Low temperature circulating fluidized bed gasification and co-gasification of municipal sewage sludge. Part 2: Evaluation of ash materials as phosphorus fertilizer

The study is part 2 of 2 in an investigation of gasification and co-gasification of municipal sewage sludge in low temperature gasifiers. In this work, solid residuals from thermal gasification and co-gasification of municipal sewage sludge were investigated for their potential use as fertilizer. Ashes from five different low temperature circulating fluidized bed (LT-CFB) gasification campaigns including two mono-sludge campaigns, two sludge/straw mixed fuels campaigns and a straw reference campaign were compared. Experiments were conducted on two different LT-CFBs with thermal capacities of 100 kW and 6 MW, respectively. The assessment included: (i) Elemental composition and recovery of key elements and heavy metals; (ii) content of total carbon (C) and total nitrogen (N); (iii) pH; (iv) water extractability of phosphorus after incubation in soil; and (v) plant phosphorus response measured in a pot experiment with the most promising ash material. Co-gasification of straw and sludge in LT-CFB gasifiers produced ashes with a high content of recalcitrant C, phosphorus (P) and potassium (K), a low content of heavy metals (especially cadmium) and an improved plant P availability compared to the mono-sludge ashes, thereby showing the best fertilizer qualities among all assessed materials. It was also found that bottomashes from the char reactor contained even less heavy metals than cyclone ashes. It is concluded that LT-CFB gasification and co-gasification is a highly effective way to purify and sanitize sewage sludge for subsequent use in agricultural systems.

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