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Expert Paper
Stručni rad

THE POSSIBILITY APPLICATION OF BIOGAS PLANT
MOGUĆNOST PRIMENE BIOGASNIH POSTROJENJA

Dragan CVETKOVIĆ, Milan DESPOTOVIĆ, Milorad BOJIĆ
**Faculty of Engineering at Kragujevac, 34 000Kragujevac, SestreJanjić 6, Serbia*
e-mail: dragan_cw8202@yahoo.com

ABSTRACT

The main goal of this paper is to point out the possibilities of investment into biogas facilities, i.e. the economic justification of their construction. In this paper, a parametric model of a biogas facility is presented, which was modelled by means of the Catia V5 software while using cow manure as a substrate. An analysis was performed at facilities designed for 100-5000 livestock units. The presented data indicate the investments in biogas facilities, quantities of produced thermal and electric energy, and achieved revenues from electric energy sales according to feed-in tariffs . The repayment period for a different number of working days of the facility during a year is also shown. The results indicate that constructing biogas facilities for the farms with lower capacities is not profitable, but for the farms with higher capacities (over 2000 livestock units) the repayment period is only 4 years.

Keywords: *biogas plant, co-generation, animal manure, anerobic digestion.*

REZIME

Osnovni cilj ovog rada je da ukaže na mogućnost ulaganja u biogasna postrojenja, odnosno ekonomsku opravdanost njihove izgradnje. U okviru ovog rada predstavljen je parametarski model jednog biogasnog postrojenja izmodelovan pomoću softvera Catia V5, kao supstrat korišćen je goveđi stajnjak. Izvršena je analiza za postrojenja veličine od 100 do 5000 stočnih jedinica. Prikazani su podaci o investicionim ulaganjima u biogasna postrojenja, količini proizvedene toplotne i električne energije kao i ostvareni prihod od prodaje električne energije prema povlašćenojtarifi. Takođe prikazan je i period otplate za različiti broj radnih dana postrojenja u toku godine. Rezultati su ukazali da je neisplativo praviti biogasna postrojenja za farme sa manjim kapacitetom, ali i da za kapacitete preko 2000 grla period otplate se može očekivati već posle 4 godine.

Ključne reči:*biogasno postrojenje, kogeneracija, životinjski stajnjak, anaerobna digestija.*

INTRODUCTION

A continuing energy crisis has reawakened the interest in anaerobic fermentation of animal and vegetable waste resulting in methane production. To date, 80% of the world's energy use still originates from combusting fossil fuels (Goldemberg and Johansson, 2004). Yet the reserves are limited, and their burning substantially increases greenhouse gas (GHG) concentrations. Biofuels are suitable to substitute fossil fuels as energy sources. Therefore, a substantial contribution can be achieved in the effort to mitigate the additional greenhouse effect. In 2020, renewable resources shall cover 20% of the primary energy demand within the European Union. In the second half of the century this contribution has to reach 50% in order to prevent an unpredictable extent of climate change (IPPC, 2001). Among renewable resources, anaerobic digestion and utilisation of the biogas produced will play a considerable role as biogas is a universal energy resource comparable with natural gas. Of the many bioenergy related processes being developed, those processes involving microorganisms are especially promising, as they have the potential to produce renewable energy on a large scale, without disrupting strongly the environment or human activities (Rittmann, 2008).

Several large demonstration plants are functioning well and many small units are in daily use (Malcolm and Chris, 1979). The total amount produced is small but of great significance locally. Using manures from animal husbandry for anaerobic digestion has a very positive ecological effect. The life cycle assessment delivers an avoidance of greenhouse gas (GHG) emissions of approx. 600 g $CO2eq \cdot kWh^{-1}$ of electricity and heat generated from biogas based on manure (Jungmeier et al., 1999). Zoranovic et al. (2008) investigated the anaerobic treatment in a digester of a biogas plant. The digester capacity was from 300 to 1500 m^3. Sklenka (2000), using a lab-scale model, conducted the study on the problem of heating digester (the capacity of 5m^3).

The main objective of this study is to investigate the applicability of biogas plants. For this purpose, the parametric model of biogas plant with a capacity of 100 to 5000 livestock was made. For the purpose of assessing the profitability of biogas plants, the costs of plant construction and the revenues from sold electric energy are taken into account.

Biogas plants and components

The appearance of facilities strongly depends on the type and quantities of raw materials used for biogas production. In this paper, a parametric model of a biogas facility is presented, designed with the Catia V5 software package, Figure 1. Cow manure was used as a raw material; the model is developed for the facilities of small/medium capacity for 100-5000 livestock units. The facility consists of a continuous digester, fresh manure warehouse, digestate warehouse with membrane for biogas collecting, scrubbers for biogas purification, storage tank for biogas, cogeneration plant, combustion torches, and supporting infrastructure.

Fig.1. Biogas plant