

Proposal for a Circular Economy of glycerin as a by-product of biodiesel production**Propuesta de una Economía Circular de la glicerina como subproducto de la producción de biodiesel**

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Abstract

The Circular Economy of glycerin a proposal to reduce the environmental impact, the economic contribution, as well as avoid the discharge of used edible oils into bodies of water, the problems towards gray water treatment plants in the pretreatment process, in the landfill to prevent runoff from contaminating the soil, due to the type of Karstic soil in the region. Obtaining glycerin is one of the objectives of the project, part of the work is its application of fuel cells, as an alternative source of renewable energy. The proposed methodology Circular Economy of glycerin by-product obtained from biodiesel and the uses derived from it, the economic contribution and sustainability of this. As a result, obtaining an environmental, economic benefit, which requires both compliance with environmental laws and regulations, letting the population of the northern area of Quintana Roo know that there are alternative places to the pipes, throwing it in garbage bags where they deposit their used oil, the use of glycerin as a component livestock feed supplement as soil fertilizers and use in the generation of biogas.

Circular Economy, Glycerin, Biodiesel

Resumen

La Economía Circular de la glicerina una propuesta para reducir el impacto ambiental, el aporte económico, así mismo evitar el vertido de los aceites comestibles usados hacia los cuerpos de agua, los problemas hacia las plantas de tratamientos de aguas grises en el proceso del pretratamiento, en el relleno sanitario evitar que las escorrentías contaminen los suelos, debido al tipo de suelo Kárstico de la región. La obtención de la glicerina es uno de los objetivos del proyecto, parte del trabajo su aplicación de celda de combustible, como una fuente alterna de energía renovable. La metodología propuesta Economía Circular de la glicerina subproducto obtenido del biodiesel y los usos que de ella derivan, el aporte económico y sustentabilidad de este. Como resultado obtener un beneficio de tipo ambiental, económico, la cual requiere tanto el cumplimiento de leyes y normas ambientales, hacer saber a la población de la zona Norte de Quintana Roo que existen lugares alternativos a las cañerías, de tirarlo en bolsas a la basura donde depositan su aceite usado, el uso de la glicerina como un suplemento alimenticio de ganado componente como fertilizantes del suelo y del uso en la generación de biogás.

Economía Circular, Glicerina, Biodiesel

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Introduction

Glycerin a by-product of transesterification in biodiesel production Glycerin or glycerol (propanetriol) in its pure state is a colorless, odorless, viscous and non-toxic liquid with a very sweet taste and has several uses. Pure glycerin is a polyol with a carbon chain of three carbon atoms and three hydroxyl groups (CH₂OH-CHOH-CH₂OH). See figure 1. Its molecule has a large number of possible reactions due to the presence of alcoholic groups (primary and secondary) that can be replaced by other functional groups and form derivatives such as esters, amines and aldehydes. It is stable against oxygen under normal atmospheric conditions, but against strong oxidants it is converted into CO₂ and water.

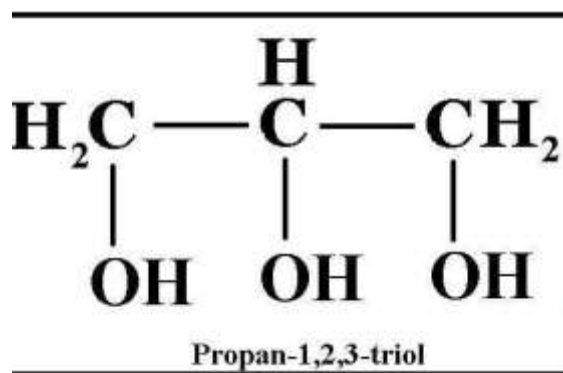


Figure 1 Glycerol propan-1, 2,3-triol - é is an organic compound belonging to the alcohol function.

Glycerin from the canola oil transesterification process is normally dark brown in color as shown in Figure No. 2 because it contains most of the substances that are not transesterifiable.



Figure 2 Transesterification process to obtain biodiesel and dark brown glycerin,
Own Source

Crude glycerin is a mixture containing different amounts of glycerin (higher percentage), detergent, alcohol (mainly methanol), sodium or potassium salts (Singhabhandhu, A. and Tezuka, T.2010) (Santibáñez, C.; Varnero, M. T. and Bustamante, M.2005) depending on the catalyst used, non-glycerol organic matter (MONG) and water.

The stoichiometric ratio for transesterification requires three moles of alcohol and one mole of triglyceride to give three moles of ester and one mole of glycerol; however, transesterification is an equilibrium reaction in which an excess of alcohol is necessary to drive the reaction to the product side, hence the usual conversion is 6:1, which is the first for which a complete reaction is achieved. The recovery of glycerin in the transesterification process is the fundamental part of biodiesel production, due to its industrial uses such as detergents, plastics, pharmaceuticals, studies such as Leevijit's suggest that the best results are achieved for higher ranges, between 9:1 and 12:1. In the production of biodiesel, glycerin is obtained as a by-product.

Glycerin is obtained in the transesterification process and is easily separated from the ester by decantation, requiring a purification process before its use in order to achieve the appropriate quality for its future application. See figure 3

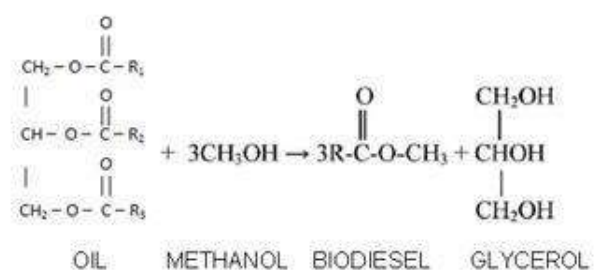


Figure 3 The transformation of vegetable oils for conversion into fatty acid methyl ester or biodiesel is carried out through the following continuous process
Source Biodis.

Used edible oils were characterized by acid number, peroxide number and dynamic viscosity, following AOAC 940.28, AOAC 965.33 and ASTM D2196, respectively. Moisture content was established by calculating the mass loss upon heating the oils (~ 5 g) from 25° to 120°C in a moisture analyzer (MX-50). González Restrepo, D. A. (2021).

Both its purification and the search for applications of crude glycerin have surprised the scientific group, due to the product of the accelerated growth of biodiesel production and the marked tendency to increase it. The glycerin obtained from the production of biodiesel has the following characteristics a maximum concentration of 60% glycerin, is of no value, since it is which contains a large amount of soaps, alkaline catalyst and methanol and this compound is environmentally hazardous; in order to take advantage of it without prior treatment (Torres-Rivero, L. A., Ben-Youssef, B. C., & Pérez-Gasca, M. 2019).

Alternative uses are being developed for this abundant biomaterial obtained from the processing of biodiesel by acid and alkaline catalysis. Once these technologies are commercialized, the potential for improving the economics of biodiesel production, from crude glycerin, would be increased to the analysis of the nutritional value used in livestock feed.

Uses of Glycerin by-product of biodiesel.

The uses are applied in since, if it is implemented in different sectors of the economy, such as in the use of fertilizers, liquid soap to clean bathroom floors, H₂ production from crude or purified glycerol.

It increases the yield of biogas production with the addition of glycerin. The applications of this by-product are the production of handmade soaps, degreaser, it is a non-irritating, biodegradable and recyclable compound.

Description of the method

The generation of large quantities of used edible oils by the restaurant industry, economic kitchens, and fast food, puts us on alert due to the lack of knowledge of the population, the bad practices on the disposal of used cooking oils, the lack of knowledge on the reuse of used oil, and the lack of knowledge on the reuse of used oil. degreaser, floor cleaner, is a non-irritating, biodegradable and recyclable compound.

Because the health of the population is at risk and, therefore, the quality of life that has been achieved by the process of industrialization, with the circular economic system, it is intended to replace the current linear system, which is only consume, use and throw away, this has led to an acceleration in the degradation of the global ecosystem. In this system, it is proposed to "reduce, reuse and recycle, and give a calm to the planet and renew its environment.

For the collection of edible oil, approximately 15 liters of edible oil were collected in the Institute's cafeteria. approximately 15 liters of residual edible oil from the cafeteria kitchen to obtain biodiesel, the final destination of the crude glycerin, see Figure 4.



Figure 4 Samples of oil collected in the Institute's cafeteria

Own Source

The entire experimental development was carried out from esterification with acid catalyst to the esterification and transesterification process to obtain biodiesel, as well as glycerin, as shown in Figure 5 below.



Figure 5. A) Esterification process, b) transesterification process to obtain biodiesel and the by-product glycerine
Own Source

Results

Crude glycerin is the main by-product obtained during the biodiesel production process, so its chemical composition contains residues of methanol, water, soaps and salts, see Figure 6, so it has to undergo a purification process to be used in various products.

A bibliographic review was carried out, resulting in the fact that there is not enough information on the subject of eco-design mentioned in one of the sections, in order to situate this research in the most current possible scenario and give this glycerin a useful life, and prevent used edible oils from contaminating large quantities of water through dumping, disposal, as well as the contamination of the karst type soil that predominates in the Yucatan Peninsula.



Figure 6 Glycerin obtained from the production of biodiesel in the Institute's chemistry laboratory
Own Source

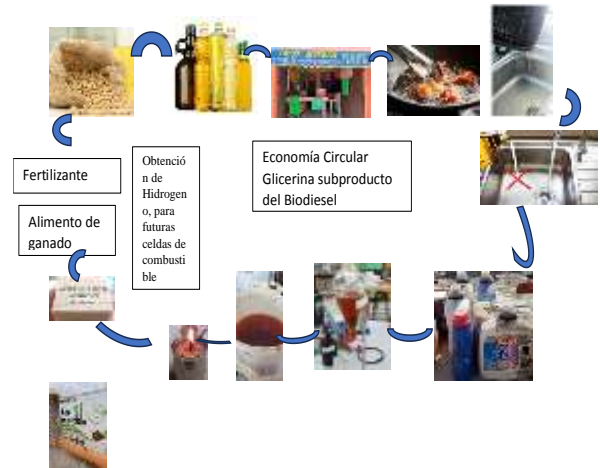


Figura 7 Below shows the circular economy proposal for glycerin as a biodiesel by-product

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Conclusions

The glycerin obtained from the biodiesel process contains residues such as methanol, salts, water, so it is of utmost importance to purify it and avoid any damage where it will be used. These pollutants, especially alcohol, are used in fuel cells to obtain H₂, as a source of renewable energy. It is of utmost importance to make this proposal known to people who are interested in acquiring the glycerin obtained from the biodiesel plant and give it an added value and obtain an additional source of income, thus protecting our environment from the negative impact of waste poured into the sewers, kitchen drains and garbage without prior treatment. The Circular Economy proposal for the use of crude glycerin obtained from biodiesel by-products will make an economic contribution and reduce the amount of oils used in frying and reduce the disposal of the AVU, and create awareness workshops on the disposal of these oils.

Annexes

The EC diagram is shown in Annex 1.

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