Vol. 10 (2): 305-316 (2020)

LIFE-CYCLE ANALYSIS AND TECHNOECONOMIC MODELING OF AN ENERGY GENERATION SYSTEM

Mohammad Kabli[1], Osman Taylan[1*], Ahmad Bakhsh[1], Rahman Calhan[2], Mustafa Tahsin Yilmaz[1], Durmus Kaya[3], Fatma ÇANKA KILIÇ[3]

[1]Department of Industrial Engineering, Faculty of Engineering, King Abdulaziz University, Jeddah, Saudi Arabia;
[2]Department of Environmental Engineering, Faculty of Engineering, Karabuk University, Turkey;
[3]Department of Energy Systems Engineering, Faculty of Technology, Kocaeli University, Umuttepe, Kocaeli, Turkey;

[*]Corresponding Author Osman Taylan, e-mail: otaylan@kau.edu.sa;

Received December 2019; Accepted January 2020; Published March 2020;

DOI: https://doi.org/10.31407/ijees10.210

ABSTRACT

Biomass is considered as a renewable energy source with increasing popularity because of its energy production and greenhouse gas (GHG) reduction potentials. The heat and electricity are produced with burned gasification products, otherwise the products are treated by synthesis of liquid transport fuels. Biomass gasification is a flexible, efficient, and environmentally acceptable process to meet the future energy demand. In this study, a life cycle analysis (LCA) approach is used to determine the environmental performance of an energy generation plant that is using synthesis gases derived from biomasses. Hence, a life cycle analysis of an Organic Rankine Cycle (ORC) power plant being able to produce 955 kW electrical, 5415 kW thermal power with 15% net electrical efficiency of biomass was carried out. The probability distribution of the daily inventory demand was examined and modeled using historical outcomes of last 200 days, and the results were analyzed. The findings are remarkable to note that the average demand of 1480 kg biomass in the 10-day simulation varies slightly after the daily projected biomass demand of 1402.5 kg calculated. The result of gasification and electrical energy production is waste heat and is used for drying waste biomass in the plant for the heat demands of other units.

Keywords: Biomass gasification; Life-cycle Analysis; Cogeneration; Power generation; Monte Carlo simulation