Chemical Stabilization

Solving Construction Problems Associated with Expansive Soils

Presented by:

Western Stabilization

Expansive Soils: $2 - 6 Billion Damage per year (Engineering News Record)

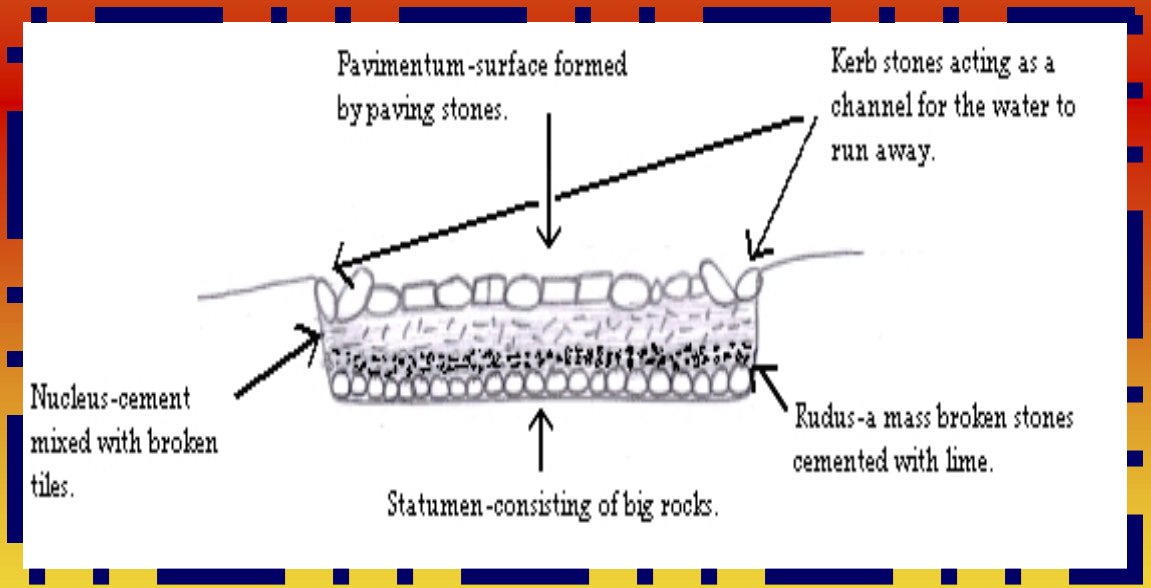
EXPANSIVE SOILS: *The Problem*

Typical Expansive Soil

- **Typically Moisture Sensitive**
  Expansion Potential & Swell Pressure
- **Exhibit Poor Pavement Support**
  Low R-values & Unconfined Compressive Strength
- **Constructability Issues**
  Highly Plastic - Poor Workability

Ancient Uses of Lime

Lime used to stabilize roadways still in existence today



Cross-Section
The Appian Way

Lime used as mortar to bind stone for roadways & bridges

The Solution:

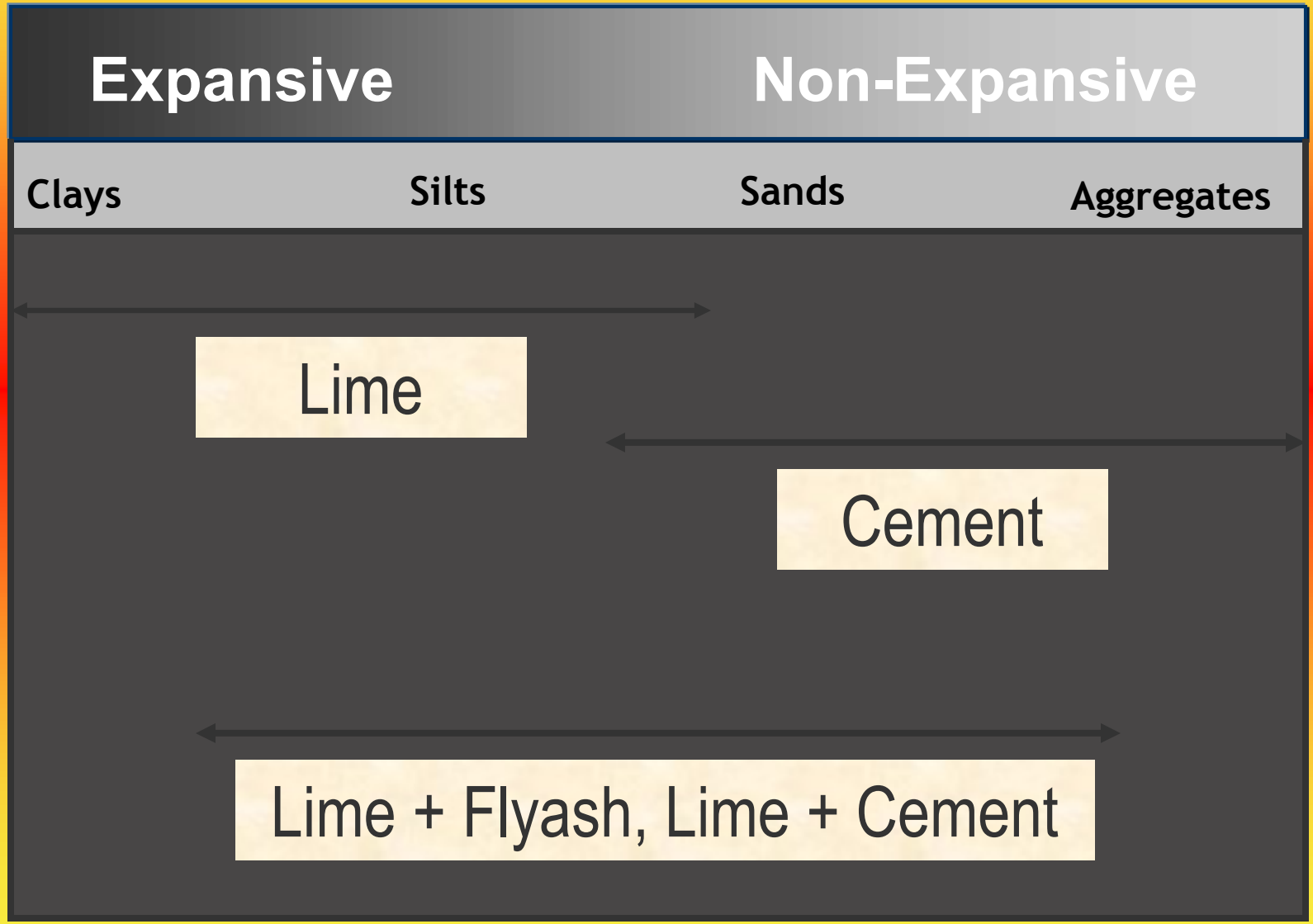
Chemical Stabilization

- CaO – Quicklime
- Portland Cement
- Fly Ash

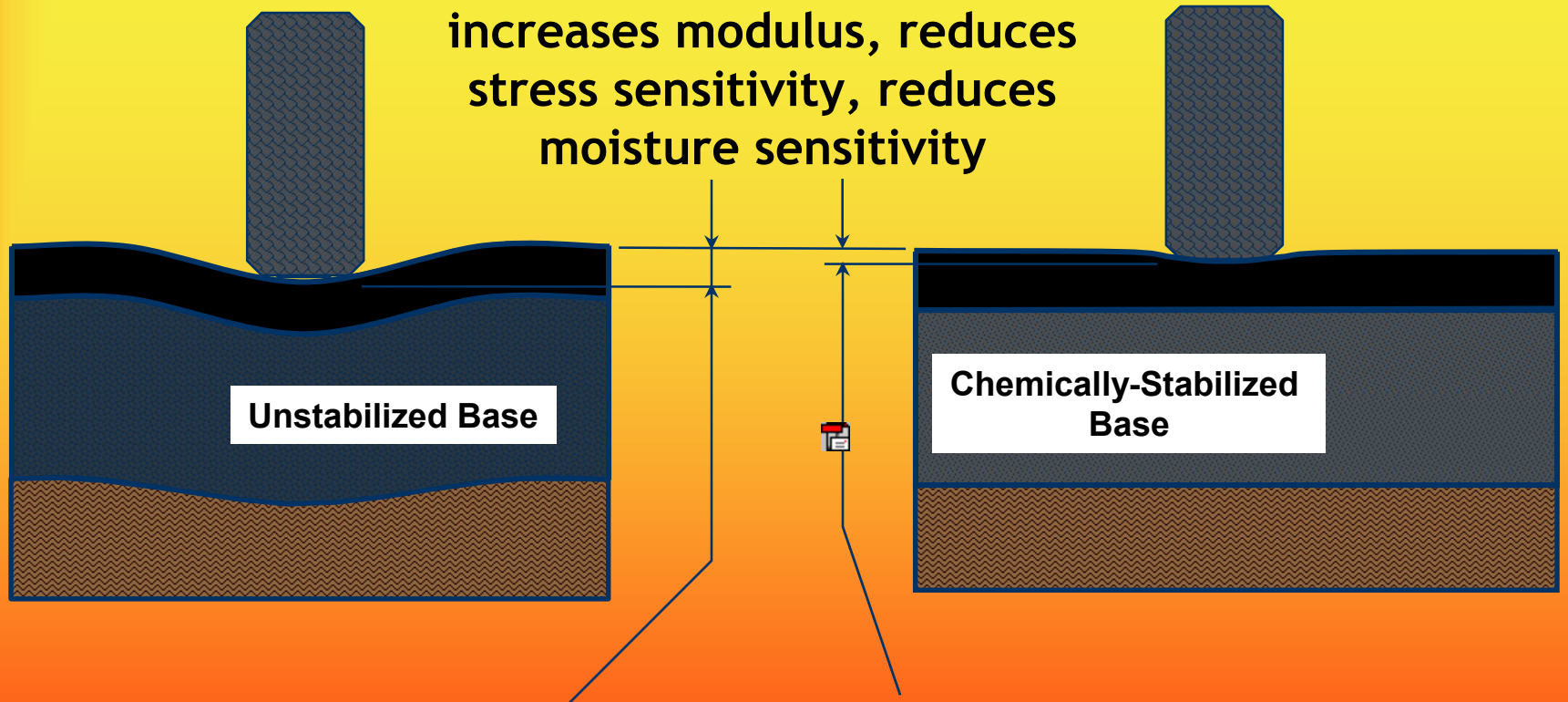
Chemical Stabilization

The application of additives into soil, that results in permanent physical and chemical alterations. Physical properties, such as strength and bearing capacity are enhanced, while expansivity and plasticity are reduced; thus creating more stable and suitable conditions for design and construction of pavement and building foundations.

Soil Stabilization Reagents for the Spectrum of Soil Types



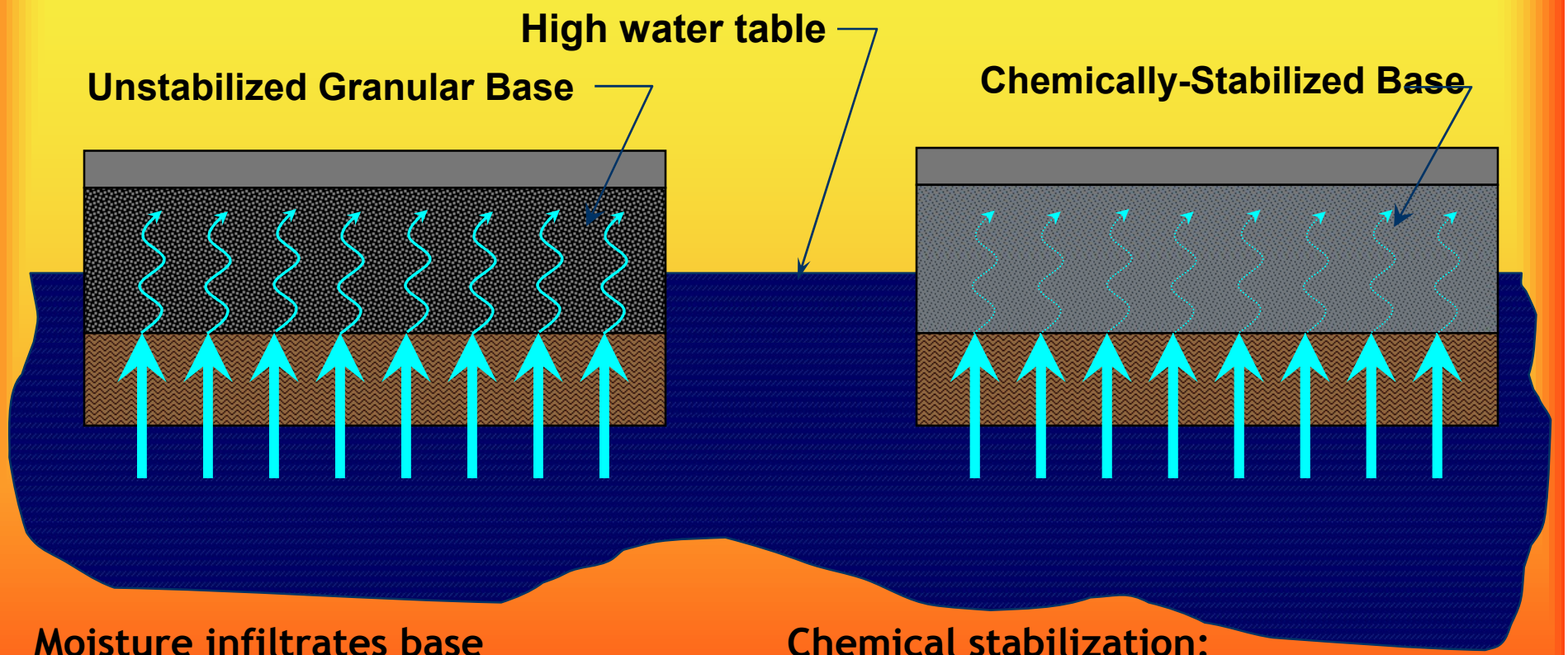
Reduces Subsurface Rutting and Cracking:



Rutting can occur in surface, base and subgrade of unstabilized sections due to repeated wheel loading.

Chemically-stabilized bases resist consolidation and movement, thus virtually eliminating rutting in all layers but the asphalt surface.

Reduced Moisture Susceptibility



Moisture infiltrates base

- Through high water table
- Capillary action
- Causing softening, lower strength, and reduced modulus

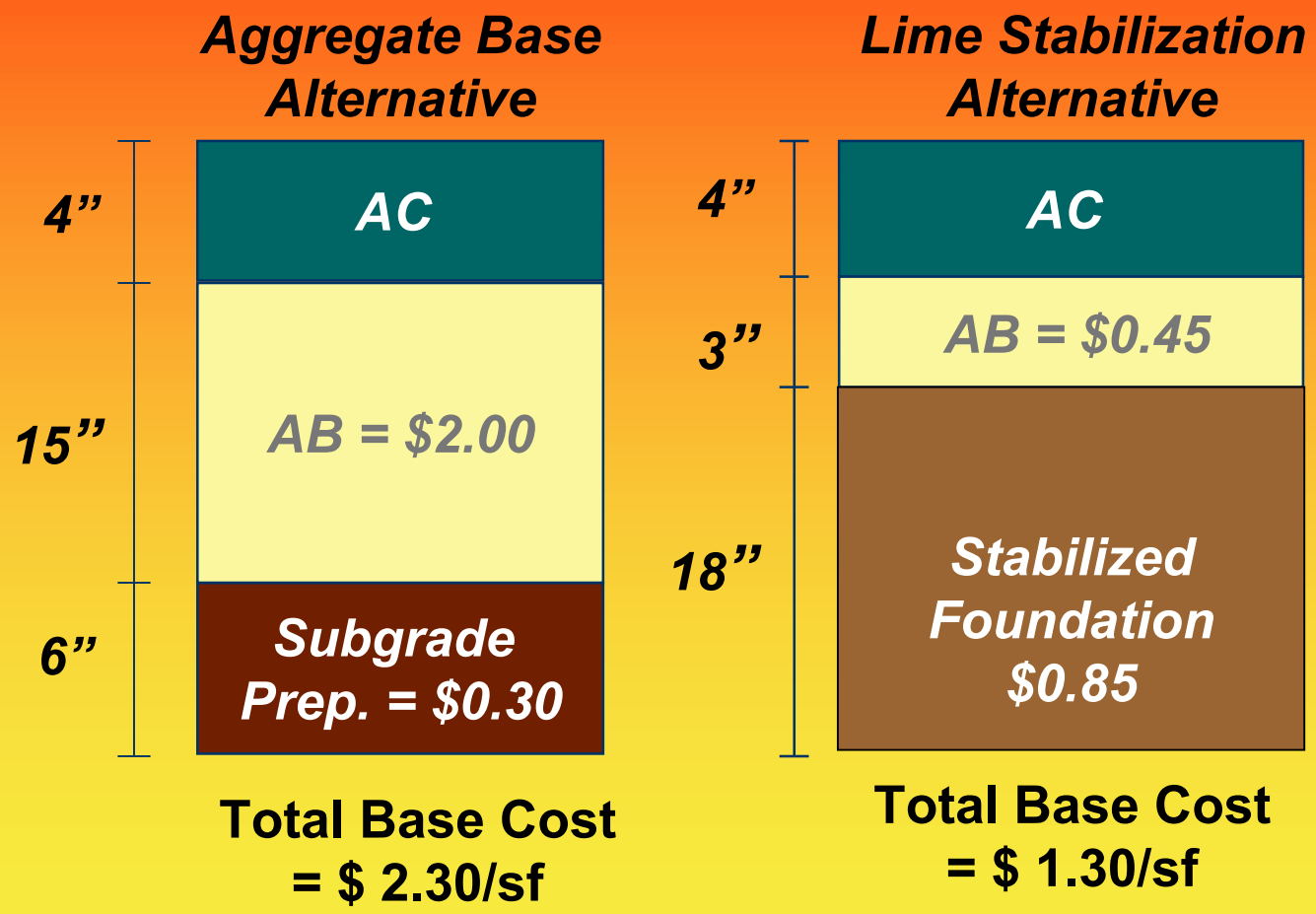
Chemical stabilization:

- Reduces permeability
- Helps keep moisture out
- Maintains high level of strength and stiffness even when saturated

Permanent Strength With Lime Stabilization

Lime subbase bridging an erosion failure

Economic Comparison of "Structurally Equivalent" Pavement Sections



Cost Savings of 43%

Key Components of Construction Process

- Lime spread rate application
- Depth of mixing
- Moisture content
- Mellowing period
- Uniformity of mixing and particle sizing
- Compaction and moisture testing
- Post compaction curing

Lime Spreading

Mechanical vane feed spreader allows for uniform distribution of dry reagents on the grade.

On board controls provide for a metered material application. Lime spread rate is determined by the in-place weight of the native soil.

Spread Rate Inspection

- **Check Point Inspection**
  Pan Method: Using a 3 sq. ft. pan, determine the spread rate in lb/sf.

- **Lime Spread Rate Inspection**
  Confirm the area of coverage for each truck load of lime using the certified truck weights & design spread rate.

Weigh lime in pan

Initial Mixing

- High capacity rotary mixers provide for increased uniformity/homogeneity of the soil, lime, and water mix.
- The integrated water system allows for introduction of water into mixing chamber for lime hydration throughout the depth of stabilization.

Structures & Edges

- Soil around structures such as manholes, utility risers, and cross gutters is “healed or pulled out” into area accessible to mixer

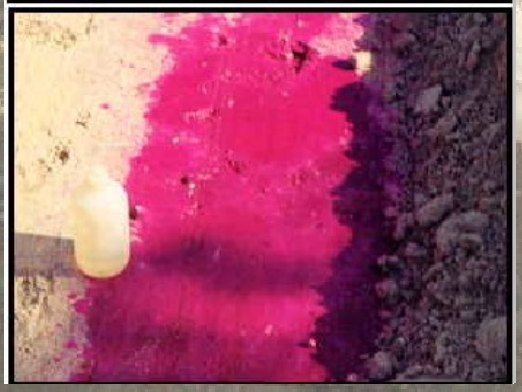
- Edges adjacent to curb and gutter are “healed or pulled out” into areas accessible to mixer

Watering & Mellowing

…no water…no time…no good

- **Moisture condition to +3% over stabilized Optimum Moisture Content, and allow to "mellow" for a minimum of 16 hours.**
- **Allows for cationic transfer and initial pozzolan formation**
- **"Breaks down" clay particles.**

Remixing



- Remix the soil-lime mixture after the mellowing period to achieve gradation:
  - *100% passing 1” sieve*
  - *60% passing No. 4 sieve*
- Moisture condition to a minimum +3% above the treated OMC prior to initial compaction
- Use phenolthalein to check for uniformity

Depth of Stabilization Inspection

- Excavate test pit in treated section either loose or compacted
- Phenolthalein pH indicator solution. Color change at pH 8.5
- Spray solution along face of test pit to determine stabilized section bottom
- Check depth using grade stake elevations or measure compacted depth

Initial Compaction

- **Initial compaction using a steel segmented compactor**
  - ***Typically 95% of wet density value at the MDD & OMC of ASTM 1557***
  - **Moisture *0% to +3% of OMC***
  - ***Up to 18” lift thickness***

Fine Grading & Final Compaction

- Fine grading of the lime stabilized section

- Final compaction of the lime stabilized section seals the surface

Curing of the Finished Surface

- **Moist cure until placement of subsequent paving course**
- **Keeps *section from drying***
  - ***minimizes cosmetic shrinkage cracking***
  - ***allows continued pozzolan formation***
- **Prior to pavement/foundation**
  - ***additional water***
  - ***emulsion curing seal***
  - ***aggregate base course section***

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