

May 2020 Investment Insight

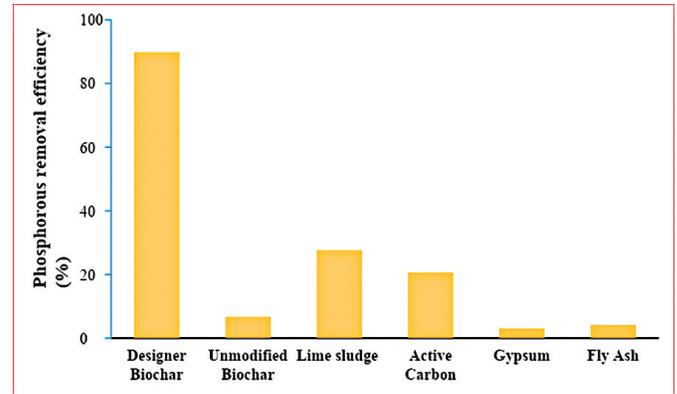
Can Designer Biochar Recover Dissolved Phosphorus from Tile Drainage?

Biochar is a carbon-rich material produced from biomass under oxygen-limiting conditions. Biochar application in soils has been proposed as a good strategy for improving soil quality and increasing agronomic productivity. Biomass was pretreated with lime sludge to generate a designer biochar using pyrolysis (burning).

- The designer biochar has extremely high capacities for holding anions such as dissolved Phosphorus, which could completely remove Phosphate ions if the concentration of Phosphate were less than 10 mg/L.
- **The designer biochar could adsorb >90% of dissolved Phosphorus, which was significantly higher than unmodified biochar.** This result suggests that the pretreatment of biomass with lime sludge for biochar production has a significant effect on Phosphate removal.
- The sorption capacity of the designer biochar is much higher than other common Phosphorus adsorbents including lime sludge, activated carbon, gypsum, fly ash, and steel slag. Therefore, designer biochar for future field trials will be produced from wood biomass pretreated with 20% of lime sludge under 6500° C pyrolysis temperature.
- This will develop a refillable biochar-sorption-channel to attach to denitrification bioreactors to effectively capture dissolved Phosphorus from subsurface drainage

water, to recycle phosphate-captured biochars as a slow-release fertilizer, and to keep nutrients in the closed agricultural loop. Compared to the traditional bioreactors, this treatment system using woodchip denitrification followed by biochar-sorption-channel **can reduce the losses of both Nitrogen and Phosphorus nutrients from tile drainage.**

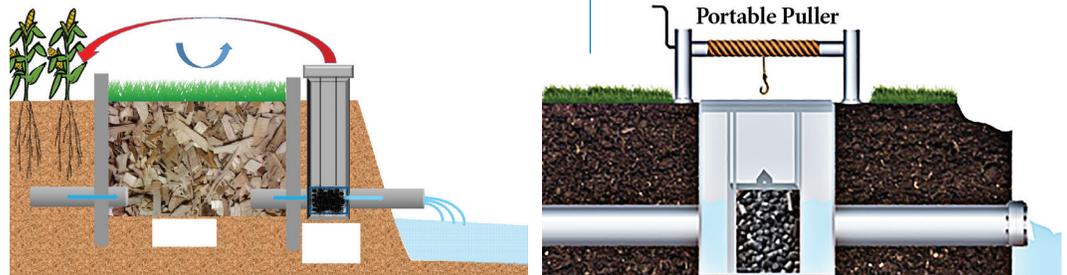
- Designer biochar pellets will be made using optimal production conditions and will be applied into the biochar-sorption-channel. After treatment, Phosphorus-captured biochars can be removed from the channels and refilled with fresh biochars.



Comparison of phosphate removal by different adsorbents.

- **The Phosphorus-captured biochars will be used as a slow-released fertilizer** to mitigate the excess nutrient loads to watersheds from agricultural fields, enhance nutrient use efficiency, and improve crop yields.

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Woodchip bioreactor and biochar-sorption-channel

