Pacific Coast Conference on Asphalt Specifications Round robin committee

Interlaboratory Study (ILS)
For
Precision of Measurements
With the
Dynamic Shear Rheometer (DSR)
March 26, 2007

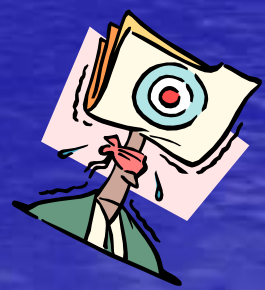
Topics

1. Objectives of the Study
2. General Information
3. Precision Statements
4. Data Management
5. Outlier Analysis

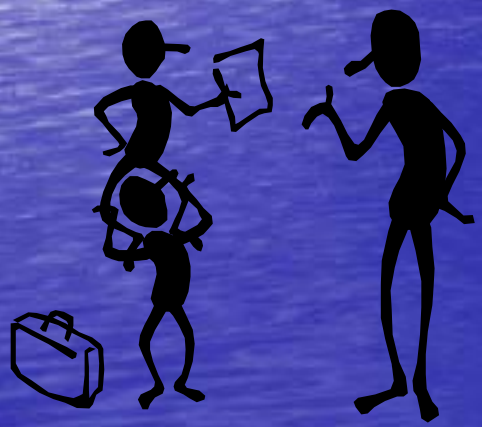
Cont'd. ⟶

Objectives

- *Reconsider Revised Procedures and Develop Precision Statements Based on These Procedures*
- *Determine Effect (If Any) of Modification*
- *Effect of PAV Temp on Precision Statements*
- *Examine Possibility of Using Phase Angle, δ To Identify Polymer Modified Binders*



General Information



Task Group on DSR Precision

Steve Davis, Washington DOT
Steve Landers, Washington DOT
Brad Neitzke, Western Federal Lands, FHWA
Julie Nodes, Arizona DOT
Ray Pavlovich, HRC Research Consultants
Don Powell, San Joaquin Refining
Shauna TecleMariam, U.S. Oil and Refining, Chair
Pat Turpen, McCall Oil

History

- Started the round robin study in 2000
- Three regional meetings were held to go over the procedures
- Completed one round robin where 84 items were identified as possible problems with the procedures. Approximately 15 items were significant.
- The report was published and given at ASTM and ETG meeting
- Revision of the procedures were started

History

- Four regional meeting were held before the second round robin was started.
- Second round robin was started.

Participating Laboratories

Albina Asphalt
Klamath Falls, OR 97603-5747

Albina Asphalt
Vancouver, WA 98668

Arizona Department of Transportation
Phoenix, AZ 85009-3740

Asphalt Paving & Recycling Technologies
Shafter, CA 93263

CALTRANS
Sacramento, CA 95819-0128

Ergon Asphalt Products, Inc.
Las Vegas, NV 89139

FHWA, Western Federal Lands
Vancouver, WA 98661

FHWA
McLean, VA 22101

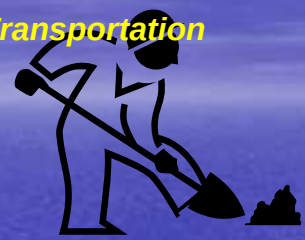
Idaho Asphalt Supply, Inc.
Nampa, ID 83651

McCall Oil & Chemical
Portland, OR 97210

Nevada Department of Transportation
Las Vegas, NV 89101

Nevada Department of Transportation
Carson City, NV 89712

Oregon Department of Transportation
Salem, OR 97310



Paramount Petroleum
Portland, OR 97210

Paramount Petroleum
Phoenix, AZ 85009

Paramount Petroleum
Paramount, CA

San Joaquin Refining Company
Bakersfield, CA 93308

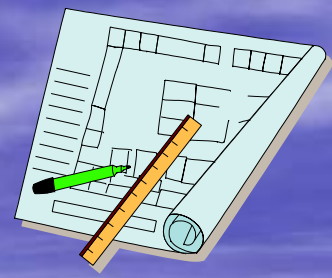
U S Oil & Refining Co.
Tacoma, WA

Valero Energy
Benicia, CA 94510

Washington Department of Transportation
Tumwater, WA 98504

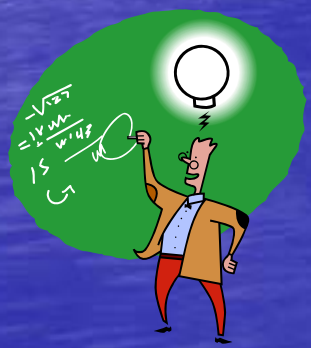
Wright Asphalt
Channelview, TX 77530

Design of the Experiment



Independent Variables

- 23 Materials
- 21 Participating Laboratories
- 3 Replicates
- Completely Randomized Test Sequence



Design of the Experiment, Cont'd.

Dependent Variables

- Unaged and RTFO Conditioning
  - Complex Shear Modulus, G*
  - Phase Angle, δ
  - Dynamic Shear, G*/sin δ

- Pressure Aging Vessel (PAV) Conditioning
  - Complex Shear Modulus, G*
  - Phase Angle, δ
  - Dynamic Shear, G*sin δ
  - Slope, m-value
  - Stiffness, S

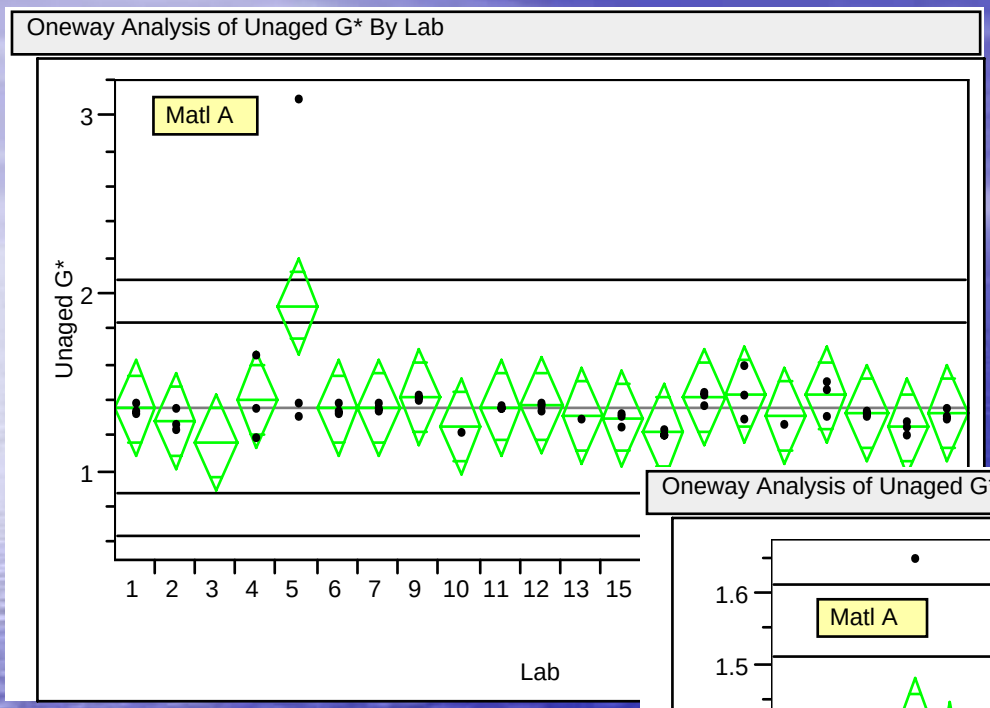
Some Facts and Figures

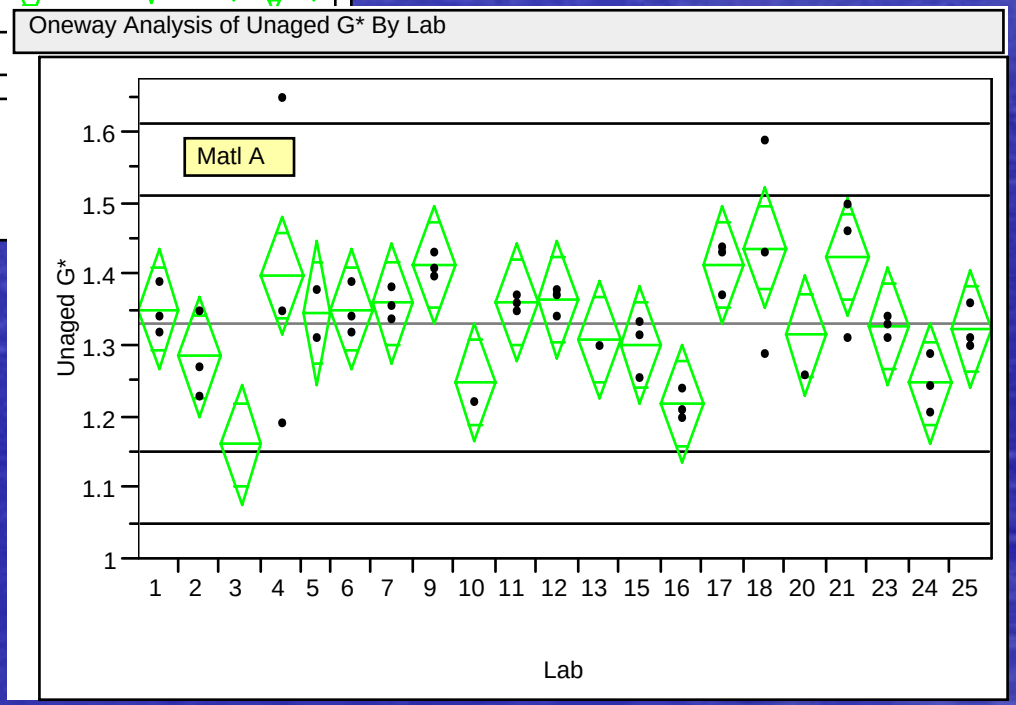
- ***Set-Ups by Participating Labs: 23 Matls x 3 Replicates = 69 Tests***
- ***Samples = 23 Matls x 25 Labs x 3 Replicates = 1,725 Quarts***
- ***Data Points = 23 Matls x 14 Properties (Including sin δ) x 21 Labs x 3 Replicates = 20,286***
- ***Database Including Temperatures and Binder Type = 28 Columns x 1,449 Lines = 40,572 Cells***

Data After Sorting by Material

			Unaged			RTFO			PAV				
Lab	Matl	Test	G* (kPa)	δ	G* / sin d	G* (kPa)	δ	G* / sin d	G* (MPa)	δ	G* sin d	m	S (MPa)
	A	25	1.32	80.0	1.36	2.84	73.4	3.09	2,240	46.2	1,620	0.336	232
1	A	64	1.39	80.0	1.44	3.11	72.3	3.42	1,720	46.7	1,250	0.329	216
	A	65	1.34	80.3	1.38	3.22	72.3	3.55	2,090	46.4	1,520	0.331	217
		Ave	1.350	80.10	1.393	3.057	72.67	3.353	2,017	46.43	1,463	0.3320	221.7
	B	2	1.46	82.9	1.48	3.80	76.5	4.02	2,190	44.9	1,550	0.309	191
1	B	8	1.52	83.0	1.54	3.49	77.4	3.67	2,510	44.9	1,770	0.332	173
	B	55	1.43	83.3	1.45	3.23	77.8	3.38	1,850	45.7	1,320	0.325	165
		Ave	1.470	83.07	1.490	3.507	77.23	3.690	2,183	45.17	1,547	0.3220	176.3
	C	6	1.17	83.4	1.18	2.64	78.8	2.74	1,960	47.9	1,450	0.312	172
1	C	16	1.40	83.1	1.42	3.06	77.8	3.21	1,450	47.7	1,070	0.327	195
	C	37	1.17	83.5	1.18	2.72	78.8	2.83	1,950	48.8	1,470	0.313	209
		Ave	1.247	83.33	1.260	2.807	78.47	2.927	1,787	48.13	1,330	0.3173	192.0
	D	10	2.46	85.0	2.48	5.06	81.5	5.17	2,120	48.5	1,580	0.370	115
1	D	15	2.24	85.1	2.26	5.79	81.1	5.93	2,780	47.4	2,050	0.368	114
	D	23	2.37	85.0	2.39	2.87	67.0	3.38	351	55.0	288	0.000	0
		Ave	2.357	85.03	2.377	4.573	76.53	4.827	1,750	50.30	1,306	0.2460	76.3
	E	3	1.54	87.6	1.55	3.36	86.0	3.38	2,630	52.0	2,070	0.368	113
1	E	59	1.71	87.6	1.72	3.13	86.2	3.14	0	0.0	0	0.000	0
	E	63	1.73	87.4	1.74	3.06	86.1	3.07	0	0.0	0	0.000	0
		Ave	1.660	87.53	1.670	3.183	86.10	3.197	877	17.33	690	0.1227	37.7
	F	33	1.15	54.8	1.72	2.01	54.1	3.06	452	48.8	340	0.404	29
1	F	34	1.19	54.5	1.79	1.90	54.1	2.90	353	50.7	273	0.414	31
	F	48	1.14	54.9	1.70	1.89	54.3	2.86	0	0.0	0	0.000	0
		Ave	1.160	54.73	1.737	1.933	54.17	2.940	268	33.17	204	0.2727	20.0
	G	44	1.70	78.0	1.77	3.83	73.0	4.19	0	0.0	0	0.318	261
1	G	61	1.82	78.0	1.74	3.60	74.0	3.89	0	0.0	0	0.000	0
	G	66	1.68	77.8	1.76	3.73	73.5	4.06	0	0.0	0	0.000	0
		Ave	1.733	77.93	1.757	3.720	73.50	4.047	0	0.00	0	0.1060	87.0

Appendix B, Participant Review and Outlier Analysis





Laboratory 5,
Test 64 Removed.
Laboratory 4
Possible Suspect

Laboratory Testing By Temperature Grouping

- *Some Laboratories Departed From Random Testing Schedule Provided by Task Group*
- *Concern Is Introduction of Laboratory Bias*

  i,e., Say Temperature is Off by a Constant Amount for This Particular Setting — This Would be Balanced Out if Temperatures Were Assigned According to Test Schedule

- *Laboratories 1,3,4 and 5 — Non-Random Testing*

Laboratory Testing By Temperature Grouping, Cont'd.

- *Conclude:*

  Non-Random Test Sequence Responsible for Disproportionate Number of Outliers

Result:

- *Reject All Data From Laboratories That Did Not Follow Random Testing Schedule*

Analyst Comments:
"Please Follow Directions"

Action Items

- Need to check the data to make sure that all of the data transferred correctly
- A study is going on about where you place the pans in the PAV and if it effects the results
- Polymers are still a problem. Need group meetings to discuss this issue
- Report will hold until we have more issues resolved.