

Novel Anaerobic Digestion System Research Progress

Baseline Evaluation:

- Winter 2003
 - Review of over 200 relevant publications and patents
 - Review of the operating advantages, disadvantages, benefits and concerns of existing commercial dairy digesters
- Spring 2004
 - Symposium with AD specialists from Chinese Biogas Institute

Initial R & D focus:

- Improve AD capital costs by 30% through engineering innovation, efficiency of design, improved digestion, and/or co-product formation
- Attack the two primary problems of poor fiber digestion and slow growth/retention of methanogens
- Attack the problem through identified areas: Biomass Immobilization, Phased Digestion, and Enzymatic Enhancement for a hybrid plug flow design

Early R & D Results:

- Fungal enzymatic treatment can lead to up to 30% enhancement in fiber digestion but costly to implement
- Acidogenic and methanogenic phasing leads to as much as 50% improvement as compared to complete mix under high loading conditions
- Bacterial Immobilization improves biogas performance but under untreated manure conditions pumping and clogging become a concern

Conclusions drawn:

- There is no point to sending the fiber through and digesting it for 20-30 days when even then only a portion digests
- Do not digest the fiber but treat it for improved co-product sales
- Separate the digestion of liquid and treatment of solid sections so as to maximize individual efficiency and overall sizing and economics
- Incorporate earlier hybrid focus into liquid digester and treat the solid fraction through a leaching-bed concept

Related Patent and Journal Papers:

- Anaerobic Digester System – Provisional patent application filed on December 27, 2004, Chen, Demirer, Wen, Liao, Frear, MacConnell
- Demirer G.N. and Chen S., 2004. Effect of retention time and organic loading rate on anaerobic acidification and biogasification of dairy manure", Journal of Chemical Technology & Biotechnology, 79 (12):1381-1387.
- Demirer G.N. and Chen S. Anaerobic biogasification of undiluted dairy manure, Bioresource Technology, Submitted 04.
- Demirer G.N. and Chen S. Anaerobic digestion of dairy manure in a hybrid reactor configuration with biomass-immobilization and biogas recirculation, Biosystems Engineering, Submitted 04..
- Demirer G.N. and Chen S. Two-phase anaerobic digestion of unscreened dairy manure, Process Biochemistry, Submitted 04.
- Uludag-Demirer S., Demirer G.N. and Chen S., Ammonia removal from anaerobically digested dairy manure by struvite precipitation, Process Biochemistry, Submitted 04.

