

Production of Biogas via Chickpea (*Cicer Arietinum*) Seed Leaching Solution

Hisham. R. Sadig*, Jilan Alameldeen Ibrahim*, Tawasol Mohamed Elbasheer*

*Chemical Engineering Department, Karary University, Omdorman, Sudan
heshamsadeg19@yahoo.com

Abstract

In this study, the Cicer seed leach solution is used as an alternative source of biomass, and the fragmentation process has a shorter time than the other biomasses. The obtained results specified that, the methane percentage by ethanol-test isn't unlike the KOH-method from the third week of the anaerobic process retention time until the tenth week. Formerly, adding new stock of Cicer seed solution. The methane production gradually increased in the dissimilarity style of the CO_2 , which gradually decreased by previous, associated, gradually increasing pH values. The period of retention and fraction of biogas mixture provide a proportional indicator of the quality of Cicer seed leaching solution. The maximum value of methane percentage (72%) was observed in the 8th week, and the maximum percentage of CO_2 was observed in the fourth week of the digestion process. Cicer seed leach solution showed a significant fragmentation agent for another biomass.

Key words-*biogas, cider seed, methane, CO_2 , fragmentation*

I. INTRODUCTION

Presently, energy is the furthestmost chief part of investigation according to the universal diminishing fuel resources. So the continually increasing world populace and demand, and the necessity of solving the problem of weather variation by eliminating the release of greenhouse emissions, the demand seeking of energy alternatives leads the exploration for an energy source that is environmentally trustworthy and can assist in facing the growing global demands of the forthcoming days[1][2][3][4]. The workable development and the basic is the resources obtainable, particularly energy facilities, to satisfy the elementary needs of an individual and the society for economic developing and enhancing social well-being. The biogas is signified as the most comprehensive field that attracted the attention of careers[5][6][7][8]. The biogas is created from bio-material. It can be produced from an extensive variety of organic materials and wastes, such as sewage sludge, manure, and civic animate waste. Materials like recyclable manure, sugarcane, waste, straw, and by-products from farming and industrial processes and particularly full-grown energy crops can also be used for the production of energy[9]. The biogas is a combination of materials, mainly, methane (50–70%), carbon dioxide, and water of the hydrogen sulfide. Owing to a high concentration of methane, biogas is very rich in energy. It's produced by anaerobic ingestion, which is the conversion of the organic material in a direction of obtaining biogas by bacterial groups functioning in the absence of oxygen[10]. The contents of biogas and its superiority will dependent on the fermentation circumstances, and nature of the organic matter used and. In over-all, the total fermentation time ranged between 35 and 60 days as common achieved period[11][12][13][14]. The abuse of this energy resource definitely, offering many advantages: energetical, environmental, economical, and technical. Mainly, the process of anaerobic digestion (AD) is chief of the gas production process and occurs through four sequential phases: hydrolysis, acidogenesis, acetogenesis, and

methanogenesis. It is reliant on the contacts between the various microorganisms that are able to provide the four above-mentioned stages[15][16]. Biogas has many advantages like, a demonstrative environmental fuel helping to decrease GHG (Green House Gases) discharges and waste reprocessing, in addition to produces a superior fertilizer as a side product along with electricity and heat production[17][18][19][20][21]. Even though, the compensations of biofuel have long been recognized, there has been a regeneration attention in this extent due to the huge sums of wastelands obtainable, predominantly in some countries like India where waste management is a major problem. A wide range of wastes, i.e. agricultural, animal wastes, civic, and food waste, also, can be used as feedstocks for the production of biogas. Biogas produced from the digestion of feedstocks under anaerobic conditions majorly constitutes methane CH_4 and carbon dioxide CO_2 with miniature amounts of hydrogen sulfide H_2S , moisture, and other trace contaminants[22][23][24][25]. Cicer arietinum (Chickpea) is a significant crop grown and used up by some part of the earth, particularly in the Africa, and Asia states.. It has noteworthy amounts of all the indispensable amino acids except sulfur containing types, which can be perfect by addition of cereals to the day-to-day diet. Chickpea has numerous possible health benefits, and, in combination with other beats and cereals, it could have valuable impact on some of the imperative human sicknesses like circulatory, diabetes, peptic diseases, and some cancers. Moreover, chickpea is a chief pulse product with a various collection of potential nutritious and health assistances[26]. The steps 'processes of AD occurs in the absenteeism of air, and passed through 5 different stages[27][28].

Countless research has studied the biogas resources and production processes, tending to find environmentally friendly alternative energy sources. Accordingly, in this research, the Cicer seed leaching solution was used as another source of that kind of biomass, as well as fast fragmentation seed for other kinds of biomass.

II. MATERIAL AND METHOD

Cicer seed purchased from local stores used as biomass, water, distilled water, and KOH purchased from Abdelmoneem Chemicals Company. Overall, the production of the biogas, began by mixing the organic resources (2.5 kg) with an identical size of water, until reached the stage of homogenization, it should be settled into the digestion container, the procedure of AD is carried out in the absence of air, and passed through 5 different stages. Firstly, Cicer seed leach solution prepared after wetting seed, and subsequently, all impurities (clay, sand, and hard parts of plant) have been disposed, they are mixed with water and decanted into the ingestion tank, and the digestion response starts. Secondly, anaerobic microorganisms worked to break down large molecules of as-prepared organic ingredients. Thirdly, the breakdown progression to the development of biotic acids to liberated gases such as carbon dioxide, hydrogen sulfide, and ammonia. Fourthly, carbon dioxide, hydrogen, acetate, hydrogen sulfide, ethanol, and very small amounts of methane, nitrogen, and ammonia gases produced by acid-forming bacteria. Fifthly, methane, carbon dioxide, and alkaline were produced by methanogenic bacteria produce and this known as methane production phase. Accordingly, in this study, the Cicer seed is mixed with water in a 1:1 ratio in a bottle size of 10 litres, and the simple process of producing and treating biogas is illustrated in Figure(1) below:

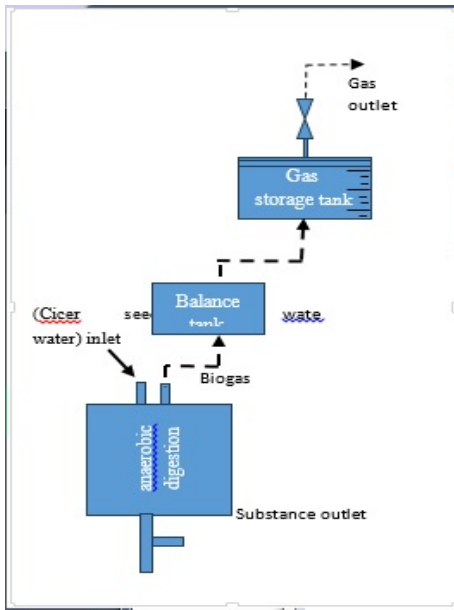


Fig. 1: the simple process of producing and treating biogas

A. The Digester

An inlet and outlet plastic tube arranged a bottle-scale, cylinder-shaped biogas digester. The digester was 10 liters and the digestion volume was 7 liters. For tracking up the digestion procedures, a tube with the orifice end for freeing the produced gas was fitted to the digester. In the digestion system, the obtained Cicer seed was wetted with the same size of water,

and the process was batch anaerobic fermentation under semi-stirring, room temperature for 3 weeks of retention time. Free gas volume was holed in the gas-catcher and valued by using the wetted shift with a formerly regulated scale in litres.

B. Biogas content

To determine the biogas content and quality. The digester and apparatus of KOH are used. The simple apparatus, as mentioned in[26] involves a glass U-tube shape for KOH solution container. This U-tube linked with a valve to regulate the solution level with ambient pressure after the removal of CO_2 . The tube was linked with injection of samples as an inlet of a biogas and with a gas outlet to release gases after removal of CO_2 . every week, regularly measurements of the temperature and pH were carried out, for calculating the biogas volume, The methane proportion was measured by means of the potassium hydroxide- method by the lab-scale investigation, as mentioned in a previous study[11] . The obtained gas was divided in a percentage (methane and CO_2 percentage) using the method of potassium hydroxide. All quantities were measured under ambient temperature and atmospheric pressure. The capacity of the gases were determined for standard conditions (temperature and pressure). The percentage of CO_2 was calculated as follows:

$$\text{percentage of } CO_2 = \frac{(V_1 - V_2)}{V_1} 100\% \quad (1)$$

Where V_1 : volume of biogas formerly removal of CO_2 , ml
 V_2 : volume of methane and the other gases after removal of CO_2 , ml

$$\text{Percentage of } CH_4 = 100\% - [CO_2\% + 3\% (H_2S \text{ and the other gases})] \text{vol.}, \% [11]. \quad (2)$$

Secondly, methane content is determined by using a syringe (10 ml) as a gas holding connected by the other holding ethanol, dissolving methane by pressing the as-produced gas through the ethanol, and. So, by calculating the remaining gas percentage in the syringe (CO_2 + other gases), and applying the equations (1) and (2), the comparison of the produced gas with other studies was carried out.

C. Cicer seed leaching solution as fragment starter agent

In addition to using Cicer leach solution as a biomass source, there is another benefit to applying it as a fragment agent for other biomass sources or food making processes, especially, toast named Qaraqosh in different parts of Sudan. In this experimental work, a simple test was done to examine this property.

III. RESULTS AND DISCUSSION

A. Methane and CO_2 contents

The results obtained from the experiments show the biogas as a purpose of its CO_2 proportion obeys the nature of commonly biogas production processes. Consequentially, when the CO_2 percentage lessening in biogas produced, the proportion of methane will increase. Figure(2). displays the difference of

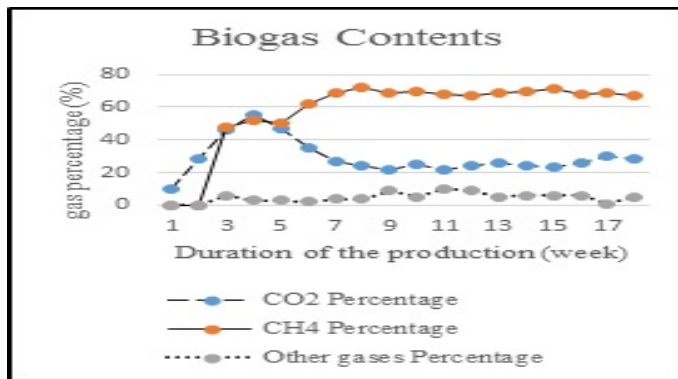


Fig. 2: variation of methane percentage, CO_2 , and other gas production with the progress of time.

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It can be perceived that the methane proportion of biogas regularly progressively rises within the and end of the second week, and then grasps a maximum value at the midpoint of the retention time. Correspondingly, to the passage of biogas through biochemical reactions and processes, it was noticed that there was no production of biogas and a very insignificant percentage of methane in biogas samples previously in the second week, and after sixteen weeks from holding time, figure(2) shows the result of methane proportion by the ethanol-dissolving test and KOH method. The methane percentage by ethanol-dissolving-test was slightly close-up to the KOH method from the beginning of the retention time anaerobic process till the tenth week, and the reason for that is due to the perfect series reaction that occurred, which was concerned with Cicer seed leach solution feeding. On the other hand, the other gases, such as H_2S and others, in some tests showed a high percentage; this was also due to the feeding manner. But, it was by both methods nearly matching and in the same direction from the third week to the termination of the holding time.

B. Retention time and pH change effect

from the figures(3 and 4). It was observed that the pH is affected by the biochemical reaction that occurs in the digestion bottle, so it gradually increases and consequently effects in increasing the methane content. Besides that, the feeding of Cicer seed solution after a week and a half influences and plays a role in fluctuation of the pH. From these results, the Cicer seed solution shows a significant interaction as improving the biochemical reaction in the all-digestion stages.

C. Impurities (other gases)

Gases calculated in this experiment by using the ethanol-test vs. KOH method. Figure(5) illustrates the comparison of the obtained values from the ethanol-test with the KOH values. The close up remarked in values from the second week until the tenth week, and then some high values were observed. This may be due to the repeating Cicer seed solution feeding to the digestion bottle.

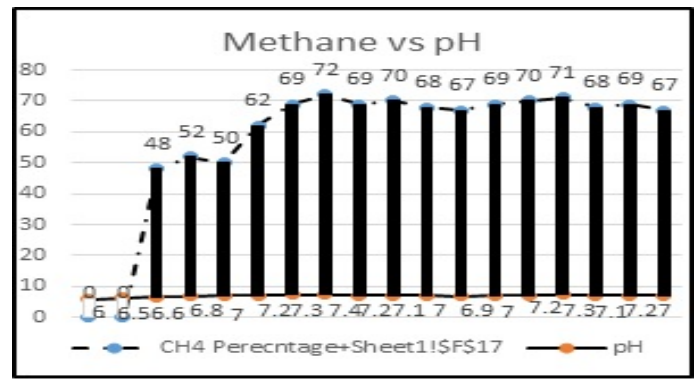


Fig. 3: Methane effected by pH

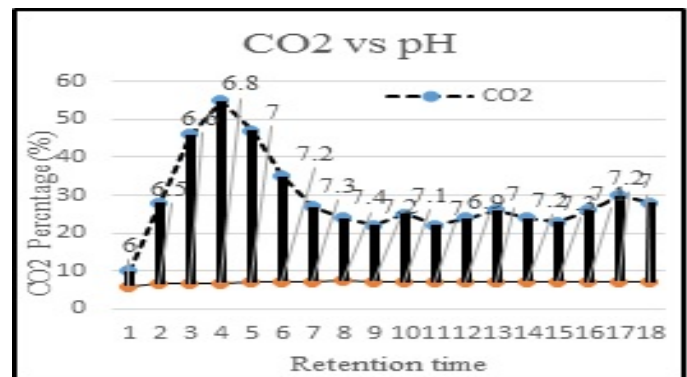


Fig. 4: CO_2 effected by pH

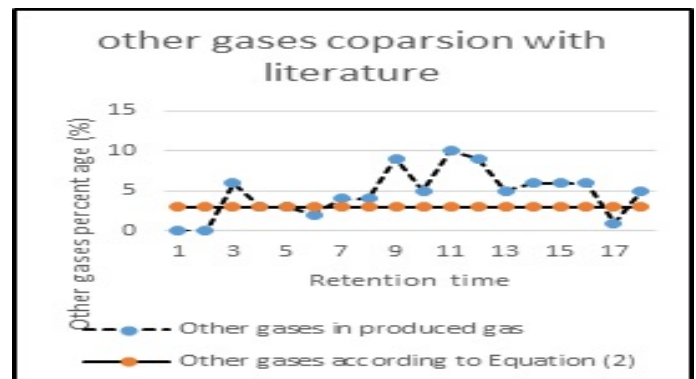


Fig. 5: The comparison of produced gas

D. Conclusion

In this research, the biomass fragmentation didn't take as long as other biomasses. Thus, the obtained results indicated that, the methane percentage by the ethanol test isn't different than by the KOH - method from the anaerobic process third week of the retention time until the tenth week. Before adding a new stock of Cicer seed solution. The methane production gradually increased and at the dissimilarity of the CO_2 , which gradually decreased by previous, accompanied by a gradually increasing pH value. The time of retention and percentage of biogas mixture should be proportional indicators of the quality of Cicer seed leaching solution. The maximum value of methane percentage (72%) observed in the 8th week. Cicer

seed leach solution showed a significant fragmentation agent for another biomass.

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Hisham Rabia Sadig is an assistant professor of physics and chemistry of materials in Chemical Engineering department Engineering Faculty- Karary University. He received his B.Sc. and M.Sc. degrees in Chemical Engineering from Karary University and his Ph.D. degree in physics and chemistry of materials from material science and technology college- Nanjing University of Aeronautics and Astronautics-China. His current research interests include materials doping and fabrication composite.



Jilan Alameldeen Ibrahim Mohamed is a Bsc. Graduated student studied in Karary University- chemical engineering; she interested in the energy field, and has training in Khartoum refinery Co.



Tawasol Mohamed Elbasheer is a Bsc. Graduated student studied in Karary University- Chemical engineering; she interested in the energy field and Chemical industries.