Direct combustion as a treatment method for the wet Brazilian waste

Andrea Carolina Gutierrez-Gomez[1]; Antonio Garrido Gallego[1]; Reynaldo Palacios-Bereche[1]; Juliana Tófano de Campos Leite[1]; Ana Maria Pereira Neto[1]

[1]Center for Engineering, Modeling and Applied Social Sciences, Post-Graduated Program in Energy, Federal University of ABC, Santo André, SP, Brazil

Abstract

Nowadays, as nations and cities become more populated and prosperous, offering more products and services to citizens, they face corresponding amounts of waste to manage through treatment and disposal. In Brazil, around 1,692 (30.37%) municipalities do not have any type of selective collection initiative, and 3,878 (69.63%) municipalities do not comply with all the guidelines recommended by the National Solid Waste Policy (PNRS) for solid waste management. Besides, 217,000 tonnes of MSW are generated every day, and the São Paulo state contributes with nearly 29% of that amount. Approximately 41% of the MSW produced is disposed of in controlled and open dumps, which do not have the set of systems and measures needed to protect the environment against damage and degradation. The remaining 59% is either disposed of at landfills or recycled, though with little progress.

Some studies in Brazil showed that waste disposal in landfills contributes with 1.9% of greenhouse gas (GHG) emissions. Moreover, it is predicted that in 2030, the GHG emissions could increase due to current waste management practices, mainly because of the high share of organic waste, paper, and cardboard that generate large amounts of methane when deposited in the soil. Although the country possesses instruments that encourage the energy recovery from waste as a treatment method, such as the PNRS, and the preliminary version of the National Solid Waste Plan (PLANARES) updated in 2020, Brazil does not have any energy recovery plants yet; being these in the design phase, or having pending environmental licenses. In order to contribute to the studies carried out so far, this research work proposes direct combustion (mass burning) with energy recovery as a treatment method for the wet waste (waste mixed and contaminated with organic fractions) generated in Brazil, based on its thermochemical characterization. The energy recovery potential and GHG emissions avoided of three scenarios of electric power efficiency (18, 25, and 30%) are also studied. Furthermore, the MSW's behavior and its characteristics as a feedstock for energy power plants are evaluated. In this research, the wet waste from the Santo André city's selective collection was adopted as a study object. The chemical and thermal characterization involved determining moisture content, proximate analysis, ultimate analysis, ash analysis, and heating value. This characterization was carried out by category (Organic matter, Sanitary waste, Paper/cardboard/Tetra Pak®, Plastics, and Textiles) for thirty-six trucks, which were randomly selected between September 2015 to January 2016 (spring-summer season).

The results show that the combustion with energy recovery could be used as a treatment method due to the Brazilian MSW characteristics as a solid fuel, highlighting that in some regions of the country, there is the possibility of using auxiliary fuels for waste combustion. In this way, MSW combustion facilities could contribute an additional 3% of electrical energy to the national energy matrix from the use of at least 67% of the MSW collected. Furthermore, around 140 million cubic meters of dumps, and about 1 million tonnes of CH4 emissions (24 million metric tons of CO2-equivalent) could be avoided, depending on the gross electrical efficiency used in the Waste-to- Energy technology.

Introduction

Andrea Carolina Gutierrez Gomez received her Bachelor's degree in chemical engineering from the Industrial University of Santander, Colombia, in 2010, and her Master's degree in energy from the Federal University of ABC, Brazil, in 2016. Currently, she is a Ph.D. candidate in energy at the Federal University of ABC, Brazil. Since 2013 she joined the research group "Energy Efficiency, Polygeneration, Biofuel Production, Waste Valorization, Sustainability" as a research student. She has experience in research about municipal solid waste treatment with energy valorization via thermal processes. Her research interest includes thermochemical characterization, thermal treatment systems (combustion), formation of ash deposition on combustion systems, and GHG emissions evaluation.

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