

Memo

To: Elke Ursin, Florida Department of Health
Eberhardt Roeder, Florida Department of Health

From: Dr. Daniel P. Smith
Applied Environmental Technology

Date: 11/10/2011

Re: *Simulation of Bioreactor Filtration of Onsite Wastewater
Task 1b. Process Forward Conference Call Minutes*

Simulation of Bioreactor Filtration of Onsite Wastewater
Process Forward Conference Call, Task 1b

Date: 11/9/2011

Time 11:00 am to 11:50 am

Attendees:

- Dr. Daniel P. Smith, Applied Environmental Technology
- Elke Ursin, Florida Department of Health
- Dr. Eberhardt Roeder, Florida Department of Health

Meeting Minutes

The conference call was held under the task: *Simulation of Bioreactor Filtration of Onsite Wastewater*, being conducted by Applied Environmental Technology (AET) as a part of the Florida Onsite Sewage Nitrogen Reduction Strategies Study (FDoH contract COCRL). AET is conducting 100% of the work for the *Simulation of Bioreactor Filtration of Onsite Wastewater* task.

Task 1a is Literature Review and Data Specification Workplan and Task 1b. is a Process Forward Conference Call and minutes. Tasks 2 and 3 entail biotool development of nitrogen removal bioreactors. The Task 1a report was supplied to FDoH prior to the conference call and was the main subject of the conference call meeting.

Dr. Smith initiated the discussion by providing the background of the *Simulation of Bioreactor Filtration of Onsite Wastewater* task and reviewing the development of the two-stage bioreactor filter processes for onsite nitrogen removal that had occurred

over the past several years. He indicated that the original proposition, that two-stage bioreactor filtration technology appeared uniquely suitable for nitrogen removal in local small scale wastewater treatment systems, had been borne out by experimental findings in the original Passive Nitrogen removal Study (PNRS 1) and Dr. Smith stated that although bioreactors systems have successfully removed nitrogen, they are not fully understood and their designs have not been fully optimized. He indicated that modeling of nitrogen removal bioreactors will provide the critical link between performance assessment and design analysis and will address knowledge gaps with important design, performance and economic implications. He indicated that quantitative simulation is a standard tool for systematizing the design and evaluation of engineered systems. Dr. Smith identified a crucial factor in developing predictive design capabilities is modeling approach that explicitly describes the functional dynamics of microbially mediated biochemical reactions, and that standardized bioreactor design platforms can be developed that reduce the economic and performance uncertainties.

Dr. Smith explained the structure of the task as described in the Task 1a report: to develop a simple, spreadsheet based, user friendly Bioreactor Filtration Tool (BFT), based on translation the results from complex models to the BFT. He described the BFT inputs, outputs and user interface. Dr. Smith described the literature review, identification of calibration datasets, review and selection of complex simulation models, and outline of modeling and calibration procedures. Dr. Smith indicated that the datasets produced from PNRS 1 and PNRS 2 were excellent and had been identified as the best suited for *Simulation of Bioreactor Filtration of Onsite Wastewater*. He indicated that other reports often contained incomplete experimental description and limited monitoring, and could perhaps be used in a model verification mode.

Dr. Roeder asked if the CWM1 model was related to the earlier CW2D model and if two-dimensional simulations would be required. Dr. Smith responded that the CWM1 model was a new model code that had evolved from the CW2D code but that CWM1 incorporated features more appropriate for *Simulation of Bioreactor Filtration of Onsite Wastewater*. Dr. Smith stated that CWM1 could be operated as a one dimensional simulation as well as two-dimensional simulation, and discussed differences between one- and two-dimensional systems in light of pilot results and full scale bioreactor filters. Dr. Smith eluded to an earlier modeling study in which he had conducted one dimensional simulations of a laboratory biofilter column using a complex multi-dimensional groundwater fate and transport code and verified the success of this approach using an analytical solution to the one dimensional advection/dispersion/biodegradation equation. Dr. Smith indicated that the results of complex simulation models would be interpreted conservatively when translating them to the BFT (i.e. err on the side of overpredicting effluent nitrogen concentrations and underpredicting removal efficiencies).

Dr. Roeder asked as to the range of applications of the BFT. Dr. Smith responded that parameter ranges would be for ranges of technological interest and centered on the operating ranges of the experimental findings of the calibration datasets.

Dr Smith stated that saturated flow modeling with added solid phase electron donors is challenging and that existing process models generally do not enable this simulation. Dr. Smith stated that he would attempt modification of CWM1 or alternatively employ the Denitrification Bioreactor Filter Model (DBFM), which was developed for solid phase electron donors and results of which were presented by Dr. Smith at WEFTEC 2008. Dr. Roeder asked if model codes included dispersion. Dr. Smith replied that CWM1 included both advection and dispersion and would predict solute profiles, while the Denitrification Bioreactor Filter Model (saturated flow model) included advection but not dispersion. Dr. Smith indicated that the reaction terms in the Denitrification Bioreactor Filter Model were highly significant and based on electron donor media surface area, and that the significance of dispersion was small in comparison.

Dr. Roeder stated that the modeling approach outlined by AET in the Task 1 report was quite well developed and very acceptable and indicated that the modeling task should proceed accordingly. Dr. Roeder and Elke Ursin indicated that they would like would like to provide additional comments to the Task 1 a report upon further review. Dr. Smith said he would be very pleased to receive further comments and Elke Ursin indicated they would be provided within a timescale of in several days.

Dr. Roeder asked if there would be opportunity to interact on the modeling and the project proceeded. Dr. Smith responded that he would most welcome that opportunity and would facilitate that process at appropriate points.

Dr. Smith indicated that his main concern with the *Simulation of Bioreactor Filtration of Onsite Wastewater* task was the project budget, which had originally been substantially higher than the \$ 19,000 in the task order. He indicated that the funding was crucial to completing the project and that none of the \$ 19,000 funding be diverted to anything other than the modeling tasks which provide the value.

Dr Smith indicated he would forward meeting minutes to fulfill the Task 1b requirement.