IMPACTS OF COAL PILE LEACHATE ON A FORESTED WETLAND IN SOUTH CAROLINA

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Abstract. This study was conducted to: (1) determine the probable cause of several areas of stressed and dead vegetation adjacent to a 15-yr-old reject coal pile in western South Carolina and (2) identify the factors limiting successful revegetation of the site. Data from an earlier study suggested that solution pH, total dissolved solids (TDS) and electrical conductivity (EC), and/or elevated trace element concentrations may have contributed to the stress and dieback. Soil water in the two vegetation kill zones is saline (TDS > 10000 mg L⁻¹ and EC > 4 dS m⁻¹), highly acidic (soil pH < 3.5), and high in Al and Mn (Al conc. > 200 mg L⁻¹ and Mn conc. > 10 mg L⁻¹). Soil water in areas of sparse vegetation is brackish (TDS > 1000 mg L⁻¹ and EC > 2 dS m⁻¹) and acidic (soil pH < 4.0), with elevated Al values (> 40.5 mg Al L⁻¹). Tissue samples were collected from volunteer loblolly pine (Pinus taeda L.) seedlings growing in the study area and analyzed for essential and non-essential elements. Seedling tissues did not contain abnormal concentrations of nutrients or trace elements. The strong relationship between the zones of vegetation stress and dieback and solution pH and soluble salt concentrations, and the lack of excessive metal accumulations by tree seedlings which have become established in the less toxic portions of the study area, suggest that low solution pH and high soluble salts are more important factors limiting plant establishment on this site than solution metal concentrations. The results of this study demonstrate the importance of site hydrology in determining the impacts of coal waste disposal on adjacent ecosystems.

1. Introduction

Potential environmental impacts of coal pile leachate, including adverse effects on water quality, plants, and animals, have received increasing attention in recent years (Anderson and Youngstrom, 1976; Davis and Boegly, 1981; Swift, 1985). However, studies reported in the literature primarily describe the characteristics of coal leachates (Anderson and Youngstrom, 1976; Wachter and Blackwood, 1978) or effects on receiving streams (Davis and Boegly, 1981; Swift, 1985). Coal leachate effects on soils and woody plants have received little attention (Bartuska and Ungar, 1980).

Leachate from high-S coal is similar in composition to acid mine drainage, with low pH values and high concentrations of SO₄²⁻, Fe, and soluble salts (Anderson and Youngstrom, 1976; Davis and Boegly, 1981). As a result, coal pile leachate has the potential to produce highly acidic, saline soils containing toxic metal concentrations. These soil conditions, in turn, may inhibit seed germination and

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plant growth (Byrnes and Miller, 1973; Berg and Vogel, 1973; Grunwald et al., 1988; Rendig and Taylor, 1989), and, in extreme cases, can be lethal to established vegetation.

Carlson (1990) described the hydrology of a reject coal pile at the Savannah River Site in western South Carolina. Reject coal (coal not of suitable quality to burn due to its low BTU content, high S content, or age) was deposited along the berm of an abandoned fly ash settling basin. Leachate from the reject coal pile has produced a highly acidic, highly saline rooting zone in the forested wetland adjacent to the disposal site (Carlson, 1990). The wetland is characterized by several areas of total vegetation dieback; these kill areas are surrounded by areas of obviously stressed vegetation. Carlson (1990) hypothesized that the acid, saline leachate from the reject coal was the likely cause of these areas of dead and stressed vegetation. Elevated metal concentrations, documented by Carlson (1990), could also be producing the observed effects. Another possible cause of the vegetation kills, flooding due to construction of a gravel road north of the area, has also been proposed. The objectives of this study were to: (1) determine the most plausible explanation of the vegetation dieback and (2) identify factors stressing the remaining vegetation and limiting revegetation of the zones of total kill.

2. Site Description and History

2.1. Site Description

The physical layout, geology, hydrology, and soils of the site were described in detail by Carlson (1990). A summary of this information, and a detailed description of the site vegetation, are given here. 400-D Area, located on the U.S. Department of Energy's Savannah River Site near Aiken, SC, contains a coal-burning electric power and steam generation facility with associated coal pile, coal pile runoff basin, ash basins, and reject coal pile (Figure 1a). Two abandoned ash basins, containing a combination of bottom ash and cyclone ash, are located directly south of the study area. The southern ash basin and the western half of the northern basin have revegetated naturally following abandonment, and now support trees, including hybrid poplar (Populus spp.), sweetgum (Liquidambar styraciflua L.), sycamore (Platanus occidentalis L.), red maple (Acer rubrum L.), and loblolly pine (Pinus taeda L.). The eastern half of the northern ash basin has been cleared and is presently being used as a landfill for wet ash dredged from the active basins located farther to the south.

The reject coal pile extends from the eastern edge of the northern ash basin berm westward approximately 380 m. The pile varies in width from near 0 to 30 m, and has an estimated thickness of 2.5 m (based on drill log and auger data). The reject coal pile was covered with soil following deposition. However, water erosion and mass wasting have exposed the coal at numerous locations along the pile and reject coal has been transported northward by both sheetwash and channel flow.