



Title: Performance and Microbiology of Swine Wastewater Treatment Bioreactors

Name: Francis de los Reyes III

Email: fdelosr@eos.ncsu.edu

Organization: North Carolina State University

State: NC **Region:** Southern

Year of Funding: 2001

Theme: Animal Waste Management

Situation: Risks associated with swine lagoons and increasingly stringent effluent quality regulations have created the need for alternative swine waste treatment technologies that will not only remove organics, but also manage nutrients. We are studying the fundamental microbiology and performance of a novel biological system for treating swine wastewater. Results are expected to provide students, engineers and researchers a better basis for design and application of a more efficient waste treatment technology, benefiting livestock farmers and communities impacted by swine farms.

Objectives: The project objectives are: 1. Develop and use molecular methods to identify and quantify key microbial populations in intermittently aerated systems removing nitrogen from swine wastewater. 2. Characterize the nitrogen-removal performance of intermittently aerated reactors. 3. Determine the biomass levels of populations involved in nitrogen removal, and incorporate these parameters in process modeling. 4. Relate changes in bacterial populations to reactor performance. 5. Optimize the reactor design and operation using laboratory-scale reactor studies.

Methods: Lab-scale intermittent aeration systems for swine wastewater treatment were operated under controlled conditions. Hybridizations with 16S rRNA-targeted oligonucleotide probes were used for identifying and quantifying bacteria involved in nitrogen transformations in the reactors. Results from this research have been and will be presented at the 2003 American Society of Microbiology Conference, the 2003 Quadrangle Conference, the Ninth International Symposium on Animal, Agricultural and Food Processing Wastes, and the 2003 Water Environment Federation Conference.

Partnerships: NC Agricultural Research Service and NCSU Animal & Poultry Waste Management Center supported the initial development of the intermittent aeration technology for nitrogen removal from swine wastewater. The town of Cary, NC has provided samples and supporting wastewater treatment plant data.

Research: This project currently supports two graduate students, providing funds to cover tuition expenses, stipend, and laboratory materials used in the investigation. The project has indirectly supported an NSF Graduate Research Fellow involved in the project. Results from this research have been presented in major national conferences in the field of microbiology, environmental engineering, and agricultural engineering. The developed technology will be transferred to the animal farmers in North Carolina through the NC Cooperative Extension Service.

Resources: North Carolina State University cost-shares Dr. J. Cheng's salary for the project. USDA research funds were leveraged for the materials and supplies needed to recruit a NSF Graduate Fellow. In effect, the NSF Fellowship funds the stipend and tuition expenses of an additional graduate student.

Results: Results from the lab-scale studies show higher than 90% mean removal of TKN, and 98% average ammonia removal in the intermittently aerated reactors. A molecular method for quantifying the nitrite-oxidizer Nitrospira was developed, and hybridization results show high levels of ammonia-oxidizers (Nitrosomonas) and nitrite oxidizers (Nitrospira). Novel nitrogen transformation (aerobic denitrification) was observed. Three graduate students are being trained. Several papers have been presented at national conferences and are being prepared for journal publication.



The mission of CSREES is to advance knowledge for agriculture, the Environment, human health and well being, and communities.

