CURRENT ASPECTS OF ANAEROBIC THERMOPHILIC DIGESTION OF ORGANIC WASTE

[1]KURMANBAYEVA A.S., [2]BAYAZITOVA Z.E.,

Ph.D., Ualikhanov University, Kazakhstan
E-mail: aygul6868@mail.ru

Abstract: –

Statement of the Problem: The amount of household waste increases annually. A significant part of them is stored in landfills and negatively affects the environment. As a result of anaerobic decomposition of food waste, paper, cardboard, etc. landfill gas is released, which contains methane (50% -75%), carbon dioxide (25% -50%), hydrogen sulfide (0% - 3%), volatile organic substances (alkanes, aromatic hydrocarbons, cycloalkanes, terpenes, alcohols, ketones) and other compounds.

Methane and carbon dioxide have a big impact on global climate change. As a result of fires and smoldering waste, dioxins, sulfurous substances, hydrogen fluoride, mercaptans and other harmful substances are released into the atmosphere. Waste storage leads to chemical contamination of soils with heavy metals, dioxins and other halogen-containing organic compounds, which leads to a loss of productivity and the ability of biological self-purification of the soil, as well as biological contamination of the soil with bacteria, rotting products, mold fungi, viruses, cockroaches, dust mites, animal hair, etc.

As a result, foci of infectious diseases may occur at landfills. Filtration waters that are formed as a result of infiltration of atmospheric precipitation, extraction waters and waste decomposition processes contain the same substances as the waste itself. These can be products of fermentation and putrefaction of organic substances (phenols, acids, aldehydes, alcohols, etc.), heavy metal compounds and other toxic substances.

Dogs, cats, rodents, birds and other animals living and eating in landfills become carriers of dangerous diseases and worsen the sanitary and epidemiological situation of the area. This can lead to outbreaks of diseases such as plague, tetanus, cholera, various helminthiasis, etc. Some of the garbage is dangerous for animals. Attracted by the smell of food, animals can cut themselves on the sharp edges of cans, get tangled and suffocate in plastic bags, etc., which leads to their death. An increase in the amount of waste leads to an expansion of the areas allocated for landfills and a deterioration of the landscape, a change in the species composition of vegetation, the dominance of ruderal vegetation and species more resistant to pollution and a general decrease in plant biomass. Unauthorized spontaneous landfills disfigure the aesthetic appearance of the landscape, reducing the recreational value of the territories.

At the moment, the volume of waste processing is 10-13% of the total volume in the Republic of Kazakhstan. In connection with the above, waste collection, sorting and recycling technologies require revision and innovation. The thermophilic fermentation method is one of the main methods of processing food waste. This method is environmentally friendly, cost-effective and safe, since the elevated temperature at which the waste processing process takes place has a detrimental effect on microorganisms and helminths. Due to the fact that most of the household waste is represented by food organic waste, which can be processed by the technology of anaerobic thermophilic fermentation to obtain effective organic fertilizer and as a result, the anthropogenic load on landfills will decrease.

Methodology and theoretical orientation: experimental studies have been carried out to study the technology of processing organic waste from farms and catering establishments by the method of anaerobic thermophilic fermentation in the BUG-R Bioreactor. The chemical and physical parameters of the obtained products were determined: acidity (pH), dry matter content; organic carbon content (S_{org}), total nitrogen content (N_{ox}). Indicators of invasiveness of manure waste and plant food waste were carried out by the Fulleborn method before and after the fermentation process under thermophilic conditions. Quantitative counting of helminth eggs was carried out according to the Krasilnikov – Volkova method.

Conclusions: The physico-chemical parameters of the products obtained after anaerobic thermophilic fermentation are similar to the characteristics of organic fertilizers, so the dry matter content varied from 12.6% to 42.3%, the organic carbon content from 19.5% to 54.6% and total nitrogen from 0.54% to 2.6%, depending

on the composition of raw materials. No invasive pathogens have been detected. Thus, the resulting fertilizer contains the main elements of plant nutrition, humus-forming substances, complies with sanitary standards, and can be used as an organic fertilizer.

Conclusion and significance: there are various ways of processing food waste. The authors have studied one of the most effective methods, this is the technology of anaerobic thermophilic fermentation. Advantages of this method: processing and neutralization of various organic waste of plant origin and animal husbandry waste; low energy costs; obtaining an effective environmentally friendly product – fertilizers. Processing of food waste by the method of anaerobic thermophilic fermentation will significantly reduce the volume of accumulation of organic waste and, as a result, reduce the burden on the environment. The resulting product can be used as an organic fertilizer, which will have a positive effect on soil fertility and will contribute to increasing crop yields.
Funding The research is funded by the Science Committee of the Ministry of Education and Science of the Republic of Kazakhstan. Grant financing of scientific and (or) scientific and technical projects for 2021-2023 with a implementation period of 36 months.

Project topic: Development of technology for efficient processing of organic waste by thermophilic fermentation for the production of biological fertilizers. Project IRN: AP09259015

REFERENCE

[1] Wongthanate, J., Mongkarothai, K. Enhanced thermophilic bioenergy production from food waste by a two-stage fermentation process. Int J Recycl Org Waste Agricult 7, 109–116 (2018). https://doi.org/10.1007/s40093-018-0196-8

[2] Yu, D.; O'Hair, J.; Poe, N.; Jin, Q.; Pinton, S.; He, Y.; Huang, H. Conversion of Food Waste into 2,3-Butanediol via Thermophilic Fermentation: Effects of Carbohydrate Content and Nutrient Supplementation. Foods 2022, 11, 169. https://doi.org/10.3390/foods11020169

[3] Bayazitova ZE, Kurmanbayeva AS, Tleuova ZO, Temirbekova NG. Application of the Thermophilic Fermentation Method to Obtain Environmentally Friendly Organic Fertilizer. Journal of Ecological Engineering. 2023;24(4):202-216. doi:10.12911/22998993/159647.

[4] Kafle, G.K. Anaerobic treatment of apple waste with swine manure for biogas production: Batch and continuous operation/ G.K. Kafle, S.H. Kim //Applied Energy.- 2013.- N103.- P. 61-72;

[5] Lin, Q., De Vrieze, J., Li, C., Li, J., Li, J., Yao, M., ... &Frouz, J. (2017). Temperature regulates deterministic processes and the succession of microbial interactions in anaerobic digestion process. Water research, 123, 134-143.

[6] Kurmanbayeva, A., Bayazitova, Z., Talal, A., Kakabayev, A., &Zhaparova, S. (2022). Waste accumulation and geoecological assessment of the territories around the landfills in Kokshetau. International Journal of GEOMATE, 23(96), 179-185. doi:10.21660/2022.96.j2384

★★★