IMPLEMENTATION OF TECHNOLOGY FOR RAPID FIELD DETECTION OF SULFATE CONTENT IN SOILS

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Introduction. In roadway construction, chemical stabilization with calcium-based stabilizing materials (CBSMs) such as lime and cement can enhance many of the engineering properties of soil (subgrade) such as compressive strength, resilient modulus, shear strength, plasticity, and long term durability. However, soluble sulfate phase contained in some soils can react with CBSMs, resulting in volume expansion stability problems due to the growth of ettringite crystals on the clay particle surfaces through the chemical reaction between calcium components in stabilizer and sulfates and aluminates in the soil. The current Texas Department of Transportation (TxDOT) testing protocol in the field uses a spot test that measures sulfate content every 500-ft interval on a project (Tex-145-E). If a high sulfate zone lies between 500-ft intervals, the current testing protocol will miss this sulfate zone. The protocol using a device called Veris 3150 system (Figure 1) was developed and used as a continuous measurement of sulfate content as a function of electrical conductivity of soils.

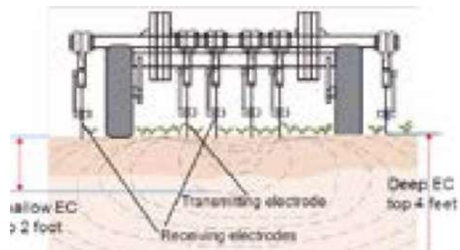

Figure 1. Principle of operation for Veris EC sensor.

Methodology. Researchers collected electrical conductivity (EC) data from Veris 3150 units. Soil samples for plasticity index, moisture content, sulfate content, and organic content tests were collected on the basis of the constructed EC color map. The data collected from these projects were analyzed to identify potential relationships between conductivity measurements and sulfate contents for different types of soil.

Results and discussion. Statistical modeling results indicate that Veris electrical conductivity is a linear function of the natural log of the sulfate content, directly if other soil parameters such as moisture content, organic matter content, and clay content remain constant. Higher EC of soil responds to higher sulfate content of soil.

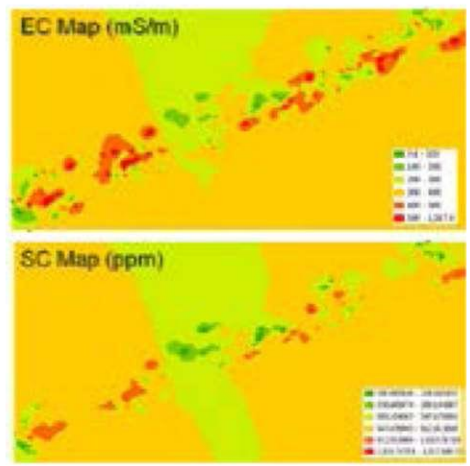

Figure 2. Electrical conductivity and sulfate content prediction map (US67 east).

In addition, a sulfate content color-coded map obtained from the multiple-ordered logit model indicates that the area with the higher sulfate content shows the greater EC, which can help one identify the areas containing sulfate in the soil (Figure 2).

Conclusions. The Veris EC and can be used as a viable screening tool to detect sulfate content of soils. The utilization of this device and new insights and logical evaluation into sulfate-contained soil stabilization will most certainly strengthen field soil stabilization studies and allow us to compete for future roadway construction projects related to sulfate-related soil stabilization.

References.

1. Harris, P.J., Harvey, O., Sebesta, S. (2010) Rapid Field Detection of Sulfate and Organic Content in Soils, Research Report 0-6362-1, Texas Transportation Institute, The Texas A & M University, College Station, Texas.