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THE IMPLEMENTATION OF BIODIGESTER AS A SOURCE OF ECONOMIC GAIN IN THE MORRO GRANDE FARM, SOUTH MINAS GERAIS BRAZIL

LA IMPLEMENTACIÓN DEL BIODIGESTER COMO FUENTE DE GANANCIA ECONÓMICA EN LA GRANJA MORRO GRANDE, SUR DE MINAS GERAIS BRASIL

A IMPLANTAÇÃO DO BIODIGESTOR COMO FONTE DE GANHO ECONÔMICO NA FAZENDA MORRO GRANDE, SUL DE MINAS GERAIS BRASIL

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ABSTRACT: Were analyzed during a technical visit carried out in the environmental engineering course at the State University of Minas Gerais at the Morro Verde farm located in the municipality of São João Batista do Glória, in the southern region of Minas Gerais (Brazil). The technologies implemented in the business were observed which, for that reason, are recognized in the national territory as examples of the applicability of sustainability in the economy. The farm has the production of biogas which is the fermentation process that leads to anaerobic digestion by bacteria resulting in the production of biogas (basically methane - CH_4), this gas is transported to the energy generator that is used in the productive processes of the farm. All the organic matter generated by the cows is somehow reused on the farm, including the by-product generated after passing through the hydraulic press that is used as a form of fertilizer for planting. After adopting sustainability, the farm had a reduction of more than 90 thousand reais in energy consumption resulting from the photovoltaic energy panels and biogas production, proving that being sustainable is economically viable.

Keywords: Biogas. Sustainability. Economy.

RESUMEN: Fueron analizados durante una visita técnica realizada en el curso de ingeniería ambiental de la Universidad Estatal de Minas Gerais en la hacienda Morro Verde ubicada en el municipio de São João Batista do Glória, en la región sur de Minas Gerais (Brasil). Se observaron las tecnologías implementadas en el negocio que, por ello, son reconocidas en el territorio nacional como ejemplos de la aplicabilidad de la sustentabilidad en la economía. La finca cuenta con la producción de biogás que es el proceso de fermentación que lleva a la digestión anaerobia por bacterias dando como resultado la producción de biogás (básicamente metano - CH_4), este gas es transportado al generador de energía que se utiliza en los procesos productivos de la finca . Toda la materia orgánica generada por las vacas es reutilizada de alguna manera en la finca, incluido el subproducto generado tras su paso por la prensa hidráulica que se utiliza como forma de abono para la siembra. La hacienda, después de adoptar la sustentabilidad, tuvo una reducción de más de 90 mil reales en el consumo de energía resultante de los paneles de energía fotovoltaica y la producción de biogás, demostrando que ser sustentable es económicamente viable.

Palabras clave: Biogás. Sustentabilidade. Economia.

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RESUMO: O trabalho apresentado refere-se a uma visita técnica realizada no curso de engenharia ambiental da Universidade do Estado de Minas Gerais na fazenda Morro Verde localizada no município de São João Batista do Glória, na região sul de Minas Gerais. Foram observadas as tecnologias implementadas no negócio que por razão, são reconhecidas em território nacional como exemplos de aplicabilidade da sustentabilidade na economia. A fazenda conta com a produção de biogás que é o processo fermentação que acarreta na digestão anaeróbica pelas bactérias resultando na produção do biogás (basicamente metano - CH_4), este gás é transportado para o gerador de energia que é usada nos processos produtivos da fazenda. Toda a matéria orgânica gerada pelas vacas é de alguma forma reutilizada na fazenda, incluindo o subproduto gerado após passagem pela prensa hidráulica que é usado como forma de adubo para plantação. A fazenda após adoção da sustentabilidade teve uma redução de mais de 90 mil reais em consumo de energia consequentes das placas de energia fotovoltaica e a produção do biogás provando que ser sustentável é economicamente viável.

Palavras-chaves: Biogás. Sustentabilidade. Economia. Redução de gastos.

INTRODUCTION

According to Dotto and Wolf (2012) agricultural activities are responsible for a large part of the Brazilian economy, directly influencing the Gross Domestic Product – GDP. Data presented by the Brazilian Institute of Geography and Statistics (2009) Brazil has one of the main herds worldwide. Also, the IBGE in 2009 showed that Brazil had the highest slaughter of cattle in the year, reaching 22 million (IBGE 2009).

With the large amount of cattle both for slaughter and for milk production is the amount of organic matter that are generated by the animals. Making the final disposal of this material becomes complex since it involves different situations such as sanitary and financial ((SILVA, 1973).

Animal waste is responsible for the generation of gases that are harmful to the environment, resulting from the degradation of matter, mainly methane CH_4. (MÜLLER 1987)

Biogas is a mixture of 40 to 75% methane (CH_4) and has a calorific value between 23338.52 and 6253.01 kcal/m3 (IANNICELLI, 2008).

Table 1.1. Specific weight and lower calorific value of biogas as a function of chemical composition

Chemical Composition of Biogas	Specific weight kg/m³	PCI kcal/kg

Composição química do biogás	Peso específico (kg/m³)	PCI (kcal/kg)
10 % CH_4 e 90 % CO_2	1,8393	465,43
40 % CH_4 e 60 % CO_2	1,46	2333,85
60 % CH_4 e 40 % CO_2	1,2143	4229,98
65 % CH_4 e 35 % CO_2	1,1518	4831,14
75 % CH_4 e 25 % CO_2	1,0268	6253,01
95 % CH_4 e 05 % CO_2	0,7768	10469,6
99 % CH_4 e 01 % CO_2	0,7268	11661,02

Source: ADAPTATION OF IANNICELLI (2008). & SOUZA (2016)

Table 1.2 Lower calorific value of gaseous fuels

Gás	PCI (kcal/m³)
Metano	8500
Propano	22000
Butano	28000
Gás de coqueria	4400
Gás de cidade	4000
Gás natural	8554
Biogás	5500

Source: ADAPTATION OF IANNICELLI (2008). SOUZA (2016) & ALVES (2000).

We can analyze that the data presented in figure 1.2 shows the energy equivalence of biogas with 60% methane whencompared to other fuels.

METHODOLOGY

Implementing a biodigester on a dairy farm involves steps that generally include:

Viability study: The owner of the farm, together with the management team, went through a long process of study so that the biodigester could be adapted to his property, through the analysis of experiences shared by other producers, analysis of the local relief, availability of cattle, specialized technical instruction, assessment of farm conditions, amount of waste generated, project costs and benefits, among other relevant aspects.

Choice of biodigester type: There are different types of biodigesters, such as batch, continuous, plug flow, among others. The choice of the most suitable type was based on the characteristics of the farm and the objectives of the project.

Biodigester design: The elaboration of the biodigester project, including sizing, choice of materials, waste input and output system, among other aspects, carried out by the team, can be demonstrated through the following mathematic formula:

$$\frac{VB}{4h + b} = bh + h^2$$

Where VB (Biodigestor Volume) was obtained based on the daily production of organic matter produced by the 500 head of cattle on the property, taking into account that each cattle have a daily production of 0.094 m3. At the end of the calculation, the value of 2350 m3 was obtained. The height value (h) was standardized following what is recommended in the literature, the value 3. With this, the following calculation was developed:

$$\frac{2350}{4 \cdot 3 + b} = 3b + 3^2$$

$$36b + 6b^2 + 108 + 18b = 2350$$

$$6b^2 + 54b - 2242 = 0$$

$$\delta = 54^2 - 4 \cdot 6 \cdot (-2242)$$

X=

$$\frac{-54 + 238{,}1}{2.6} = 15{,}34\ m$$

Being x the value of the smaller base of the Biodigester in the form of a trapeze, h the height and following the 45° inclination, the value of 21.34 m was obtained for the smaller base, allowing the sizing to support the daily capacity of the property.

Construction and installation: After sizing, the biodigester was built and the necessary equipment was installed, such as mixers, agitators, and pumps, among others.

Tests and adjustments: It is necessary to carry out tests and adjustments to the system to ensure proper functioning and optimization of biogas and fertilizer production.

Operation and maintenance: The training of those responsible for operating the biodigester and implementing a preventive and corrective maintenance plan has been improved and monitored by the farm owner, in order to optimize the process.

RESULTS

On the property there is a rainwater catchment basin that is used to wash the organic matter generated by the cows, the basin was strategically installed taking advantage of the slope of the land (installed in the lowest part) with this, no pump is needed to carry rainwater to the catchment basin.

Figure 1. Rainwater catchment basin. (2023). Authors.

The water is pumped to the sheds where the animals stay and generate the organic matter, it washes away all the generated matter that is taken to the beginning of the biogas production process.

Figure 2. Shed for the oxen. (2023). Authors.

After being washed, this water will pass through the decantation basin and also through the conveyor belt where the separation of particles of different densities will take place. The sand that makes up the bed of the cows and ends up going to the area where the washing takes place is recovered in this process.

Figure 3. Sedimentation basin. (2023). Authors.

The hydraulic press is used to separate the liquid from the solid, on the farm the solid material that passes through the press is used in planting crops as fertilizer since it is rich in nutrients needed by the plants. There is also the fertilizer generated this liquid material is rich in nutrients and is used for crops as well. The probability of also covering where the fertilizer is stored is being studied, since it can also produce biogas.

Figure 4. Hydraulic press. (2023). Authors.

It is estimated that the process for biogas generation takes around 35 to 42 days, the temperatures will also influence the productivity and acceleration of the process.

REFERENCIAR FOTO

FINAL CONSIDERATIONS

The implementation of a biogas production system is not cheap, however, the benefits generated by it are of great value looking at the economic side. The farm had a drastic reduction in the amount of energy consumed thanks to the implementation of the high-tech system, proving that sustainability and economic viability can go together, the farm also has a photovoltaic energy production system that also helps a lot in reducing consumption. spent. The farm is also a model for the southern region of Minas Gerais who seek to apply the biodigester on their respective properties.

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