A better understanding of readily biodegradable chemical oxygen demands (RBCOD) in biological nutrient removal (BNR) is essential for the removal of biological nitrogen (N) and phosphorus (P). The presence and loading of RB substrate in the influent provide suitable substrate for microorganisms to easily metabolize and to produce volatile fatty acids (VFA). The oxygen utilization rate (OUR) has been used to evaluate the oxygen consumption for the biodegradable substrate in wastewater. Wastewater with low organic content contains the limited availability of RB substrate and thus, it is required to supply the additional carbon source to improve the biological treatment capability. Acetate, propionate, methanol, and glycerol are the commonly available carbon sources for biological treatment process. However, the cost of acetate and propionate is relatively high and it is not economic to use them in wastewater plant. Methanol has safety issue in field uses due to its toxic and flammable property. On the other hand, crude glycerol is the byproduct of biodiesel which can be an excellent candidate as a carbon source. However, crude glycerol contains variable impurities and needs a certain degree of purification to enhance the performance.

The overall goal of the research was to evaluate the effect of the glycerol as an external carbon source for carbon limited influent. The sample for experiment was collected from the Iron Bridge Wastewater Reclamation Facility designed for treating municipal wastewater. The TCOD of the sample influent was in the range of 237 to 408 mg COD/L and RBCOD value was between 38 to 80.5 mg COD/L containing 0 to 10 mg COD/L of VFA. This study also provides the relationship between the glycerol concentration and OURs during the diauxic growth phase from the addition of glycerol. The first growth was by the existence of RB substrate of influent and second growth by the availability of glycerol for microorganisms. TCOD increased from 284 to 378 mg COD/L and to 323 mg COD/L by spiking approximately 30 and 15 mL of glycerol stock solution (6.667 g/L), respectively. RBCOD increased from 45 to 89 mg COD/L and 55 mg COD/L by spiking 30 mL and 15 ml glycerol stock solution, respectively. The initial influent heterotrophic active biomass (ZBH) increased from 5.4 to 15.8 mg VSS/L due to the addition of glycerol, indicating that the glycerol may be an adequate carbon source. The COD of wastewater with limited VFA (e.g., 10 mg COD/L) increased up to 2,502 mg COD/L where propionic acid (2,468 mg COD/L) exists as the main end product with a small quantity of acetic acid (34 mg COD/L). Propionic acid was the main VFA component fermented from the glycerol addition. This research has been limited to investigate the short-term effect of glucose addition on the existing RBCOD in wastewater. Therefore, it is recommended to explore the effect of increased RBCOD by the addition of glycerol on the effluent characteristic of N and P for future study.

Keywords: Wastewater, readily biodegradable oxygen demand (RBCOD), oxygen utilization rate (OUR), Glycerol, biological nutrient removal

Major: Environmental Engineering

Educational Career:
Bachelor's of Environmental Science, BS, 2006, Trichandra Campus
Master's of Environmental Management, MS, 2009, School of Environmental Science and Management

Committee in Charge:
Woo Hyoung Lee, Chair, Civil, Environmental, & Construction Engineering
Steven J. Duranceau, Civil, Environmental, & Construction Engineering
Anwar Sadmani, Civil, Environmental, & Construction Engineering

Approved for distribution by Woo Hyoung Lee, Committee Chair, on January 12, 2016.
The public is welcome to attend.