Utilization of Extractable Soil Test Sulfate as an Indicator for Acid Producing Pyritic Sulfur[1]

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Abstract: Overburdens in the Mississippi Embayment are mined for lignite in Mississippi, Louisiana, and Texas. Similar Eocene deposits are mined for lignite in Wyoming, Montana, and North Dakota. These are unconsolidated sediment layers that are unoxidized gray materials and may be suitable inclusion as final respread. Variable amounts of pyritic sulfur may be present in these overburdens selected for reclamation that can be difficult to predict from visual characterizations. Generally, red oxidized materials contain little pyritic S, so these are favored as suitable topsoil substitutes. Standard agricultural soil testing determines exchangeable potassium (K) and phosphorus and extractable potassium (K), but neither pH nor the predicted lime requirement provides an indication of potentially oxidizable sulfur. Normal agricultural soils contain 50 to 200 mg kg^{-1} extractable sulfate depending upon seasonal sulfur mineralization stages and it can vary by extractant utilized (Bray, Mehlich, Lancaster, etc.). The Mississippi Soil Testing laboratory routinely utilizes the Lancaster solution to determine agricultural fertilizer and lime recommendations. It determines most of its parameters by Inductively Coupled Plasma Spectroscopy including Ca, Mg, P, K, Na, Zn, Mn, and SO_4-S, though Mn and SO_4-S are not routinely reported. Since 2005, all samples from reclamation research in Mississippi have had SO_4-S and Mn reported. Samples with known pyritic-S levels of 0.05 (A) to 0.16% (B) were found in some gray unoxidized materials not suitable for topsoil replacement utilization. These were mixed with various portions of suitable red oxidized materials with 0.00 % pyritic-S and tested for extractable sulfate and incubated in the greenhouse for 12 months. Extractactable S from B (high pyritic S) was 500 to 1000 mg kg^{-1} initially and 150 to 180 mg kg^{-1} SO_4-S from the low pyritic-S site (A). Apparent pH remained high (7.2 to 7.8) at site A, but it declined to 4.6 to 5.1 in the higher pyritic-S materials. Economical utilization of routine agricultural soil testing provides a viable initial screening tool prior to expenditure of scare resources for expensive overburden testing procedures.

Additional Key Words: Oxidizable Sulfur, Initial Screening Tool

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