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Energy efficiency and sustainability of wastewater treatment plants

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Energy efficiency and sustainability of three wastewater (ww) treatment plants operating on Anaerobic-anoxic-oxic (A_2O) and oxidation ditch systems (Plant A- A_2O System, Plant B –A_2O system and Plant C- Oxidation Ditch System) were studied to investigate the energy efficiency and overall effectiveness (economical, environmental and social) of ww treatment. Energy consumption was obtained from an onsite survey and level one energy audit. Key performance indicators (KPI_{1-4}based on energy consumption) and load factor (operational index) were used to evaluate the energy efficiencies of treatment technologies. Further, sustainable indicators (capital cost, operational cost, community size served, level of nuisance from odor BOD_5 removal efficiency, N-removal efficiency, P-removal efficiency) were used to identify the economic and social sustainability of the plants while life cycle assessment results were incorporated to evaluate the environmental sustainability of each ww treatment plant. According to the KPI's (KPI_{1-3}) calculated, plant A needed a higher amount of energy to treat $1m^3$ of ww, one PE, and to remove one kg of COD, than plant C (95% confidence level). But Plant A showed the highest BOD_5 and N removal efficiency from all the three plants (95% confidence level). Although plant C showed lower values for $KPI_{1-3,}$ their removal efficiencies were lower compared to plant A. Further, KPI_3 and KPI_4 showed a higher values for plant A than for plant B. From the two wastewater treatment technologies considered, the oxidation ditch process gave the highest impact in six out of seven life cycle impacts categories considered. When the overall impacts from LCA were considered, Plant B showed the lowest environmental impacts in all seven impact categories while plant C showed the highest impact in a majority of the categories. Hence when the overall sustainability is considered (economic, social and environmental sustainability) A_2O process is identified as the more sustainable and energy efficient wastewater treatment technology to treat wastewater.

Keywords- Impact categories, Key performance indicators, Life cycle assessment, treatment technology

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