Blue Plains Engineering Studies for Fiscal Year 2015

HVAC Equipment Survey:
Purpose: To conduct a survey of all ventilation equipment at the Blue Plains Advanced Wastewater Treatment Plant (AWTP). This is done by reviewing contract and as-built drawings for ventilation equipment and field-verifying that they exist. For project management purposes, the Blue Plains AWTP has been divided into eight treatment areas and three miscellaneous areas. The National Fire Protection Association (NFPA)-classified "Influence Areas" in the buildings or galleries of these areas are identified from the reviewed contract and record drawings and the air exchange rate is approximated from the equipment rating and "Influence Area" volume. Volumes are either based on dimensions from contract drawings or field measurements

Status: Study is ongoing and a draft report was submitted in January 2015.

Lime Slurry System:
Purpose: To evaluate options for a temporary and long term approach to alkalinity addition at Blue Plains and to implement the approved method.

The approved method of alkalinity adjustment was a lime slurry (30% calcium hydroxide)) application system to supplement the alkalinity requirements of the wastewater treatment process. With the a new Filtrate Treatment Facility due to start operations at Blue Plains in 2017, the total alkalinity demand of the plant is expected to increase. Before this project, the method of alkalinity addition and pH adjustment used was the introduction of caustic soda (50% sodium hydroxide). Based upon an analysis of the costs of caustic soda, and project cost, the project is projected to result in significant annual chemical cost savings.

Status: Study was completed in December 2014.

Blue Plains Research Studies for Fiscal Year 2015

Quantitative Risk Model for Flooding of Plant Infrastructure:
Purpose: To develop quantitative analytical tools for DC Water to assess the vulnerability of flooding at Blue Plains over a range of river stages and to develop data to assess breach points, sequence of inundation, and islanding of facilities in support of emergency response plans, and provide risk based evaluations for a range of flood wall configurations for the plant.

Status: Study is complete.

Greenhouse Gas Study in Headworks & Sewer:
Purpose: To evaluate mitigation trials in both the US and Australia, through comprehensive field monitoring of GHG emissions from sewers.

Status: Study is ongoing and scheduled completion in 2016.

Publications in 2015:

John Willis, Haydee DeClippeleir, Walter Graf, Akshay Kumar, Barry Lucas, Sudhir Murthy, Chris Peot, Pusker Regmi, Abhiram Satyadev, Charles Sweeney, Keshab Sharma, Hiram Tanner, and Zhiguo Yuan. "Manuscript: DC Water's Sewer-Methane Carbon Footprint" WEFTEC proceedings 2015.

Aeration and Diffuser Fouling Study:

Purpose: To study oxygen transfer rates of different diffusers, including membrane panel diffusers that might be used for future upgrades, and to investigate both the causes and possible mitigation methods of microbial fouling.

Status: Study is ongoing and was scheduled for completion in 2016. However, the study was on hold in 2015 to move and modify the pilot reactor. The pilot is expected to resume operation in mid 2016 and scheduled completion in 2017.

Publications:

Manel Garrido-Baserba, Pitiporn Asvapathanagul, Graham W. McCarthy, Thomas E. Gocke, Betty H. Olson, Hee-Deung Park, Ahmed Al-Omari, Sudhir Murthy, Charles B. Bott, Bernard Wett, Joshua D. Smeraldi, Andrew R. Shaw, Diego Rosso. "Linking biofilm growth to fouling and aeration performance of fine-pore diffuser in activated sludge". Water Research.

Victory O. Odize1,4*, John Novak4, Diego Rosso3 , Haydee De Clippeleir2,4, Ahmed Al-Omari4, and Sudhir Murthy. "Mechanical Cleaning/Treatment Method for Mitigating Membrane Diffuser Fouling and Improving Aeration Efficiency" WEFTEC 2015.

Shortcut Nitrogen removal Studies:

Full Plant Deammonification:

Purpose: To study the application of full-plant deammonification for nitrogen removal. The successful implementation of this process could lead to a significant reduction in energy consumption and supplemental carbon addition. Two major technological concepts are applied – selective sludge wasting to retain Anammox granules and intermittent aeration to repress nitrite oxidizers.

Status: Study is ongoing and scheduled completion in 2016.

Publications in 2015:

M Han, H De Clippeleir, A Al-Omari, H Stewart, B Wett, SE Vlaeminck, C Bott, and S Murthy (2015) NOB out-selection in mainstream deammonification – A resilience evaluation. WEFTEC 2015, Chicago, IL.

H Stewart, A Al-Omari, C Bott, H De Clippeleir, A Massoudieh, S Murthy, I Takacs and B Wett (2015) Evaluating the impact of multiple substrate limitations for optimizing control strategies. Conf. IWA Nutrient Removal and Recovery 2015. Gdansk, Poland

Sidestream filtrate treatment startup study:

Purpose: To evaluate the startup of the filtrate treatment process under the fullscale filtrate characteristics and develop strategies to mitigate impact of inhibition on process performance.

Status: The study was completed in 2015.

Publications in 2015:

Q Zhang, H De Clippeleir, A Al-Omari, B Wett, SE Vlaeminck, and S Murthy (2015) Efficient THP-AD Filtrate Treatment via Optimized Control Strategies in Sidestream Deammonification Reactor. Conf. WEFTEC 2015. Chicago, USA

Q Zhang, H De Clippeleir, A Al-Omari, B Wett, SE Vlaeminck, and S Murthy (2015) Efficient THP-AD Digestate Treatment via Optimized Aeration Control in Sidestream Deammonification Reactor. Conf. WEF/IWA Residuals and Biosolids Conference. Washington DC, USA

Q Zhang, H De Clippeleir, A Al-Omari, B Wett, SE Vlaeminck, and S Murthy (2015) Sidestream Deammonification on THP-AD Digestate: Strategies to Overcome Nitritation Inhibition. Conf. IWA Nutrient Removal and Recovery 2015. Gdansk, Poland

Anaerobic Treatment:

Anaerobic digestion startup study:
Purpose: To evaluate the startup strategy of the anaerobic digesters at Blue Plains AWTP. The study investigated an approach of adding alkalinity to the digesters during startup and compared to a scenario where alkalinity was not added.

Status: The study was completed in 2015.

Publications in 2015:

Mandy Mitchell, Tanush Wadhawan, Ahmed Al-Omari, Christine deBarbadillo and Sudhir Murthy.”***EVALUATING THE IMPACT OF ALKALINITY ADDITION ON START-UP OF ANAEROBIC DIGESTERS WITH THE THERMAL***

HYDROLYSIS PRETREATMENT PROCESS" Residual and biosolids conference, 2015.

Co-digestion study:
Purpose: To evaluate the impact of adding co-substrate such as food waste on the performance of the anaerobic digestion of thermally hydrolyzed sludge. The impact is measured based on specific gas production yield, VS destruction and dewaterability.

Status: Study is ongoing and scheduled completion in 2016.

Anaerobic digestion modeling:
The purpose of the study is to develop and calibrate a working model that can describe the dynamic behavior in the digestion process. The goal is to use the model as a tool to predict process failure and to develop proper control and operational strategies of the anaerobic treatment train to maximize capacity use and specific gas yields.

Publications in 2015:

Zwelani Ngwenya, Steven Beightol, The Ngone Oo, Justin Vega, Bipin Pathak, Ahmed Al-Omari, Kuang Zhu, Tanush Wadhawan, Sudhir N. Murthy, Matthew J. Higgins. *"**A Stoichiometric Approach to Control Digester Chemistry and Ammonia Inhibition in Anaerobic Digestion with Thermal Hydrolysis Pretreatment: Model Development***

Fasil Haile, Tasneem Ghoor, David Ikumi, Tanush Wadhawan, C.J. Brouckaert , Sudhir Murthy, Ahmed Al-Omari, and George Ekama. *"**A Stoichiometric and Elementally Balanced Model for Simulating Anaerobic Digester Failure". Residual and biosolids conference, 2015***

WERF Study Floc-Densification:
Purpose: To test the soluble and particulate substrate removal efficiency in different full-scale and pilot plants to understand how substrate surface loading and diffusion resistance affects both granule and floc formation and performance. The possible synergy of maintaining a mixed floc and granule system to allow for high removal rates and good effluent quality will be explored.

Status: Study started in 2015 and scheduled completion in 2017.

High Rate Activated Sludge (HRAS) Process:
Purpose: To investigate operational parameters for improving carbon capture and redirection of carbon to digestion and to investigate new methods by which to quantify the forms of carbon (particulate, colloidal and soluble) that is captured.

Status: Study was completed in 2015.

Publications in 2015:

Rahman, A., De Clippeleir, H., Winckel, T. V., Le, T., Riffat, R., Wett, B., Jimenez, J. A., Bott, C., Al-Omari, A. and Murthy, S., 2015. Does optimization of carbon redirection always imply energy recovery? Proceedings of WEFTEC 2015, 4432-4443, Chicago, IL.

DC Council - EDCs in the Potomac River:
The intent of the project is to develop a dataset which can be used to accurately quantify the relative input of various anthropogenic discharges on endocrine disruption in the Potomac River Watershed.

Status: Phase I of the study was completed in 2015. Phase II scheduled completion in 2016.