



**LESSONS LEARNED:  
Geotechnical Engineering**  
OBSERVATIONS AND LESSONS FROM THE SCHOOL OF EXPERIENCE

**SOIL STABILIZATION WITH CEMENT**

The proper application of lime or cement to a problem soil can sometimes assist in solving wet or unstable soil subgrade problems. While lime and cement can both affect soil moisture, each alters the soil in very different ways. In a previous Lessons Learned we discussed the proper use of lime as an agent for improving certain soils. This Lessons Learned will address the use of cement for improving soil subgrades.

- **WHAT IS CEMENT STABILIZATION:** Cement, like lime, can be a quick answer to drying very wet soils. It does this by using up the free moisture in the soil in a chemical reaction called hydration. Cement stabilization can also add great strength to soils by actually cementing the soil particles together; making weak unstable soils strong. Stabilization is typically used in the surficial eight inches to twelve inches of soil. The depth of treatment is dependent of the ability of the equipment to work the cement into the soil. While mixing cement into the soil and then adding additional layers is sometimes used to stabilize slopes or in other applications; cement stabilizations is most commonly used in pavement or slab subgrades.
- **DIFFERING SOIL TYPES:** The physical properties, and thus the performance, of soil-cement are greatly dependent on the type of soil used in the mix. Cement stabilization works best with soils that have a low plasticity index (PI). Most references suggest a PI of 10 or less. Grain size also affects the benefits of the addition of cement. Fine soils with more than 50% of their particles passing a #200 sieve require relatively more cement and therefore are not as cost effective. High organic content in soil will often retard or completely arrest the cement reaction, giving little increase in strength. Cement stabilization should not be used on soils having an organic content in excess of 2%.
- **AMOUNT OF CEMENT:** The amount of cement needed for a given soil should be determined by laboratory testing for each soil type. The amount of cement needed is dependent on the plasticity, grain size and final required soil strength. Mixtures with 8 to 14% by weight cement generally produce adequate strength gain. Higher amounts of cement will improve the mixtures resistance to degradation by freeze thaw. However, higher amounts of cement can also cause difficulties with future excavation. This should be considered in areas where future excavation for structures or utilities is planned.
- **APPLICATION METHOD:** The soil should be loosened; the cement mixed then shaped and compacted. It is sometimes necessary to add additional water to the mix to provide enough moisture to fully hydrate the cement. Final compaction should be completed within about 4 hours of the addition of the cement. Temperature is important when deciding on cement stabilization. Cooler temperatures can slow or stop the hydration process, although you may still have some drying affect when the soil temperature is less than 40°F.
- **SHRINKAGE CRACKS IN SOIL-CEMENT:** Shrinkage is a natural occurrence of soil-cement as the cement hydrates. The size and frequency of cracks is dependent on soil grain size and the amount of cement added. Keeping the water content in the soil near to the amount of water needed in the mix for full hydration will also reduce the amount of shrinkage cracking. These cracks can sometimes “reflect” through with asphalt pavements. This reflective cracking can be reduced or eliminated by placing a 4 inch crushed stone layer between the asphalt and the soil cement subgrade.

It should be noted that in some jurisdictions mechanical modification of soil is regulated, so understanding and following local jurisdiction’s requirements prior to the application of cement is important.

Unfortunately, there is not enough space on this page to fully explore the finer details of this subject, so should you have any questions regarding soil stabilization or, for that matter, any other soils issues, please feel free to contact the Geotechnical Engineering staff at our local office in your area.

Respectfully,  
ECS Corporate Services, LLC