

The Abstract of the doctoral dissertation on  
"Mixing substrates in reactors fermentative biogas plants"  
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The literature on the study of the influence of mixing methods on biogas production presents various results that are difficult to interpret unambiguously. Most authors consider mixing to be an important parameter that has not been sufficiently researched yet. Lindmark Johan (2014), summarizing the results of his research, said that due to its complexity, the mixing process requires further research.

In the analyzed literature, there is no information on the mutual correlations between the mixing frequency, type of mixing and hydraulic retention time (HRT) and their impact on biogas production. Therefore, the following questions were formulated in the work, which were adopted as research problems:

- Will the type of mixing and change of mixing intervals affect the production and composition of biogas in the reactors tested?
- Will the type of mixing and change of mixing intervals with simultaneous HRT change affect the production and composition of biogas in the reactors tested?

The aim of the research was to gain knowledge about the processes occurring during the mixing of the fermentation mass in the laboratory in the biogas reactor, which will allow better understanding of this process and help in the planning and implementation of the construction of biogas plants.

In order to achieve the above assumptions, laboratory tests were carried out and the results were subjected to statistical analysis. So-called multidimensional approach, which allowed to assess the simultaneous influence of the type of mixing, mixing frequency and HRT on selected components of biogas.

The experiment made it possible to conclude that the type of mixing has a significant impact on the biogas production, which is higher when using a mixing pump with mixing with a paddle agitator. An additional analysis showed that the type of mixing has a significant effect on the content of carbon dioxide, oxygen and the concentration of hydrogen sulphide in the biogas composition. However, no influence was found on the methane content.

The research also showed a significant impact on the composition and production of biogas mixing frequency. In contrast, the mixing frequency had no effect on the oxygen content which was at a constant level of 0.3 - 0.4%. There was also no significant influence of the mixing frequency on the content of carbon dioxide.

The best results of biogas production were obtained for the 3n mixing frequency, i.e. extending the mixing frequency in both reactors by 10 minutes, i.e. from 30 minutes to 40 minutes in a paddle reactor and from 20 minutes to 30 minutes in a reactor equipped with a mixing system with a pump. The proportion of methane was the higher at a mixing rate of 2n, i.e. shortening the mixing rate by 10 minutes in both reactors. In the reactor with a paddle agitator time from 30 minutes to 20 minutes was shortened, while in the reactor with the mixing system of the pump, the pump activation time was shortened from 20 to 10 minutes.

The hydraulic retention time (HRT) had an effect on the contribution of the gases studied: methane, carbon dioxide and hydrogen sulphide, and biogas production. It did not affect the percentage of oxygen. In total, the highest biogas production values were recorded with HRT 9 days lowest with HRT 15 days. In turn, the share of methane in the biogas composition was the highest at HRT 9, and the lowest for HRT 15 as well as the content of hydrogen sulphide.

Studies have shown, and also the statistical analysis has confirmed that the hydraulic retention time and mixing frequency considered simultaneously have a significant impact on the biogas production and its composition in particular methane and hydrogen sulphide. Similarly as the HRT and the type of mixing considered simultaneously.

Moreover the hydraulic retention time, type and frequency of mixing considered simultaneously have a significant impact on the contribution of carbon dioxide and hydrogen sulphide in the biogas composition. They do not affect the amount of biogas produced.

The results obtained will be used in the design and construction of a prototype biogas installation implemented as part of the Biostrateg 2 acre project. KompUtyl

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