Systems improvement and energy savings program for the existing conventional extended aerobic treatment of domestic wastewater in compliance of DAO 2016-08 new general effluent regulations

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Abstract
This is a system improvement and energy savings program for a Sewage Treatment Plant treating wastewater coming from a shopping mall operation. Wastewater from shopping mall is considered domestic wastewater, which needs a big volume of water, and produced big amount of wastewater. Generators of wastewater such as in this case, from shopping mall, is mandated to be responsible for the collection, treatment of wastewater, and the ultimate disposal of the treated wastewater, as well as the separated solids, in a manner that is safe, and within the new effluent regulations as provided under DENR Administrative Order No. 2016-08. Under this new effluent regulations which only takes effect on June 2016, shopping mall is now mandated to meet stringent parameters to comply, particularly on Nitrate, Phosphate, Ammonia and Surfactants. To comply the new general effluent regulations, there were innovative solutions and energy programs implemented, resulting of savings in water and energy.
Keywords: Aerobic, mall effluent, reuse wastewater, energy and water savings

1. Introduction

The Department of Environment and Natural Resources (DENR) of the Environmental Management Bureau (EMB) is now very strict in the implementation of the new general effluent regulations as provided for in DAO 2016-08, which only takes effect on June 2016. This new general effluent regulations is in compliance of the Philippine Clean Water Act otherwise known as Republic Act 9275.

The new general effluent regulations under DAO 2016-08 entails an additional capital expenditures investment for owners. Retrofitting of the existing Sewage Treatment Plant (STP) has to be undertaken in order to remove Nitrate, Phosphate, Ammonia and Surfactants.

Sewage Treatment Plant treating domestic wastewater, if unabated and not properly designed, not operated effectively and efficiently, it is known that there is a social, economic and environmental issues associated with uncontrolled phosphorous (P) release to surface waters (Chislock et al, 2013). Also, with the increasing regulatory impetus to reduce P release to the environment has resulted in tightening of discharge limits for domestic sewage treatment plants.

Currently, significant efforts are being expended to integrate low-energy consumption processes with resource (e.g., energy, nutrients) recovery in wastewater treatment layouts (Chen et al., 2015).

2. Existing Conventional Aerobic Treatment System

2.1. Operations and Treatment

The shopping mall maintains sewage treatment plant (STP) to treat the organic-based wastewater generated from the various facilities. Wastewater from the shopping mall will pass through the lift station, ready for pumping to equalization tank, then pumped to the aeration tank, then treated water then pumped to clarifier tank, and finally to the effluent tank where chlorination is being done for disinfection (Figure 1).

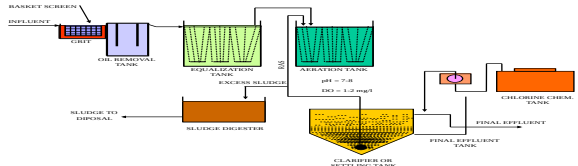

Figure 1. Conventional Aerobic STP

2.2 Systems Improvement and Analytical Methods

The STP was monitored daily for pH, temperature, dissolved oxygen (DO), BOD, sludge volume and COD. The plant was also monitored for total suspended solids (TSS), volatile suspended solids (VSS), sludge volume index (SVI), ammonia, nitrite, nitrate, phosphorous, according to Standard Methods (APHA, AWWA, WEF,

2005). Volatile fatty acids (VFAs) were estimated by gas-chromatographic measurements.

mg/L in the aeration tank; and, 3) to convert the existing equalization tank to anoxic tank and additional construction of mixing tank; and, 4) installation of tertiary treatment to treat

RA 9275 or Philippine Clean Water Act of 2004
DENR Administrative Order No. 35 series of 1990
Revised Effluent Regulations of 1990
DENR Administrative Order No. 2016-08
Water Quality Guidelines and General Effluent Standards of 2016

DAO 35 series 1990 for Parameters Monitor for Shopping Malls

Parameter	Standards
pH	6.5 – 9.0
BOD	50 mg/L
COD	100 mg/L
TSS	70 mg/L
FOG	5 mg/L

Reference: DAO 2016-08 General Effluent Standards

Domestic Wastewater (Hotels, and other accommodation services & Real Estate Activities)	
Significant Parameters	Effluent Standards DAO2016-08 for Water Class C
BOD	50 mg/L
Fecal Coliform	400 MPN/100mL
Ammonia	0.5 mg/L
Nitrate	14 mg/L
Phosphate	1 mg/L
Oil and Grease	5 mg/L
Surfactants	15 mg/L

Figure 2. Parameters Monitored in DAO 35 & DAO 2016-08

3. Energy Mapping and Conservation

To optimize the system, while monitoring diligently the pH and DO, an energy savings program was implemented by turning on and off aeration. This was done by maintaining the DO reading between 1-2mg/L. Rectifications of the system were fully checked and implemented. An energy mapping was implemented, with all the equipment used in the STP were tabulated and recorded of their actual energy consumption. Figure 3 shows an actual total cost of electricity per month which shows a cost of Php 140,823.33 and total cost per year of Php 1,689,879.94.

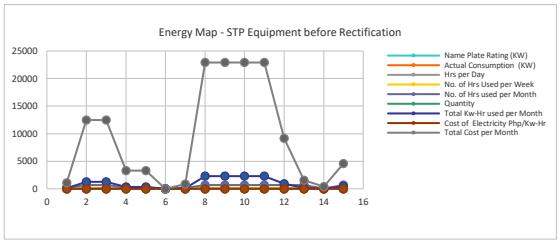

Figure 3. Energy Map STP Equipment before Rectification

However, as soon as rectifications were implemented, as shown in Figure 3, the actual total cost of electricity per month was reduced to Php44,151.44; and the total actual cost per year was reduced to Php529,817.28. Figure 4 shows the summary of actual cost of electricity for all the equipment in the STP system before rectifications and actual rectifications.

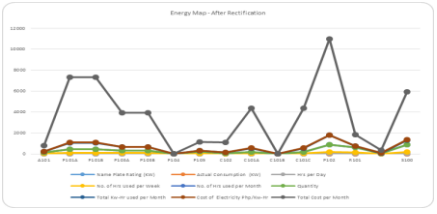

Figure 4. Energy Map STP Equipment after Rectification

4. Retrofitting of STP to comply DAO 2016-08 & Installation of Tertiary Treatment

To comply the new effluent regulations as per DAO 2016-08, the current STP has to be retrofitted to have a biological nitrogen and biological phosphorous removal. Equalization Tank was converted to Anoxic Tank to have nitrification and denitrification process. The treated effluent is then polished in the Tertiary treatment using Multimedia Filtration and Activated Carbon in pressure vessels. The treated effluent are then used for flushing toilets and landscaping purposes.

The effluent of the WWTS after tertiary treatment using activated carbon could be used for landscape watering and flushing toilet. The laboratory results of the samples collected from the tertiary treatment signify that it conforms with the USEPA standards for Class A Water Recycle. Better health protection has to be achieved not only by implementing stringent water quality, especially for water reuse, but also, by defining other appropriate practices that could provide additional barriers for pathogens on the reuse of wastewater for flushing toilet.

5. Conclusion

The government is very strict in the implementation of the Philippine Clean Water Act or RA 9275, particularly on domestic wastewater such as those coming from shopping mall operation, as this always contains high concentrations of plants nutrients nitrogen and phosphorous (N & P). These nutrients are key factors that cause eutrophication of closed water systems and excessive growth of algae.

Treated wastewater from shopping malls is a potential source of non-potable water that can be used for toilet flushing and landscape watering. To comply the new general effluent regulations, innovative solutions and energy programs were implemented, resulting of savings in water and energy.

Technology development is a continuing process in order to adopt to the changing environment. Future study is recommended not only to focus on the improvement of wastewater treatment plant operation and maintenance, but also, on the responsibility of the management for safety and protection of the environment, as part of the corporate social responsibility.

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