Producing Nutrients Concentrated Bio-solids via AnSBEARs (Anaerobic Sequencing Batch Electrode-assisted Reactors)

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Abstract

Animal manure contains high levels of nutrients (N/P/K) necessary for crop growth, and is therefore a valuable product from livestock industry. However, conventional use of direct land application delivers manure only to croplands near animal barns, causes nutrients overloading, and results in potential water contamination. Concentrating nutrients into solids and decreasing water content in final products will serve as a partial solution.

Based on that rationale, we propose here to develop a systematic manure management approach for sustainable fertilizer production from animal manure (swine and dairy). The system will incorporate processes of anaerobic digestion, electrocoagulation, crystallization, solid/liquid separation, and solid drying and packing. The processes will mainly be fulfilled in a novel type of reactor, termed as an anaerobic sequencing batch electrode-assisted reactor (AnSBEAR). Animal manure will be anaerobically digested for biogas production and sludge volume reduction. The nutrient rich supernatant will be treated by two-step electrocoagulation to precipitate ammonium and phosphate to solids which settle down together to digestate solid and are subjected to further processing of solid/liquid separation, drying, and packaging. The final product will be nutrients concentrated bio-solids fertilizer suitable for longer distance transportation and for long-term storage without substantial nutrients loss. The byproduct will be the liquid portion of effluent which can be used as irrigation water. This technology aims to recover 80% of both N and P into bio-solids and to increase both N and P concentrations in solids by 100% on a dry basis.

Given enough funding supports, the economic feasibility of this technology will be assessed in an on-farm study of pilot-scale. The fertilizer performance of the bio-solids on typical crops of corn and soybean will be evaluated in parallel with chemical fertilizers in an inter-disciplinary research project. The proposers of this technology are enthusiastic about potential collaborating opportunities of technology development and product innovation. The proposers believe that better animal manure management is critical to the future wellbeing of food-water-environment nexus, and this partnership led by EPA is right on time.