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Waste from energy production in coal fired power plants

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Although the share of energy generated by coal-fired power plants is decreasing, waste from this sector remains significant due to its large total mass and volume, as well as its numerous possible applications. In this study we analyzed bottom ash, fly ash, and flue gas desulfurization (FGD) waste from a power plant equipped with a pulverized fuel boiler and, using hard coal from the Upper Silesian Coal Basin.

The chemical composition of bottom ash and fly ash is similar, though some differences were observed, such as higher concentrations of Fe, Co, and W in bottom ash compared to fly ash. Significant differences in magnetic properties of bottom and fly ash distinct forms of occurrence of iron in Fe-rich phases in these waste types.

Mineralogically, quartz and mullite dominate in both bottom ash and fly ash. Fly ash contains minor hematite, while bottom ash features calcite and feldspar. Both waste types also contain significant amounts of amorphous material. In FGD waste, anhydrite and gypsum are the predominant phases, with minor amounts of mullite, hematite, cordierite, and halite.

Bottom ash consists mainly of irregular silicate and aluminosilicate particles, along with common spherical aluminosilicate or Fe-rich particles and char fragments. Fly ash, in contrast, is dominated by spherical particles, many of which contain Fe-rich exsolutions within an aluminosilicate matrix or are composed primarily of Fe oxides.

Leaching tests in distilled water revealed significant differences in the concentrations of cations and anions in leachates from bottom ash, fly ash, and FGD waste.

Sequential extraction of fly ash separated four fractions: (1) water-soluble, (2) bound to carbonates, (3) oxides and reducible metals, bound to organic matter, oxidizable metals and sulphides, and (4) residual. When considering fractions 1, 2, and 3 as mobile or potentially mobile, and fraction 4 as immobile, results indicate that some elements, including lanthanides, Th, Fe, Sn, and Zr, are predominantly in the immobile fraction. However, many elements, including potentially harmful ones, were found to be 70–90% in the mobile fraction.