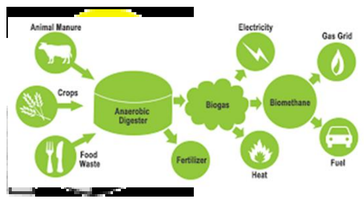

НАУЧНА КОНФЕРЕНЦИЯ С МЕЖДУНАРОДНО УЧАСТИЕ

“НОВИ ИНДУСТРИИ, ДИГИТАЛНА ИКОНОМИКА, ОБЩЕСТВО – ПРОЕКЦИИ НА БЪДЕЩЕТО – IV”

БЪЛГАРСКА АКАДЕМИЯ на НАУКИТЕ 1869

РУСЕНСКИ УНИВЕРСИТЕТ “АНГЕЛ КЪНЧЕВ”

ФИЛИАЛ РАЗГРАД

BULGARIAN ACADEMY OF SCIENCES

INSTITUTE OF CHEMICAL ENGINEERING

“PRODUCING BIOGAS BY APPLIYNG ELECTRICAL CHARGE”

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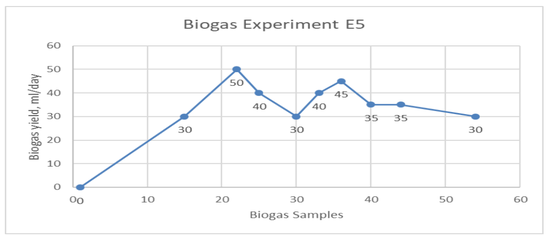
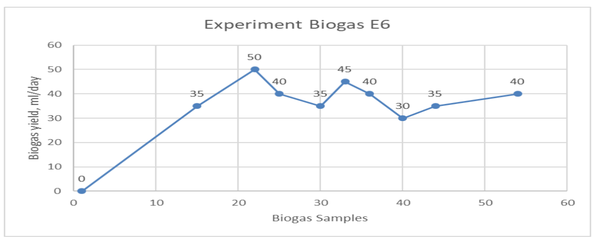
Abstract: *The paper reviews the methods of applying electrical charge to manure, which is important part of the anaerobic fermentation, in order to produce biogas. During the experiments, different voltages are applied to the manure. The aim is to investigate the influence of the electrical charge with manure. It's believed that the electric charge improves the process of anaerobic digestion and results in higher yield of biogas with higher methane content. The experiment consists of two main parts: part one is the plant material, which is treated with acid and part two which is the manure treated with electric charge. After the two materials are treated, they are mixed and placed in glass bottles, which are hermetically closed and attached to biogas collectors. Then the bottles are placed in a water bath at 35 ° C. Samples were taken daily for analysis.*

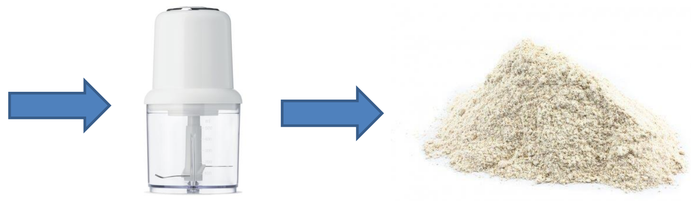
Keywords: Biogas, plant material, electric charge, methane content

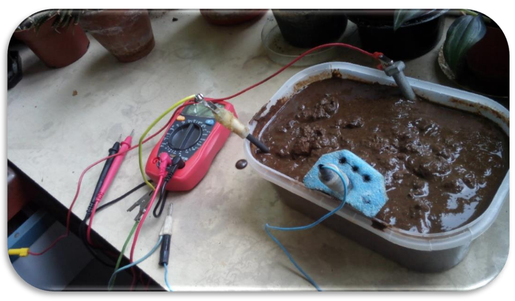
Experiment 5
The coniferous material is shredded with a chopper. This treatment is needed in order to make the organic material more easily accessible for the following acid hydrolysis treatment and also to be more accessible by the microorganisms. After the shredding is finished, 16 g are checked on scales and placed in a flask, then a solution of 100 ml of 1% of sulphuric acid is added to the flask. Then the flask is placed in autoclave for 20 minutes, at 121 ℃. After the autoclave treatment is over, the flask is taken out and left to cool down. In the meantime, the manure is treated with electrical charge for ½ hour at 0.75 V. When the flask is cool enough, the electrically treated manure (300 g) is poured into a glass bottle, which will serve as bioreactor vessel. Then 8 g of glycerol are added as a cosubstrate. Then the bioreactor is placed in water bath and it is also connected with pipes to cylinder which will serve as gasholder. Samples were taken for analysis.

Experiment 6
The coniferous material is shredded with a chopper. This treatment is needed in order to make the organic material more easily accessible for the following acid hydrolysis treatment and also to be more accessible by the microorganisms. After the shredding is finished, 16 g are checked on scales and placed in a flask, then a solution of 100 ml of 1% of sulphuric acid is added to the flask. Then the flask is placed in autoclave for 20 minutes, at 121 ℃. After the autoclave treatment is over, the flask is taken out and left to cool down. In the meantime, the manure is treated with electrical charge for ½ hour at 1 V. When the flask is cool enough, the electrically treated manure (300 g) is poured into a glass bottle, which will serve as bioreactor vessel. Then 8 g of glycerol are added as cosubstrate. Then the bioreactor is placed in water bath and it is also connected with pipes to cylinder which will serve as gasholder. Samples were taken for analysis.

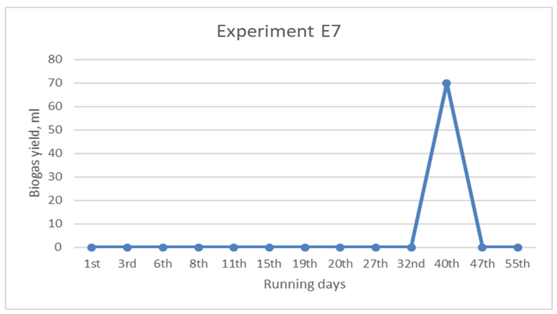




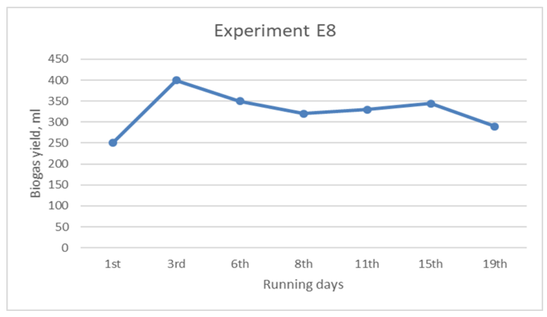




Experiment 7
In this and the next several experiments, the plant material is changed with straw. The purpose for that is to research how materials from different plant origin would behave according to the treating procedures and what results would be obtained regarding biogas production. The treatment includes the very same steps as with the coniferous material. The straw is shredded with a chopper. After shredding, 16 g of straw material are weighted on scales and placed in a flask, then a solution of 1% H_2SO_4 100 ml are added to the flask. Then the flask is placed in autoclave for 20 minutes at 121 ℃. After the autoclave is finished, the flask is left to cool for some time. When the flask is cool enough, 8 g of glycerol (waste glycerol) are added to the flask. After that 300 ml of cattle manure are poured into the flask. Then the flask is placed in water bath and it is also connected with pipes to cylinder which will serve as gasholder. Samples were taken for analysis.

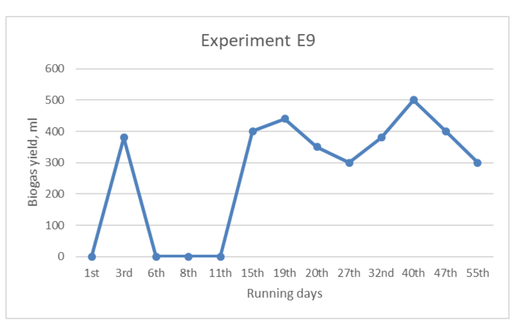


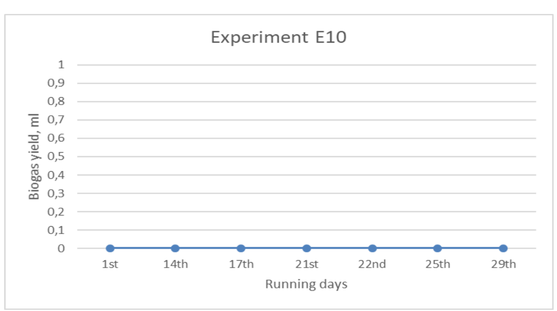
Experiment 8
The straw is shredded with a chopper. After shredding, 16 g of straw material are weighted on scales and placed in a flask, then a solution of 1% H_2SO_4 150 ml are added to the flask. Then the flask is placed in autoclave for 20 minutes at 121 ℃. After the autoclave is finished, the flask is left to cool for some time. When the flask is cool enough, 16 g of glycerol (waste glycerol) are added to the flask. After that 300 ml of cattle manure are poured into the flask. Then the flask is placed in water bath and it is also connected with pipes to cylinder which will serve as gasholder. Samples were taken for analysis.



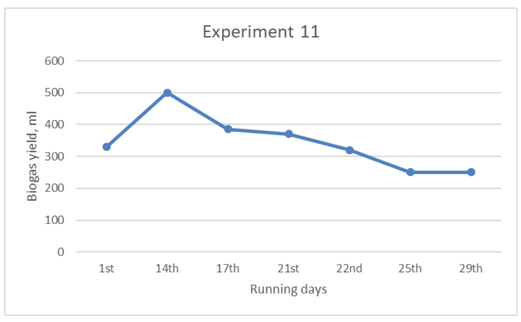
Experiment 9
The straw is shredded with a chopper. After shredding, 32 g of straw material are weighted on scales and placed in a flask, then a solution of 1% H_2SO_4 200 ml are added to the flask. Then the flask is placed in autoclave for 20 minutes at 121 ℃. After the autoclave is finished, the flask is left to cool for some time. When the flask is cool enough, 16 g of glycerol (waste glycerol) are added to the flask. After that 300 ml of cattle manure are poured into the flask. Then the flask is placed in water bath and it is also connected with pipes to cylinder which will serve as gasholder. Samples were taken for analysis.

Experiment 10
The straw is shredded with a chopper. After shredding, 16 g of straw material are weighted on scales and placed in a flask, then a solution of 1% H_2SO_4 150 ml are added to the flask. Then the flask is placed in autoclave for 20 minutes at 121 ℃. After the autoclave is finished, the flask is left to cool for some time. When the flask is cool enough, 8 g of glycerol (waste glycerol) are added to the flask. After that 300 ml of cattle manure (DC 0.5V ½ h) are poured into the flask. Then the flask is placed in water bath and it is also connected with pipes to cylinder which will serve as gasholder. Samples were taken for analysis.

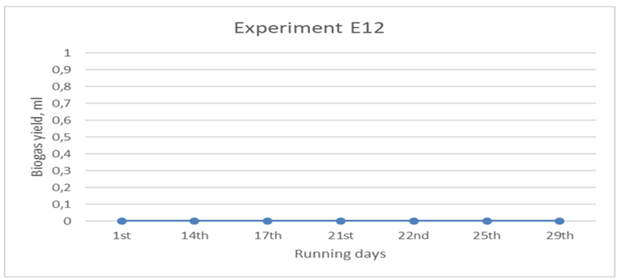




Experiment 11
The straw is shredded with a chopper. After shredding, 16 g of straw material are weighted on scales and placed in a flask, then a solution of 1% H_2SO_4 150 ml are added to the flask. Then the flask is placed in autoclave for 20 minutes at 121 ℃. After the autoclave is finished, the flask is left to cool for some time. When the flask is cool enough, 16 g of glycerol (waste glycerol) are added to the flask. After that 300 ml of cattle manure (DC 0.5V ½ h) are poured into the flask. Then the flask is placed in water bath and it is also connected with pipes to cylinder which will serve as gasholder. Samples were taken for analysis.



Experiment 12
The straw is shredded with a chopper. After shredding, 32 g of straw material are weighted on scales and placed in a flask, then a solution of 1% H_2SO_4 200 ml are added to the flask. Then the flask is placed in autoclave for 20 minutes at 121 ℃. After the autoclave is finished, the flask is left to cool for some time. When the flask is cool enough, 16 g of glycerol (waste glycerol) are added to the flask. After that 300 ml of cattle manure (DC 0.5V ½ h) are poured into the flask. Then the flask is placed in water bath and it is also connected with pipes to cylinder which will serve as gasholder. Samples were taken for analysis.



CONCLUSION
The purpose of the carried experiments was to determine the influence of electrical charge to the process of anaerobic digestion in conjuction with mixing plant waste (as main substrate), glycerol (as cosubtrate) and manure (as cosubtrate). In both experiments, the accumulated amount of biogas is close, and also the yield. The burning test in both experiments showed low results. Very little amount (around 10%) of the total biogas were flammable. The most probably cause for that might be the very high voltage used in the experiments. In previous experiments, it was observed that voltage of 0.5V have given much better results. That lead us to the conclusion that, 0.5V might be the optimum voltage for anaerobic digestion.

Experiment №	Feeding scheme	Total biogas volume, ml	Total mass of feeding material, g	Yield ratio
E5	16 g conf. mat. + 100 ml 1% H2SO4 + 8 g glycerol + 300 g manure + DC (0,75V 1/2h)	335 ml	324 g	1,03
E6	16 g conf. mat. + 100 ml 1% H2SO4 + 8 g glycerol + 300 g manure + DC (1V 1/2h)	350 ml	324 g	1,08
E7	16 g straw + 100 ml 1% H2SO4 + 8 g glycerol + 300 g manure, no DC	70 ml	324 g	0,22
E8	16 g straw + 100 ml 1% H2SO4 + 8 g glycerol + 300 g manure, no DC	2284 ml	332 g	6,88
E9	32 g straw + 200 ml 1% H2SO4 + 16 g glycerol + 300 g manure, no DC	3450 ml	348 g	9,91
E10	16 g straw + 150 ml 1% H2SO4 + 8 g glycerol + 300 g manure + DC (0,5V 1/2h)	0 ml	0 g	0
E11	16 g straw + 150 ml 1% H2SO4 + 16 g glycerol + 300 g manure + DC (0,5V 1/2h)	2405 ml	332 g	7,24
E12	32 g straw + 200 ml 1% H2SO4 + 16 g glycerol + 300 g manure + DC (0,5V 1/2h)	0	0	0

Участието ми на конференцията бе финансирано по програма КП-06-Н27-4 ФНИ. Докладваните резултати и експерименти са проведени с помощта на програма „Млади учени и постдокторанти” МОН.