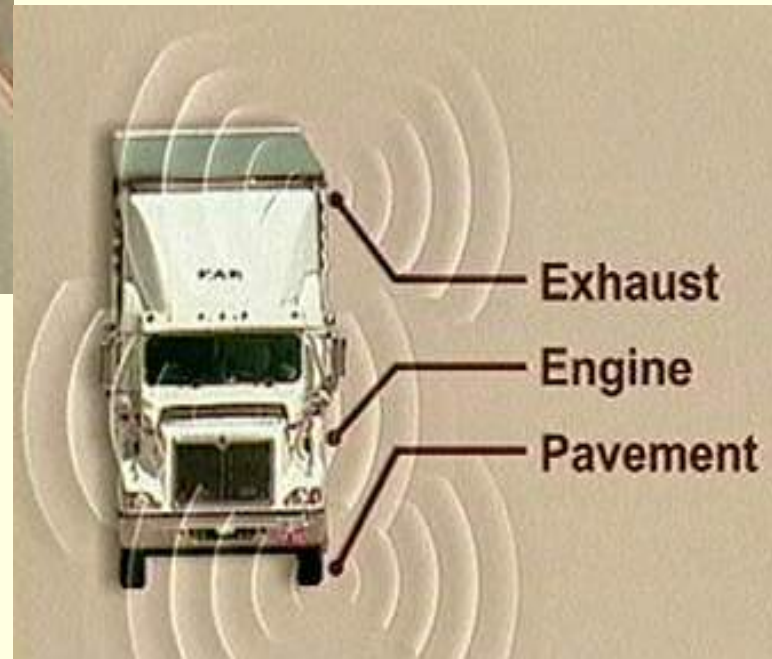
The *Technical* Journey?

- Development of Improved OGFC for Use in Snow Country (1970s-80s)
- Improved OGFC Used to Resist Reflective Cracking (1980s-90s)
- Improved OGFC Used as PCCP Overlay (1980s-2000s)
- Benefit For Smoothness (1990s)
- Benefit for Noise (1990s-2000s)

ADOT Uses ARFC to Provide Quiet Pavements

- The ARFC is Minus 9.5mm & 9-9.5% Binder
- 12.5 mm Thick When Used on Flexible Pavement
- 25 mm Thick When Used on PCCP
- ADOT Uses Pavement Type (ARFC) as a Noise Mitigation Strategy (4 dBA)

Controlled At the Source



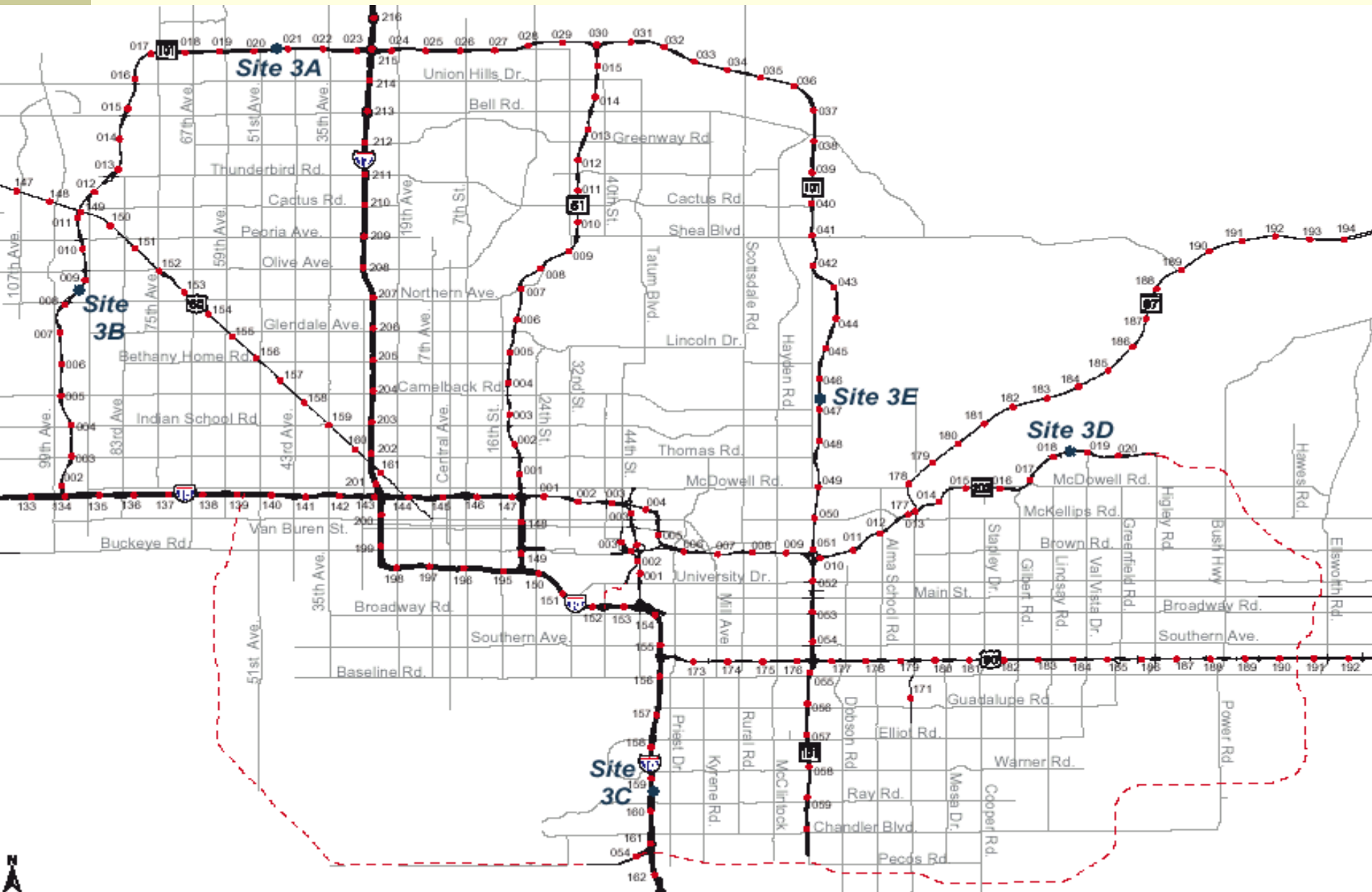
Arizona Quiet Pavement Research Effort

- FHWA/ADOT Quiet Pavement Pilot Program (QP3) or Composite Program—Ten Year, Multi Million Dollar Effort
- Flexible Pavement Program
- Rigid Pavement Program
- Study of Environmental Effects

Development of the Arizona Quiet Pavement Pilot Program

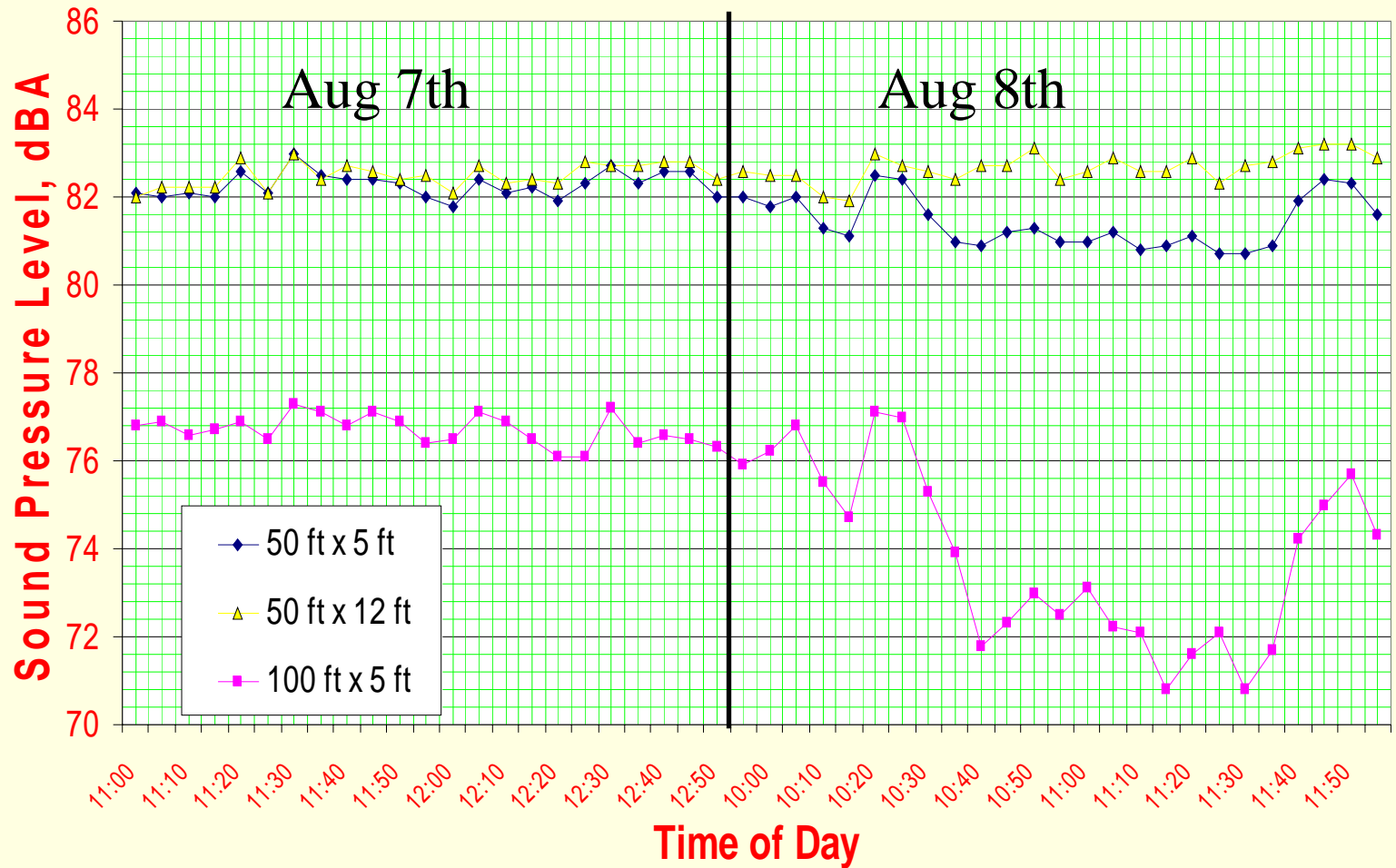
- ADOT Receives a 4 dBA Credit for ARFC
- Ten Year, Multi Million Dollar Research Program Underway
 - Composite
 - Flexible
 - Rigid
- Program Intended to Evaluate the Efficacy of Quiet Pavement Solutions

Quiet Pavement Pilot Program



Environmental Factors

5 Minute L₅₀ Values - AZ 101 Preproject PCCP



Ways of Measuring Sound

Wayside (Far Field)

Close Proximity (Near Field)

Noise Intensity (Near Field)



ADOT ISO CPX Trailer



1995



Spg 2000



Spg 2001



Spg 2002

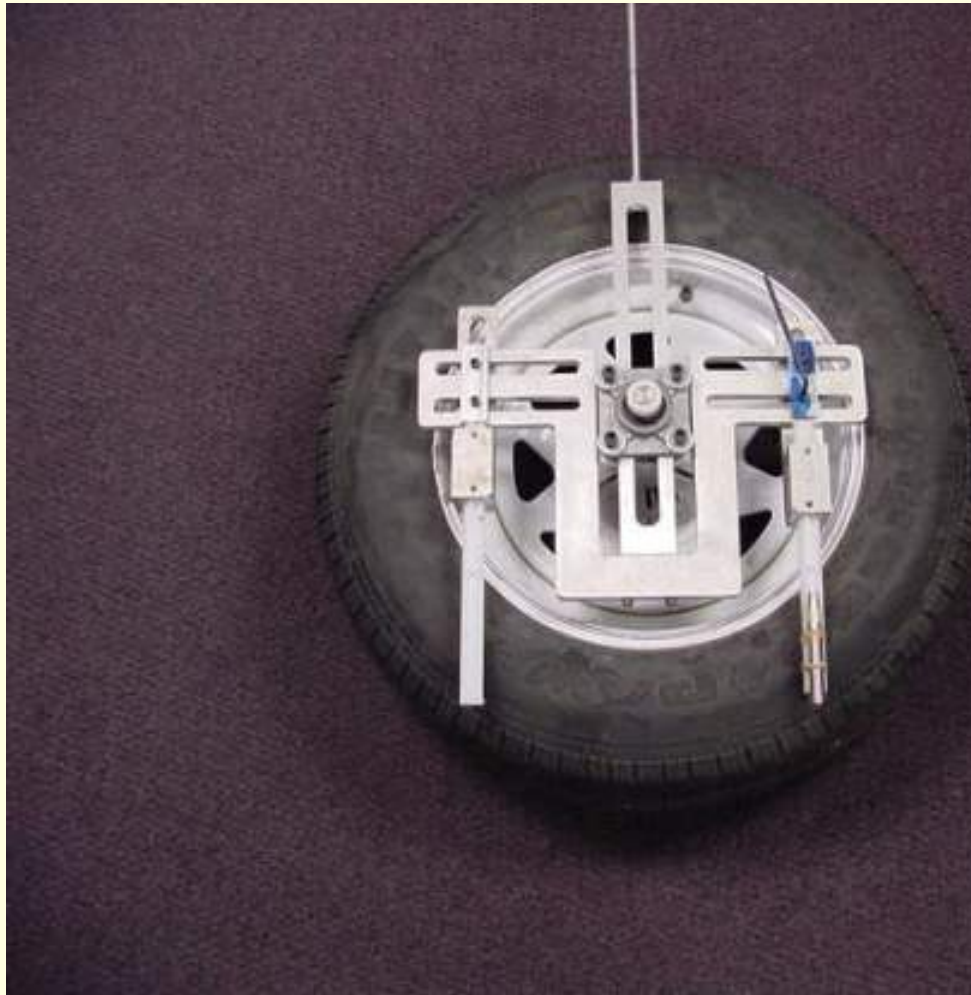


Spg 2003

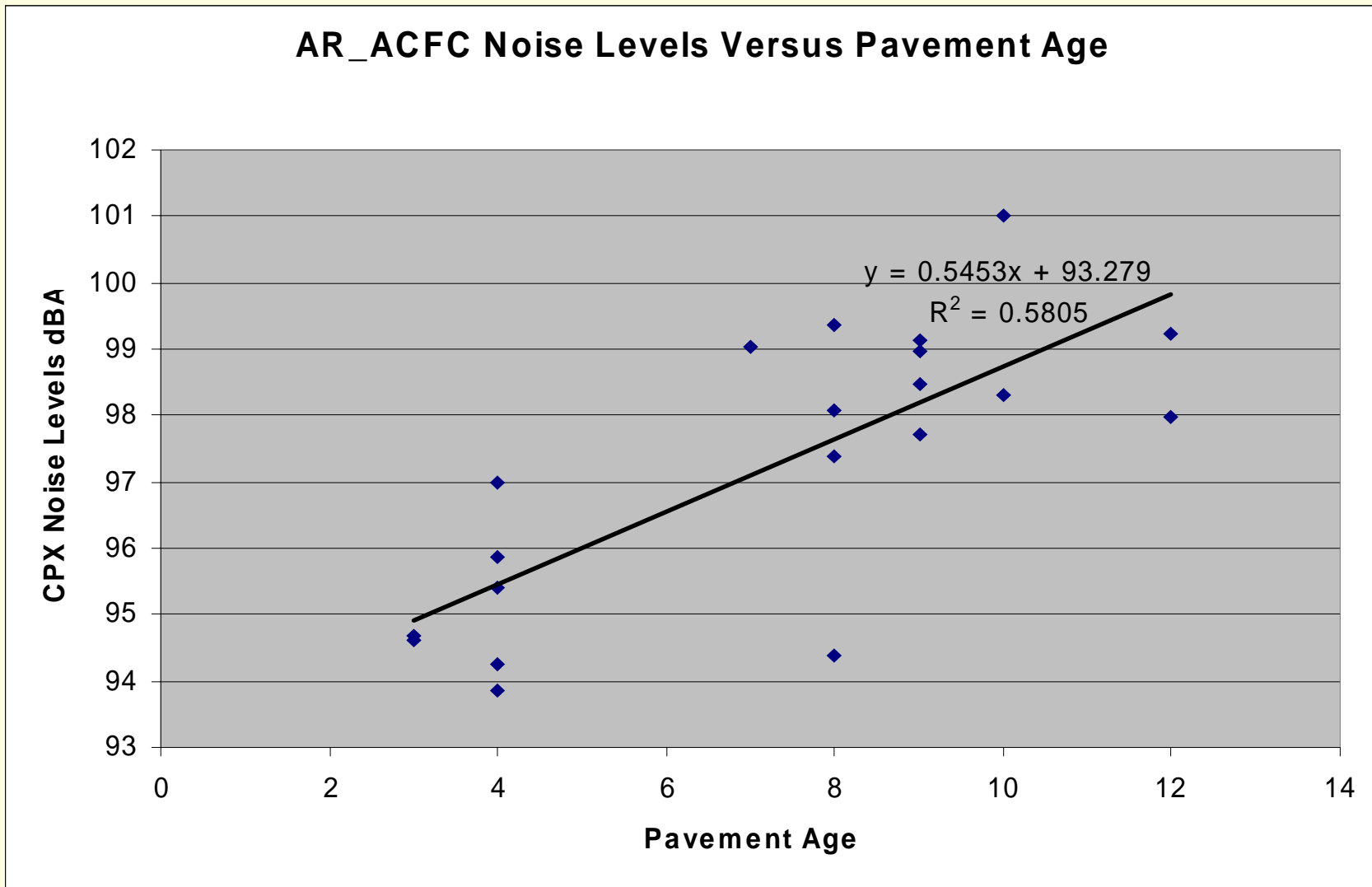


2004

Noise Intensity



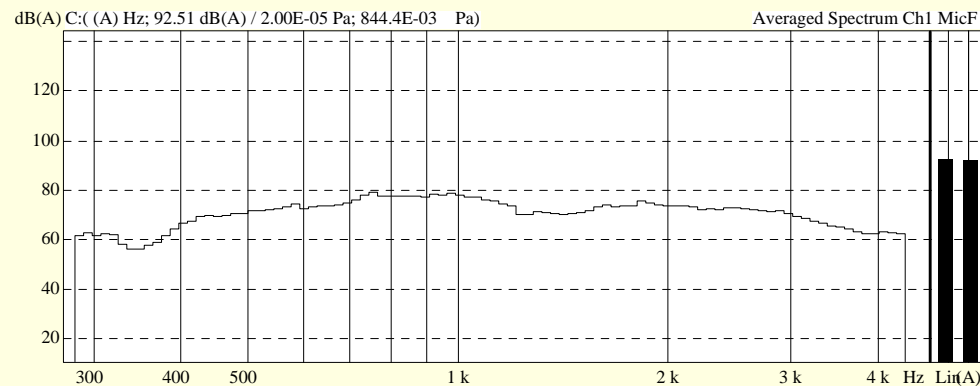
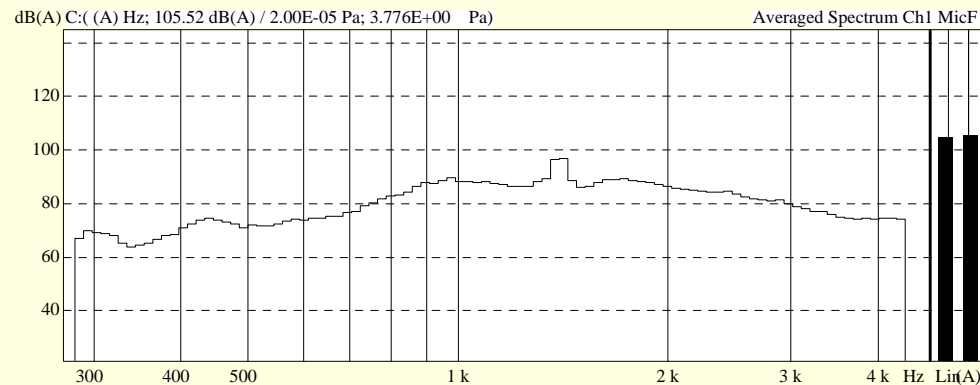
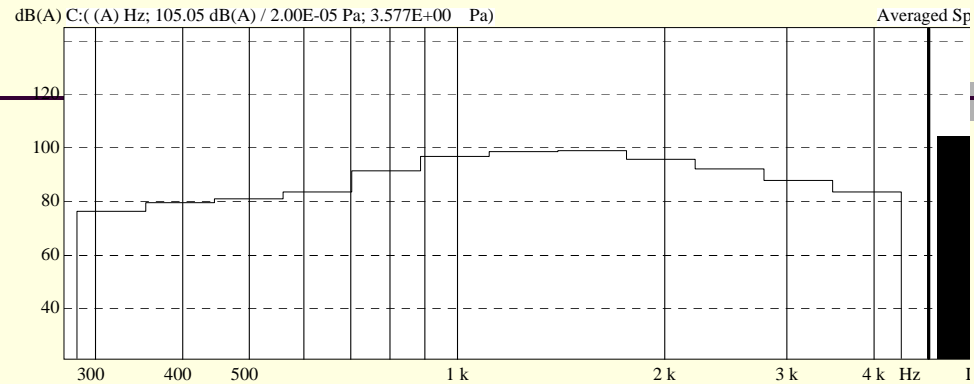
Network Level Evaluation of ARFC Surfaces



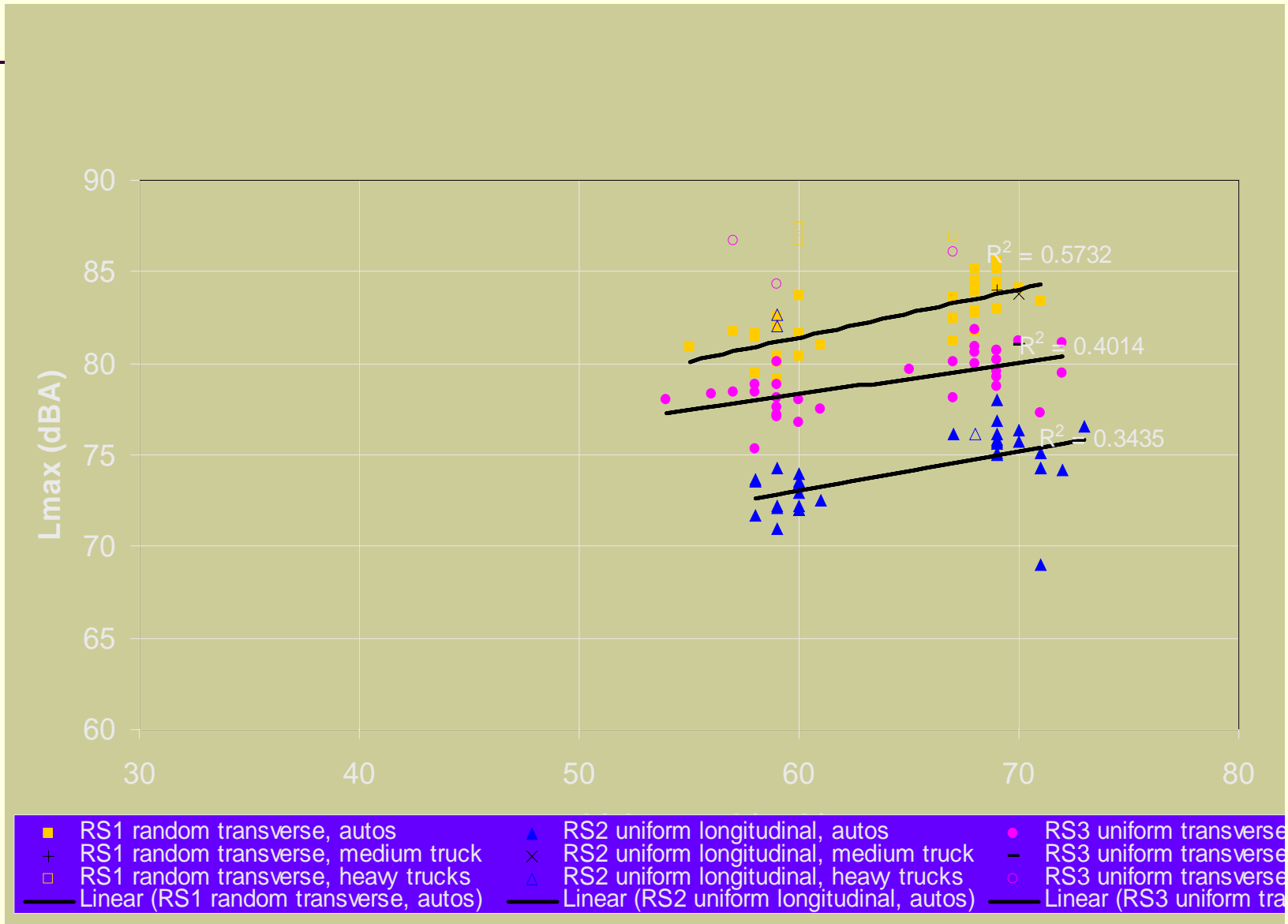
Evaluation of PCCP Tining Methods



SR 101 Before and After Results

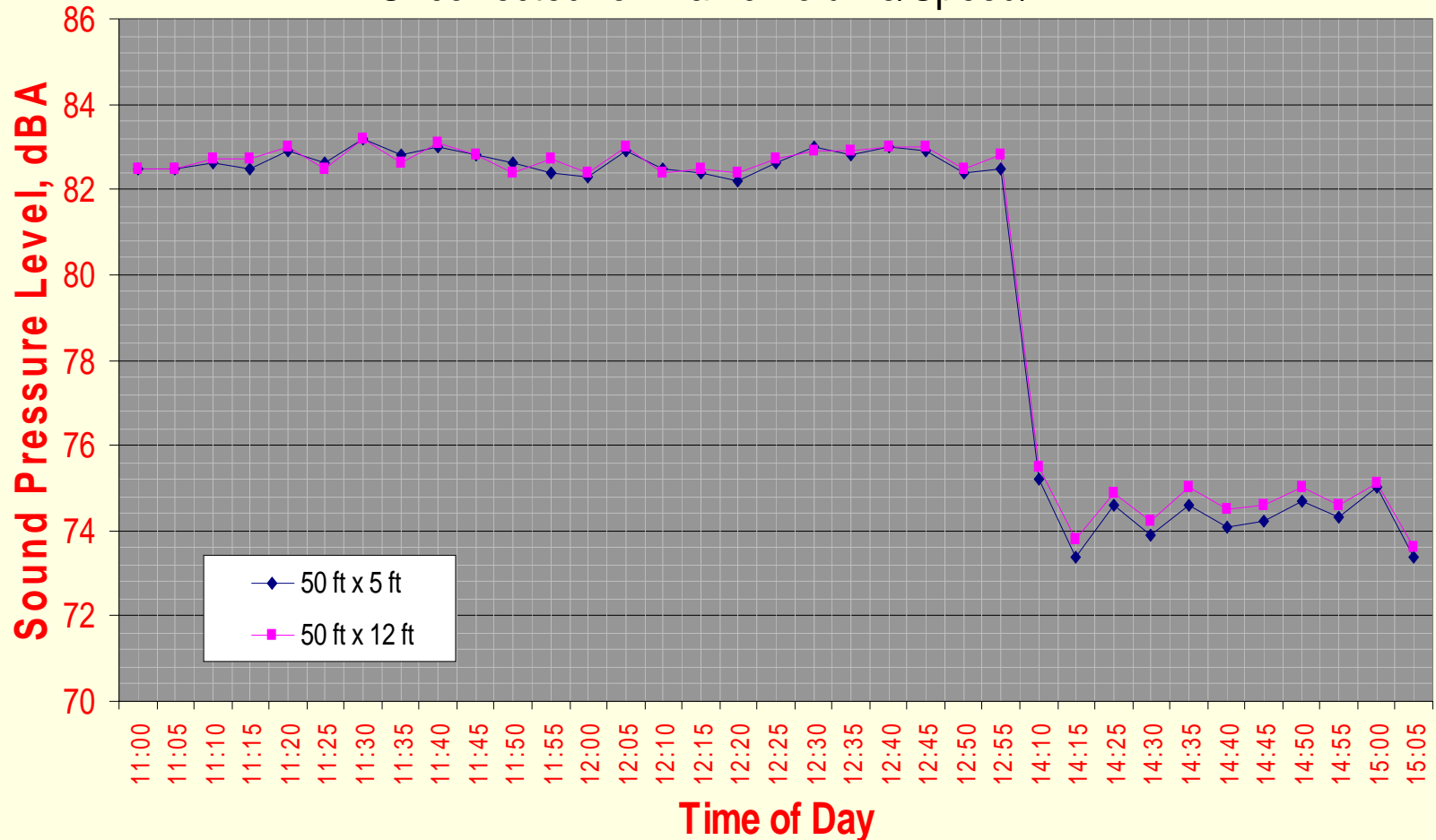


Tining Experiment Roadside Measurement Results at 50 ft



Before and After Results of Site 3A

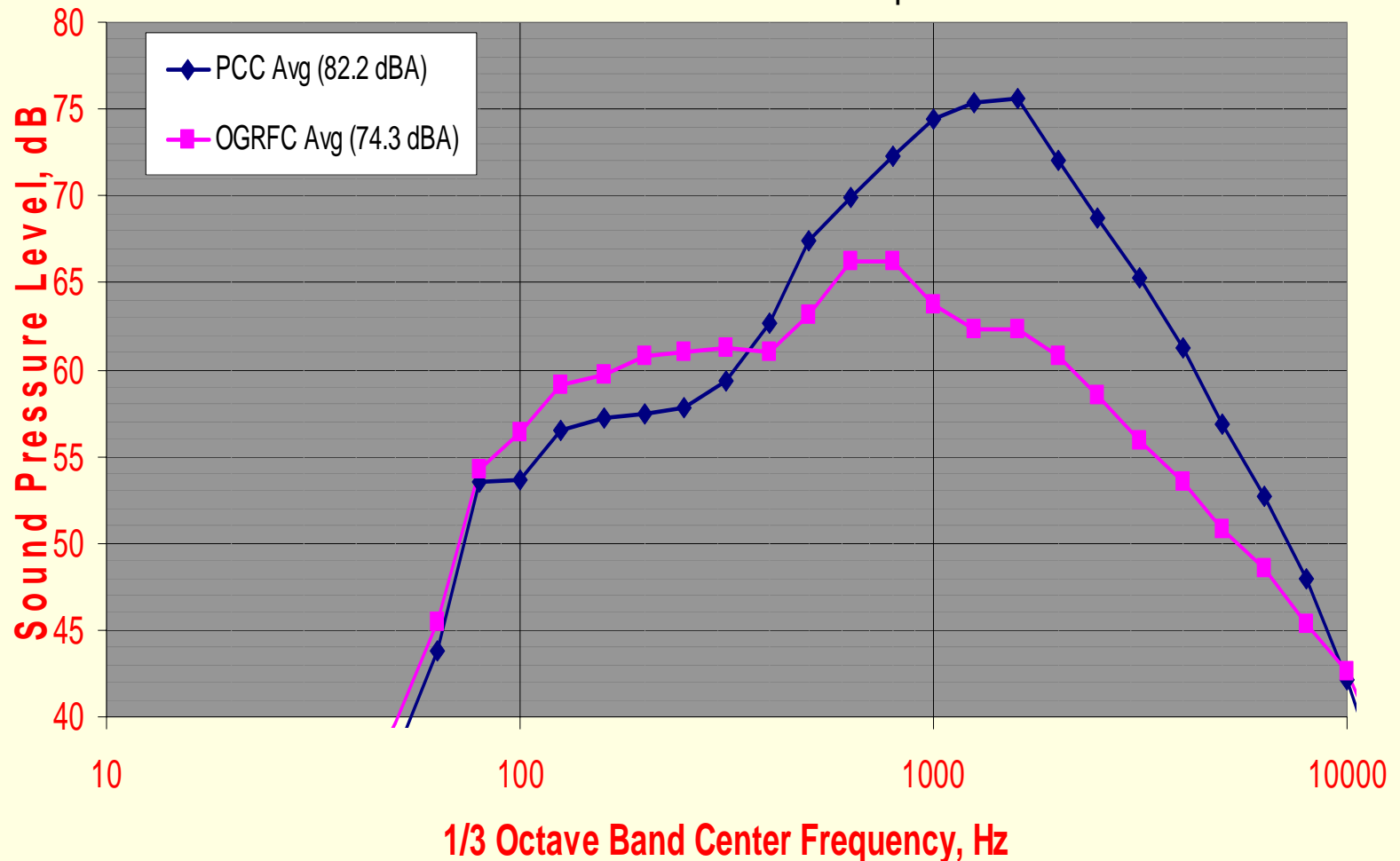
Sound Levels at 50 ft - AZ 101 Pre & Post Project
Uncorrected for Traffic Volume/Speed/Mix



More Before and After Comparison for Site 3A Location

Arizona 101 Wayside Data at 50 ft - Pre & Post Project OGFC

Uncorrected for Traffic Volume/Speed/Mix



In Summary

- Surface Type Does Matter-Noise Should be Controlled at the Source
- Noise Should be Managed Just Like Friction, Roughness, Rutting, and Cracking
- **People Do Care How They Live-It's a Quality of Life Issue!!!**

Acknowledgments

- Arizona DOT; Larry Scofield
- Rubber Pavements Association; Doug Carlson, executive director (www.rubberpavements.org)
- Colorado Scrap Tire Fund (Colo. Commission on Higher Education)