GEOTECHNICAL CONSULTANTS INC.

Building Solid Foundations on Wet Soils

How to use soil stabilization and soil modification to keep your projects on track despite wet site conditions.

Springtime is historically a time when contractors are battling wet site conditions in an effort to keep projects on track. Spring thaws and recurring rains create soft, muddy construction sites with challenging soil conditions and subgrades that are not capable of supporting pavements and slabs.

From a geotechnical perspective, wet soils make it very difficult to achieve proper compaction requirements, raise building pads and paved areas to grade, or improve subgrades.

Traditional approaches such as natural air drying, removing the wet soils and replacing them with dry materials, importing select materials, geogrids, etc. are time consuming, subject to changeable weather, and costly.

Soil modification and **soil stabilization** are two methods GCI recommends to improve the workability, constructability and strength of soils. Although soil modification and soil stabilization use the same construction process and some of the same chemicals, the applications are quite different. Each process is briefly described below.

Soil modification is the addition of materials such as lime and LKD (lime-kiln-dust) used in relatively low percentages to speed up the soil drying process and improve the workability and constructability of the soils. It provides an economical solution to dealing with wet site conditions to allow construction to stay on track during traditionally wet seasons.

In contrast, **soil stabilization** is an engineered product that is designed to meet exact specifications. The use of soil stabilization is determined early in the design process so appropriate specifications are developed. For soil stabilization, materials are added to the soil to improve soil strength and durability.

Cement, lime, and LDK are the most commonly used soil stabilization materials. When added in sufficient quantities, lime or LKD causes a chemical reaction with the clay base soils, the end result of which is a “glue” (pozzolan) that binds the soil particles together.

The “stabilized” structurally-enhanced layer can be accounted for in design through a reduction in the pavement section (i.e., reducing the thickness of aggregate base and hot mix asphalt), which reduces construction costs. In some cases, the thickness of heavily loaded floor slabs can also be reduced due to an increase in subgrade strength.

Chemicals for Soil Conditioning

The chemicals typically used for soil modification are lime (herein lime refers to quicklime) and LKD which have four different and favorable effects described below.

1. Water is absorbed as the lime hydrates.

2. The hydration process gives off heat, which further drives off water through evaporation.

3. The chemicals change the compaction characteristics of the soils; the optimum moisture content increases and the maximum dry density decreases.

4. The chemical decreases the overall soils plasticity, which improves the workability of the soils, reduces soil swell characteristics, and potentially extends the construction season.

Soil modification typically utilizes between 1% and 4% chemicals (by dry weight of soil); it normally takes less lime than LKD to realize similar moisture content and textural changes. A good rule of thumb is 1% lime for each 2% moisture change desired.

Soil stabilization typically requires application rates of 5% to 7% chemicals (by dry weight of soil) and possibly the addition of cement in order for stabilization to occur.

Construction Process

Regardless of whether soil modification or soil stabilization is performed, the construction process is essentially the same:

1. **Spreading** – the materials are delivered to the site and spread in dry form or as slurry with specialized equipment to control the percentage of additive. For drying purposes, dry bulk materials are normally used. For smaller projects, more traditional construction equipment can be used to spread the materials.

2. **Mixing** – the materials and the soil are thoroughly mixed using a rotary reclaimer mixer to a depth of 12 to 16 inches. Deeper instabilities may require a partial excavation of wet soils to be able to treat the entire wet layer. For stabilization purposes water is added to initiate the hydration reaction. The additive is allowed time to react with the soils; this is typically a few hours.

3. **Compaction** – the soils are then compacted with a sheep's foot roller or vibratory pad foot roller to the specified density. For pavement subgrades, the surface is sealed with a smooth drum roller.

In summary, materials such as lime and LKD applied in relatively low percentages can be used effectively to speed up the soil drying process and provide an economical solution to deal with wet site conditions and allow construction to stay on track during traditionally wet seasons through a process referred to as soil modification. If desired, slightly higher percentages of the chemicals (including lime, LKD and cement) can be used to create a structurally enhanced layer through a process known as soil stabilization, which can result in a reduced pavement section and potentially cost savings.

Contact David Caprio or Curtis Miller at GCI at (614) 895-1400 to discuss soil modification and soil stabilization options for your construction projects.

GCI Staff Certification News

Mike Lacher with GCI's Environmental Services received his Certified Professional (CP) certification from the Ohio Environmental Protection Agency. The CP designation qualifies Mike to provide environmental investigation and cleanup services and to write No Further Action Letters to the Ohio EPA for client properties that have been investigated and cleaned up to levels meeting the standards of the Voluntary Action Program. There are only about 100 CPs authorized to provide these services, including **Bruce Savage**, GCI Principal and Director of Environmental Services.

David Svoboda recently earned certification as a Level 1 & 2 Unbonded Post-Tensioning Inspector. Along with GCI's **Bob Hahn**, he is nationally certified to perform Special Inspections on the construction of
single strand unbonded post-tensioning systems for parking garages and high rise buildings.

Carl (Ric) Mullins recently joined GCI as a Senior NDT Technician and a Certified Welding Inspector. Ric will provide structural steel and NDT inspections along with GCI's **Alex Boatman**. These services include bolting and welding inspection, ultrasonic and magnetic particle testing, fire-proofing inspection and testing paints and epoxy thickness testing.