showed the decrease of DOC in the water extractions from the soil with BMC. In other words, DOC was greater for the BMC, which indicated more DOC was retained by the BMC. For the aged BMC's, fungi hyphae were observed using SEM, suggesting the BMC promoted microbial activity.

Biochar, the Oldest Technique but Newest Hope

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Biochar is the oldest techniques but newest hope of the planet. Biochar is defined simply as charcoal that is used for agricultural purposes. It is created using a pyrolysis process, heating biomass in a low oxygen environment. Once the pyrolysis reaction has begun, it is self-sustaining, requiring no outside energy input. Byproducts of the process include syngas (H_2 + CO), minor quantities of methane (CH_4), tars, organic acids and excess heat.Evidence shows native peoples in the Amazon used the substance centuries ago to enrich their soil to feed a thriving civilization. New grassroots efforts are aimed at showing biochar is not ancient history. Research shows that the stability of biochar in soil greatly exceeds that of un-charred organic matter, sequestering carbon in stable soil carbon pools for centuries to millennia. Bioenergy coproduction with biochar can displace fossil fuel use. Because biochar retains nitrogen, emissions of nitrous oxide (a potent greenhouse gas) maybe reduced. Turning waste biomass into biochar also reduces methane (another potent greenhouse gas) generated by the natural decomposition of the waste. Biochar systems are integrated systems with multiple, cascading benefits It is very much necessary to broadcast the techniques all over the woirld to save our planet.

Continuous Production of Biochar Through Direct Contact, Aerobic Pyrolysis

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A process and apparatus for the production of charcoal through direct contact aerobic pyrolysis is described in which a biomass input is pyrolysed in a reaction chamber that is open to atmospheric air. Energy released in the pyrolysis of biomass supplies the heat necessary to cause the pyrolysis of incoming material. There are a number of issues with this method including reduced control over reaction temperature and a need for input biomass to have moisture content below 20%. These issues can be addressed by drying input material and by adjusting reactor conditions such as air flow rates and stirring rates. Using direct contact, aerobic pyrolysis, char can be produced across a range of conditions, specifically between 500-700 ˚C so that the adsorption of a product biochar can be maximized while other properties can be modified through production temperature to produce a biochar that is well suited to a particular application.

Hydrothermal Carbonization of Residues from Anaerobic Digestion

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Fermentation residues from anaerobic digestion are an abundant source of biomass. High concentrations of minerals and water, however, are limiting their use to a few applications. Therefore, the aim of this study was to investigate the feasibility of HTC for converting these wastes to biochar. For comparison purposes, also the microcrystalline cellulose Avicel PH-101 (Fluka) was tested.

The experiments were carried out in a 1 L stirred batch reactor (Parr, USA) using distilled water as process medium. The fermentation residue (TS = 96.9 g/kg; Total-N = 7.9 g/kg; NH_4-N = 735 mg/kg, C in % of TS = 45.4) was obtained from a laboratory digester using maize silage as a sole substrate. Avicel (C in % TS = 43.7) was processed at temperatures of 190, 230 and 270°C whereas the fermentation residue was only treated at 230°C. All experiments were started at pH 5 (after addition of citric acid) and operated with a retention time of 4 h. The reactor's initial TS concentration of Avicel and fermentation residue was 97 g/L and 73 g/L, respectively.

The particulate carbon produced from Avicel at 190, 230 and 270°C was 13.7, 14.2 and 16.0 g corresponding to a C efficiency of 64.7%, 67.2% and 75.6% and a C content of the biochar of 49.9%, 67.7% and 73.1%, respectively. Treated at 230°C, the fermentation residue yielded 8.1 g of particulate C. This corresponds to a C efficiency of 61.2% and a C content of the biochar of 53.6%. When comparing the final liquor pH values from processing Avicel (pH 2.7-3.2) and fermentation residue (pH 6.4) it can be assumed that the HTC of fermentation residue was affected by the puffer capacity deriving from its minerals. In respect to the HTC liquid phase, it appears noticeable that acetate is the dominant volatile fatty acid (VFA) of both carbonized Avicel (0.59-1.77 g/L; 90-97% of total-VFA) and carbonized fermentation residue (1.33 g/L; 81% of total-VFA).

As shown by the experimental results, the HTC of fermentation residues from anaerobic digestion is feasible but could be disturbed by their relative high concentrations of minerals. As acetate is an ideal substrate for anaerobic digestion, recycling the HTC liquor back to the original digester could be a promising option. Topics for future research concerning the HTC of fermentation residues should include the optimal process design and optimal process control as well as a suitable pre- and post-treatment strategy.