

Germanium and Gallium Extraction from Gasification Fly Ash: Optimisation for the Up-Scaling of a Recovery Process

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ABSTRACT

Germanium and gallium occur as water soluble Ge (hexagonal-GeO₂ and GeS₂) and Ga oxide species in relatively high contents in the Puertollano Integrated with Gasification Combined cycle (IGCC) fly ash. Both the speciation and contents of Ge and Ga in this co-gasification (50:50 coal/pet-coke) fly ash, allowed starting research for developing water (Ge) and alkaline (Ga) extraction methods. In view of the relatively high Ge and Ga extraction yields obtained in these early extraction tests, the research was currently directed towards the optimisation of the extraction procedure by investigating the extraction (simultaneous if possible) of both elements to obtain high extraction yields regardless the fly ash and operational conditions of the IGCC plant. A number of extraction tests were carried out using different extractants (H₂O, NaOH, HCl, H₂SO₄, H₂O₂, Ca(OH)₂, NaHCO₃, H₂C₂O₄ and C₆H₆O₂), to cover a wide range of extraction conditions (acid, alkaline, complexant, reducing and oxidising), on a number of IGCC fly ash from the Puertollano IGCC plant produced under different conditions. The results revealed that relatively high Ge extraction yields (up to 83 % after 2 h leaching period) may be achieved using a weak acid solution. Gallium yielded up to 70 and 64 % extraction after 24 h leaching period using a weak acid and alkaline solution, respectively. The variability obtained on Ge extraction yields among fly ash samples is lower than that obtained by water extraction. These major findings increased feasibility for a potential extraction of these elements for a potential up-scaling of the process and allowed to start research of subsequent enrichment and separation methods for these elements and on extraction in a small scale pilot plant.

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