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Electrodialytic extraction of phosphorus from ash of low-temperature gasification of sewage sludge

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Recirculation of nutrients to agricultural soils is especially important for those produced from non-renewable resources, such as phosphorous (P) obtained from phosphate rocks. The reserves of this mineral, mostly located outside the European Union (EU), are foreseen to be depleted in a range of 100-400 years [1]. In 2012 EU imported 88% of the phosphate rock consumed. Since only about one fourth of the P applied to agricultural fields is actually recycled today [2], innovative recycling and re-use concepts need to be developed and adopted. Low-temperature gasification allows an energy production from biomass resources with high contents of low melting ash compounds – often shown to be a source of boiler operational problems in more traditional incineration. Materials like sludge, have a high P content, which should preferentially be recycled back to agricultural soils after this thermal process. However, major concerns are its heavy metal content and the low plant availability of P; hence, a separation of phosphorus from the bulk bioashes and heavy metals would be beneficial.

P separation can be achieved by acidifying the bioashes in a water solution; nevertheless, heavy metals will also be released (Figure 1).

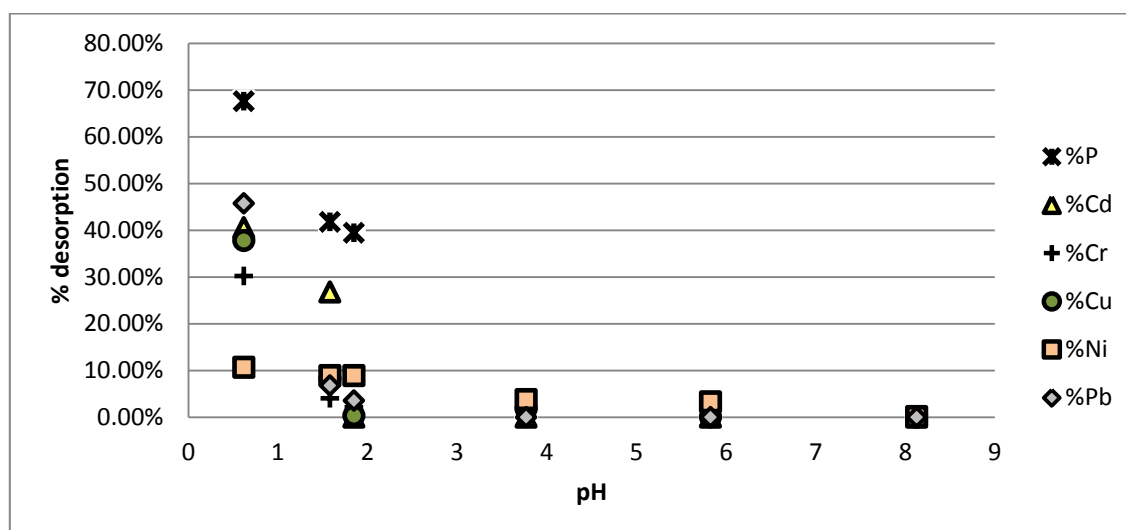


Figure 1. pH-desorption of P and Heavy metals in gasified sludge bioashes

In contrast, Electrodialysis (ED) is a technology that allows the mobilization of P from sewage sludge based bioash materials to aqueous solutions, ensuring its plant availability as well as separating it from heavy metals. ED was applied to a gasified

sludge with low Fe content, allowing a recovery of around an 80% of the P in a water solution. Similar experiments were run to a gasified sludge with high Fe content, showing less encouraging results as the recovery of P was found to be around 30%. For both ashes, the mass ratio heavy metals/P in the aqueous solution was considerably lower than in the original material, showing a potential in heavy metals reduction.

References

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