LECTURE 37

Chemical Modification or Stabilization

The transformation of soil index properties by adding chemicals such as cement, fly ash, lime, or a combination of these, often alters the physical and chemical properties of the soil including the cementation of the soil particles. There are the two primary mechanisms by which chemicals alter the soil into a stable subgrade:

1. Increase in particle size by cementation, internal friction among the agglomerates, greater shear strength, reduction in the plasticity index, and reduced shrink/swell potential.
2. Absorption and chemical binding of moisture that will facilitate compaction.

Design Procedures

Criteria for Chemical Selection

When the chemical stabilization or modification of subgrade soils is considered as the most economical or feasible alternate, the following criteria should be considered for chemical selection based on index properties of the soils.

1. Chemical Selection for Stabilization.

   a. Lime: If PI > 10 and clay content (2μ) > 10%.

   b. Cement: If PI ≤ 10 and < 20% passing No. 200.

   Note: Lime shall be quicklime only.

2. Chemical Selection for Modification

   a. Lime: PI ≥ 5 and > 35 % Passing No. 200

   b. Fly ash and lime fly ash blends: 5 < PI < 20 and > 35 % passing No. 200

   c. Cement and/ or Fly ash: PI < 5 and ≤ 35 % Passing No. 200

   Fly ash shall be class C only.
   Lime Kiln Dust (LKD) shall not be used in blends.
   Appropriate tests showing the improvements are essential for the exceptions listed above.

Suggested Chemical Quantities For Modification Or Stabilization-

a. Lime or Lime By-Products: 4% to7 %

b. Cement: 4% to 6%

c. Fly ash Class C: 10% to 16%

% for each combination of lime-fly ash or cement-fly ash shall be established based on laboratory results.

Strength requirements for stabilization and modification

The reaction of a soil with quick lime, or cement is important for stabilization or modification and design methodology. The methodology shall be based on an increase in the unconfined compression strength test data. To determine the reactivity of the soils for lime stabilization, a pair of specimens measuring 2 in. (50 mm) diameter by

4 in. (100 mm) height (prepared by mixing at least 5% quick lime by dry weight of the natural soil) are prepared at the optimum
moisture content and maximum dry density (AASHTO T 99). Cure the specimens for 48 hours at 120o F (50o C) in the laboratory and test as per AASHTO T 208. The strength gain of lime soil mixture must be at least 50 psi (350 kPa) greater than the natural soils. A strength gain of 100 psi (700 kPa) for a soil-cement mixture over the natural soil shall be considered adequate for cement stabilization with 4% cement by dry weight of the soils and tested as described above

In the case of soil Stabilization, enhanced subgrade support is not accounted for in pavement design. However, an approved chemical (LKD, cement, and fly ash class C) or a combination of the chemicals shall attain an increase in strength of 30 psi over the natural soils when specimens are prepared and tested in the same manner as stabilization.