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Migration and emission behavior of arsenic and selenium in a circulating fluidized bed power plant burning arsenic/selenium-enriched coal

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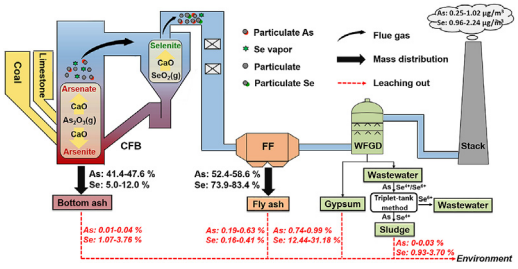
HIGHLIGHTS

- As was enriched in bottom ash and fly ash while Se was mostly trapped by fly ash.
- Most selenite was of poor thermal stability and formed in low-temperature regions.
- As removal from WFGD wastewater was more efficient than Se by triplet-tank method.
- As and Se contents in the stack were 0.25–1.02 and 0.96–2.24 μg/m^3, receptively.
- The leachability of As/Se followed: gypsum > fly ash ≈ sludge > bottom ash.

GRAPHICAL ABSTRACT



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ABSTRACT

Arsenic (As) and selenium (Se) pollution caused by coal combustion is receiving increasing concerns. The environmental impacts of As/Se are determined not only by stack emission but also by leaching process from combustion byproducts. For a better control of As/Se emission from As/Se-enriched coal combustion, this study investigated the migration and emission behavior of As/Se in a circulating fluidized bed (CFB) power plant equipped with fabric filter (FF) and wet flue gas desulfurization (WFGD) system. The results demonstrated that arsenic was both enriched in bottom ash (41.4–47.6%) and fly ash (52.4–58.6%), while selenium was mainly captured by fly ash (73.9–83.4%). Limestone injection into furnace promoted As/Se retention in ash residues. Arsenic was mainly converted into arsenate in high-temperature regions and partly trapped in bottom ash as arsenite. In contrast, selenium capture mainly occurred in low-temperature flue gas by the formation of selenite, because of the poor thermal stability of most selenite. Triplet-tank method can totally remove arsenic in WFGD wastewater. And 18.4–58.7% of selenium was removed, resulting from the precipitation of Se^{4+} anions with highly soluble Se^{6+} anions remaining in wastewater. The concentrations of As and Se in the stack emission were 0.25–1.02 and 0.96–2.24 μg/m^3, receptively. The CFB boiler equipped with FF + WFGD was shown to provide good control of the As/Se emission into the atmosphere. Leaching tests suggested that more attention should be paid to As leachability from fly ash/gypsum, and Se leachability from gypsum/sludge.

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