THE KINETICS OF IRON SULFIDE OXIDATION IN LIGNITE OVERBURDEN AS INFLUENCED BY CALCIUM CARBONATE

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Surface mine reclamation in Texas, is often hindered by the formation of acid minesoil. The acidity is a product of FeS_2 oxidation. Mixed overburden topsoil substitutes containing FeS_2, are often limed to prevent acid minesoil formation.

The main objective of this study was to measure the effects of liming rates on the kinetics of FeS_2 oxidation in overburden. To accomplish this objective, two overburden materials with different FeS_2 content (1.9 and 4.1%) and low acid neutralization potential were limed with $CaCO_3$. Lime rates of 0, 25, 50, 75, 100 and 125% were based on the amount of $CaCO_3$ needed to provide an acid/base account (A/B_a) of zero (A/B_a = acid neutralization potential - Potential acidity - exchangeable acidity). The limed overburdens were inoculated with *Thiobacillus ferrooxidans* and leached weekly with deionized water for 53 weeks.

Iron sulfide oxidation followed two different rate laws depending on the pH of the system. The oxidation followed zero-order kinetics with respect to FeS_2 concentration at pH values above 4 and first-order kinetics below 4. The rate of oxidation was also found to differ with FeS_2 source. The zero-order oxidation rate ranged from 0.01 to 0.46 $\mu mol\ g^{-1}\ d^{-1}$ in overburden 2 and from 0.01 to 0.22 $\mu mol\ g^{-1}\ d^{-1}$ in overburden 4. Oxidation following the first-order rate law had a first-order rate constant of 0.03 d^{-1} in overburden 2 and 0.01 d^{-1} in overburden 4. The calculated half-life is 23 and 69 d, respectively. Additions of $CaCO_3$ affected FeS_2 oxidation by controlling the pH of the system. The higher the pH the slower the oxidation. Liming to 25% of the A/B_a deficit maintained the pH above 4 for approximately 100 d in overburden 4. At that time, oxidation changed from zero- to first-order. The addition of lime did not affect the subsequent half-life of FeS_2 after the pH decreased below 4.

Liming to greater than 50% A/B_a deficit did not significantly affect the zero-order oxidation rate. The dissolution of the applied $CaCO_3$ was found to be faster than the release of potential acidity. It is projected that the lime would dissolve out of the system before all the FeS_2 would oxidize leaving the potential for acid minesoil formation.

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