WESTERN RESEARCH INSTITUTE
Providing solutions to highway building materials problems

Subtask 2-1: Moisture Damage

Subtask Manager: Eric Kalberer

Presented by Fred Turner

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Topics to be Covered

1. Use of the Hamburg Wheel-Tracking Device to Evaluate Moisture Susceptibility (Year-1 start)

2. Evaluation of the Impact of Microbes on the Performance of Mixes

3. Synthesis of Modifiers to Elucidate the Combined Effect of Polymer and Anti-Stripping Agents (multiple modification)

4. Correlation of freeze-thaw results with asphalt and aggregate surface energies

Hypothesis

Organic and mineral materials generated in the Hamburg test provide clues to the moisture susceptibility of mixes.

Development of Hamburg Methodology

- First developed in the 1970’s to evaluate the rutting potential of pavements in Hamburg, Germany.

- The stripping aspects (inflection point) were not incorporated into the procedure until the early 1990’s.

- All of the current tests used to evaluate moisture susceptibility incorporate a hot water soak / saturation step.

Investigate the Nature of the Turbidity Produced During Hamburg Testing

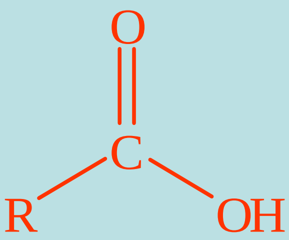
1. Use Micro-Deval (M-D) test to evaluate the durability of aggregates used in Hamburg tests and to produce fines for comparison with those generated in the Hamburg.

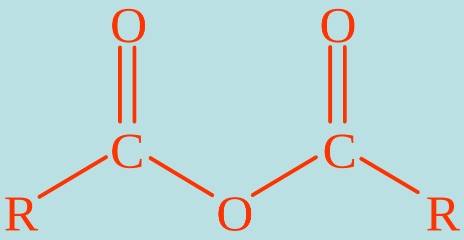
2. Analyze organic material extracted from the Hamburg water baths and from aggregates using FTIR.

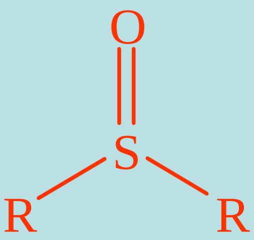
3. Determine the mineralogy of fines from M-D and Hamburg water baths using electron-probe microanalysis and powder x-ray diffraction.

Potential Organic Species Present

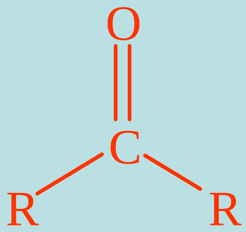
Easily Displaced by Water:

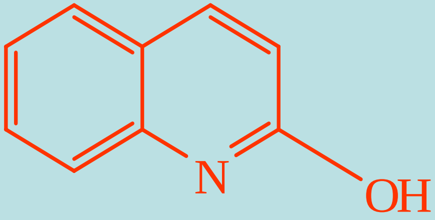


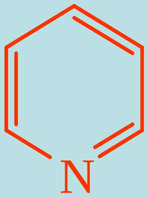




Resists Displacement by Water:







Petersen et al., AAPT, #46, 1977

Moisture Sensitivity Of Asphalt-aggregate Mixes

Freeze-Thaw Cycles-to-Failure

Asphalt	Aggregate					
	RJ	RC	RF	RB	RG	RK
AAA-1	1	33	49	3	6	4
AAC-1	2	>50	46	5	25	30
AAD-1	1	>50	19	2	25	10
AAF-1	1	>50	46	3	9	4
AAG-1	1	43	9	1	5	2
AAK-1	1	>50	13	3	11	5
AAM-1	2	>50	35	6	43	>50

Experiment

- An accelerated failure time, linear regression analysis was used to compare the predictor variables and rank the aggregate properties that contribute to the moisture susceptibility of the briquets.

Robl et al., SHRP report, SHRP-A/UIR-91-509, 1991

Results

- **Good correlations with freeze-thaw performance were obtained for the following parameters:**

Acid Insolubility increases with decreasing performance (inverse)

Calcium, Loss on Ignition, and Zeta Potential (inverse)

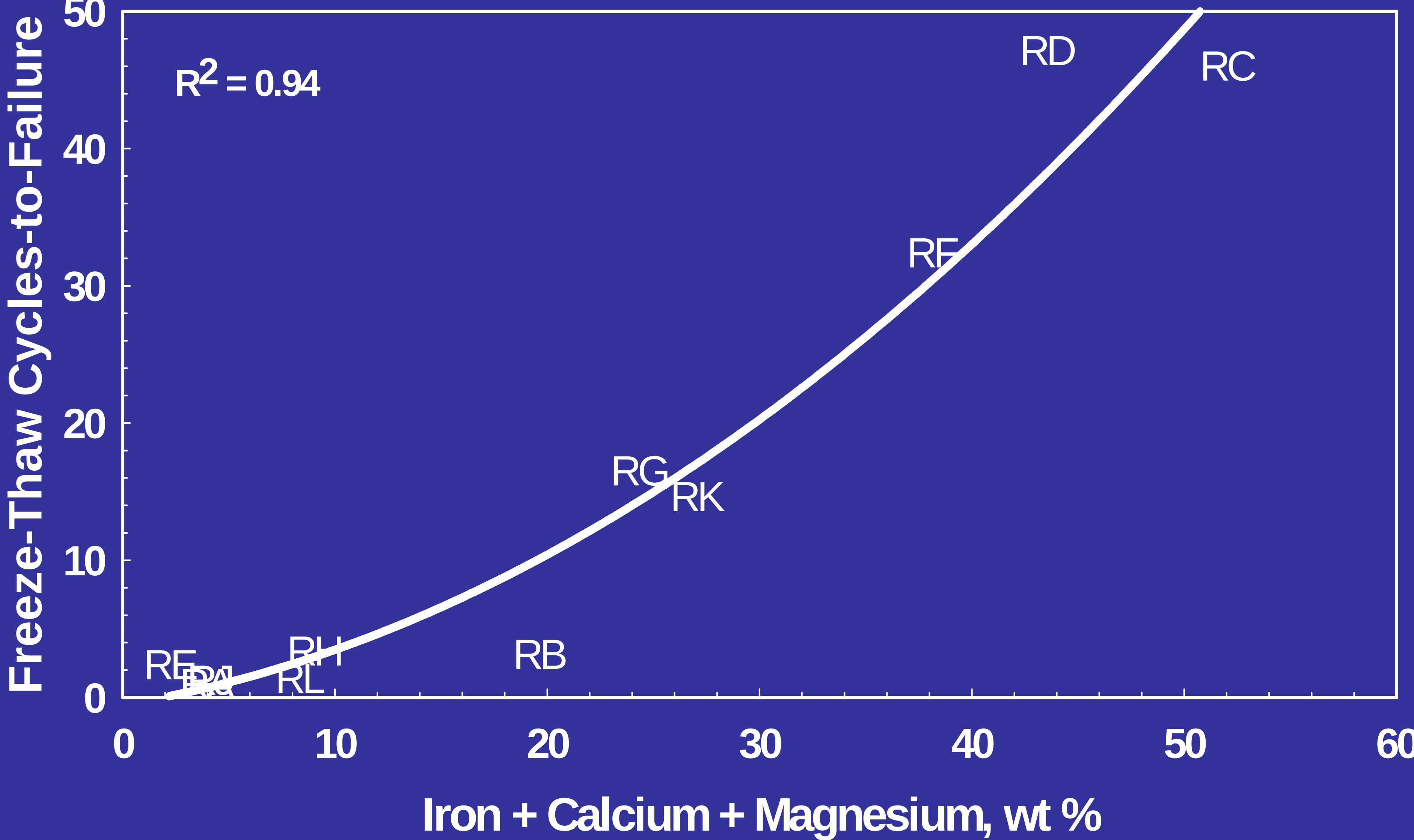
Silicon (direct)
Aluminum (inverse)
Potassium (inverse)
Iron (direct)

Pore Ratio (inverse) [Pore Ratio = PSs/(PSm + PSl), PS = pore size]
Surface Area (direct)

Results

Felsic Silicate Minerals	Mafic Silicate Minerals
Acidic	Basic
Light Colored	Dark Colored
Silicon, Aluminum, Potassium	Calcium, Magnesium, Iron

IMPACT OF MAFIC NATURE OF AGGREGATE ON PERFORMANCE OF BRIQUETS



Questions?