

Economic and environmental assessment of small and decentralized wastewater treatment systems

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Received 14 April 2008; Accepted in revised form 5 August 2008

ABSTRACT

The aim of the present work was the assessment of economic and environmental aspects of decentralized energy-saving wastewater treatment systems. The formulated investment and operation cost functions were adjusted by a power law function. The different wastewater systems serving population settlements between 50 p.e. and 250 p.e., presented associated investment costs varying from €400/p.e. to €200/p.e. and annual operation costs in the range of €70/p.e.–€20/p.e., respectively. A life cycle analysis approach was used to compare the environmental impact of alternative wastewater treatment systems. The assessment was focused on two energy-saving systems (constructed wetland and slow rate infiltration) and a conventional one (activated sludge process). Low environmental impact of energy-saving wastewater treatment systems was demonstrated, being the most relevant the global warming indicator. Options for reduction of life cycle impacts were assessed including materials used in construction and operation lifetime of the systems. A 10% extension of operation lifetime of constructed wetland and slow rate infiltration systems lead to a 5% and 7% decrease in the abiotic depletion indicator, respectively, and to a 1% decrease in CO₂ emissions in both systems. Replacing steel with HDPE in the activated sludge tank resulted in a 1% reduction in CO₂ emission and 1% in the abiotic depletion indicator. In the case of the Imhoff tank a 1% reduction in CO₂ emissions and 5% in abiotic depletion indicator were observed when concrete was replaced by HDPE. Therefore, considering the huge potential of energy saving wastewater treatment systems, the overall environmental impact of such design alternatives should not be discarded.

Keywords: Wastewater treatment; Slow rate infiltration; Constructed wetland; Cost function; Life cycle assessment

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