Wastewater System Audit Protocol for Toxicity Testing

Aster Bio's technical staff has been evaluating biological treatment unit impact from new waste streams, increases in loadings, or in systems experiencing treatment performance declines. Our testing protocols function synergistically to give a full overview of the biological treatment unit. Below is the list of audit process flow and the deliverable information we seek to provide.

From our toxicity audit, customers will have the following information:

- Potential impact of a new waste stream or increased loading
- Data on key inhibitory substances and the system's ability to treat these substances
- Opportunities to enhance biological treatment unit performance with emphasis on reducing overall treatment costs
- Ways to improve daily monitoring and process control

Toxicity testing involves surveying contributing process units and existing influent characterization information. Instead of performing all tests at one time, working through a check list will help identify sources of toxicity and produce an inhibition curve for the wastewater treatment system.

Is the problem acute or chronic toxicity?

- Acute toxicity is associated with spills. Detected by a loss of removal of COD, TOC, TKN, or phenol, acute toxicity comes on rapidly and decreases as soon as the influent is removed.
- Chronic toxicity often occurs with metals or other inorganic accumulation in the biomass. With chronic toxicity, the inhibition increases over time, with ammonia oxidizing bacteria (AOB) being the most susceptible microorganisms. Loss of floc density and size usually follows AOB inhibition with chronic toxicity.

Acute Toxicity Testing Protocol

- **Data review** – look at process units, waste streams, and influent/effluent data to find trends and correlations.
- **Heterotrophic bacteria toxicity testing – Tox-Bac™.** This test relies on a known biomass with uniform respiration rates. Exposing the biomass to inhibitory substances results in lower respiration rates than the control. Running multiple dilutions gives an inhibition curve for the waste stream sample. If a sample is inhibitory to Tox-Bac, you know it will inhibit AOB growth in almost all circumstances.
- **Ammonia Oxidizing Bacteria (AOB) toxicity testing – Tox-N™**. Using a concentrated slurry of AOB, the Tox-N test is very sensitive to inhibition by acute toxic compounds such as phenol, sulfides, and amines. Tox-N can also be used to evaluate effluent toxicity prior to running bioassay tests on daphnia or fathead minnows.
- **Environmental Genomics™** – wastewater DNA based testing. We use Environmental Genomics™ to show similarities and differences in biomass composition in a facility

over time and with different influents, or in comparison to similar treatment systems in our genetic testing database. Testing can show missing or inhibited populations of key bacteria such as AOB/NOB, identify filaments and causes of non-filamentous bulking.

- **Lab-Scale Reactor Studies** – bench-scale influent testing. The reactors simulate activated sludge plants using the customer's MLSS or MLSS from a similar facility. We can then test various influent makeups to determine impact on floc formation, microbial makeup (DNA testing), ATP, and COD removal.

Chronic Toxicity Studies

- **Inorganic testing** – using metals screening (ICP-MS) and specific compound tests, we can screen for bioaccumulation of inhibitory substances in the MLSS. We use a full data review to identify likely metals and compounds to shorten the list for testing.
- **Lab Scale Reactor Studies** – by running the reactor with fresh MLSS (from a similar wastewater treatment system), we can test the influent for potential chronic toxicity. Using genomic testing over a pre-determined end point, we can identify microbial population shifts and changes in compounds that bioaccumulate. Testing is supplemented by running daily microscopic exam, DOUR, ammonia, and COD. This is the most complex testing protocol that should be done only after other analyses.