

Supplemental Material

Phosphorus speciation in sequentially extracted agro-industrial byproducts: Evidence from X-ray absorption near edge structure spectroscopy.

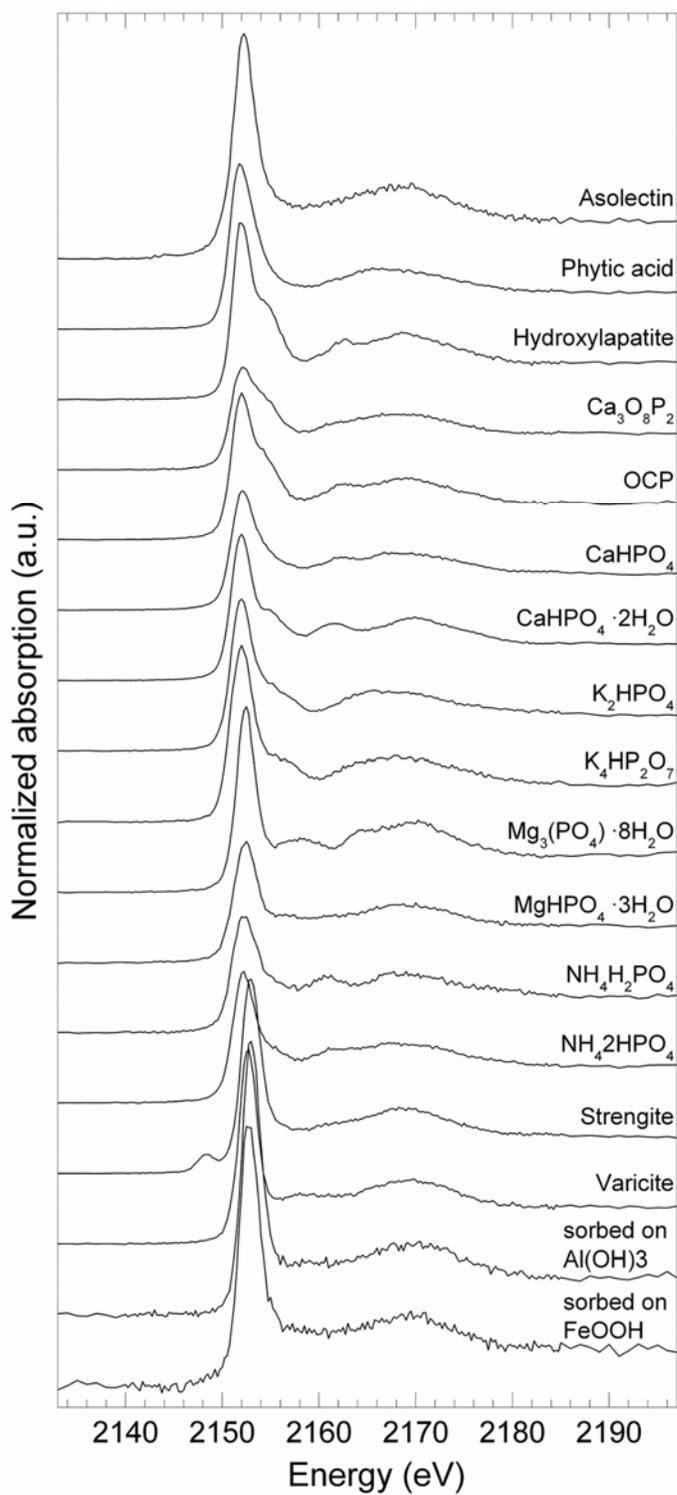
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Supplemental Material Description

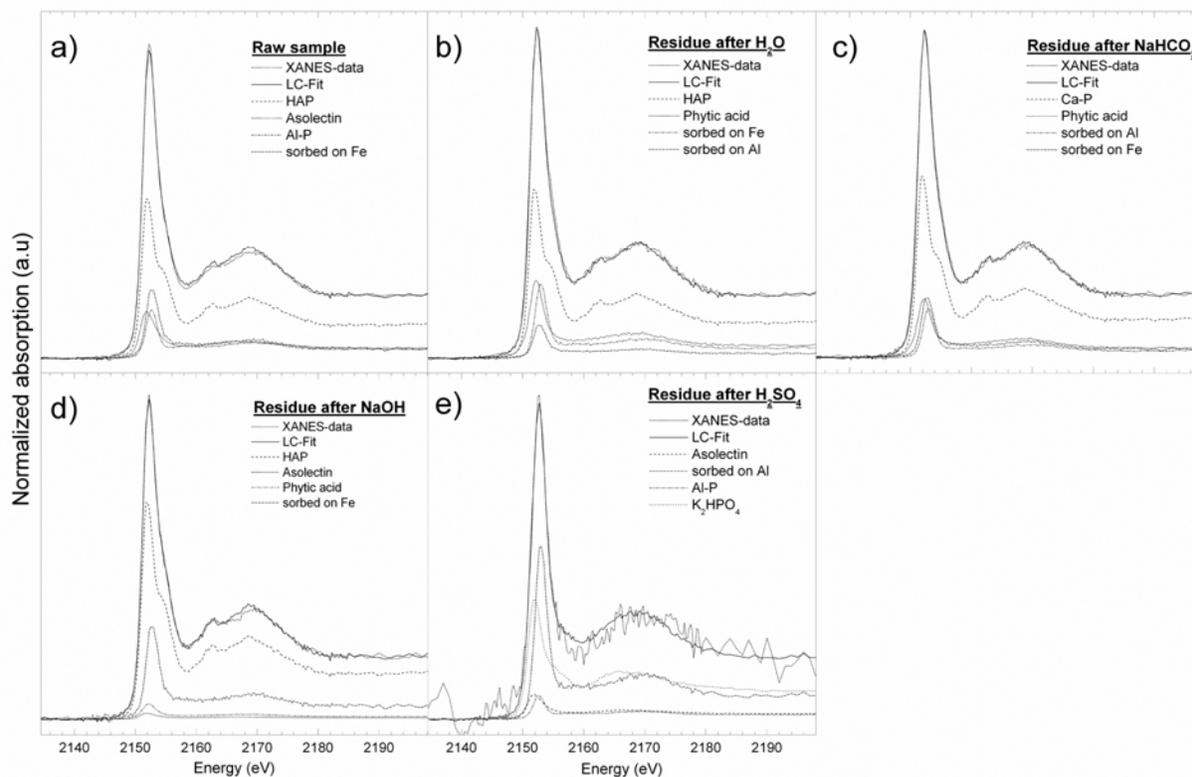
Filter cake is besides bagasse (fibrous residue) and molasse (viscous residue) the major byproduct in the processing of sugar cane into sugar. The filter cake is generated during the purification process of the sugar cane juice. In this process lime is added to neutralize the juice, and remove and precipitate mineral impurities. A more detailed description of the whole process can be found elsewhere (USEPA, 2005). Around 3.4% of filter cake per weight of fresh sugar cane is typically generated in this process (Paturau, 1989; Meunchang et al., 2004). Based on mean production data (1998-2008) of sugar cane in Africa about $3 \cdot 10^{12}$ g of filter cake are released annually. For Ethiopia the release of filter cake is suggested to be around $7.6 \cdot 10^{10}$ g.

Niger is an oil seed crop primarily grown in Ethiopia. Annual production of Niger seed is estimated to be around $2.5 \cdot 10^{10}$ g (Lin, 2005). Since seeds contain about 40% (w/w) oil (Kandel et al., 2004), which is extracted using an expeller, the annual release of the expeller cake (solid residue) is expected to be $1.5 \cdot 10^{11}$ g.

These byproducts were selected because of their total P (P_t) concentrations which were among the highest in a range of byproducts tested by Negassa et al. (2010). These large P_t concentrations (FIC 12.3 g kg^{-1} , NIC 9.3 g kg^{-1}) agreed with data published in literature (FIC: P_t 5-14 g kg^{-1} , NIC: P_t 7-23 g kg^{-1} ; Barry et al., 1998, FAOSTAT, 2010). This was also valid for the N and Ca-concentrations. Therefore, we considered that byproducts sampled by W. Negassa in Ethiopia as representative for this kind of materials.



Supplemental Figure S1. Normalized stacked phosphorus *K*-edge XANES spectra of reference standards used in linear combination fitting. Hydroxylapatite $3\text{Ca}_3(\text{PO}_4)_2\cdot\text{Ca}(\text{OH})_2$; Octacalcium phosphate (OCP) $\text{Ca}_8\text{H}_2(\text{PO}_4)_6\cdot 5\text{H}_2\text{O}$; phytic acid sodium salt (myoinositol hexakisphosphate) and asolectin (a mixture of phospholipids from soybean).



Supplemental Figure 2. Linear combination fit results showing proportions of identified phosphorus species in the FIC sample (filter cake from sugar cane processing).

References

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