SCIENTIFIC ANALYSIS OF PROBLEMS RELATED TO MUNICIPAL SOLID WASTE MANAGEMENT

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Abstract: This research examines the ecological and technological issues linked to the management of municipal solid waste (MSW). The rising amount of domestic and industrial waste has emerged as a significant environmental and socio-economic problem globally. The adverse effects of MSW on soil, groundwater, air quality, and human well-being are analyzed, especially the emissions of harmful substances and greenhouse gases during both aerobic and anaerobic decomposition in landfills. The research also points out the increasing proportion of plastic and polyethylene-derived waste in the morphological makeup of MSW and stresses the poor recycling efficiency. The study emphasizes the importance of adopting contemporary waste management practices, recycling methods, and eco-friendly disposal technologies to minimize environmental pollution and enhance ecological sustainability.

Keywords: municipal solid waste, waste management, environmental pollution, landfill, recycling technologies, greenhouse gases, toxic compounds, plastic waste, secondary energy resources, ecological safety.

Introduction

The issue of municipal solid waste management is also considered highly relevant in the Republic of Uzbekistan. Although the waste collection and disposal system in the country is gradually developing, several significant problems still remain. In particular, the insufficient implementation of waste sorting practices, the limited number of recycling enterprises, and the inadequate level of environmental awareness continue to exert negative impacts on the environment [1-3].

Therefore, the effective management of municipal solid waste, the introduction of modern recycling technologies, and the обеспечение экологической безопасности represent some of the most important contemporary challenges. The study of this issue provides an opportunity to analyze waste-related problems in Uzbekistan and to develop scientifically grounded recommendations for their solution. These problems contribute to environmental pollution, disruption of ecological balance, and adverse effects on human health. Consequently, the development and implementation of efficient waste management systems and advanced recycling methods have become essential ecological and technological priorities of the present time [4].

Methods and materials

Today, the problem of waste management has become one of the most pressing environmental, socio-economic, energy, housing, and communal challenges not only in Uzbekistan but throughout the world. Analytical studies indicate that the volume of municipal solid waste (MSW) and industrial waste has been steadily increasing in recent years [5-8]. Under the influence of ambient temperature and humidity, MSW undergoes decomposition processes, leading to the infiltration of harmful substances into surface and subsurface soil layers. As a result, fertile soils, groundwater resources, atmospheric air, and vegetation become contaminated, causing deterioration in their quality, toxic effects, and an increase in the concentration of hazardous compounds. Consequently, humanity is increasingly facing shortages of clean

drinking water, clean air, and fertile land, as well as the emergence of new sources of infectious diseases [3].

The annual growth rate of MSW generation is estimated at no less than 4%, while in some countries it reaches approximately 12%, significantly exceeding the global population growth rate. The majority of MSW is disposed of in landfills, which are major sources of surface and groundwater pollution. In addition, waste accumulated in landfills frequently ignites, causing severe environmental and atmospheric pollution.

In modern urban areas and densely populated residential complexes, municipal solid waste generated by daily human activities is temporarily stored at designated waste collection sites before being transported for disposal or recycling. Waste disposed at such collection sites creates favorable conditions for the development of microorganisms responsible for infectious diseases. Therefore, failure to properly neutralize waste or promptly transport it to landfills or recycling facilities results in widespread environmental contamination and the formation of natural sources of diseases harmful to human health.

Due to direct interaction with the environment, the temperature of MSW accumulated in landfill sites rises to approximately 25–35 °C, initiating aerobic decomposition processes. Simultaneously, the upper layers of waste dry out and become highly susceptible to ignition. Furthermore, because of the high moisture content (85–90%) and oxygen deficiency within waste layers, anaerobic decomposition processes occur, resulting in the release of various hazardous compounds such as NO, NO_2, NH_4, HCl, C, SO_2, H_2S, CO, CoF_3, ClF_5, CH_4, CH_3, C_nH_m, and PhMe. These emissions contribute to environmental toxicity, depletion of the ozone layer, and the formation of greenhouse gases. This process is illustrated in Figure 1.



Figure 1. Environmental impact of municipal solid waste

As a result of precipitation, toxic compounds and hazardous elements released from landfill sites are dissolved and subsequently infiltrate into groundwater and subsurface water resources, leading to their contamination.

Results and discussions

Rainfall dissolves toxic compounds and hazardous elements released from landfill sites, allowing them to infiltrate into groundwater and subsurface water resources, thereby causing contamination. Figure 2 illustrates the dispersion of harmful compounds emitted from municipal solid waste under the direct influence of natural climatic conditions and ambient temperature at landfill sites [7]. Particularly hazardous are untreated industrial wastes and products containing mercury.

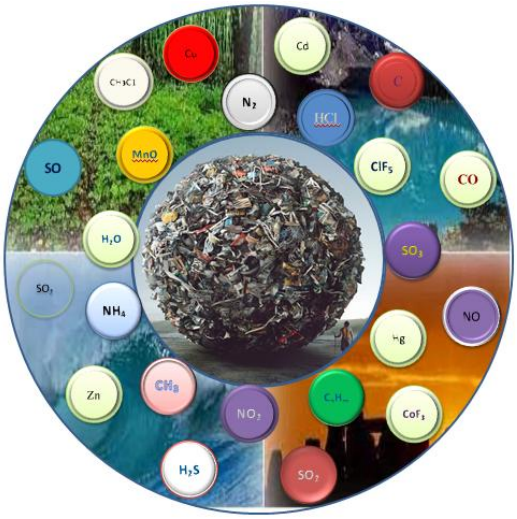

Figure 2. Environmental impact of waste

In recent years, the morphological composition of municipal solid waste has experienced a sharp increase in products made from polyethylene, plastic, and cellophane intended for single-use applications. Disposable containers, plastic bags, packaging materials, bottles, and various plastic products constitute the most widespread types of plastic waste generated on a daily basis. Only about 5% of these wastes are recycled and reused in everyday activities, while the remaining portion is disposed of in landfills and oceans.

Conclusions

Therefore, the problems associated with the transportation, collection, neutralization, disposal, utilization, and recycling of municipal solid waste are highly significant, primarily due to their negative impacts on the environment and human health. At the same time, municipal solid waste represents an important source of secondary energy resources and low-cost raw materials.

It should be emphasized that approximately 80% of these wastes consist of hydrocarbon-based substances, and their processing makes it possible to produce substantial amounts of energy and energy carriers.

References

1. Uzakov G.N. et al. On the efficiency of using solar energy for the thermal processing of municipal solid waste. // Journal Of Critical Reviews. – 2020. –No.7 (05). – PP. 1887-1892.
2. Toshmamatov B.M., Arziev B.R. From local organic waste to biogas: energy efficiency, safety aspects relating to biogas plants. // IBET International bulletin of engineering and technology. – 2023. - Volume 3. - Issue 2. - PP. 37-42.
3. Toshmamatov B.M., Valiev S.T., Shomuratova S.M., Boitova A.O. Waste is harmful, if it is recycled it is a great resource, a huge source of energy. / Development and innovations in science International scientific-online conference. – 2023 29-may. – 49-52 betlar.
4. Rafaelle Vinturelle and et al. Slow pyrolysis of Terminalia catappa L. municipal solid waste and the use of the aqueous fraction produced for bovine mastitis control. // Biochemistry and Biophysics Reports. – 2024. - No.38. – p. 101704.
5. Toshmamatov B.M. , Valiev S.T. Justification of the technical-economic efficiency of the device for thermal processing of municipal solid waste. // International journal of advanced research in science, engineering and technology. – 2023. - Vol. 10. - Issue 8. – PP. 20942-20946.
6. Toshmamatov B., Davlonov Kh., Rakhmatov O., Toshboev A. and Rakhmatov A. Modeling of thermal processes in a solar installation for thermal processing of municipal solid waste. // AIP Conference Proceedings. – 2023. – 2612. – P. 050027.