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Utilizing the agitator and initial digestion before the ABR reactor for biogas production factors pre-regulation

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ABSTRACT: Utilization of solutions and pre-activating wastewater and correcting it before entering the bioreactor for biogas production is an important issue. In this paper, we tried to cover the technical problems of using the ABR reactor as the main reactor for biogas production by adding a primary digester with the agitator while improving the quality of the ABR reactor production. The ABR reactor is capable of increasing the growth of methane bacteria and reducing the COD of wastewater, but due to its lack of mixing in the indoor environment and high stagnation time, it will induce nutrient deposition and slow down the production process in the long run. The use of agitators can be effective in solving problems and improving the quality of production, since the presence of the agitator in the first phase can regulate factors such as pH and wastewater temperature. On the other hand, it is capable of activating bacteria. Therefore, the use of an initial digester of the input wastewater with the mixer is effective before the wastewater is introduced into the main reactor.

***Keywords*:** bioreactor -ABR reactor-initial digester- agitator- stagnation time

INTRODUCTION

The reaction of the agitator engine and its effect on the bioreactors and the types of anaerobic digestion has been proven by the researchers for 20 years. Although the existence of a mixing system and agitator engine will increase the power consumption of the bioreactor, it is necessary for the better functioning of microorganisms. Usually, mixers are used in mixing reactors for displacement of sludge and biogas lubricant production. So, you should pay attention to two things: firstly, the type of agitator blade design is effective in place of the active sludge, and in the next step, how to start and operate the mixer engine to minimize electricity consumption for biogas production. Now, referring to a series of studies and experiments on the impact of the mixer's advantages and disadvantages on biogas, we will get comprehensive information to advance the paper. In order to obtain the best possible growing conditions the speed, pH and temperature levels are maintained at constant rate. To investigate the relationship between speed and concentration the effects of the other parameters with respect to the agitator speed were studied [1]. Verifying the 2-Hz vertical stirrer in reactors will stabilize some of the effective parameters in the production of biogas, especially acidity [3]. The effect of temperature and stirring process on biogas production from cow dung manure was studied in two types of experiments, under constant temperature 37°C and average environmental temperature with the same loading rate. Mixing process is usually finished through different methods, including mechanical mixers or recirculation of the produced biogas using pumps with low rpm. Biogas is obtained by fermentation of organic materials such as animal, human, agricultural and industrial wastes [4]. Stirring of the fermentable material of biogas reactor is often recommended to ensure intimate contact between the micro-organisms and particle organic material to increase rate of breakdown and degradation of organic compounds and increasingly the gas production rate, as well as breakdown the flouting material as scum to help the gas storage in

gas space of biogas reactor [2]. The biogas production rate and the methane content were being measured at different stirring speeds and intervals periods [16]. The importance of mixing in achieving efficient substrate conversion has been reported by several researchers [6]. Applying effective changes to the temperature and speed of the agitator can have a great influence on the factors of biogas production such as minerals, pH and moisture. This has increased the methane and has been proven in BES and BETS systems [7]. In order to create a uniform mix of different wastewater to achieve the amount of suspended solids that affect the production of biogas, the mixing system should be used, which the best mixer system is the mixer engine [9]. Adequate mixing was shown to improve the distribution of substrates, enzymes and microorganism throughout the digester[8] whereas inadequate mixing was shown to result in stratification and formation of floating layer of solids. Studies have been shown using a slow moving motor with a large butterfly diameter Advantages of using a fast floating displacement mixer with a smaller butterfly diameter, savings potentially increases the quality of the mix by up to 70% [10]. In the above cases, the activities of the researchers and the general effects of the mixing system on bioreactors were noted for biogas production. In the next section, we intend to achieve new and similar results with new experiments and compare them with other studies in order to complete the data.

Discussion

Add the initial digestion of the complete mixture before the ABR bioreactor

First and foremost, we have comprehensive information on agitator bioreactors. In this experiment, it was attempted to determine if the presence of the primary digester with the agitator engine had an effect on the better production of biogas in the ABR reactor? The answer to this question can be verified by knowing the ABR reactor. ABR reactor is defined as a series of small reactors (UASBs) that do not require granularity for their operation. The design consists of a series of vertical baffles where the sewage flows from below it to reach the outlet. The bacteria inside the reactor are rising and landing because of the characteristics of flow and gas production in each compartment. So the sewage can have excellent contact with a large amount of active biomass [7,11]. One of the most important advantages and characteristics of these reactors is the low level of hydraulic stay (HRT), resulting in less volume, high cellular residence time (SRT), resistance to sudden hydraulic and organic loads, the need for gas separators and Solid, the ability to separate the phases of acidification and mechanizing, the lack of complex mechanical equipment and the cost of construction and management [15,16]. The separation of the acid phase and methane increases the resistance to toxic substances and changes in environmental parameters such as pH, temperature and organic loading (ORL) [6]. The ABR process is widely used in the treatment of tannery waste, pharmaceutical industry, as well as wood and paper units. First, we will introduce the experimental model of the developed ABR reactor along with the initial digester, along with the steps of the upcoming experiments. Figure 1 shows the laboratory model.

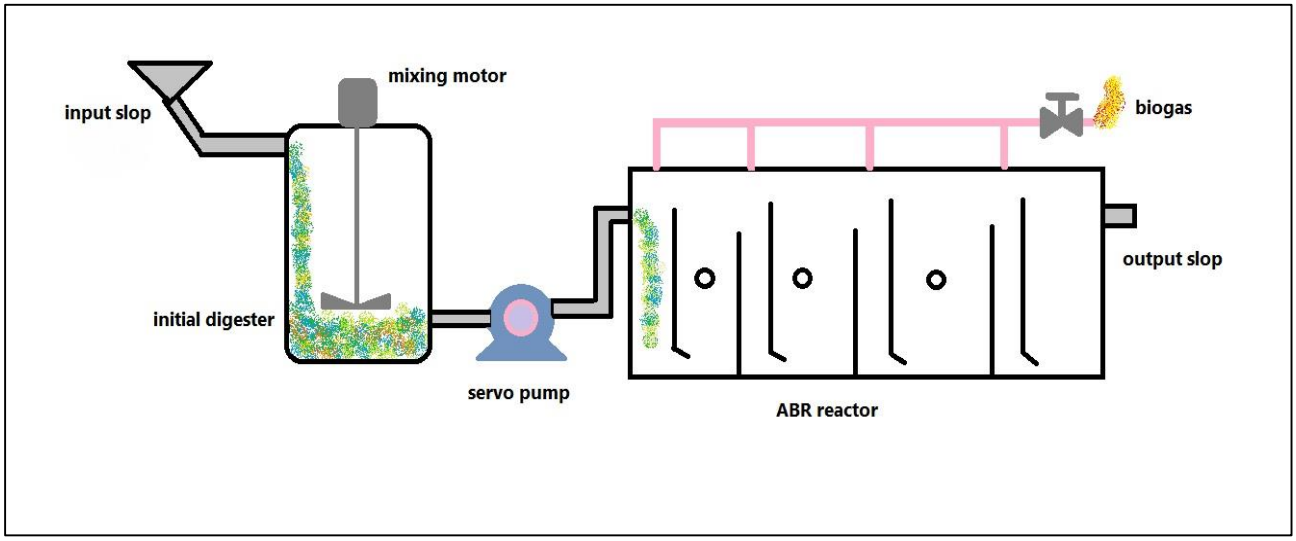

Figure 1: Developed ABR Reactor with Primary Complete Mixing

The above process was examined in 2017 by Shengjun[13] and his colleagues. Their research was mostly about the changes in potato starch COD for a kilogram of gas. By applying the initial digesters and agitators before the ABR reactor, they noticed the effects of the parameters of the two digesters, but mentioning the effects of the stirrer in maintaining the desired conditions there was no waste water before the main digestion[13]. materials and methods for testing are specified in Table 1. In the forthcoming research, livestock exhausts are used and the site of the experiment is a cool place. The reason for selecting a cold garlic region is the feasibility of such areas for biogas production.

Table 1: Materials and methods of testing

Type of wastewater	Initial temperature	pH	Ts	Flow of wastewater to ABR	Stirrer speed	Initial digestion volume	ABR Reactor Size
cow	30°C	7.5	15%	0.2 lit/time	300Rpm	20 liter	25liter

according to the data in the above table, the experiments are based on the duration of the agitator operation at initial digest. The time of duration of the mixer operation is as follows:

1) 45 minutes per hour.
2) 15 minutes per hour.

In the primary digestion, no auxiliary heating system has been used and attempts have been made to bring the waste into existing digestion with its present conditions. The main objective of the initial digestion test is to keep the wastewater condition stable before reaching the original reactor. Therefore, taking into account the above, only the effect of the agitator on the initial digester without the auxiliary equipment is considered.

The data obtained from the experiments

The data in the above experiments that directly get affected with the agitator, are temperature and pH. These two factors are tested online in bioreactors and have direct impact on biogas production. So maintaining their condition is very important. following are indicated diagrams showing the effect of the agitator characteristic time on temperature and acidity. The research can be characterized by two comprehensive experiments

Test 1:

Stirrer speed= 300RPM
Operating time= 45 minutes per hour of full day
Type of parameters= Temperature and pH

Test 2:

Stirrer speed= 300RPM
Operating time= 15 minutes per hour of full day
Type of parameters= Temperature and pH

The reason for choosing these types of tests is specified in the papers.

In particular, the speed between 200RPM and 300RPM is suitable for the circulation of the mixer in the wastewater and regulates the mobility of the microorganisms [13]. Adjusting mixing time and stirring stimulus is an effective factor in setting parameters and accept suitable effective output[9]. Therefore, it is possible to achieve acceptable results using the maximum operating hours of the stirrer, but it is necessary to control the operating time and the standby of the mixer to maintain proper response. According to the steps of the test, the response of the pH agent in the two experiments is shown in Fig. 2, and in Fig. 3, the graph of the two experiments is shown.

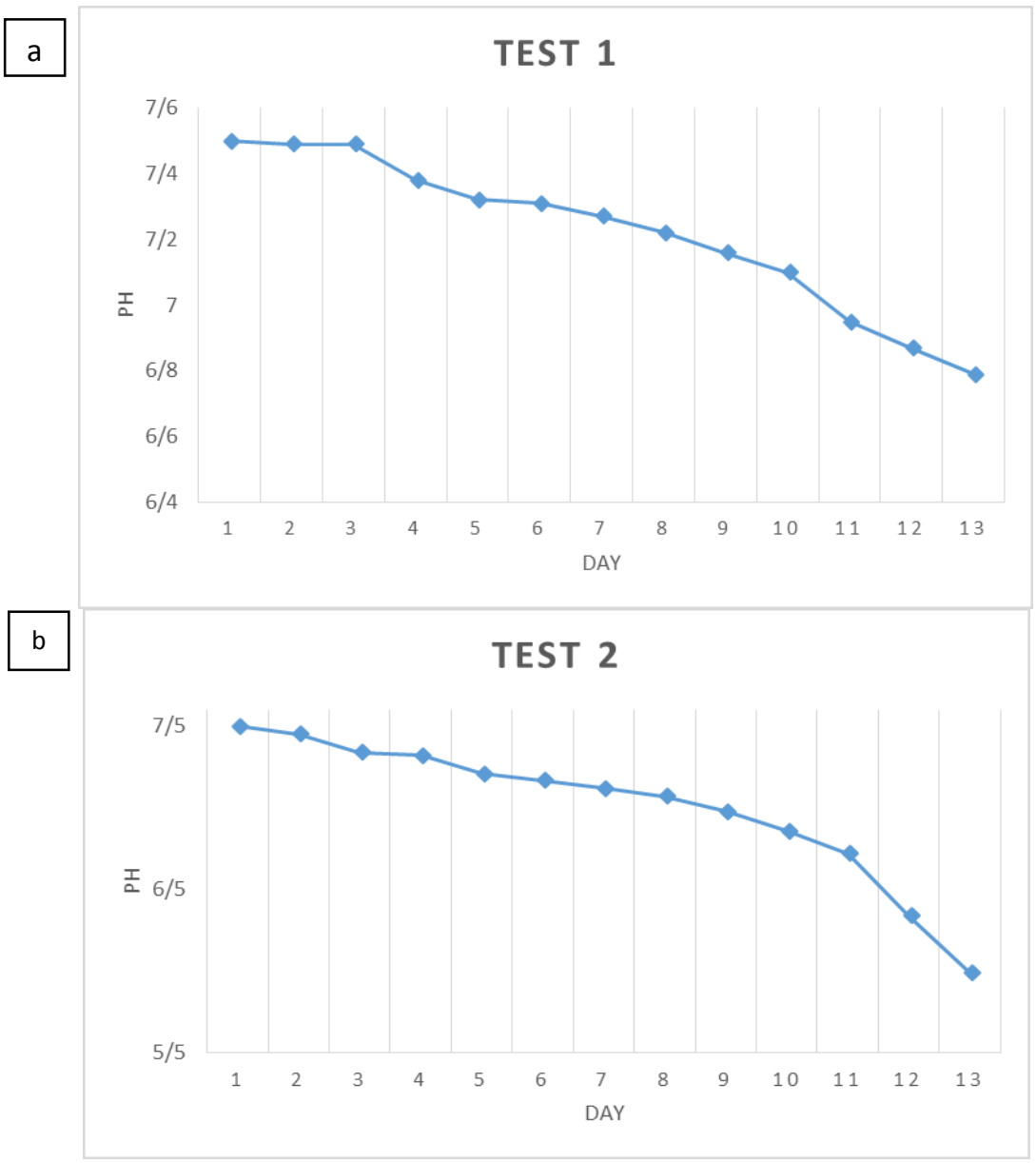

Fig 2: PH diagram in experiment 1 (a) and pH graph in experiment 2 (b).

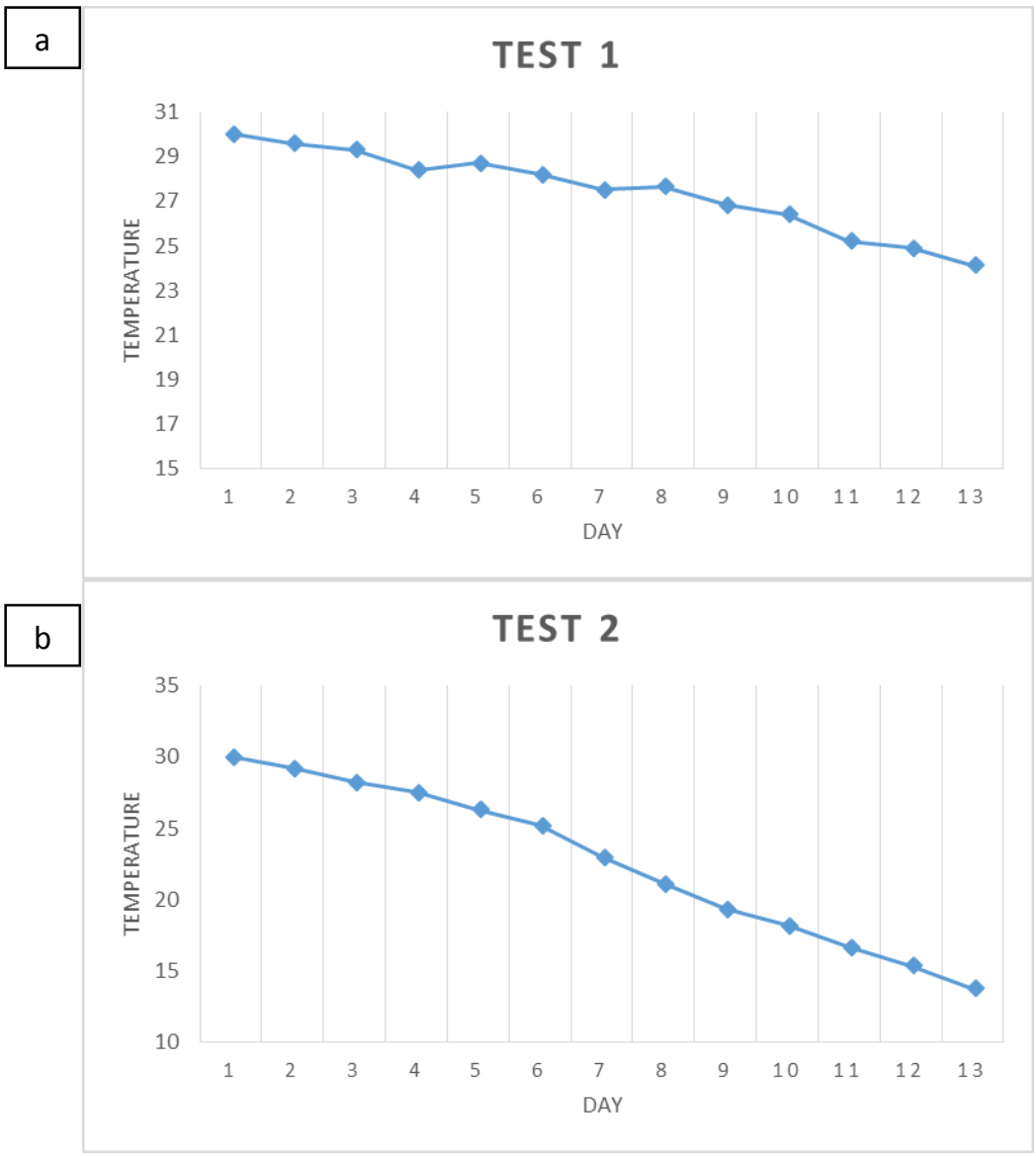

Fig 3: The temperature graph in experiment 1 (a) and

the temperature graph in experiment 2 (b).

By comparing the values of the above experiments and putting them together, we find that the presence of the stirrer has a great influence on changing the pH and temperature factors, and the existence of this system will control the loss and stabilization of the above factors. However, increasing the agitator time improves the stabilization and reduction process. Figures 4 and 5 show, respectively, the process of changing the pH and temperature factors in two experiments.

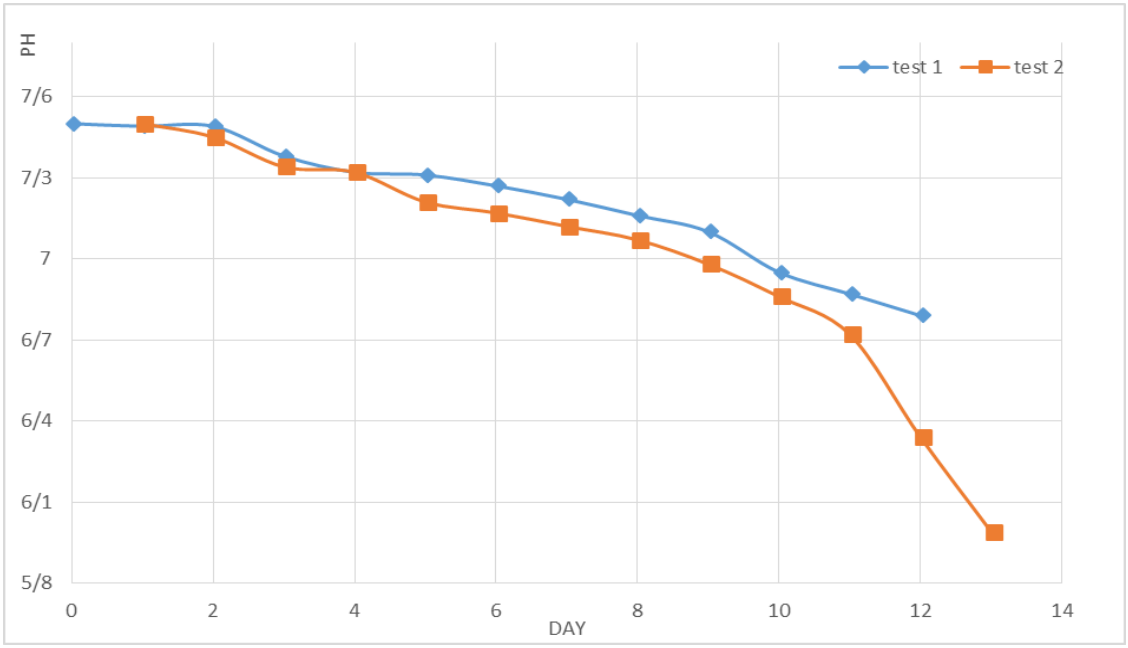

Fig 4: comparison of pH in two experiments

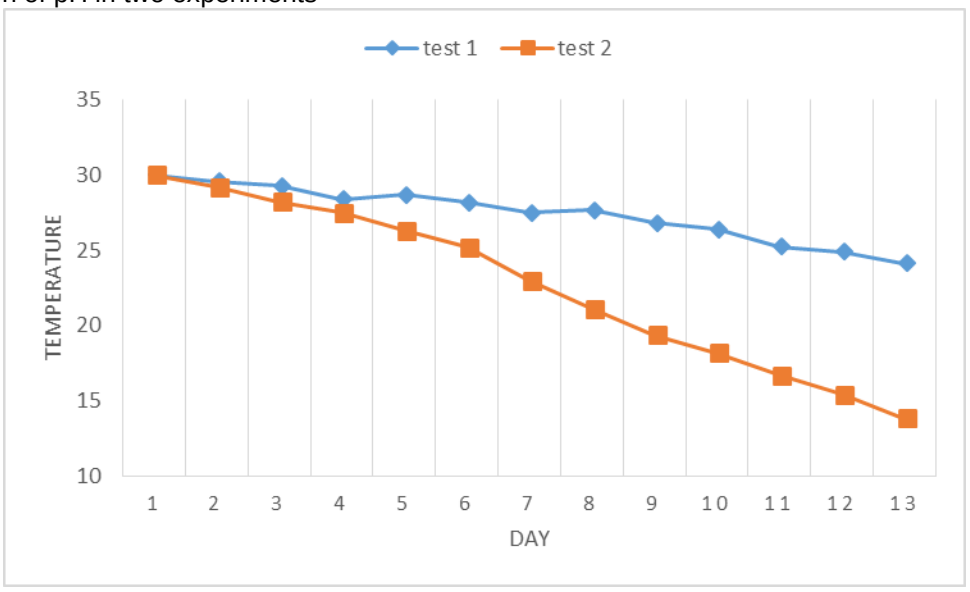

Fig 5: Compare the temperature chart in two experiments

Compare data with similar articles

Several papers on the effect of the agitator on the bioreactor and its positive effect on the biogas production factors have been published. Here, we plan to make sure that the tests performed are verified by comparing the charts of some of the papers. Since the present study did not utilize any auxiliary equipment other than the agitator in the initial digest. Thus, the charts of the factors under test were decreasing and gradually diverged from their initial conditions. For example, if you were using preheater equipment in the initial digester, it was possible to see better responses. According to recent studies, the use of horizontal and vertical mixers and the addition of controllable heating equipment to the bioreactor maintains the pH and stabilizes its desired amount in the wastewater [1].

Figure 6 shows the graph of acidity caused by the action of digestion with a horizontal and vertical stirrer.

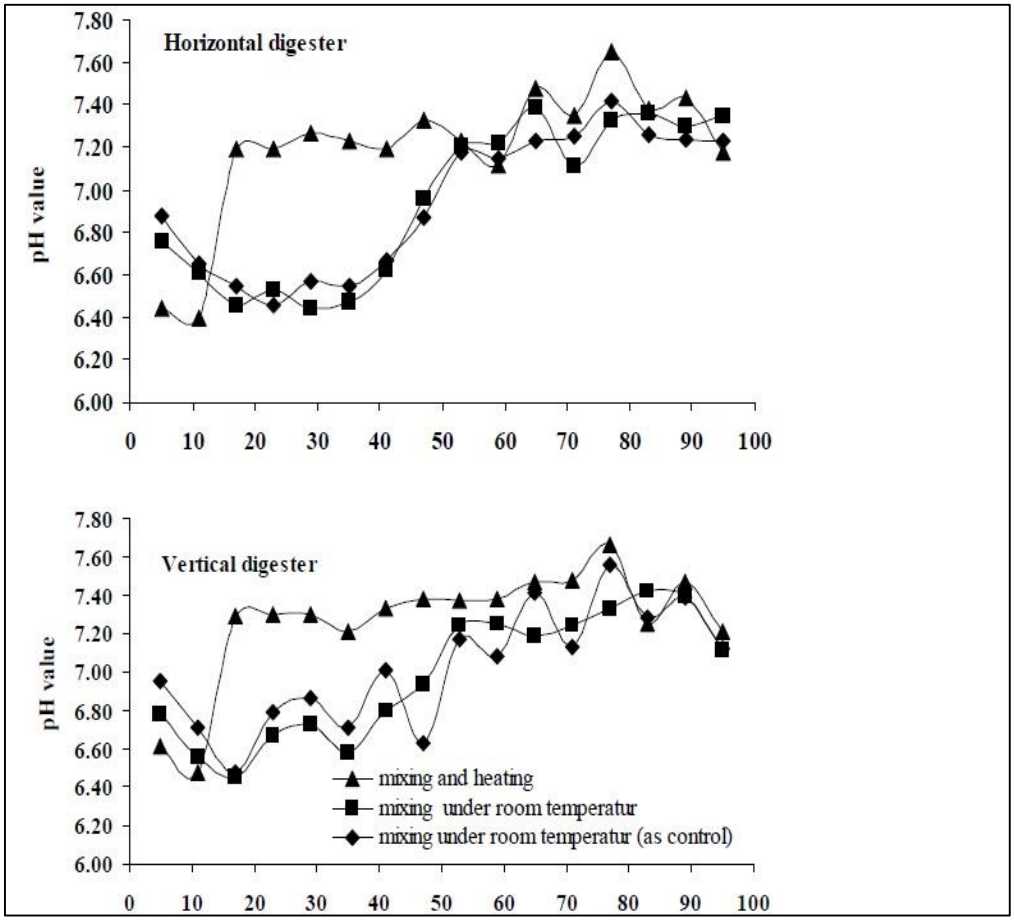

Fig 6: The pH diagram of the yield of two digesters with different mixers[1].

In addition to the desired effect of the mixer on the acidity adjustment, we will have a good effect on reducing the amount of COD of the wastewater by the agitator system[9]. One of the important issues in setting the environmental conditions of the wastewater is to reduce the amount of wastewater COD below 1000ppm. Therefore, it can be concluded that the use of anaerobic digestion and complete feeding of bacteria in anaerobic conditions reduce contaminating factors. On the other hand, increasing the speed and timing of the agitator will improve the process. The effect of adding a speed control system and operating time on the mixer also improves the control of the biogas production factors[14]. Figure 7 shows the graph of the temperature and acidity adjustment by applying the control system on the stirrer.

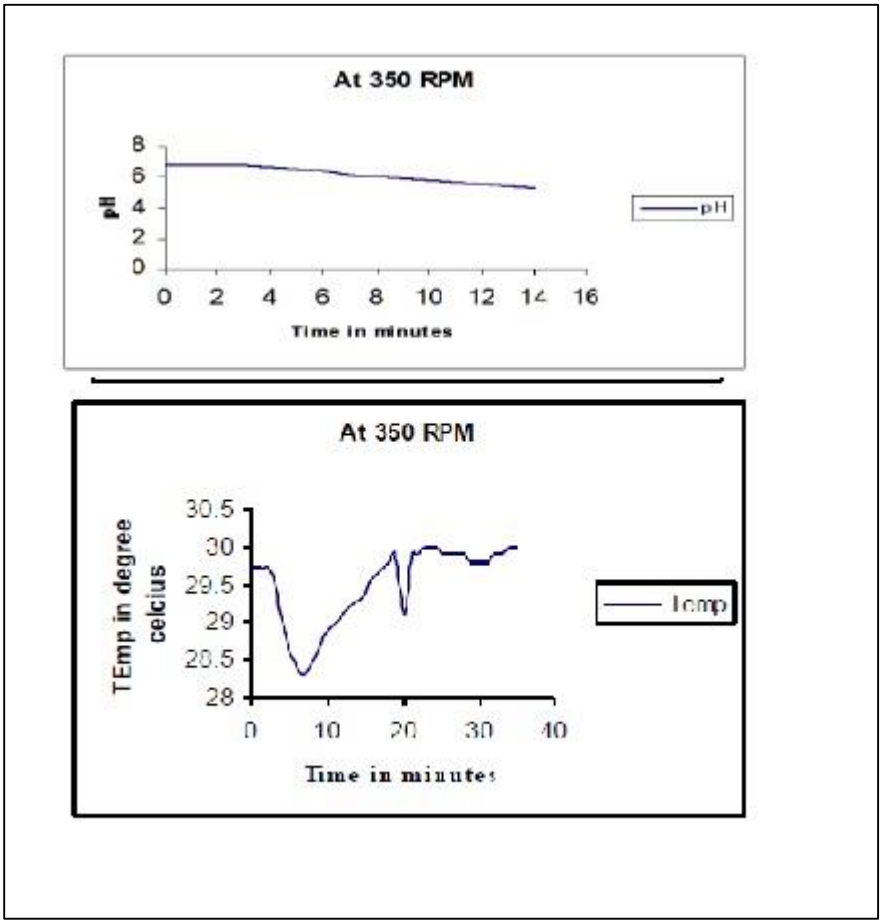

Fig7: Applying the agitator control system and adjusting pH and temperature[14].

According to the tests and studies on the characteristics of the ABR reactor, it can be concluded that the initial digestion with the stirrer is able to increase the benefits of the ABR reactor. In principle, the preparation of wastewater for production at any stage can make the biogas production path more smooth.

Conclusions

Based on the experiments carried out and their comparison with previous studies, the results of this research are as follows:

1- Adding the first digestion, such as the complete mixing of the bioreactor before entering the effluent into the ABR reactor, will control the loss of pH and temperature, and therefore, the conditions of the bacteria before entering the environment of the ABR environment will be better.

2- The slow speed of the stirrer and its increased working time prevent the rapid reduction of pH. on the other hand, Increasing the performance of the mixer makes the temperature uniformity in the sewage and prevents the sudden drop in temperature in the wastewater.

3- The mixer moves the microorganisms and allows them to feed and grow before they enter the main reactor.

4- Since the ABR reactor is capable of removing acidifying agents and decreasing the amount of COD, the agitator also has similar effects on the wastewater. Therefore, it can be concluded that the presence of a bioreactor with an agitator before the ABR reactor increases its efficiency.

5- The technology used to pre-activate bacteria and the speed of production of biogas is effective before nutrient deposition and can have a beneficial effect on the environmental problems of the wastewater.

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