University of Zabol

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The Thesis Submitted for the Degree of M.Sc (in the field of Agronomy Science)

Life cycle assessment of the wastewater treatment plant of Zabol industrial town

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Abstract

Life cycle assessment (LCA) is a powerful environmental quantification tool that can be used to measure the environmental impacts of a product system or process. This study was conducted with the aim of evaluating the wastewater treatment system of Zabul Industrial Town using the life cycle assessment method. The stages of life cycle assessment include four stages that were addressed based on ISO 14040 and ISO 14044 standards. For this purpose, first the input and output data of the system, which include materials, energy and pollutants, were determined.The data required for this research include the measured values of wastewater (such as BOD, COD, pH, chloride, etc.) before and after treatment, as well as materials and energy consumption (electrical energy) for wastewater treatment in one year, and was studied.Then the analysis stage was done with the help of SimaPro software and using ReCePi and Cumulative Energy Demand (CED) methods. The functional unit in this research is one cubic meter of treated wastewater. Environmental consequences were analyzed in 18 groups of mid-level index results using the ReCiPe 2016 Midpoint(H) method and 3 groups of end-level index results using the ReCiPe 2016 Endpoint(H) method. Then the environmental consequences were quantified and analyzed after data normalization. The results obtained from the analysis of the effects index at the intermediate level showed that the greatest environmental effects resulting from the wastewater treatment of Zabul industrial town are respectively related to the consequences of human carcinogenic toxicity (50%), the toxicity of the fresh water ecosystem of (13%), the toxicity of the marine ecosystem (10%) and also the consequences of overnutrition of water ecosystems Shirin and the loss of fossil fuel each have (8%) in the next ranking of environmental effects. Based on the sensitivity test, the most important factor affecting the results was the COD amount, which with a 10% decrease from its initial value, the range of results was between 1.40-7.50%. The index of the final level of environmental effects showed damage to human health (55%), damage to ecosystem health (43%) and damage to resources (2%). The analysis of the effects at the final level showed that the most important effective substances on the human health outcome, which is the highest outcome at the final level in this research, include water (50.26%) and CO2 (40.13%). Water (46.63%) and CO2 (5.54%) are also the most important factors influencing the health outcomes of ecosystems. On the other hand, the most important processes at the level of these two were consequences of electricity. The analysis of CED results showed that the most energy required in this research for wastewater treatment by activated sludge method is from the consumption of non-renewable fossil fuels (93.66%). At the end, it can be concluded that the wastewater treatment system of Zabul Industrial Town cannot have many harmful environmental effects due to the small amount of wastewater entering it. It can also be acknowledged that carrying out LCA projects is considered as an effective method in reducing the harmful effects of the environment and is used by managers and decision makers in order to increase the productivity of systems and make them more compatible with the environment and sustainable development goals.

Keywords: wastewater treatment, life cycle assessment, ecosystem toxicity, ecological footprint, Zabul industrial town