

Supplementary Materials: Life-Cycle Assessment of Fly Ash and Cenosphere-based Geopolymer Material

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Online Resource

Figure S1 plots the volume-based particle size distribution for the three industrial by-product materials used to produce the two geopolymers FA-G and C-G. The particle size of cenospheres is the highest due to their hollow microstructure and shows a bimodal distribution while fly ash and GGBFS present a unique peak at higher and smaller particle sizes, respectively. As clearly shown in the figure, the decrease in density results from C-G naturally having, on average, a coarser particle size than FA-G.

Figure S2 shows the Scanning Electron Microscopy (SEM) images of the hollow microstructure of cenospheres.

Table S1 shows the inventories for energy/fuel.

Table S2 shows the inventories for transport.

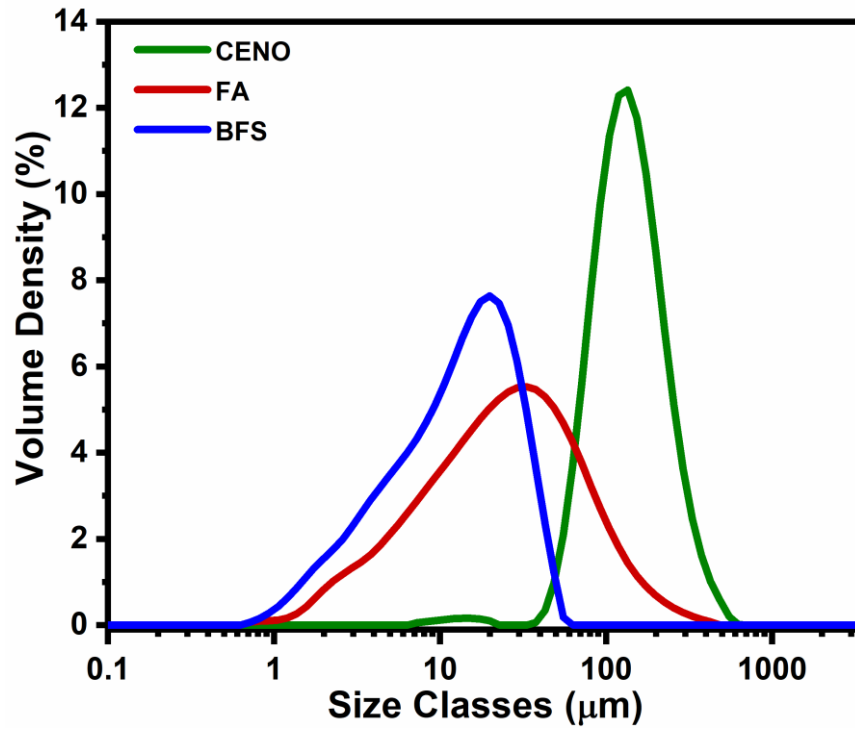


Figure S1. Volume density against particle size distribution of the industrial by-product materials (cenospheres in green, fly ash in red, and GGBFS in blue).

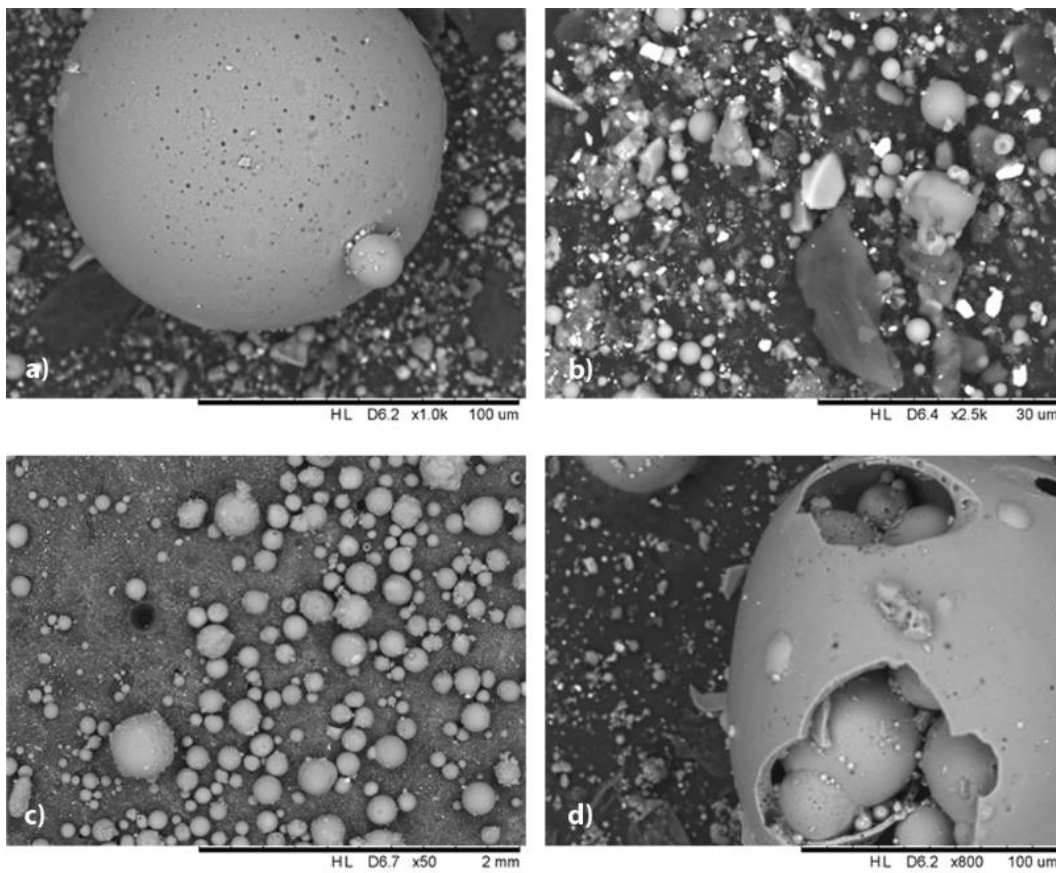


Figure S2. Scanning electron microscopy (SEM) images of the pure hollow cenospheres used in this study: a) x1.0k, b) x2.5k, c) x50, and d) x800.

Table S1. Inventories for energy/fuel.

Ecoinvent 3.7.1 databases	
Electricity	Electricity, medium voltage (AU)
Diesel	Diesel burned in building machine (GLO)
Natural gas	Natural gas, from high-pressure network (1-5 bar), at service station (RoW)
Fuel oil	Light fuel oil (RoW)
Coal	Heat, district or industrial, other than natural gas (RoW) heat production, at coal coke industrial furnace 1-10MW

Table S2. Inventories for transport.

Ecoinvent 3.7.1 databases	
Truck	Transport, freight, lorry 16-32 metric ton, Euro5 (RoW)
Ship	Transport, freight, sea, ferry (GLO)
Train	Transport, freight train (RoW)