NCAUPG Workshop and Conference

St. Louis, Missouri

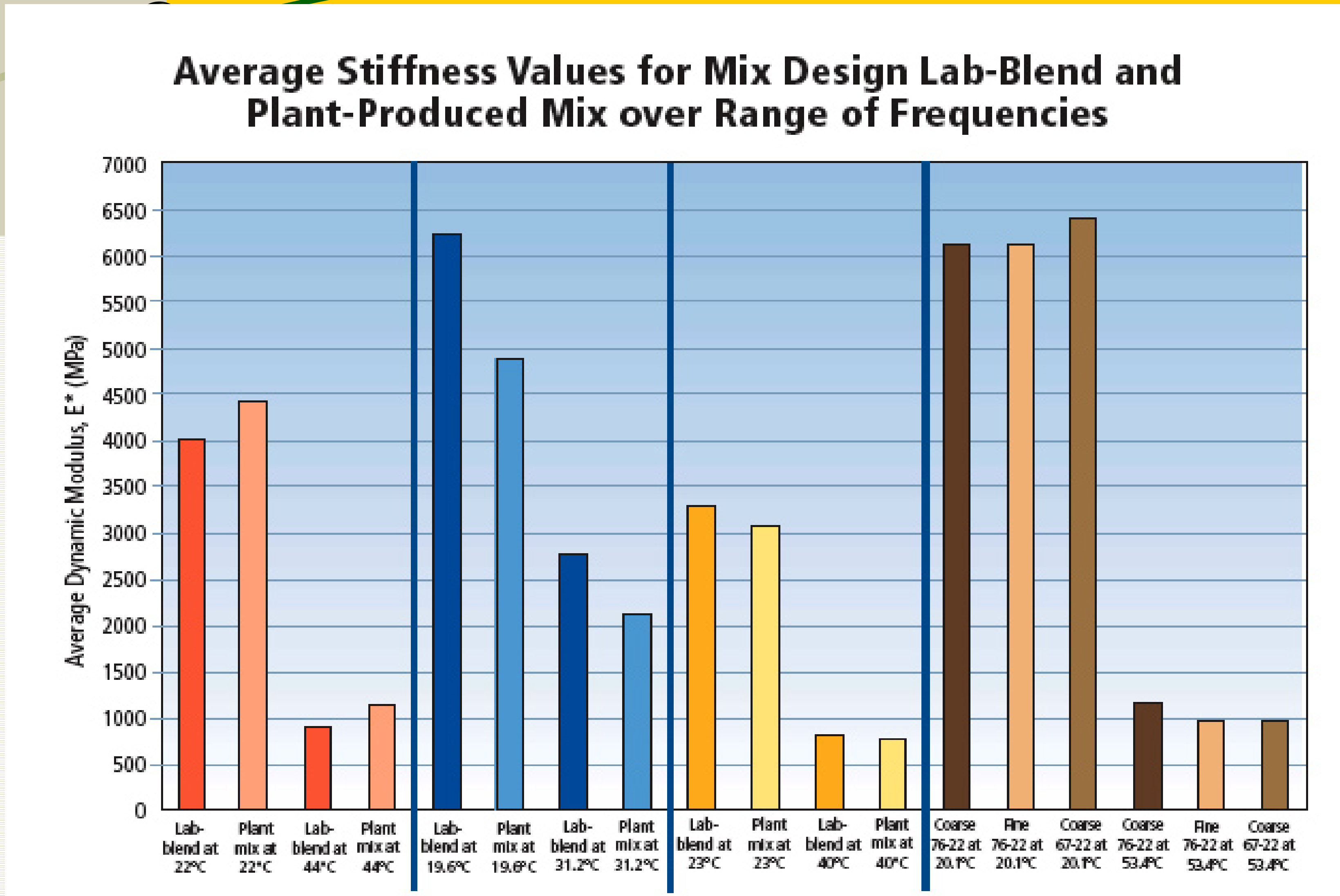
January 10 – 12, 2006

HMA Mix Design Trend Analysis Snapshot of … what ?

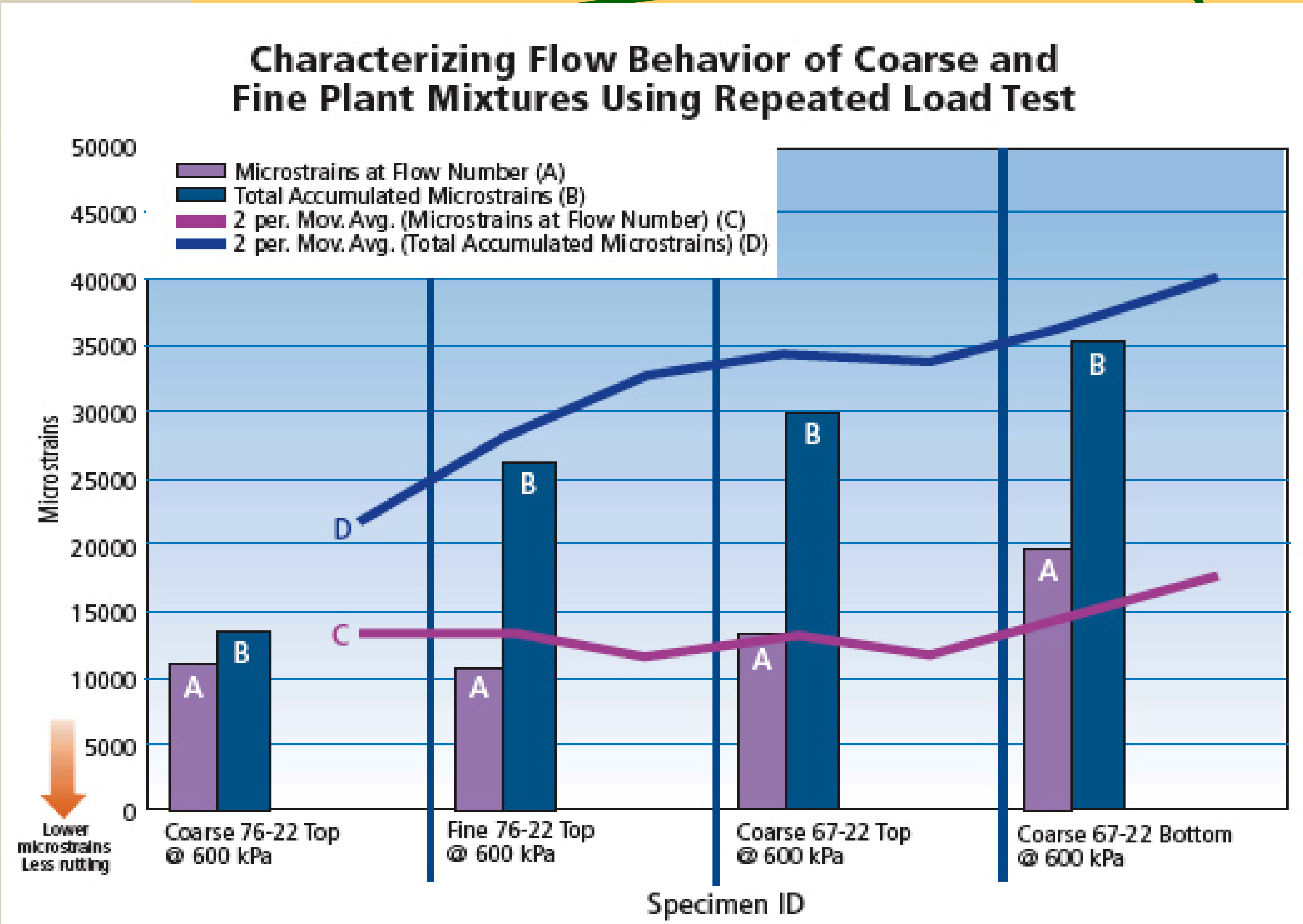
- Past
  - Tradition based on local materials and success
  - Performance data exists
- Present
  - Provides a reflection of any recent changes
  - Comparison / Correlation
- Future
  - Allows forecasting and prediction

HMA Mix Design Trend Analysis

- Motivating factors for change?
  - Define the goal and potential impact
- Identify key components of your mix designs
  - What properties do you currently track
- Curly (J. Palance character in “City Slickers”) … “the one thing”
  - Is there really only one true answer or solution?



How do I design a mix to increase stiffness?



What do I change to affect a mix Flow Number?

HMA Mix Design
Data Collection

Start with a database (example: JMF targets)

- Simple spreadsheets
- All inclusive data vs. prioritize
- Track what you understand or measure now
- Biggest pay items (most economic impact)

2002 Mix Design JMFs

NMAS	ESALs	%AC	%VMA	3/4"	1/2"	3/8"	#4	#8	#16	#30	#50	#100	#200	%RAP	Gse	Gsb	Gmm	Gmb
			(mm)	19.0	12.5	9.5	4.75	2.36	1.18	0.60	0.30	0.15	0.075					
SPPV-12.5R	E-10	5.2	14.2	100.0	97.9	89.8	71.9	52.6	37.7	27.2	14.1	6.5	4.7	15	2.740	2.674	2.521	2.419
SPPV-19.0R	E-1	4.5	13.1	100.0	89.3	69.1	55.9	48.1	40.7	31.0	13.9	5.1	3.7	25	2.691	2.647	2.508	2.408
SPPV-19.0R	E-0.3	4.7	13.1	100.0	89.3	69.1	55.9	48.1	40.7	31.0	13.9	5.1	3.7	25	2.707	2.647	2.514	2.414
SPPV-19.0R	E-0.3	4.9	13.7	99.6	90.0	77.3	54.6	40.8	31.0	22.1	13.4	6.9	4.5	10	2.783	2.716	2.568	2.465
SPPV-12.5R	E-0.3	5.4	15.2	100.0	97.4	90.0	67.5	51.8	40.1	29.2	17.8	8.6	5.0	15	2.779	2.726	2.545	2.443
SPPV-19.0R	E-3	4.4	13.1	99.5	85.4	76.0	58.4	44.8	35.6	26.2	13.8	6.5	4.0	10	2.776	2.718	2.574	2.472
SPPV-12.5R	E-3	5.1	14.8	100.0	92.7	85.6	67.3	51.7	41.1	30.1	15.6	7.1	4.3	10	2.757	2.714	2.539	2.437
SPPV-19.0R	E-0.3	4.6	13.4	99.0	87.7	77.7	58.2	44.8	35.7	26.4	14.0	6.7	4.2	15	2.767	2.715	2.567	2.464
SPPV-12.5R	E-0.3	5.7	15.5	100.0	95.8	88.3	71.1	56.3	45.7	33.9	17.6	8.1	5.0	15	2.767	2.702	2.524	2.422
SPPV-19.0	E-30	4.6	13.7	97.1	84.1	72.2	52.0	34.5	21.7	13.1	6.7	4.4	3.7		2.798	2.751	2.593	2.489
SPPV-19.0R	E-0.3	5.0	14.2	98.1	89.3	80.2	58.7	48.2	39.2	28.0	12.0	6.0	4.6	15	2.749	2.697	2.537	2.436
SPPV-12.5R	E-3	5.4	15.0	100.0	98.3	89.9	68.7	52.5	39.6	27.0	12.0	6.3	4.9	15	2.766	2.708	2.535	2.434
SPPV-19.0	E-10	4.6	13.7	97.1	84.1	72.2	52.0	34.5	21.7	13.1	6.7	4.4	3.7	15	2.798	2.751	2.593	2.489
SPPV-19.0R	E-10	4.6	13.2	99.3	89.5	80.4	58.4	39.4	27.5	18.4	10.2	5.7	4.1	10	2.772	2.716	2.572	2.470
SPPV-12.5	E-10	5.1	14.4	100.0	96.5	86.8	64.0	43.5	30.4	20.2	10.8	5.8	4.1	15	2.778	2.720	2.556	2.454
SPPV-19.0R	E-0.3	4.6	13.6	97.6	87.2	78.7	56.6	43.2	34.2	23.6	10.7	5.7	4.3	18	2.733	2.693	2.540	2.438
SPPV-12.5R	E-0.3	5.2	14.6	100.0	97.6	89.4	63.4	48.3	38.5	26.7	12.1	6.3	4.7	18	2.740	2.688	2.522	2.421
SPPV-9.5R	E-3	5.9	15.4	100.0	100.0	98.5	74.6	55.0	42.6	31.6	14.8	6.2	4.2	20	2.725	2.653	2.483	2.384
SPPV-12.5R	E-3	4.9	14.1	100.0	97.5	89.4	73.5	53.9	39.2	28.6	15.6	7.4	4.1	5	2.756	2.708	2.547	2.445
SPPV-19.0	E-3	4.4	13.4	98.8	88.7	78.7	62.1	48.2	36.2	26.7	13.8	6.4	3.3		2.741	2.706	2.554	2.452
SPPV-12.5R	E-30	5.2	14.6	100.0	97.2	84.1	58.9	39.5	25.1	15.3	8.0	5.1	4.2	10	2.809	2.746	2.576	2.473
SPPV-12.5R	E-10	5.2	14.6	100.0	97.2	84.1	58.9	39.5	25.1	15.3	8.0	5.1	4.2	10	2.809	2.746	2.576	2.473

Example Question:

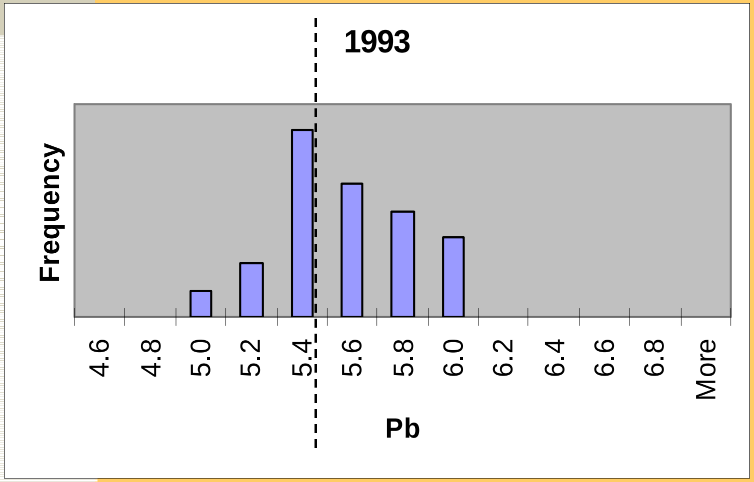
Do we need to affect a change to increase Pb in mixes?

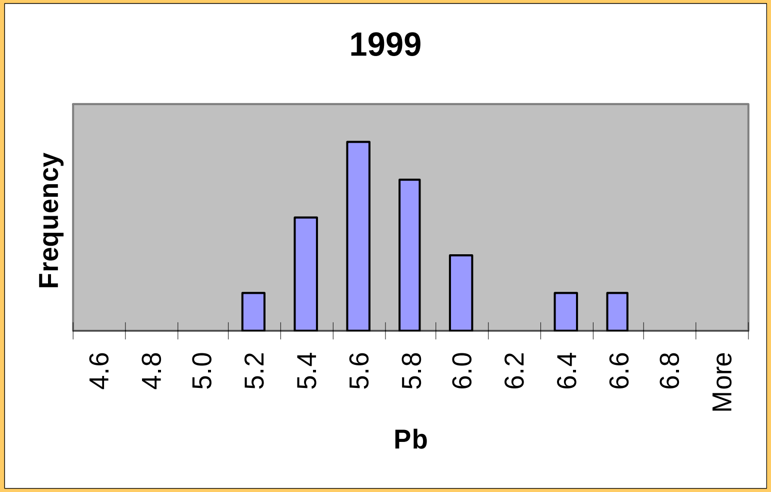
EX:

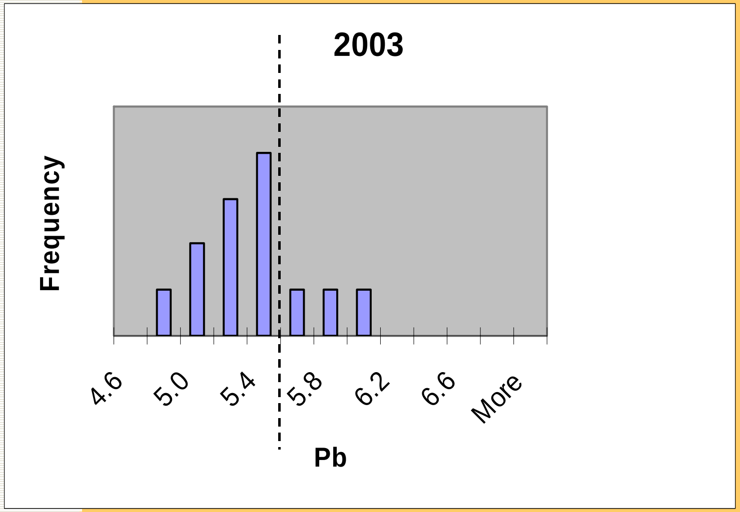
Same mixtype

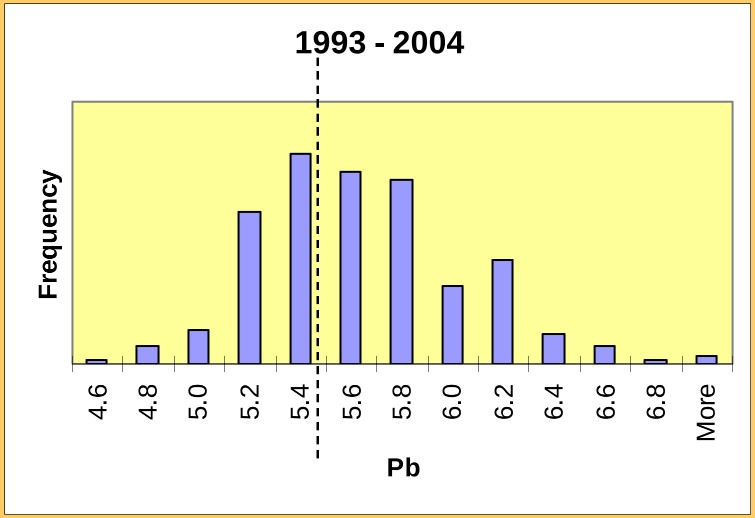
3-10mil

ESALs



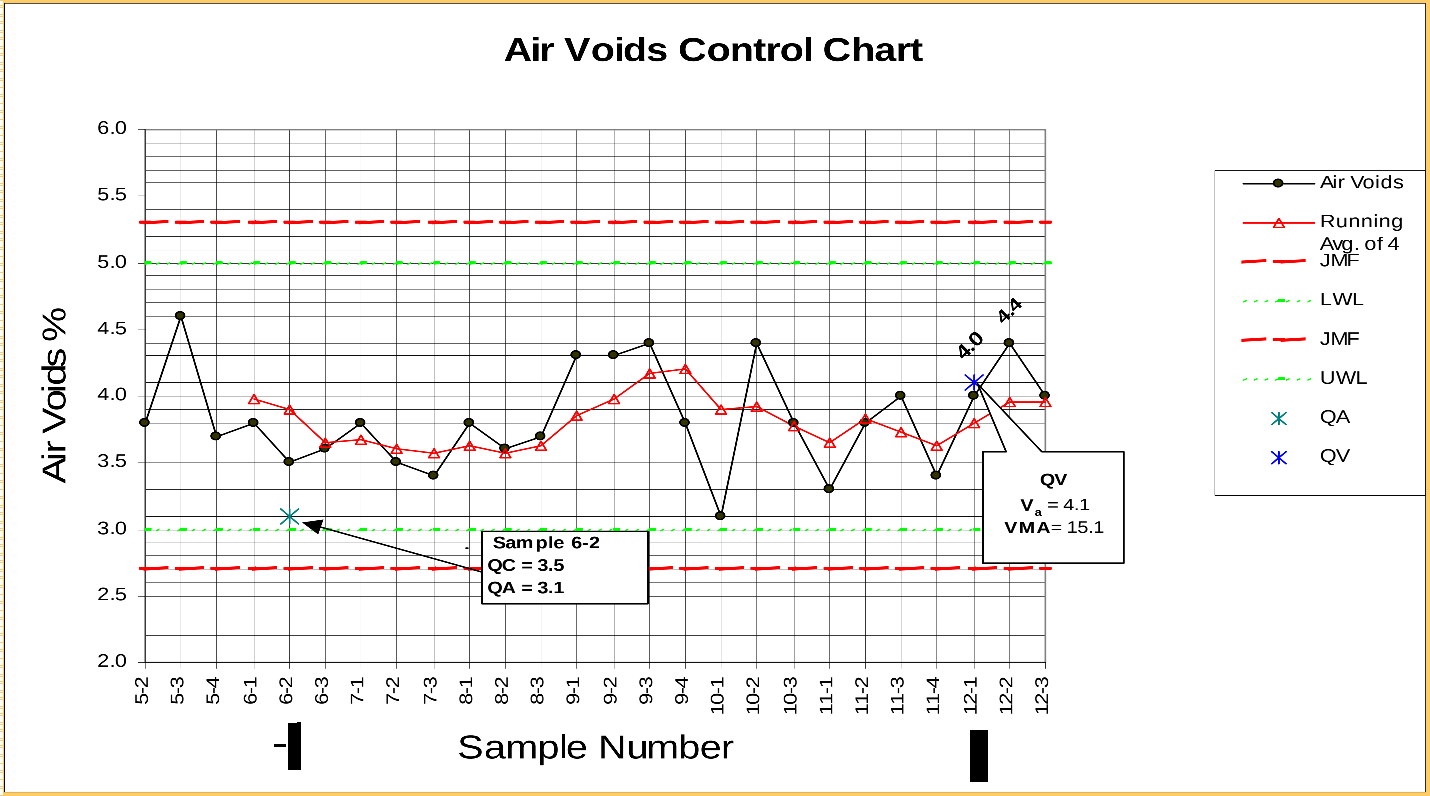




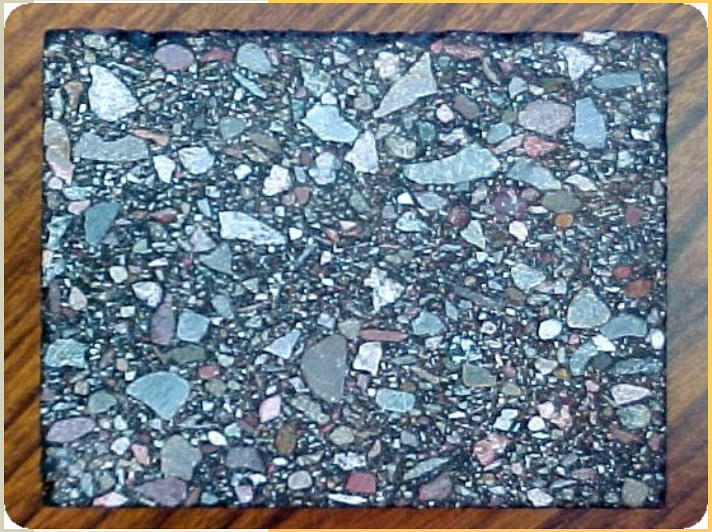


Quality Management Programs
Source of Data, Relating Lab to Field

Production Control … Verification … Assurance



Laboratory Data and Field Data Design Graphics



WisDOT Test # 250-0068-01

Aggregate Source: **Bungartz, Chippewa County**

Mix Type: **12.5mm - 1million ESALs** N_{des} = **60**

Sieve	Blend	Qc	Qa
19.0	100.0	100.0	100.0
12.5	94.5	96.3	93.6
9.5	83.6	89.8	84.0
4.75	64.6	71.2	69.0
2.36	51.4	57.2	54.3
1.18	41.6	45.7	42.1
0.60	31.6	33.1	31.2
0.30	18.9	18.2	16.9
0.15	8.4	8.8	8.5
0.075	5.4	5.6	5.6

	JMF	QC	QA
V_a	4.0	4.1	4.3
G_{mm}	2.529	2.527	2.530
G_{mb}	2.428	2.424	2.421
VMA %	16.3	16.1	16.3
P_b	5.4		
FAA	77.0		
G_{se}	2.759		
G_{sb}	2.744		
$\%Gmm_{Nini}$	90.6		

Mix Property Evaluation (Related to Quality)

- From Mix Design to Production (Lab vs. Field)
  - How do the properties measured in the field correlate with the mix design JMF?
  - What is the affect on resultant performance?

- Other Properties to Evaluate
  - FAA (Fine Aggregate Angularity)
  - Compactability (Research Studies)

Mix Property Evaluation Study

- Begin with Mix Design Parameters (specs)
- Workplan Developed (Technical Teams)
  - Minimize additional efforts
  - Not looking to solve, rather initial fact-finding
- To determine:
  - Fine Aggregate Angularity (develop field test procedures)
  - Dust Proportion (DP – Stiffer mixtures)
  - Voids Filled with Binder (VFB – coating)

Mix Property Evaluation Study

- Summary of Goals
  - Should we modify the existing mix design requirements to reflect “field” testing capabilities?
  - Should we develop a field testing tolerance table paralleling laboratory mix design requirements?
  - Can the SGC (compactor) densification values predict performance?

Currently completing testing and ready to move to the analysis phase this winter

Certified Mixtures and Mix Designs

Change the way you look at things, and the things you look at will change

(Dr. W. Dyer)

Certified Mixes and Mix Designs

- Recent Past Practice
  - Express and Comparative Submittals
  - Report (JMF), Materials, Testing
  - Log-in (tracking ID), Data Transfer Entry, Review Out
- Current Tool Enhancements
  - Electronic File Submittals
  - E-mail Distribution Lists (inclusive)
  - Reviews out as “Reply-All”

Certified Mixes and Mix Designs

- Does the system we have in-place enhance product improvement (quality)?
- Are we in a position to move into performance-based specifications if we continue on the same?
- Is there a different system to better allocate department resources and expertise?
- As we increase movement towards Warranty concepts, is there a transition/hybrid step we could be taking (some motion forward).

Certified Mixes and Mix Designs: *Vision*

- Contractor Entry to the WisDOT Database
- Possible Requirements (no additional inspection)
  - Certified Mix Designers
  - Certified Production Control Personnel
  - Certified Verification Personnel
  - Certified Materials (Binder, Quality Aggregates)
  - Qualified Laboratories
- Materials Acceptance = Spot-Check Method
- Product Acceptance = Stiffness, Smoothness

Certified Mixes and Mix Designs

Potential Benefits

- Shift Focus to Real Time Analysis of Data vs. Current Resources Devoted to Collection
- Agency Workforce Attention to Performance Causes and Affects
- Create a more Global Atmosphere or Understanding for HMA as a Product
- A System not as Dependent on Schedules
- Dollar Investment Realized for Certifications

Certified Mixes and Mix Designs

Issues

- Different Expectations for Permanent Plants vs. Portable (dual-system)
- FHWA Requirements tied to “Project” Specific Acceptance
- Impacts of Non-Compliance or Failures
- Define “risk” involved
- How and When could we Affect a Change

Future Performance Challenges (video clip)