STUDY OF DISSOLVED OXYGEN DYNAMICS IN THE CHA-AM MUNICIPALITY WASTEWATER TREATMENT PONDS SYSTEM USING MATHEMATICAL MODELLING AND GIS

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ABSTRACT

This study investigated the spatial and temporal variation of dissolved oxygen (DO) in the Cha-Am wastewater treatment ponds to assess treatment dynamics and identify possible areas where the treatment train could be improved. Cha-Am is a small resort town with an extensive beach area located on the west coast of the Gulf of Thailand. The wastewater treatment system for Cha-Am consists of four ponds in sequence; i) aeration pond; ii) sedimentation pond; iii) extended aeration pond; and iv) evaporation pond. Two YSI 6920 datasondes were installed near the inlet of aeration pond and in the sedimentation pond, measuring dissolved oxygen (DO), pH, conductivity, temperature, and turbidity at 30 minute time intervals over a 3 month period. DO at the AP and the SP sites averaged 3.09 mg/L and 3.33 mg/L, respectively. DO generally varied over a diel cycle with higher values occurring in midafternoon and lows occurring after midnight. DO also often increased after a rainfall event. The metabolism rates of the pond system (rates of reaeration, photosynthesis and respiration) were obtained by Delta Method based on YSI continuous monitoring. Delta Method results showed the mean reaeration rates of AP and SP were 3.86 and 5.08 per day, respectively, usually lower than rivers, streams or canals. The P/R ratios of AP and SP were always less than 1, which means both ponds were heterotopic systems with low photosynthesis rates.

Ordinary Kriging (OK) interpolation in ArcGIS10.1 was used to map the spatial distribution of DO at different depths based on YSI spot measurement. The kriging indicated the highest DO concentrations were near the surface (0.5 – 1.0 m), averaging 18.53, 20.5, 17.31 and 9.7 mg/L in the four ponds, but sometimes the concentrations were below 2 mg/L near the bottom of the ponds. A couple of the ponds are used as a wild catch fishery and low DO seems to negatively impact the fish. The spatial trend of DO shows that normally the aeration pond is lower at the inlet than the outlet even though mechanical aerators are operated through part of the day. Improved aeration and sunlight penetration through enhanced particle settling may be of benefit.

KEY WORDS: DISSOLVED OXYGEN / DELTA METHOD/ GIS / ORDINARY KRIGING/ WASTEWATER TREATMENT PONDS

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