


# SEAUPG 2003 CONFERENCE

## Moisture Issues



MACTEC

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## National Seminar - Feb 2003

La Jolla, CA



## National Seminar - Goals

- Presentations & Group Discussions
  - ◆ Best Practices
  - ◆ Gaps & Barriers
  - ◆ Research Needs
- Products
  - ◆ Proceedings
  - ◆ Road Map



## Organization & Participation

- The Usual Suspects
  - ◆ TRB, FHWA & State DOTs
  - ◆ Association
  - ◆ Industry
  - ◆ Consultants
  - ◆ Academia

*125 attendees*



## Presentation Topics

■ Fundamentals	■ Construction
■ Test Methods	■ Field Experiences
■ Treatments	■ Specs
■ Design & Production	■ Implementation



## Group Discussions

- Fundamentals
- Testing & Treatments
- Design & Specs
- Construction & Field Performance

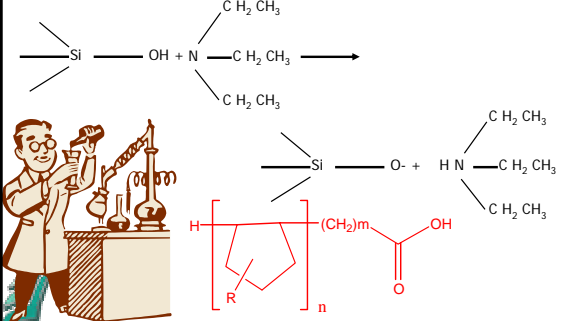


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## Results - Proceedings



## Fundamentals




$$\text{Si-OH} + \text{N}(\text{C}_2\text{H}_5)_3 \rightarrow \text{Si-O-N}(\text{C}_2\text{H}_5)_3$$

The diagram also shows a polymer chain segment with a repeating unit  $[\text{R}]_n$  and a terminal group  $(\text{CH}_2)_m\text{COOH}$ .


## Factors to Consider

- Chemical
- Physical
- Mechanical




## Mechanisms

- Emulsification
  - ◆ Clay, Dust, Filler
  - ◆ Salts in Asphalt
- Adhesive Failure
  - ◆ Aggregate Aging
  - ◆ Molecular Orientation at Interface




## Mechanisms

- Cohesive Failure
  - ◆ Water Absorption - Molecular Orientation
  - ◆ Mastic
  - ◆ Aggregate

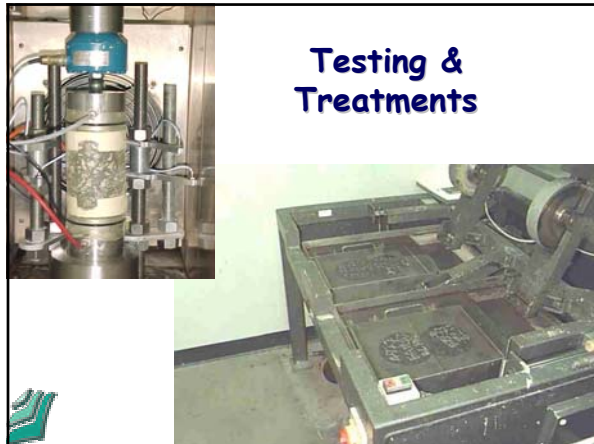


## Gaps & Research Needed

- Adhesive Failure
  - ◆ Surface Energy Measurement
- Cohesive Failure
  - ◆ Pull Off
  - ◆ Water Absorption & Diffusion Test



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## Current (Best?) Practices

- **AASHTO T283-02**
- **Hamburg Wheel Tracking**
- **Loose Mix**
  - ◆ **Static Boiling**
  - ◆ **Rolling Bottle**
  - ◆ **Ultrasonic**

## Issues

- **Compaction, Conditioning & Loading**
- **Sample Parameters - Air Void Content, Permeability, Saturation**
- **Calibration for Local Materials & Conditions**
- **Reproducibility & Repeatability**
- **Precision & Bias**

## Gaps

- **Field Performance**
  - ◆ **Test Output**
  - ◆ **Definition of Moisture Damage**
  - ◆ **Data Collection**

## Research Needed - Testing

- **Fundamental Property**
- **Long-Term Aging**
- **Rapid QC**
- **Completion of ECS research**
- **Dynamic Modulus - E (AASHTO 200?)**
- **Traffic Effect - Pore Pressures**
- **pH of Water**

## Treatments

This slide includes a photograph of a construction site with various pieces of equipment and materials. To the right of the photo is a cartoon illustration of a scientist wearing a white lab coat, glasses, and a tie, holding a clipboard and a test tube.

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## Best Practices

- Mix Design w/ Additives
- Lime
  - ◆ Dry on Damp Aggregate
  - ◆ Method Spec
  - ◆ Acceptance - Production Data
- Liquid
  - ◆ Test Binder for Spec Compliance

## Gaps

- Quantity of Additive
- Performance w/ Time
- Compatibility w/ Bitumen, Polymers

## Research Needed - Treatments

- Uniformity of Additive Distribution
- Performance w/ Time
- Aggregate Stockpiling
- Lime in Bitumen

## Design & Specs

- Design
  - ◆ Like Nike, Just Do it!
- Specs
  - ◆ Enforce 'em!

## Design & Specs

- Structural Design
  - ◆ Drainage - Surface & Subsurface
  - ◆ Don't Overlay OGFC
- Materials Selection & Proportioning
  - ◆ Clean & Good Quality
- Construction - Joint Density

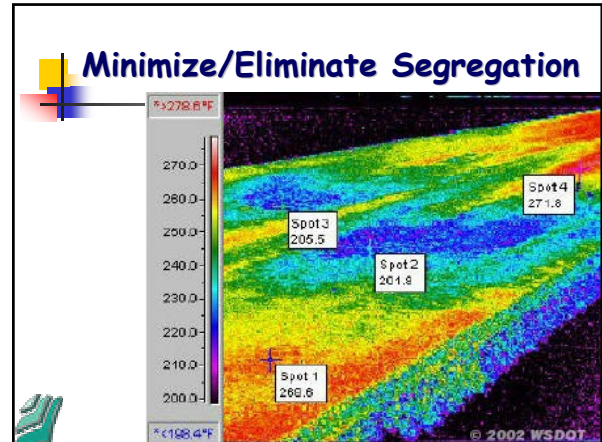
## Construction



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## Best Practices

- **Joint Training**
- **Production Balance & Control**
- **Materials Handling & Monitoring**
  - ◆ **Temp & Moisture**
- **Mat & Joint Density**
  - ◆ **Optimum & Uniform**



## Joint Density

Notched Wedge

## Gaps

- **Personnel**
  - ◆ **Training & Turnover**
- **Real-Time Process Control**
- **Accuracy of Density Measurements**
- **Equipment Constraints**
- **Pre-Construction Partnering**

## Research Needed

- **Continuous Density/Stiffness Measurements**
- **Real Time Automated Plant Control**
- **Automated Paver Control/Feedback**
- **Effect of Temp on Adhesion**
- **Incentive/Disincentive**

## Recurring Themes

- **Long-Term & Widespread Problem**
- **Need Implementable Solutions**

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## Recurring Themes

- **Fundamentals**
  - ◆ **Chemical, Physical & Mechanical Properties of Components**
- **Testing**
  - ◆ **Standardize & Calibrate**
  - ◆ **Correlation w/ Field Performance**

## Recurring Themes

- **Treatments**
  - ◆ **Compatibility**
  - ◆ **Long-Term Effectiveness**
- **Construction**
  - ◆ **Training → Good Practices**
  - ◆ **Real-Time Process Control**
  - ◆ **Equipment Feedback**

## Recurring Themes

- **Design**
  - ◆ **Implement What We Know!**
- **Specs**
  - ◆ **Consistently Enforce**



## Best Practices

- **Design - Subsurface & Surface Drainage**
- **Tests to Screen Aggregates**
- **Treat Mixes - Lime & Liquid Both Work**
- **Dry Lime on Damp Aggregate - Most Cost Effective**
- **Include Additive in Mix Design**
- **Conduct Mix Test - AASHTO T283 & Hamburg**
- **Verify Presence of Additive**
- **Adhere to Good Construction Practices**
  - ◆ **Materials Handling**
  - ◆ **Compaction - Mat & Joint Density**
  - ◆ **Training**
  - ◆ **Drainage**
  - ◆ **Acceptance Based on Mix Production**

## Gaps in Knowledge

- **Standardized Test Procedures**
- **Refine Tests for Components and Mix**
- **Binder - Additive Compatibility**
- **Test to Evaluate Emulsibility of Binder**
- **Better Understanding of Failure Mechanisms**
- **Correlation of Lab Test(s) w/ Field Performance**
- **Documentation of Field Performance**
- **Correctly Identifying Moisture Damage**
- **Equipment Constraints on Production**