

ABSTRACT

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THE ENERGY AND ENVIRONMENTAL EFFECTS OF AGRICULTURAL BIOGAS INSTALLATIONS AND THEIR IMPACT ON THE ENVIRONMENT

The dissertation addresses the impact of agricultural gas installations on the energy balance of the farm to which the biogas plant is connected and on the surrounding environment. Agricultural biogas plants fit very well in the Podlaskie Voivodeship due to easy access to substrates (crops, grass, organic waste and liquid manure). Agricultural biogas plants can be used as a source of electricity and heat to cover the needs of a given agricultural holding. The energy generated in biogas plants is stable, i.e. the power value and the amount of heat generated do not change significantly over time. In extreme cases, an agricultural biogas plant can ensure the energy self-sufficiency of farms without access to other energy sources. The production and use of methane in a biogas plant avoid a significant proportion of the greenhouse gas emissions from the decomposition of animal manure. The digested slurry has a less unpleasant odour, a more favourable consistency for further processing, and better properties than slurry. During fermentation, there is no loss of nitrogen and only a reduction to ammonium nitrogen, which is more assimilable for plants, occurs.

The research began with a review of the state of the art and information available in the literature on agricultural biogas plants. The knowledge acquired, and information obtained from owners of agricultural biogas plants located in the Podlaskie Voivodeship made it possible to formulate the research problem and the objectives and scope of the study. Two agricultural biogas plants with the exact technological solutions that were applied were selected for the study. In order to realise the main research objectives, field studies were conducted in both biogas plants. Investigations were carried out at each stage of biogas plant operation, starting from chemical tests of the input (slurry), through tests of the biogas production process (amount and rate of substrate feed-in, temperature and substrate level in the digester, sulphur content and amount of biogas, efficiency of the biogas plant), to the quality of electricity generated in the generator and the quality of the digestate obtained. One biogas plant showed problems achieving the rated efficiency (power) during the investigations. As a result, calculations and simulations were conducted to propose a solution to the fault noted. This solution was implemented in the biogas plant, resulting in the agricultural biogas plant operating with power and efficiency close to the rated values. The impact of agricultural biogas plants on carbon dioxide emissions was also studied. The results obtained were analysed to answer questions representing (describing) the research problem established earlier.