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Phosphorus Recovery from bio-feedstocks using the Improved Hard Process

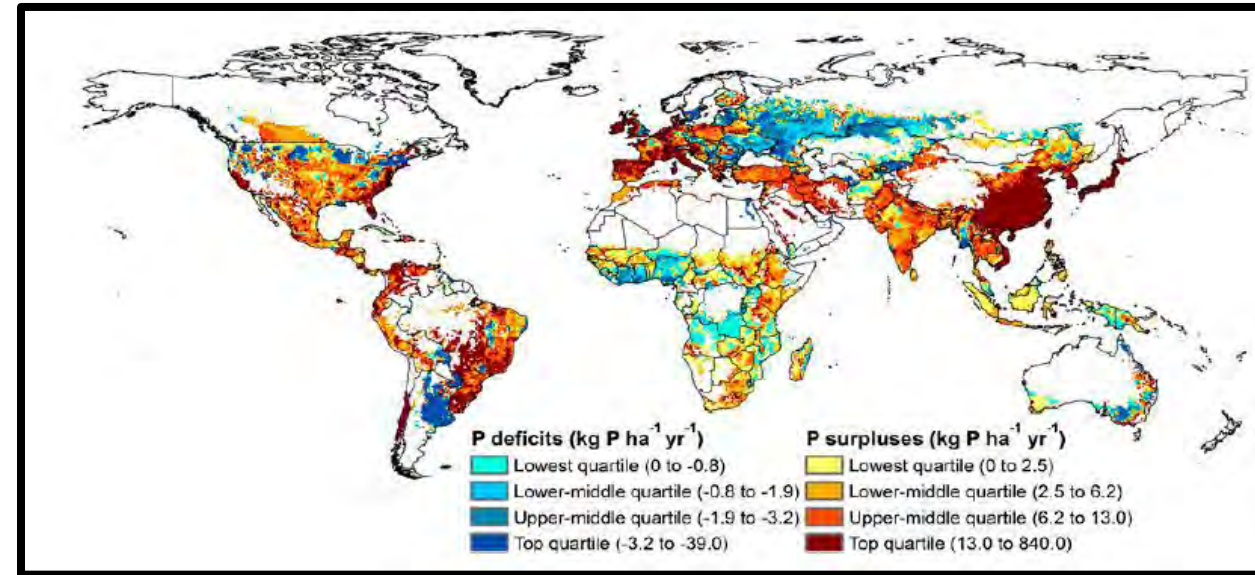
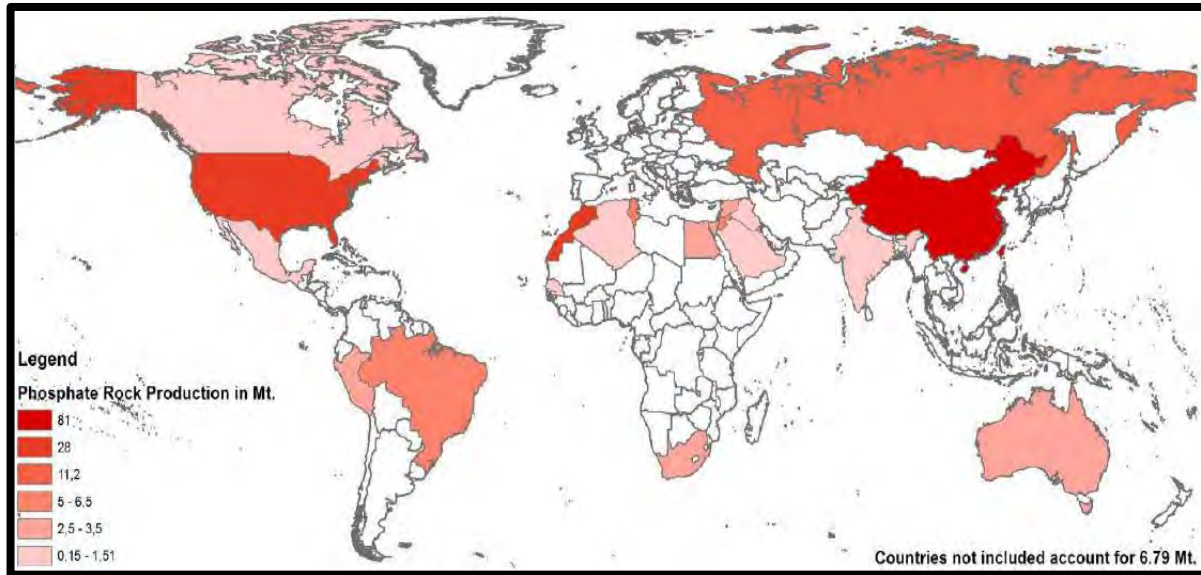
***Bhavish Patel^a, Mohamed Tarik^a, Tobias Borgmeyer^b, Albert Schuler^a and Christian Ludwig^{a,b}**

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World Resources Forum 2019, Geneva, CH

(23-24 Oct 2019)



Feedstock

1. Phosphate Rock (Morocco)



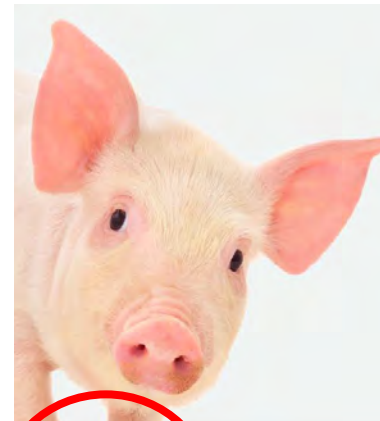
14.6 %

2. Sewage Sludge Ash (Zurich)



10 %

3. Pig Bone (CH)



11.5 %

4. Cattle Bone (CH)



12.7 %

5. Algae Ash from Coal Mine Wastewater



19 %

6. Algae Ash from Domestic Wastewater



16.6 %



Bone sample collected from local butcher and grinded at PSI

P wt.%

Samples generated in Colombia. Incinerated at PSI

P: SiO₂:C – Mole Ratio

Mole of P in feedstock: mole of SiO₂: mole of Carbon

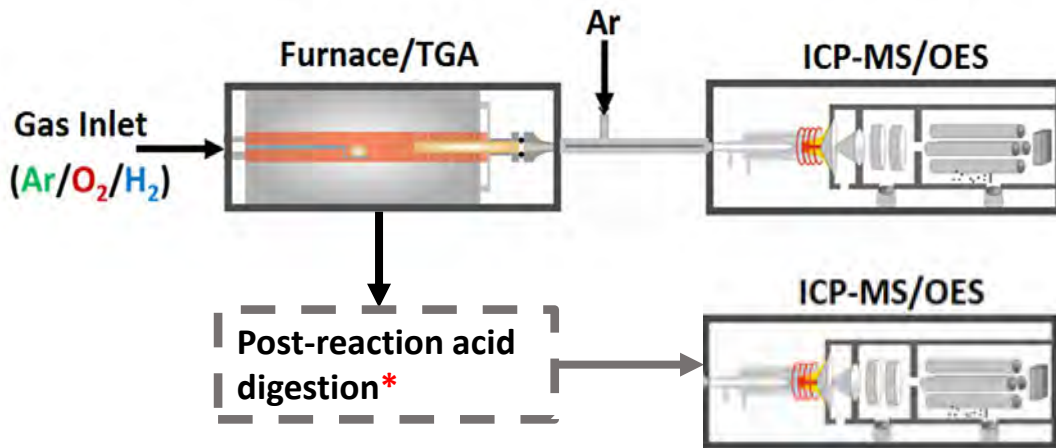
Carbon source: 99% purity activated carbon

Typical ratio used for IHP experiments:

2:3:5

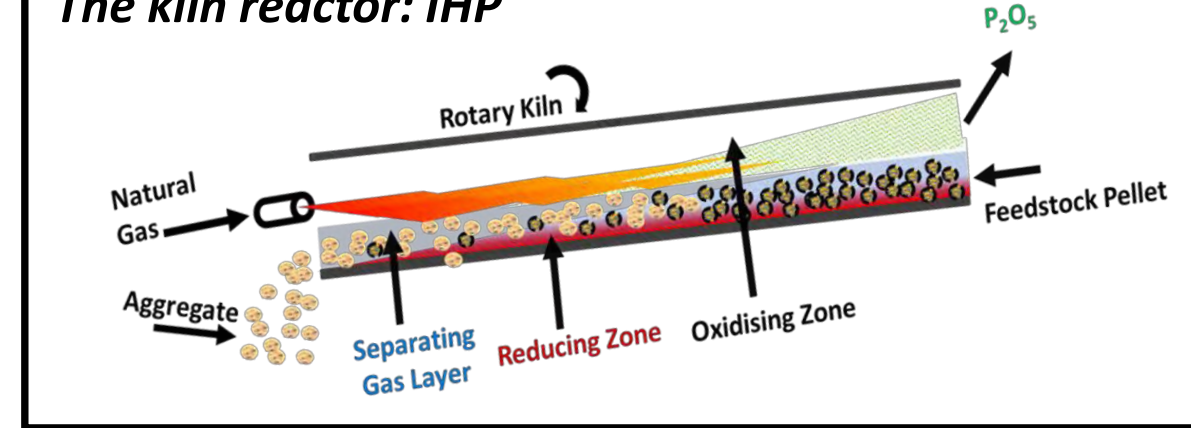
2 mol P: 3 mol SiO₂: 5 mol C

Experimental set-up and procedure



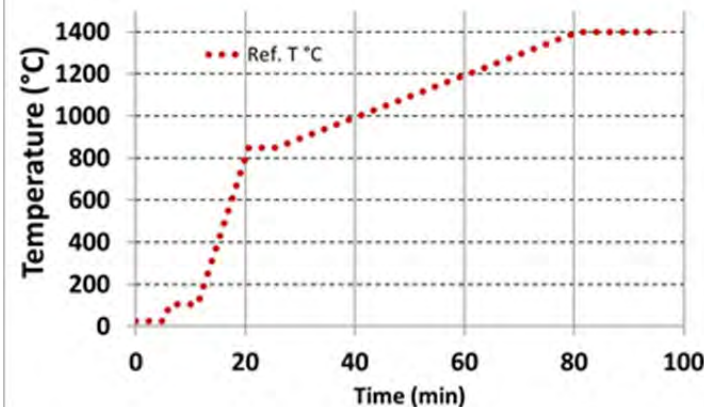
* Possible cause of misleading P recovery value: Slag sticks and possibly fuses with the crucible resulting in incomplete digestion.

The kiln reactor: IHP



[11] 4,351,809
[45] Sep. 28, 1982

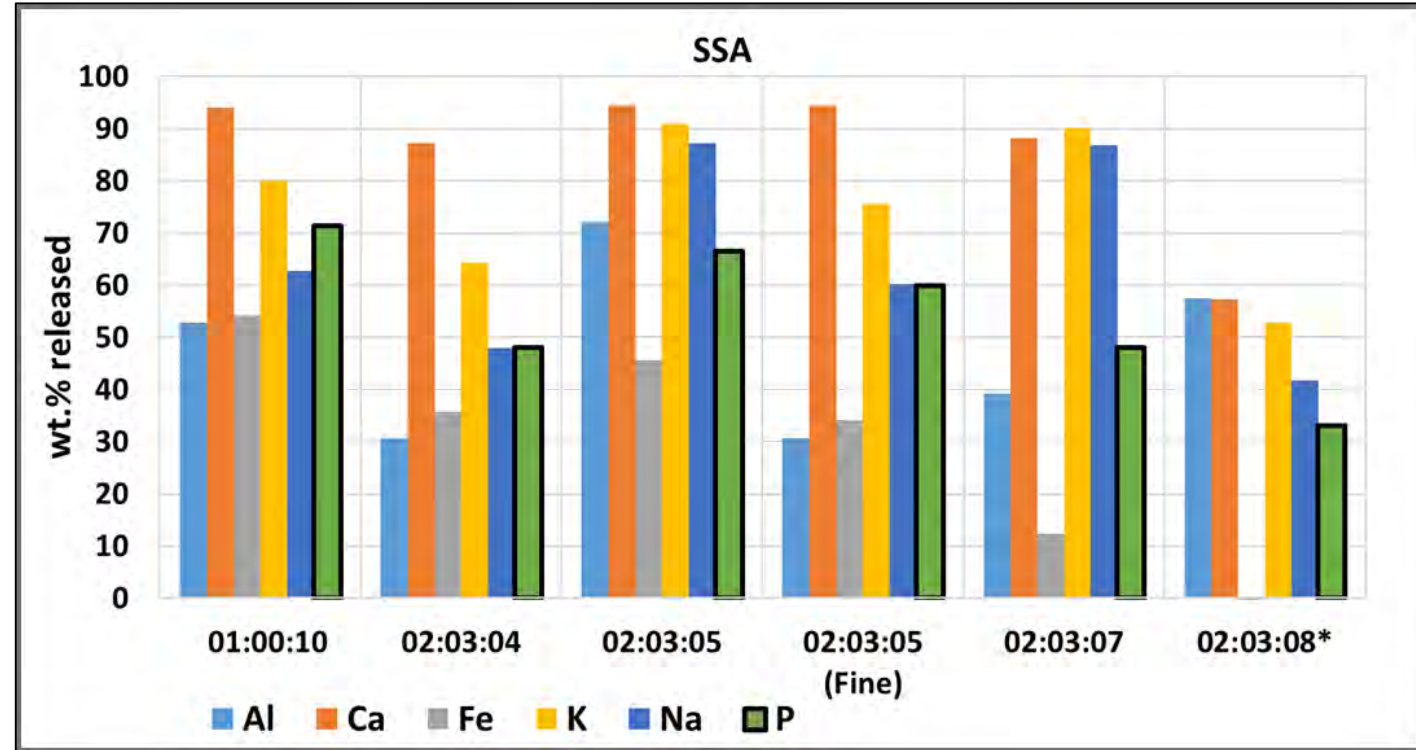
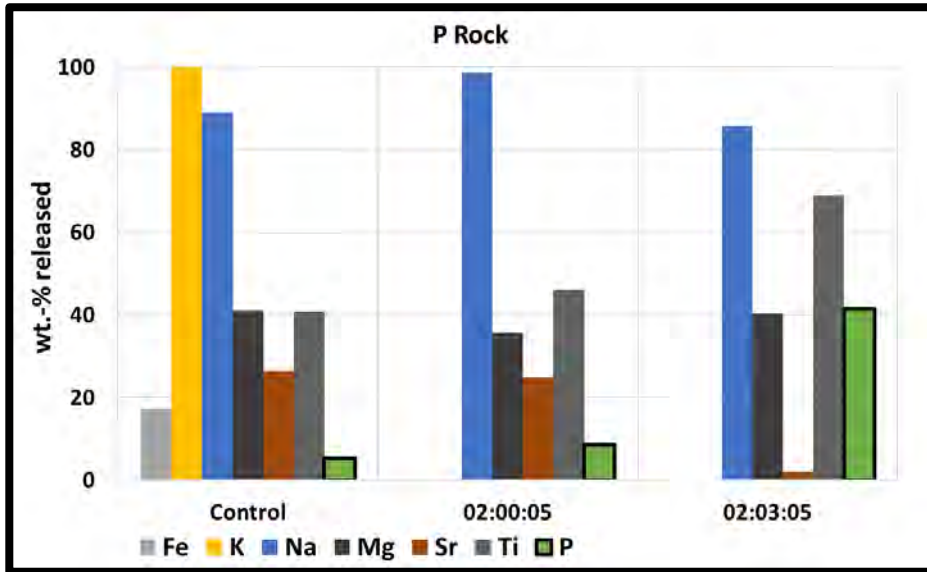
TGA method

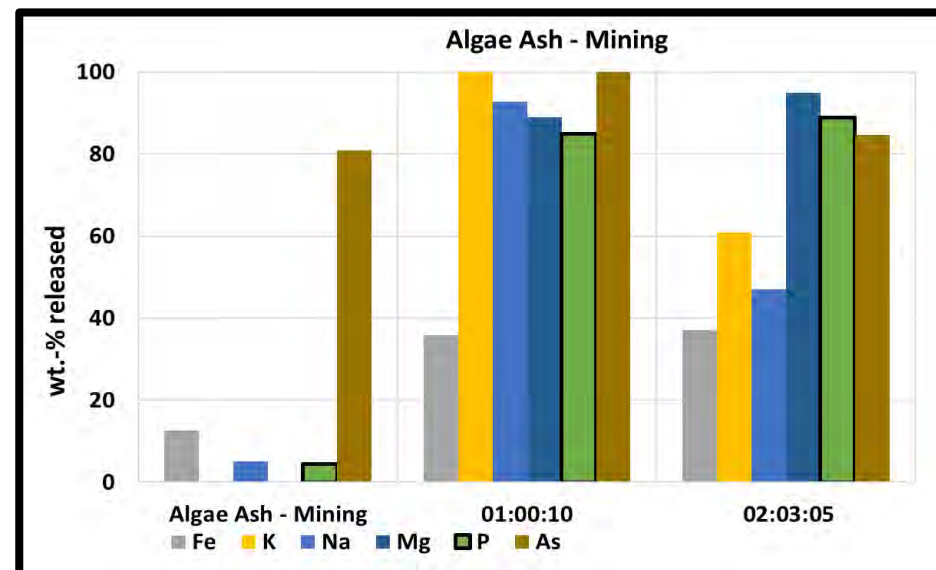
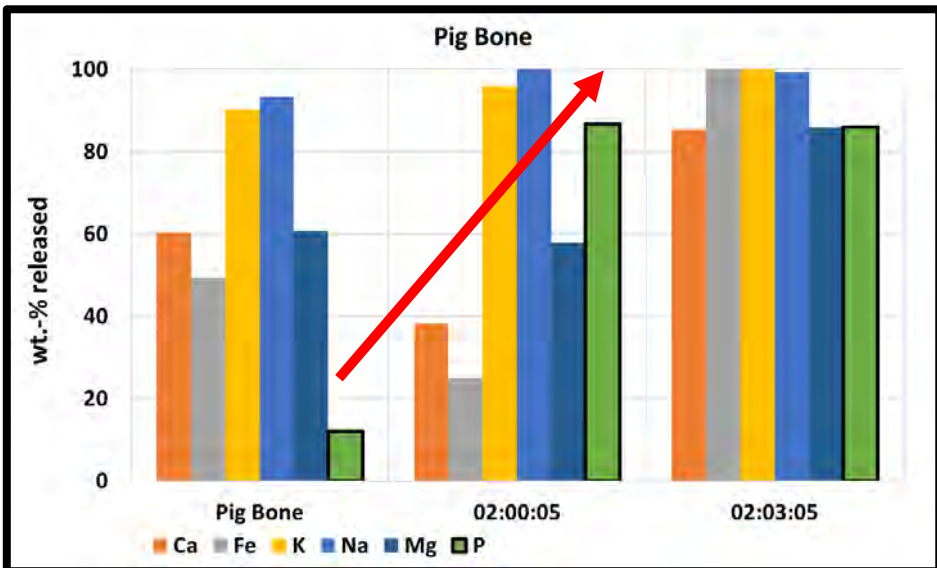
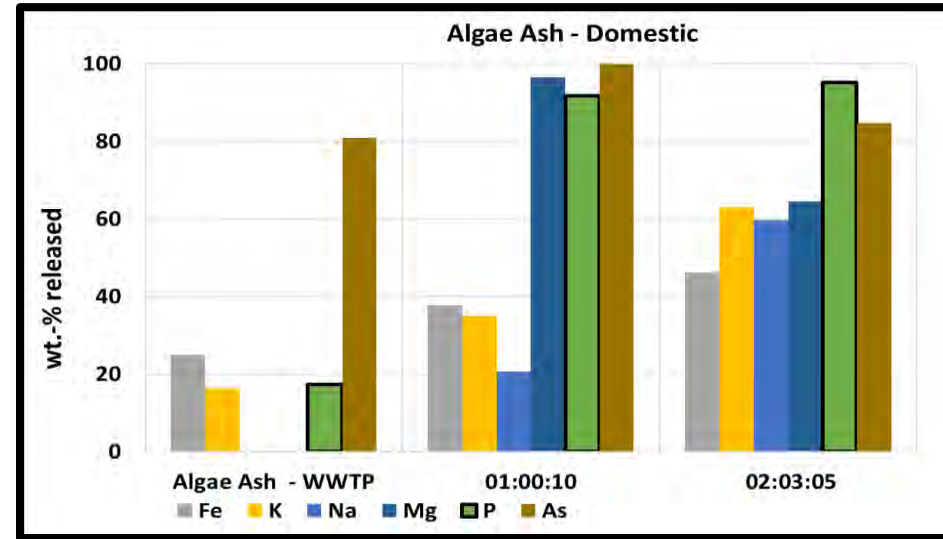
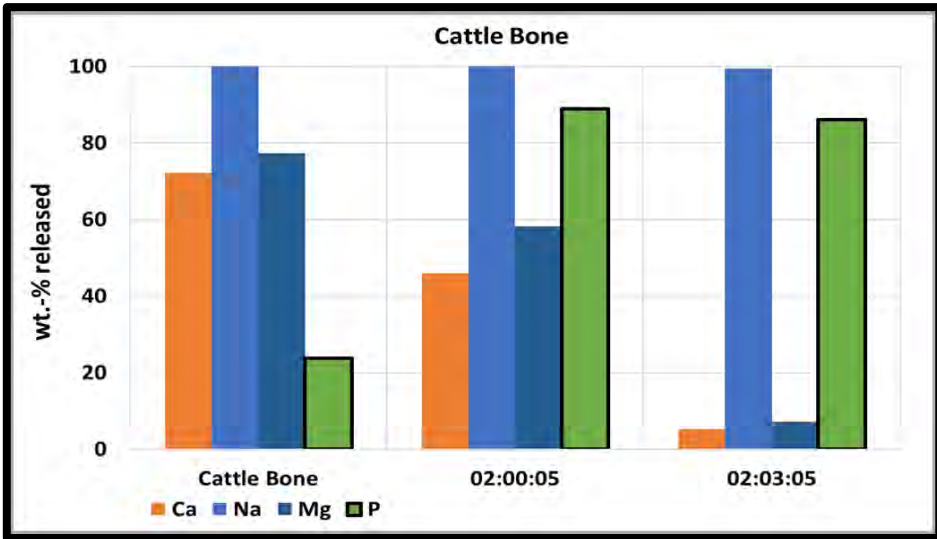


United States Patent [19]
Megy et al.

[54] PROCESS FOR REDUCING PHOSPHATE ORE
[75] Inventors: Joseph A. Megy, Mission Viejo; Robert A. Hard, Laguna Beach, both of Calif.
[73] Assignee: Occidental Research Corporation, Irvine, Calif.
[21] Appl. No.: 265,305
[22] Filed: May 20, 1981
[51] Int. Cl.² C01B 25/01
[52] U.S. Cl. 423/167; 423/304; 423/323
[58] Field of Search 423/304, 323, 167

Results: Phosphate Rock and Sewage Sludge Ash

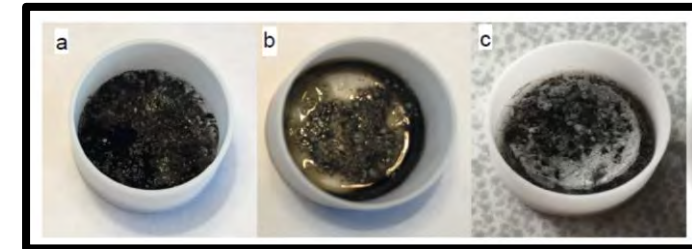




- The IHP is capable of recovering P as well as other trace metals from a variety of bio-feedsstocks. The form and separation of these downstream remain to be investigated
- The ratio of C/SiO₂ added in the feedstock is key for efficient removal P from the ash. But this depends on the amount of Fe/Al/Ca species present which will be different for all ashes – Slagging a big issue, perhaps thermodynamic calculations can help decipher better experimental parameters

Effect of additives on P volatilisation

Species	Fe	Al	Ca
SiO ₂	Positive	-	Positive
C	Limited	Substantial	Substantial



- The inclusion of all (major) compounds present in the Sewage Sludge Ash results in number of competing reactions which makes the ratio of C and SiO₂ needed for reduction challenging to decipher
- Much of the knowledge can be interpreted from the ore processing industry (1920s and 30s)



Outotec



CODEV



Acknowledgments

- Dr Rudolf Struis
- Ms Carla Pausta
- Ms Daniela Ortiz
- LBK/CPM Group

Thank You