BioCycle™·D — Digester Optimization

Key Benefits

- Sophisticated automated control algorithms for optimized digestion
- Energy reduction of up to 30-40%
- Aeration cycling enables sludge denitrification
- Minimization of nitrogen (NH_3, NO_x) and phosphorus in supernatant return
- Increased settleability
- Thickened sludge improves dewatering and reduces hauling
- Reduced maintenance

Introduction

BioCycle™·D is designed to meet the challenges facing the wastewater industries: escalating energy costs, tighter legislation on effluent quality, and demands for greater efficiency from existing capital assets and personnel.

Separation of Mixing from Aeration

Tangible benefits (e.g., power savings, improved process control) are created by separating the mixing function from the aeration function in an aerobic digester. If a aeration system is the only way to mix the digester, power is wasted. Industry design metrics of 30 $ft^3/10^3\ ft^3 \cdot min$ (diffused aeration) and 1.1 $hp/10^3\ ft^3$ (mechanical aerator) are related to mixing, not the actual oxygen requirement, which usually requires much less power. By utilizing an energy-efficient mixing system (such as EnviroMix BioMx) along with dissolved oxygen (DO) control, aeration may be limited to that necessary for effective digestion.

Utilizing only diffused air to mix also results in unwanted process conditions due to over-aeration, such as bulking and foaming. Increased maintenance and sludge handling result, reducing personnel and operational efficiency.

Digestion Oxygen Recovery

If the digester aeration system is turned off (while maintaining mixed conditions) and efficient denitrification is enabled, the oxygen generated may return a significant portion of the oxygen required for digestion. Aerobic digestion may be described by the following mass stoichiometric equation:

$$1.00\ C_5H_7NO_2 + 1.98\ O_2 \ \text{->}$$
$$1.95\ CO_2 + 0.54\ NO_3^- + 0.48\ H_20 + 0.01\ H^+$$

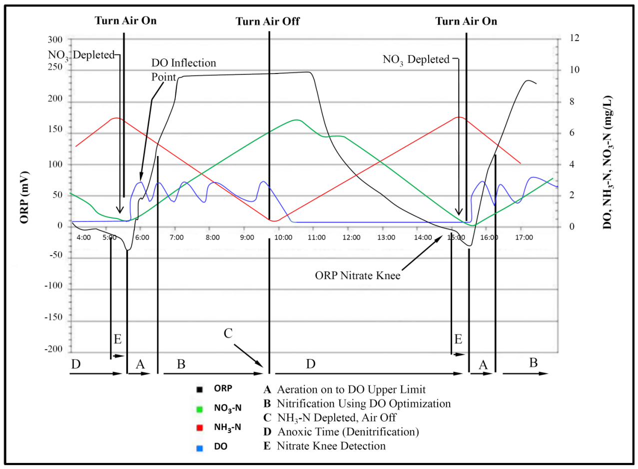
It is well known that the denitrification process returns 2.86 gram O_2 per gram NO_3^- reduced.

Stochiometrically, (1.00) NO_3^- moles reduced creates 2.86 (0.52) O_2 moles, or 1.48 O_2 moles. Thus, 1 mole $C_5H_7NO_2$ digested then denitrified creates (0.54 NO_3^- created) (1.48 O_2 created / NO_3^- reduced), or 0.8 O_2 mole.

Therefore, the calculated potential oxygen reduction using BioCycle™·D to optimally digest then denitrify would be:

0.8 O_2 mole/ 1.98 O_2 mole, *or 40%*.

BioCycle™·D automates and optimizes this digestion/denitrification process, providing power reduction and significant process benefits.



BioCycle™—Digester Process Monitoring

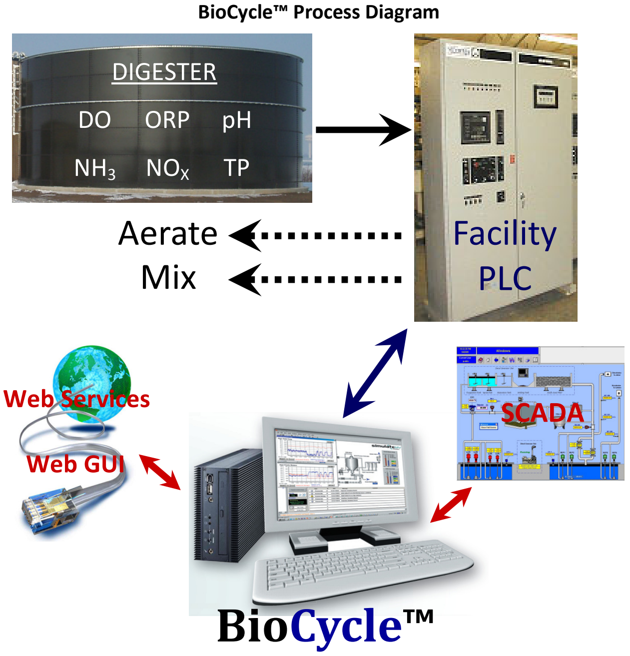
BioCycle™·D — Digester Optimization (cont.)

Process Benefits

Denitrifying increases settleability results due to the minimization of filamentous bacteria. Improved digester settling increases sludge concentrations, and reduces volume. The thickened sludge increases dewatering cake concentration output and reduces hauling expense. An optional drum thickener (BioCycle™·DT) may be used to further increase sludge concentration and reduce digester volume requirements. When combined with the BioMx system, BioCycle™·DT sludge concentrations of over 4% may be efficiently mixed.

Supernatant from denitrified digester sludge will contain a minimal amount of nitrogenous compounds (NH_3, NO_2, and NO_3) requiring little additional biological treatment. Severe process upsets and operational expense can occur due to high nitrogen compound concentration recycles. BioCycle™·D optimizes the digestion/denitrification process to produce superior supernatant quality and alleviate operational fluctuations.

BioCycle™ Process Diagram



Chemical Feed

Chemical addition may be required to supplement alkalinity as digested cell tissue is oxidized aerobically. Theoretically, 7.1 grams alkalinity (as $CaCO_3$) are destroyed per gram of NH_3 oxidized. However, the BioCycle™·D denitrification step may recover up to 3.6 grams of alkalinity (as $CaCO_3$) per gram NO_3 reduced. Thus alkalinity addition may be minimized or eliminated using BioCycle™·D.

It is also common to chemically bind phosphorus into a settleable solid that is released by digested bacteria. Phosphorus concentrations should be minimized in the digester supernatant and not returned to the main wastewater treatment process. This is particularly critical at enhanced biological phosphorus removal facilities as high supernatant concentrations may compromise the delicate treatment process.

Feed rates and specific type of chemical used are dependent on a number of factors. EnviroMix will work with you to determine the optimal solution to achieve the desired result.

Chemical Feed Storage Tanks

Contact Your Local Representative