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AquAeTer
optimizing resources | water, air, earth

The AquAeTerian

In This Issue:

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Hot Topics

Dr. James H. Clarke received a Distinguished Service Recognition award from the Nuclear Regulatory Commission for his service on the NRC's Advisory Committee on Nuclear Waste and Materials (ACNW&M). Plaques were presented in a ceremony at the Rockville, Maryland, headquarters of the NRC to Clarke and to three other members recognized by the agency. Jim was the lead member for the committee for the areas of decommissioning and risk-informed regulation.

The President's Corner

Alescendum in Numero et Facultate
"Growing in Numbers and Abilities"

AquAeTer began its 16th year on August 17th of this year and we continue to grow in numbers and capabilities. Paul Marotta, Brentwood Operations Manager has recently added several new **AquAeTerians** in our Brentwood office including Amanda Whisler, Chemical Engineer; Todd Olsen, Environmental Engineer; Rachel Meadors, Administrative Assistant; Aris Yowell, Marketing Coordinator; and Richard Rogers, GIS specialist. Chris Bolin, Centennial Operations Manager has added Richard Buckmaster, Geologist; and Terra Plute, Environmental Engineer. We are also proud to announce that Stephen Smith has rejoined **AquAeTer** and represents us from his Helena office. Tyler Smith has been promoted in the Brentwood office to Environmental Technician and Trey Lewis will be relocating to the Brentwood office.

Amanda Whisler has hit the ground running for **AquAeTer** and has been hard at work doing air permitting work for the oil and gas industry. Steve Smith and Chris Bolin continue our efforts on a Life Cycle Assessment for the wood industry. Steve Wampler and his team of Dr. Jim Grant, Miriam Sielbeck and John Michael Corn are completing work on a distinguished task force to project human health risks from a variety of failure and radionuclide release mechanisms for a closed low-level radioactive waste disposal site in the Eastern U.S.

Steve and Chris recently completed CQA oversight of hazardous waste landfill cell construction at the US Ecology landfill in Nevada. Nevada DEP has given approval to begin waste disposal immediately in the new Trench 12. They have also completed the design for Subtitle C landfill closure using an alternative final cover design. Cathryn Stewart continues her involvement in the assessment of the new EREF protocol for evaluating post-closure care requirements for municipal solid waste landfills, and has enjoyed working with Waste Management counterparts on the hydrogeologic characterizations of a central Utah landfill. Chris Green and his team of Tyler Smith, Josh Kelley and Trey Lewis have been busy conducting Phase I, Phase II and Phase III investigations and remediation at commercial real estate sites. Amanda Klink and Josh Kelley have also completed several wetlands inventories for real estate transactions. Amanda Klink and Pam Hoover have managed their teams who have completed another 300 Phase I and NEPA investigations for cell tower sites. Dr. Wes Eckenfelder and Paul Marotta have recently completed final design on an upgrade to a low-energy aerated lagoon system for Interstate Paper. Paul also assisted the mill in recommending Best Management Practices (BMPs) that have resulted in decreased water use and improved fiber recovery.

Vince Newberry presents Mike Corn with the 2008 Technical Excellence and Weston Award at the TAPPI EPE Conference in Portland, Oregon.

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energy • engineering • environmental • sustainability • risk analyses

COMPARISON OF CBOD$_U$ TIME-SERIES BOTTLE RATES WITH ACTUAL STREAM CBOD$_U$ DEOXYGENATION RATES

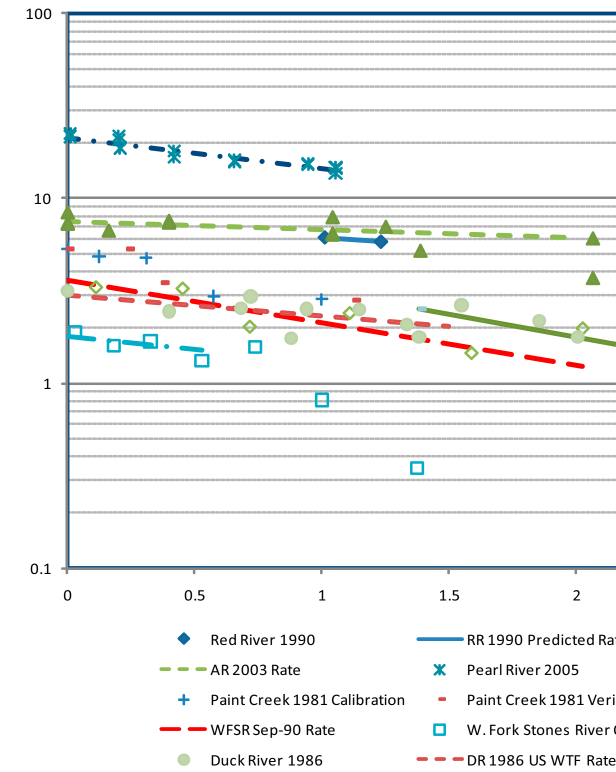
Many of today's water quality models utilize a fast (labile) and slow (recalcitrant) deoxygenation rate for ultimate carbonaceous biochemical oxygen demand (CBOD$_U$). These rates are developed from laboratory analyses of CBOD$_U$. In 1980, Dr. Ray Wittemore of the National Council for Air and Stream Improvement (NCASI) conducted the first set of long-term (approximately 365 days) time-series CBOD$_U$ and ultimate nitrogenous biochemical oxygen demand (NBOD) tests that identified both a fast and slow CBOD$_U$. Dr. Wittemore was able to determine from the 5-gal glass carboy BOD tests that pulp and paper mill wastewaters had both a labile or fast oxygen demand from CBOD$_U$, and a slow or recalcitrant CBOD$_U$ demand. NCASI did not measure the actual river deoxygenation rate for CBOD$_U$ during these studies conducted in 1980. **AquAeTer** has been conducting studies for a number of pulp and paper clients, measuring time-series BOD's from pulp and paper mills and in the streams receiving these effluents. In addition to the laboratory analysis, we have also measured the actual river deoxygenation rate for CBOD$_U$. As will be discussed, the river deoxygenation rate for CBOD$_U$ cannot be measured in a laboratory BOD test.

The term labile simply means that the parameter, whether it is carbonaceous BOD, organic nitrogen, or organic phosphorus, is readily degradable or is transformed within a reasonable period of time. The term recalcitrant means that the parameter is not readily degradable or does not transform within a reasonable period of time. In wastewater treatment, this time limit is usually on the order of a few hours to a day, depending on the retention time of the treatment system. In river systems, a reasonable period of time can easily extend from a few days to many weeks.

There has been much discussion recently on modeling stream CBOD$_U$ decay using separate labile and recalcitrant CBOD$_U$ decay rates based on decay rates measured in BOD test bottles in the laboratory. **AquAeTer's** staff of engineers and scientists have measured CBOD$_U$ deoxygenation rates in various rivers and streams, as presented in Figure 1. The rates determined for the rivers do not match the rates developed from individual samples in the bottle analyses. The bottle rates are at times greater (faster deoxygenation) and at other times less (slower deoxygenation) than the rate developed from measurements of CBOD$_U$ decay with time of travel downstream in the river system, i.e., the true CBOD$_U$ deoxygenation rate. In addition, the amount of recalcitrant CBOD$_U$ decay to our knowledge has never been measured nor has it been documented that a separate rate exists in river systems for this recalcitrant fraction of the CBOD$_U$ in the river. Therefore, a separate rate for the recalcitrant CBOD$_U$ is not discernible within the river, if it even exists.

In Figure 2, both the labile and recalcitrant CBOD$_U$ can be clearly determined using the Georgia Environmental Protection Division (GA EPD) LTBOD program for analyzing laboratory time-series BOD data originally developed by Dr. Roy Burke. These samples were set-up in the field without icing or introduction of foreign seed into the bottles, i.e., represents oxygen uptake from the in-situ suspended bacterial population existing in the river itself. It is interesting to note that in this test, the nitrogen decay began in this sample at time zero and the recalcitrant CBOD$_U$ oxygen uptake began between about 10 and 20 days into the test. The labile fraction of the CBOD$_U$ in this time-series BOD test had a deoxygenation rate of 0.086/day at 20°C. The recalcitrant CBOD$_U$ is ubiquitous in all river CBOD$_U$ samples collected regardless of whether there is an effluent source in the river where the sample is collected or not.

FIGURE 1. ACTUAL IN-SITU MEASURED RIVI



The actual measured CBOD$_U$ deoxygenation rate determined from the time-series BOD tests collected with dye time of travel (the median point in the dye mass) is also presented in Figure 1 and was calculated to be 0.35/day at 20°C. AquAeTer measured the river CBOD$_U$ decay rate by collecting time-series BOD samples at the median point of a dye-slug injection as it moved downstream. The measured bottle rates in this instance, (and in almost all other cases where we have measured actual river CBOD$_U$ deoxygenation rates), did not match up with the laboratory bottle CBOD$_U$ deoxygenation rates. If one developed a model using the bottle rate of 0.06/day, the calculated deoxygenation rate would have been greatly underestimated. In order to make the model results balance, another rate parameter would have to be adjusted in order to meet the target dissolved oxygen concentration in the river, thereby compounding the inaccuracies of the model. The use of the bottle rate in this case would have grossly underestimated the impact of the CBOD$_U$

ER CBOD$_u$ DEOXYGENTATION RATE

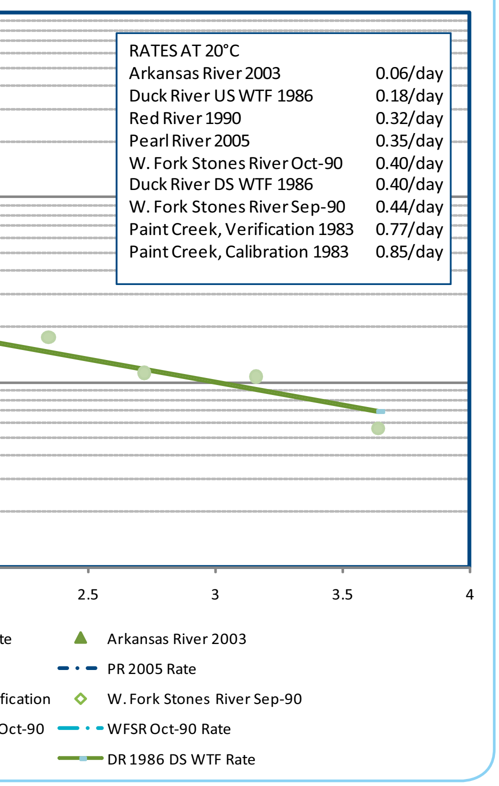
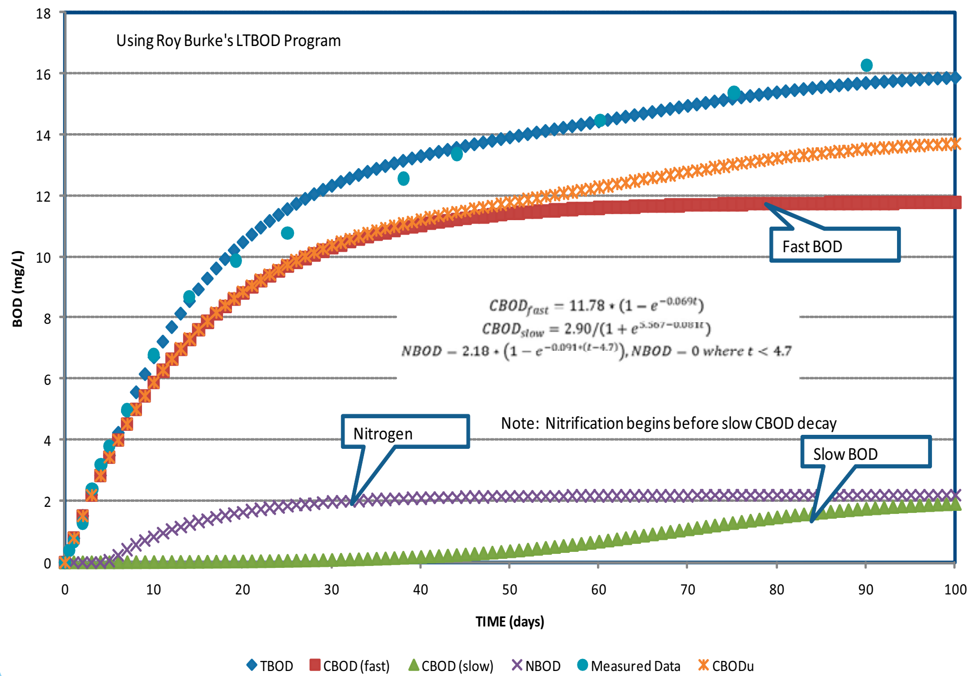


FIGURE 2. BOD ANALYSIS - MILL MIXED WITH BACKGROUND RIVER WATER



effluent loadings on the river dissolved oxygen concentrations in the subsequent wasteload allocation modeling, and another rate parameter would have had to be adjusted to balance the oxygen uptakes and additions. Many modelers with poor understanding of river kinetics use the sediment oxygen demand (SOD) rate to adjust for this inaccuracy and thereby produce a model that is not predictive or accurate and must be recalibrated to accommodate differing conditions.

In general, in the 1,000 or so time-series BOD tests that we have run, CBOD$_U$ bottle rates typically range from 0.05 to 0.2/day. As can be seen from Figure 1, river CBOD$_U$ deoxygenation rates, shown for a wide variety of streams from deep reservoir settings to small low-flow pool and riffle streams, never come close to the laboratory bottle rates. Simply stated, use of the individual time-series bottle CBOD$_U$ deoxygenation rates in a mathematical model will not be an accurate predictive tool for establishing wasteload allocations. Additionally, of the 30 or so dye time of travel CBOD$_U$ deoxygenation rates that we have measured, we have never been able to discern or measure a second stage or recalcitrant CBOD$_U$ deoxygenation rate during time of travel wasteload allocation studies in the river system. This rate may be immeasurable in the river or the actual river bacterial populations may not discriminate. Regardless, the recalcitrant CBOD$_U$, when the BOD test is run correctly, constitutes a small portion of the total CBOD$_U$ in the river system.

For more information about the content of this article, please contact John Michael Corn at jmcorn@aquaeter.com or 615-373-8532.

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John Michael Corn has been with **AquAeTer** for over four years and has more than five years of environmental engineering experience. Mr. Corn graduated from University of Tennessee with a B.S. in Chemical Engineering. His work at **AquAeTer** has included projects such as, water quality assessments, air emissions calculations and modeling, environmental litigation support, dispersion studies, groundwater investigations, geomorphologic analysis, wastewater treatment selection, bioaccumulation, and environmental site assessments. He has been involved in environmental sampling, bench and pilot-scale studies, groundwater tracer tests, site assessments for spill prevention, control, & countermeasures plans, wastewater allocation studies, design of single-port and multi-port diffusers, statistical distribution analyses, emissions estimations for facility permitting, toxicity testing, surface water remediation, project planning and budgeting.

Amanda E. Whisler

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Ms. Whisler graduated from Virginia Tech in 2003 with a B.S. in Chemical Engineering. Her environmental and industrial expertise includes environmental permitting, compliance monitoring, and reporting for air (Title V), stormwater (NPDES) and wastewater. In addition, she has facilitated industrial health and safety training courses and managed industrial facility environmental and safety (OSHA) records. Ms. Whisler joined AquAeTer in June of 2008 and currently manages and assists with industrial air permitting, remediation projects and wastewater projects. She also aids in litigation report preparation and calculations. Ms. Whisler has also been assisting with a water quality study in lower Alabama along with several **AquAeTer** field team members for a wasteload allocation study.

Air Permitting for the Oil & Gas Industry

AquAeTer, Inc. was approached by a client in the Oil & Gas Industry with a request to provide air permitting assistance. The client was looking to expand their transloading capabilities into new states, potentially including Colorado, Wyoming, Utah, New York, Tennessee, Arkansas and more. With the Renewable Fuel Standard for 2008 and other Fuel Standards enforced by the U.S. EPA under the Clean Air Act, there is an increased need for petroleum product transportation throughout the U.S. and Canada. Petroleum products are being used in new and innovative processes.

While transloading of petroleum products increases in the United States, individual state air quality departments are seeing more and more applications. **AquAeTer** has made multiple contacts with engineers and scientists within the state and city permitting divisions as it prepares air permit applications for operation of transloading in these states. In general, the states are focused on emissions of Volatile Organic Compounds (VOCs) and Hazardous Air Pollutants (HAPs). To produce a clear and concise permit application, **AquAeTer** worked diligently and developed a spreadsheet that utilized basic principles of chemistry and chemical engineering to estimate emissions from over 150 compounds. As always, we have provided our client with a solution backed by science. Utilizing the components of the transloaded products, the fundamentals of vapor pressure, Raoult's Law, and product-content data developed by the client, **AquAeTer** can accurately predict the emissions of these facilities. Each permit application is supported by an electronic copy of the calculations used to estimate emissions.

In previous meetings with respective state Air Quality Divisions, **AquAeTer** continues to hear praise over our thorough, transparent, and mathematical estimation system. Our presentation is organized, user friendly, and is consistent in each state where permits are being requested. Not only has **AquAeTer** helped develop a solid system for estimating emissions, but we are also producing Screen3 or AERMDD air dispersion models when required by regulations.

Petroleum Products in Route

Our client's facilities meet the requirements of a minor/synthetic minor source. There are three permit applications currently pending; a temporary permit issued, two permanent permits issued, and multiple calculations and permits in the development process. The spreadsheet approach ensures a consistent and rapid method for preparing an air permit application in any state.

In addition to air permits, **AquAeTer** is working to provide our client with a generic calculation spreadsheet that will enable future marketing decisions to not only meet customer needs, but also be an ideal product choice based on potential emissions and state thresholds. We look forward to working with you on your air permitting needs. Please contact Amanda Whisler or Paul Marotta with requests for information on how we can provide your company with science-based solutions to optimize your resources.

To learn more about air permitting, please contact Amanda Whisler at awhisler@aquaeter.com or call 615-373-8532.