

Cover amendment using boiler ash for AMD amelioration

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The use of alkaline materials (e.g., limestone (CaCO_3), quicklime (CaO) and more recently hydrotalcite ($\text{Mg}_6\text{Al}_2\text{CO}_3(\text{OH})_{16}\cdot 4(\text{H}_2\text{O})$) to neutralise and control acid and metalliferous drainage (AMD) is a well-established global practice. However, continual use of these finite materials can become cost prohibitive; therefore, alternative materials for reducing AMD are needed. Industrial by-products, such as boiler ash, a coal combustion product produced by paper mills, could be used.

In this study, two types of ash were used, a fine fly ash and a coarser bed ash collected from the Boyer Paper and Pulp Mill, Tasmania. Mineralogically, both were Class F ash comprising of mullite ($\text{Al}_{4+2x}\text{Si}_{2-2x}\text{O}_{10-x}$), quartz, carbon, minor gypsum and trace calcium oxide. Bulk chemical analysis reported As, Cd, Cu, Cr, Ni and Zn concentrations below ANZECC (2000) Interim Sediment Quality Guideline values. Mine waste materials were collected from six sites (tailings: Rossarden, Royal George, Savage River; waste rock: Old Spray, Mt. Lyell and Mt Bischoff) in Tasmania.

Boiler ash was applied in different configurations (capping layers, intermingled, combined with lime and organic material) in free draining kinetic column tests ($n=27$) for a period of 24 weeks. Results of this testing were variable, with bed ash showing some potential for increasing pH, particularly for low pyrite (< 1 wt. %) tailings collected from Royal George and Rossarden. Fly ash materials were most effective when blended with lime or intermingled throughout low-sulphide waste. Elution of metals and metalloids (i.e., As, Cu, Zn, Ni, Pb) was initially observed on addition of boiler ash with quantities slightly exceeding ANZECC (2000) aquatic protection guideline values (80 % trigger level). These concentrations decreased over time for select treatments (e.g., bed ash, blended lime and fly ash). Our results demonstrate that boiler ash may have potential to be used in mine waste covers, but longer-term kinetic testing and pilot scale studies are required to confirm this.