Technical and Financial Evaluation of Composting Versus Biodrying Treatment Facilities in Egypt

Nehad Ahmed[1], Mariam Khaled[1], Sherien Elagroudy[1]
[1]Egypt Solid Waste Management Center of Excellence, Faculty of Engineering, Ain Shams University, 1 Elsarayat St., Abassia, Cairo, 11517, Egypt.
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*Presenting Author Email: s.elagroudy@eng.asu.edu.eg

Abstract
This study evaluates the feasibility of a Mechanical Biological Treatment (MBT) facility for managing 450 tons of municipal solid waste (MSW) daily in Egypt, comparing two pathways: Mechanical Sorting with Composting and Mechanical Sorting with Biodrying. The analysis integrates a mass balance framework with financial modeling to assess the technical outputs, economic performance, and environmental impacts of each pathway. Data includes a 450-ton daily waste processing capacity, local market dynamics, regulatory frameworks, and GHG emission calculations aligned with international protocols.

Technically, composting excels in resource recovery, converting 38% of the organic fraction into nutrient-rich compost and supporting agricultural applications and 17% of medium-grade RDF, while reducing landfill dependency to under 10% of total input. In contrast, biodrying focuses on producing energy-efficient Refuse-Derived Fuel (RDF), with outputs of 17% high-grade and 13% low-grade RDF, suitable for industrial applications (Figures 1 and 2). However, biodrying is more energy-intensive, requires sophisticated infrastructure, and does not offer composting's agricultural benefits.

Economically, composting is more viable with a Net Present Value (NPV) of USD 22.5 million, an Internal Rate of Return (IRR) of 37%, and a payback period of 3.8 years, compared to biodrying's NPV of USD 0.99 million, IRR of 29%, and 4.9-year payback (Tables 1 and 2). Environmentally, composting reduces greenhouse gas emissions by 48.5% compared to landfilling, emitting 28,496,004 kg CO_2e annually, while biodrying achieves a 28.5% reduction, emitting 39,552,723 kg CO_2e annually. These findings establish composting as the optimal pathway, balancing technical efficiency, economic returns, and environmental benefits to align with Egypt's Vision 2030 and sustainability objectives.

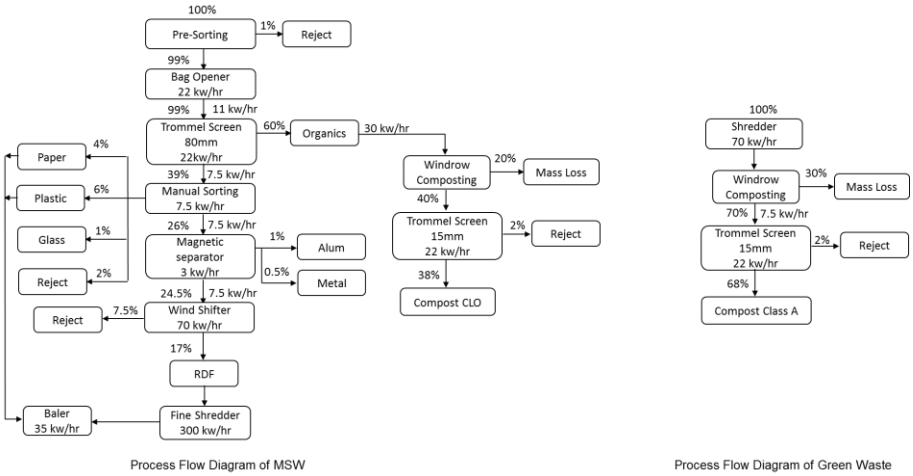

Figure 1: Mass Balance of MBT with Mechanical sorting of MSW and composting of organic waste and green waste

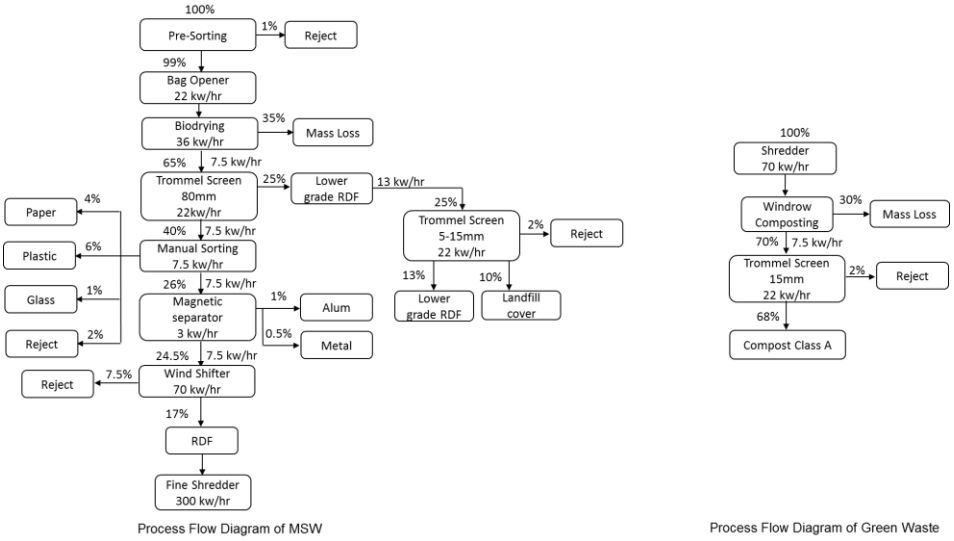

Figure 2: Mass balance of MBT with mechanical sorting & biodrying of MSW and composting of green waste

Table 1: Key financial indicators

Indicators	Composting	Biodrying
Net Present Value (‘000 USD)	2.55	0.99
Internal Rate of Return (IRR)	37%	29%
Benefit -Cost Ratio (BCR)	1.6	1.5
Payback Period (years)	3.8	4.9

Table 2: Sensitivity analysis results

Scenario	NPV (USD ‘000)	IRR	Discount Rate	BCR	Payback Period (years)
Baseline Scenario	2,550	37%	29%	1.5	3.8
Revenue Reduction (20%)	445	28%	29%	1.1	5.1
CAPEX Increase (10%)	2.109	34%	29%	1.5	4.2
OPEX Increase (10%)	2,100	33%	29%	1.2	3.9
CAPEX & OPEX Increase (10% each)	1,773	32%	29%	1.3	4.3
Salaries Increase (20%)	2,389	36%	29%	1.4	4.1
Electricity and Fuel Cost Increase (20%)	2,471	37%	29%	1.5	3.8
Maintenance and Spare Parts Cost Increase (20%)	2,513	37%	29%	1.5	3.8

References

1. Environment (2021). *Egyptian Environmental Report*. Egyptian Environmental Affairs Agency (EEAA).
2. IPCC (2014). Climate Change 2014: Synthesis Report. Intergovernmental Panel on Climate Change.
3. Hoornweg, D., & Bhada-Tata, P. (2012). *What a Waste: A Global Review of Solid Waste Management*. World Bank.
4. Magrinho, A., Didelet, F., & Semiao, V. (2006). *Municipal solid waste disposal in Portugal*. Waste Management, 26(12), 1477–1489.

5. NSWMP (2017). *National Solid Waste Management Programme Report*. GIZ and Egyptian Environmental Affairs Agency.
6. United Nations (2015). *Transforming our World: The 2030 Agenda for Sustainable Development*. United Nations.
7. Mathlouthi, S., et al. (2024). *Advances in Mechanical Biological Treatment Technologies: An International Review*. Renewable and Sustainable Energy Reviews.
8. WMRA (2024). *Waste Management Regulatory Authority Report*. Waste Characterization Study.
9. Mengistu, D. A., et al. (2018). *Composting as an Effective Waste Management Strategy*. Waste Management Journal, 48(4), 15–24.
10. Bosilj, A., et al. (2024). *Advances in Biodrying Technologies for MSW*. Renewable Energy Reviews.
11. Egypt Sets Waste-To-Energy Tariff, (2020). Retrieved from Riad&Riad. Retrieved from: https://riad-riad.com/egypt-sets-waste-energy-tariff/
12. IFC, Unlocking Value: Alternative Fuels for Egypt's Cement Industry, 2016.
13. Ministry of Environmental, National Solid Waste Management Program, Annual Report for Solid Waste Management in Egypt, 2020. Retrieved from: https://www.eeaa.gov.eg/Uploads/Reports/Files/20230802183320389.pdf
14. Netherlands Enterprise Agency (2023). Market Scan Solid Waste Management in Egypt: Sector Overview and Business Opportunities. Retrieved from: https://www.rvo.nl/sites/default/files/2023-03/Market-Scan-Solid-Waste-Management-in-Egypt.pdf