Bioreactor to produce ethanol “Bioethanol”

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Summary

In the following experiment, a bioreactor was carried out with the main objective of producing ethanol, our main source was the banana peel, which we used to create a fermented product and, through the same fermentation, achieve the exclusive and total production of ethanol, within the reach of After 20 days, it was possible to achieve the production of ethanol and it was determined from a very simple process in which the content of the bioreactor was placed in a beaker and it was set on fire with a lighter, the production of ethanol would be reflected through combustion, which is a type of exothermic chemical reaction that causes a rapid oxidation process of fuel elements formed, mainly, by carbon and hydrogen; When bringing the lighter closer to the beaker, a flame was generated and that was the end of the experiment and its verification.

Keywords: Bioreactor, banana peels, ethanol production, fermentation, pH, refractometer.

Introduction

Different general and main aspects of the project will be presented. Fossil fuels are a source of energy that comes from the decomposition of organic matter from animals, plants and microorganisms, and whose transformation process takes millions of years. They are classified into three types: oil, coal and natural gas. These fuels have a problem and that is that their use is finite, so they are permanently threatened by the risk of disappearance if continued overexploitation occurs.
Currently, substances of organic origin are being used as fuel to obtain energy. That is why biofuels or biofuels prosper

Biofuels are fuels derived from renewable sources that do not release CO2 when burned. The net CO2 emissions of these biofuels are considered zero, since they are balanced with the CO2 absorbed by renewable energy sources, the origin of the biofuels.
One of the most common biofuels is ethanol, for which we want to work on this project for its production.

The most important thing to start this experiment is to understand mainly, what a bioreactor is. A bioreactor is a container or system that maintains a biologically active environment. In some cases, a bioreactor is a vessel in which a chemical process involving organisms or biochemically active substances derived from such organisms is carried out. This process can be aerobic or anaerobic. These bioreactors are commonly cylindrical, ranging in size from a few milliliters to cubic meters, and are usually made of stainless steel.

Thanks to the use of bioreactors, science has been able to present advances in recent years, managing to create vaccines, antibiotics, produce alcoholic beverages such as wine and beers. One of the latest advances with which a bioreactor has been used is for the production of fuels due to the environmental problems caused by fossil fuels together with the pollution generated by humans on a daily basis, resulting in greenhouse gases and the contamination of the habitats of thousands of species, putting their existence at risk.

From vegetable organic waste, ethanol or bioethanol can be obtained, which consists of a fuel, where use is made of the reuse of organic waste instead of ending up in landfills, where they will later produce greenhouse gases and finally we will have the production of a less polluting fuel than a fossil fuel. This is classified as a generation two biofuel since it is obtained from biomass of a lignocellulosic nature, that is, of a woody or fibrous nature, in addition to the use of residues that do not reduce the population's food products.

Ethanol is a fuel that can be produced from a large number of vegetable substrates, it has been classified as a potentially sustainable energy resource that can offer long-term environmental and economic advantages in replacement of fossil fuels.

In industries made up of large companies, they focus on continuous improvement and optimizing their processes with the maximum use of resources that do not have a negative effect on the environment.

They can be used for different market segments such as:

- Agriculture: in plant cell cultures, compound fertilizer, biopesticides, biofertilizers, inoculants, among others.
- Food: in the production of breads, cheeses, snacks, beer, wine, unicellular protein, pre-biotics, pro-biotics and others Industria Química: en la producción de cremas, cosméticos, butanol, acetona, glicerol, ácidos orgánicos, enzimas, bio-polímeros.

- Energy: in the production of ethanol, 2G ethanol, biogas, biodiesel, biomass.
- Environment: oil recovery, bioremediation, miner bioleaching, waste and effluent treatment.
- Livestock Sector: animal nutrition, production of vaccines and antibiotics.
- Health: production of hormones and other drugs, antibiotics, vaccines, animal cell cultures.

Materiales utilizados:

1 sachet of yeast
Link of reference: Levadura Tradi-Pan 55 g | Walmart
1 bacteriological loop
Link of reference: Asa Bacteriológica De Nicromo Calibre 1/1000 Roja 3mm 10 Pzs | Meses sin intereses (mercadolibre.com.mx)
blender
Link of reference:LICUADORA SUPER CHEF KOBLENZ DE 3 VELOCIDADES | The Home Depot México
1 T-shirt with distilled water
Link of reference:Piseta de seguridad para agua destilada 500ml. Modelo CRM-46046-115E – Científica Vela Quin S de R.L de C.V
1 glass of alcohol
link of reference:Piseta de seguridad para etanol 500ml. Modelo CRM-46046-120E – Científica Vela Quin S de R.L de C.V
1 spoon
Link of reference: Espátula - Cuchara De Laboratorio De Acero Inoxidable | MercadoLibre
2 fisher lighters
Link of reference:CHEMIT (chemitargentina.com.ar)
1 small digital autoclave
Link of reference:AUTOCLAVE DIGITAL DE 24 LITROS - GREETMED - ASIA EUROPA IMPORT SAC
lighter
Link of reference:Yeepi BBQ Long Lighter 5002B Assorted Colors (20 Units) | Gas Lighter Malaysia
1 1000 ml autoclave bottle
Link of reference:Frasco Para Laboratorio 1000ml Graduado C/ Tapa Autoclavable | Envío gratis (mercadolibre.com.mx)
1 500 ml autoclave bottle
Link of reference:Frasco Para Laboratorio 1000ml Graduado C/ Tapa Autoclavable | Envío gratis (mercadolibre.com.mx)
1 250 ml measuring cylinder
Link of reference: Probeta de vidrio - 250ml - Tu Cerveza Casera
Refractometer
Link of reference.Refractómetro Irfora Refractómetro digital de azúcar Brix Medidor de dulzura de mano electrónico Ran Irfora Refractómetro | Walmart en línea
1 pair of asbestos gloves
Link of reference:Guante De Asbesto Guantes De Asbesto Para Objetos Calientes | Envío gratis (mercadolibre.com.mx)
3L capacity container
Link of reference:Botellas De Agua Plásticas De La Bebida De Tres 19 Litros O De 5 Galones Stock de ilustración - Ilustración de azul, reciclable: 78507062 (dreamstime.com)
Indelible marker pen
Link of reference: Plumón indeleble - Sodimac.com.pe
pH strips
Link of reference:Tiras De Papel Ph Rango 0-14 Caja Con 100 | MercadoLibre
Aluminum foil
Link of reference:Papel para Regalo en Caja Despachadora - 24" x 100', Aluminio Plateado S-12353 - Uline

The process to obtain ethanol

Alcoholic fermentation

Alcoholic fermentation: it is a biological process of fermentation in the absence of air, caused by the activity of some microorganisms that process carbohydrates to obtain as final products: an alcohol in the form of ethanol (whose chemical form is: CH_3-CH_2-OH), carbon dioxide (CO_2) in the form of gas and ATP molecules that are consumed by the microorganisms themselves in their anaerobic cellular energy metabolism.

The biological purpose of alcoholic fermentation is to provide anaerobic energy to unicellular microorganisms (yeasts) in the absence of oxygen from glucose. In the process, the yeast obtain energy by dissociating glucose molecules and generate alcohol and carbon dioxide CO_2 as waste.

Description of the main components and design of the bioreactor:

Cylindrical container: It is a cylindrical container with a flat bottom; It is found in various capacities, from 100 mL to several liters. It is usually made of glass, metal or a special plastic and is the one whose objective is to contain gases or liquids. It has Teflon components or other corrosion resistant materials.

Fermented: Banana peel liquefied with an inoculated and non-inoculated mixture (it was inoculated with yeast to start the indicated fermentation process).

Fig. 1 Fusion 360°. La following image is to refer to a 360° view of the bioreactor design.

Reason why the banana peel was used

The banana peel is composed of a lignocellulosic matrix that contains lignin, hemicellulose, and cellulose. The latter can be transformed into sugars for the production of value-added components by fermentation.

Development of the experiment

Step 1

Wash and blend the banana peels until you get a paste. Place 250 mL of the macerated shells in the 500 mL autoclavable laboratory bottle. label the bottle: INOCULUM, place the rest of the paste in the other 1000 mL autoclavable laboratory bottle, label it as NO INOCULUM. Sterilize both vials at 115 to 120°C for ten minutes, cool to room temperature.

After the sterilization process is finished, the jars are carefully removed and one of them is meticulously placed in a bucket with cold water to avoid any accident; the reason why it is decided to use the bucket with cold water is to cool the jar with 250ml of mixture because it will be used as an inoculum object.

After cooling, a sterile area is extended in a 30cm x 30cm perimeter and two Fisher burners are connected to the gas area and turned on, it is important that the Fisher burners are turned on because this will mark the sterile area. Under sterile conditions, inoculate the jar labeled INOCULUM with the yeast. Incubate the inoculum for eight days at room temperature.

Store the NO INOCULUM bottle in the refrigerator at 4°C until use. Sterilize the 5L glass bottle by washing it with the sanitizing solution, let it dry and store it until use. It *is left for 7 days.*

Step 2

Once the 8 days have passed, the inoculum liquid will be poured into the non-inoculum and stirred to transfer to the 5L jug.

The growth of the flasks will be reviewed, but especially that of the inoculated one, since what we want to know is if CO2 was generated, we know that CO2 was generated due to the pressure that was generated in the flask, the steps that were carried out were to create the perimeter sterilized, with two Fisher burners on the sides and everything previously disinfected with the help of ethanol and cotton. In a 5-liter jug, both mixtures will be put, both the inoculated and the non-inoculated ones, and they will be mixed correctly. Later, the jug will be left ajar to prevent the pressure generated by the CO2 from causing an accident. We clean everything and leave it until the next day.

Step 3

See the changes that are generated in color, in size, in pH and calculate its temperature in Brix degrees, this is done after a week and since everything is inside the 5-liter jug, monitoring any movement and waiting for it to produce ethanol, it is important to note that this is a homemade bioreactor and ethanol production is expected in a 15-day environment.

Step 4

15 days have passed and all that time the measurement was continued and step 3 continued during those days.
The crucial and most important moment for this bioreactor has arrived and that is to check if ethanol was generated.
This is done as follows: 2 Fisher burners and the bioreactor in the middle are placed in a sterilized space, it is opened taking care of the presence of factors that may intervene and a small amount of the liquid produced is removed, poured with a strainer into a beaker and we put a lighter in the beaker, if combustion occurs that means that ethanol was produced, in our case there was ethanol production which leaves us with the conclusion that the bioreactor was successful.

Conclusion:

The production of ethanol was carried out as desired, opening up the possibilities for the creation of controlled bioreactors without the need for a large use of materials. The realization of this bioreactor also helps us to consider the uses that can be given to the bioreactor. Although a large production of ethanol was not expected, production was double what was expected; This project is an active way to test your skills and your patience, it motivates you to be disciplined and constant, which is one of the achievements we achieved in this experiment.

Images








ATAGO
22.6 °C
15.1
Brix %
(0 ~ 93%)
START
ZERO
Pocket
REFRACTOMETER PAL-3

MColorpHast™
pH 0 - 14
Universal Indicator

ATAGO
16.5
Brix %
START
ZERO
Pocket

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