

AZƏRBAYCAN RESPUBLİKASI ELM VƏ TƏHSİL NAZİRLİYİ

AZƏRBAYCAN DÖVLƏT NEFT VƏ SƏNAYE UNİVERSİTETİ

MINISTRY OF SCIENCE AND EDUCATION

REPUBLIC OF AZERBAIJAN

AZERBAIJAN STATE UNIVERSITY OF OIL AND INDUSTRY



**“NEFTİN, QAZIN GEOTEXNOLOJİ PROBLEMLƏRİ VƏ KİMYA” ELMİ-TƏDQIQAT
İNSTITUTUNUN**

ELMİ ƏSƏRLƏRİ

SCIENTIFIC PROCEEDINGS

SCIENTIFIC RESEARCH INSTITUTE

“GEOTECHNOLOGICAL PROBLEMS OF OIL, GAS AND CHEMISTRY”

Sci. Proc. SRI GPOGC. Volume 24, Number 1, 2024

BAKU-2024

Impact of environmental problems of municipal solid waste on climate change and ways to solving them in Azerbaijan

R.A. Ismailova¹, E.N. Aliev^{1,*}, S.A. Geraibeyli²

¹ Scientific Research Institute “Geotechnological Problems of Oil, Gas and Chemistry”, 227 Dilara Aliyeva str., AZ1010, Baku, Azerbaijan

² Azerbaijan State Oil and Industry University, 20 Azadlig Avenue, AZ1010, Baku, Azerbaijan

Abstract: The development of civilization has led to anthropogenic activity that affects the environment, leading to climate change. The article considers the risks associated with the accumulation and burning of municipal solid waste (MSW) in uncontrolled open landfills, which have a negative impact on the climate. The inefficiency of using thermal processing of MSW, which requires the creation of landfills for the disposal of secondary waste, is noted. The transition of the environmental policy of Azerbaijan to the path of a closed-loop economy is shown. Information is provided on the country's integrated approach to solving environmental problems of MSW due to the modern industrial park operating in the country. Separate sorting, reuse of individual fractions, processing of fractions that are not subject to reuse can significantly reduce the accumulation of MSW. The presence of a modern plant in the park ensured the replacement of incineration in an open landfill with electricity generation. The resulting ash from MSW incineration, used to obtain mineral fertilizers, completed the closed cycle of the new MSW management model, allowing to mitigate the negative impacts on climate change. An assessment was given of the trust in Azerbaijan at the international level in connection with the holding of the 29th session of the Conference of the Parties to the UN Framework Convention on Climate Change (COP 29) in our country.

Keywords: solid municipal waste, climate change, environmental policy of Azerbaijan, integrated approach, industrial park

*Corresponding author. Tel.: +994 50 620 15 16

E-mail address: elsan67@mail.ru

Introduction

Anthropogenic activity contributes to the emission of greenhouse gases in excess of natural quantities, which are the main source of climate change. According to the forecast, climate change will cause an increase in average temperature, leading to an increase in the frequency and intensity of droughts, the manifestation of such abnormal manifestations as hurricanes, storms, etc. In this regard, society is obliged to take care of reducing the risks affecting climate change in the name of preserving ecosystems and infrastructure to ensure the normal life of the planet's population.

1. Risks of handling solid municipal waste

Excessive accumulation of solid municipal waste deserves special attention, since even with high organization of removal to designated landfill sites, emissions of landfill gas into the atmosphere cannot

be eliminated. Unregulated open landfills are considered especially dangerous, as they contribute to the spread of hazardous solid municipal waste components into various ecological zones. Burning waste in open landfills leads to the release of hazardous chemical compounds into the environment [1].

Being greenhouse gases CH_4 , CO_2 , NO_2 formed during the combustion of solid waste when released into the atmosphere increase their natural content. Capable of absorbing part of the infrared radiation emitted by the Earth, remaining in the atmosphere for years, greenhouse gases retain heat, leading to global warming. The main gas responsible for climate change is CO_2 , which accounts for 73.5% of the total emissions, CH_4 and N_2O emissions, amounting to 21.5% and 4.9%, respectively. No less dangerous environmental impact is NO_x emissions leading to the formation of acid rain and phytotoxicity, as shown in figure 1 [2].

Groundwater is polluted by landfill leachate, causing soil degradation H_2S emissions cause respiratory problems in humans. Depending on the pollutants present in the waste, the harmful effects on humans can include acute intoxication, endocrine toxicity and mutagenicity, and decreased immunity in children [3].

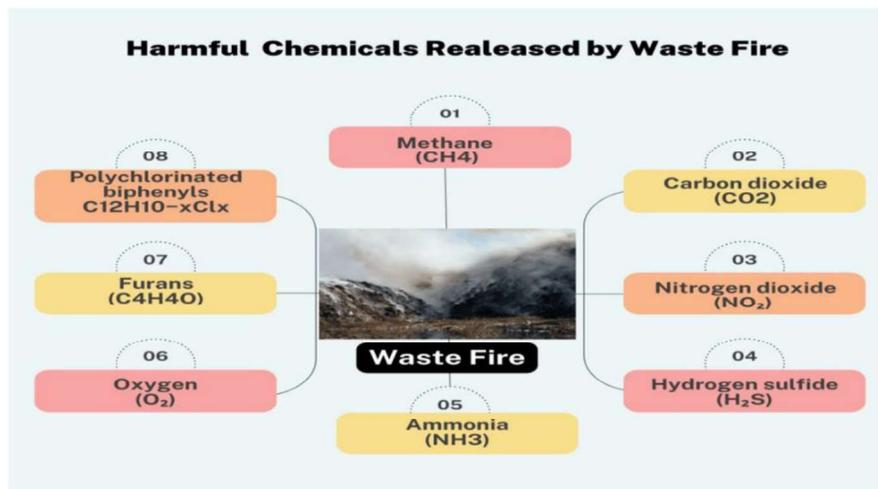


Figure1. Burning of solid waste in open landfills

Recently, in some countries, in the issue of solid waste management, in order to reduce the volume of waste, preference is given to its processing into renewable energy, including methods of high-temperature waste processing, known under the general name of thermal treatment (incineration, pyrolysis, gasification), shown in figure 2 [4].

While providing a significant reduction in the volume of solid municipal waste, thermal treatment is accompanied by such negative factors as the formation of solid ash residue and fly ash. The presence of heavy metals in ash and fly ash increases the risks of air, water and soil pollution, leads to environmental and sanitary problems and requires a special burial site for secondary waste.

High risks in handling solid municipal waste also include inhalation or skin contact with pollutants when disposing of solid waste in landfills with open burning and reuse from landfills as compost.

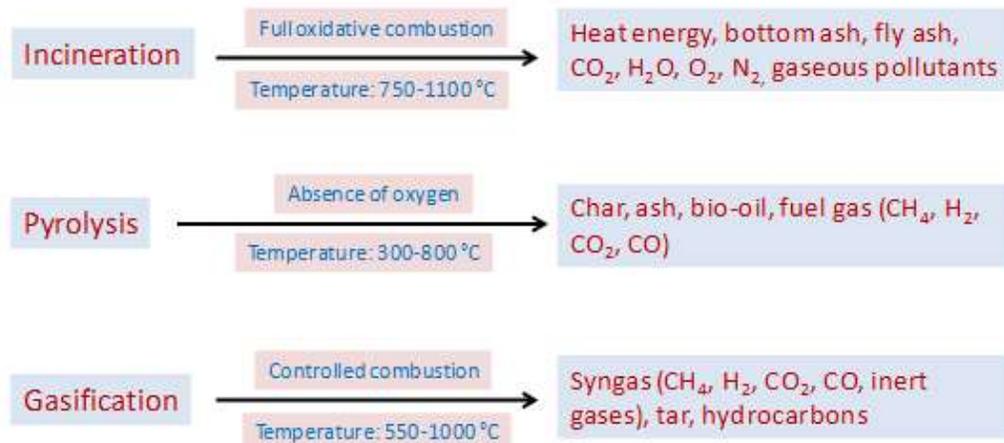


Figure 2. Thermal treatment of solid waste

A rather gloomy picture of the consequences of the stunning growth in the formation and accumulation of solid municipal waste can become a completely solvable problem through a new management model focused not on incineration or burial of waste, but on the practice of their recycling. In this regard, waste management is one of the sectors responsible for greenhouse gas emissions, capable of mitigating the consequences of climate change through the creation of new technologies and innovations.

2. Zero Waste Strategy - Myth or Reality?

At all stages of civilization development, human activity related to production and consumption processes has an impact on the world around us. Scientific and technological progress, paradoxically, has led to an increase in the amount and variety of waste that has a negative impact on the global ecosystem.

On March 30, 2023, the world community celebrated for the first time the International Day *for a World Without Waste* adopted by decision of the UN General Assembly. The adoption of such a decision is due to the global trend of rapid growth in the formation and accumulation of waste, including solid waste.



Figure3. Excessive accumulation of solid municipal waste

According to the State Statistics Committee, 3 million 984.1 thousand tons of waste were generated in Azerbaijan in 2022, which is 5.4% more than the previous year. Of these, 66.7% were solid municipal waste, and 33.3% were industrial waste. Assessing the negative consequences of solid municipal waste accumulation, the Azerbaijani government pays great attention to resolving issues related to environmental impacts and environmental protection.

Priority directions in the sphere of environmental protection, determining the state policy in the field of ensuring ecological balance in nature, providing for the use of waste as secondary raw materials, were laid down by the Law of the Republic of Azerbaijan No. 514-IQ "On industrial and household waste" of June 30, 1998. Many of the subsequently adopted legislative acts directly concern the management of solid waste, including the one of August 6, 2008 "On improving the management of household waste in the city of Baku" [5].

The environmental policy of the state today is based on a new view of the relationship between society and nature, accepted by the world community, in which waste is perceived as a valuable resource, choosing the path of transition from the linear economic model *make, use, dispose* to the closed economy model. The new economic model provides for a closed cycle, including the use of waste from the production of primary products as raw materials for the production of a new product, including the following main stages of activity [6]:

- use of primary raw materials;
- reuse of material;
- recycling of waste.

Optimizing waste management with a closed-loop economy platform requires an efficient whole chain of integrated MSW activities:



By order of the President, the open joint-stock company "Clean City" was created, which carries out work on the placement and disposal of all solid household waste that appears on the territory of the city of Baku. The sanitary condition of the city is controlled by operational work on the elimination of waste that is generated daily in residential buildings, commercial and public utility facilities. Landfills for the disposal of household waste have been transferred to the balance sheet of the joint-stock company. In order to form an ecological culture of the population, the most advantageous separate waste collection has been introduced [7].

An important factor for solving subsequent actions is the availability of the necessary infrastructure in the country, ensuring separate sorting of solid waste and processing of separated fractions, which should be used to improve the level of waste management. The industrial infrastructure of Azerbaijan,

which has concentrated sorting and processing facilities, is represented by the Balakhani Industrial Park, located in the suburbs of Baku, with a total area of 10.15 hectares.



Figure4. Industrial park in Baku (Balakhani)

The solid municipal waste sorting plant, which is part of the infrastructure of this industrial park, annually sorts up to 800 thousand tons of waste. Currently, 25 residents are registered in the industrial park, who, after sorting solid municipal waste, process, in particular, waste paper and polymer waste, furniture and building materials, recycling car tires into fuel using the pyrolysis method, etc., implementing the "green" project of the European Bank for Reconstruction and Development. Residents of the Balakhani Industrial Park invested 53 million manats, and products worth 229 million manats were produced using the waste. Ten percent of the products obtained as a result of processing were exported to foreign countries [8, 9].

An example of the transition from solid waste disposal to industrial processing is the solid waste disposal plant located on the territory of the Balakhany Industrial Park with a capacity of 500 thousand tons per year, built by the French company Constructions Industrielles de la Méditerranée S.A. The plant, equipped with modern equipment, the performance characteristics of which meet the environmental requirements of the European Union, is capable of generating up to 200 million kilowatt-hours of electricity per year. In 2023, the municipal waste processing plant processed 531,400 tons of garbage, a record figure for 11 years of operation. By burning this volume of waste, 200 million kilowatt hours of electricity were generated [10].

When considering solid waste as an energy source, one cannot ignore the negative effects inherent in solid waste incineration, such as the formation of vat ash (slag) and fly ash. In this regard, scientific research in the country is focused on finding opportunities for recycling waste generated during incineration and creating innovative technologies that allow waste generation to be reduced to a minimum. One of the interesting developments is the involvement of solid waste incineration slag in processing for the production of mineral fertilizers required for the needs of the country's agro-industrial complex, using local agricultural ores [11]. The capabilities of the industrial park made it possible to separate the raw organic component of solid waste that is not subject to secondary use during the sorting

of solid waste, which has found application in the developed technology for producing organomineral fertilizers [12], contributing to the implementation of the task of reducing waste to a minimum.

Azerbaijan participates in all international events aimed at environmental protection. The EU-funded *EU4Environment* program, created in 2019, helps Azerbaijan create mechanisms for effective management of environmental risks associated with environmental impacts. The priorities of this program include issues of a circular economy and its opportunities. About 35 Azerbaijani enterprises are to be assisted in revising their business models. The program includes an assessment of waste sources and identification of recycling options [13].

The President of the Republic of Azerbaijan Ilham Aliyev highly appreciates the trust and respect of our country at the international level, in connection with the holding of the 29th session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP 29) in our country. The year 2024 has been declared the "Year of Solidarity for a Green World" in the country. A commitment has been made to reduce greenhouse gas emissions by 35% by 2030 compared to 1990 [14].

The solution of environmental problems of solid waste in Azerbaijan in a comprehensive cyclical way, starting with the modernization of the collection process, increasing the range of reuse and innovative processing of solid waste components through the created infrastructure of the industrial complex for processing solid waste is an example of the implementation of the closed-loop model.

Conclusion

The chosen path is extremely important for ensuring normal living conditions for society, environmental safety, and easing the burden on natural resources for the sake of a clean and ecologically stable future for the planet, which will allow us to claim in the near future that the zero waste strategy is a reality.

Conflict of interest

The authors declare that they have no conflict of interest in relation to this research.

References

1. Awino, F.B., and Apitz, S.E. Solid waste management in the context of the waste hierarchy and circular economy frameworks: An international critical review. *Integrated Environmental Assessment and Management*. 2023. Vol. 20. No 3. P. 1-27. DOI:10.1002/ieam.4774
2. Filonchyk, M., Peterson, M.P., Zhang, L., Hurynovich, V., He, Y. Greenhouse gases emissions and global climate change: Examining the influence of CO₂, CH₄ and N₂O. *Scie of The Total Environment*. 2024. Vol. 935. No 2. P.1-7. <https://doi.org/10.1016/j.scitotenv.2024.173359>
3. Siddiqua, A., Hahladakis, J.N., and Al Attiya, W.A. An overview of the environmental pollution and health effects associated with waste landfilling and open dumping. *Environmental Science and Pollution Research*. 2022. Vol. 29. P. 58514-58536. <https://doi.org/10.1007/s11356-022-21578-z>

4. Ram, C., Kumar, A., and Rani, P. Municipal solid waste management: A review of waste to energy (WtE) approaches. *Bio Resources*. 2021. Vol.16. No 2. P.4275 - 4320.<https://doi.org/10.15376/BIORES.16.2.RAM>
5. Aliyev, T.N., and Ismayilov, B.V. Innovative mechanisms for solid municipal waste management in Azerbaijan. *The scientific heritage*. 2020. No 49. P. 9-21.
6. Order of the President of the Republic of Azerbaijan. On improving household waste management in the city of Baku. 2008. https://azertag.az/ru/xeber/rasporiyazhenie_prezidenta_azerbaidzhanskoi_respublikio_sovershenstvovanii_upravleniya_bytovymi_otxodami_v_gorode_baku-689332
7. Poluektov, T.Y. Cyclic economy as a promising concept in the field of waste processing. *Moscow economic journal*. 2022. No8. P. 106-132. https://doi.org/10.55186/2413046X_2022_7_8_491
8. Improving the Environment in Azerbaijan: Balakhani Plant Sorts 800 thousand tons of Water per year. June 27, 2024. [In Russian]
<https://az.sputniknews.ru/20240627/uluchshenie-ekologii-v-azerbaydzhane-balakhanskiy-zavod-sortiruet-800-tys-tonn-otkhodov-v-god-465639472.html>.
9. Azerbaijan exports products from Balakhani Industrial Park to a number of countries. February 15, 2024. [In Russian] <https://moderator.az/ru/diger/737881/azerbaydzhan-eksportiruet-v-ryad-stran-produkciyu-balahanskogo-promyshlennogo-parka>
10. Business on waste: EBRD implements new “green” projects in Azerbaijan. May 14. 2022. [In Russian] URL: <https://caliber.az/post/79514/>
11. Garaybeyli, S.A. Recycling slag from combustion of MSW into complex mineral fertilizers using poor phosphorite. *Chemical problems*. 2022. No 2(20). P.138- 144.
12. Alosmanov, M.S., Hasanov, G.S., Huseynov, D.A., Mammadov, M.N. [et al.]. Method of obtaining organic-mineral fertilizer. Patent AR. 2019. No 0052.
13. Circular Economy and new growth opportunities. [In Russian] URL azerbaijan.un.org/sites/default/files/2020-12/RECP%20leaflet_Azerbaijan%20final_ENG.
14. The first meeting of the Organizing Committee in connection with SOP 29 was held. *Vyshka news paper*. 2024. No 3. P. 2. [In Russian]