



Municipal solid-waste in Port Harcourt, Nigeria

A.H. Igoni ^a, M.J. Ayotamuno ^a, S.O.T. Ogaji ^{b,*}, S.D. Probert ^b

^a *Agricultural and Environmental Engineering Department, Rivers State University of Science and Technology, Port Harcourt, P.M.B. 5080, Rivers State, Nigeria*

^b *School of Engineering, Cranfield University, Bedfordshire MK43 0AL, United Kingdom*

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Abstract

In Port Harcourt metropolis, municipal solid-waste (MSW) is generated and collected in large quantities, but some remains as litter in parts of the municipality. Refuse is mostly buried, but some reckless open-burning ensues, so posing environmental hazards. Waste collected from different receptacles and dumpsites in the city was subjected to analysis: on average, it consisted of 66.6% volatile solids, 13.5% fixed solids, 19.1% liquid and 0.8% other components. The average biodegradability fraction is 0.807, with a carbon-to-nitrogen ratio of 27:1. The energy content of the refuse was 7.25 MJ/kg as collected. These results indicate that such refuse is amenable to several disposal options with less adverse impact on the environment. It is also a source of energy.

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1. Introduction

Refuse is too often regarded as useless, unwanted and therefore discarded. Waste is defined as “anything rejected as worthless, or in excess of what is required” [1]. But Byrne [2] said that waste is material, which has no direct value to the producer and so must be disposed of. Bailie et al. [3] insist that “for practical purposes, the term ‘waste’ includes any material that enters the waste-management system”, i.e. organized programmes and central facilities established not only for final disposal of waste but also for recycling, reuse, material reclamation, composting and incineration. Wastes are usually classified

* Corresponding author. Tel.: +44 1235 750 111; fax: +44 1234 751 232.
E-mail address: s.ogaji@cranfield.ac.uk (S.O.T. Ogaji).

Nomenclature

$A_1, A_2, A_3, \dots, A_n$	areas of each cross-sectional unit or strip (m^2)
BF	biodegradability fraction expressed on a volatile solids (VS) basis
CP	% of cardboard and paper in refuse by weight
d	distance between the analytical ordinates (m)
E	energy content of MSW, MJ/kg
F	% of food in refuse, by weight
LC	lignin content of VS, as a % of dry weight
P_d	% moisture content of the refuse on a dry basis
P_w	% moisture content of the refuse on a wet basis, i.e. as collected from source (e.g. a household)
PLR	% of plastic and rubber in refuse, by weight
r	compaction ratio
S_d	mass of solid-refuse sample when dried (kg)
S_w	mass of wet solid-refuse sample (kg)
V_c	“as-compacted” volume
V_d	“as-discarded” volume
V_1	volume of refuse load per refuse truck (m^3)
VM	volatile matter
W	mass of moisture in refuse sample (kg)
ρ_c	‘as-compacted’ density
ρ_d	‘as-discarded’ density, i.e. as at source and termed ‘wet’

according to the three states of matter, namely gaseous, liquid or solid. Materials in the third category (i.e. solid waste) form the subject of the present study.

Bailie et al. [3] described solid-refuse as including all waste materials that are not hazardous; in addition there are liquid wastes and emissions to the atmosphere. Kiely [4] surprisingly defined solid-refuse to embrace wastes from “human and animal activities, including liquid wastes like paints, old medicines, spent oils, etc.”. Nevertheless, this present study considers solid-refuse to be largely non-flowing. Because of this characteristic and its inability (at ambient temperatures) to vaporize, its handling and management are relatively difficult compared with those for liquid and gaseous wastes [5]. Hence it has to be retained hygienically until it is physically removed for disposal. Solid waste in Nigeria poses many environment problems, such as blocking of waterways and drainage channels (so leading to flooding) and air pollution (e.g. with offensive odours), and the concomitant dangers for public health.

Municipal solid-waste (MSW) is all waste collected by private and public authorities from domestic, commercial and some industrial (non-hazardous) sources. Furthermore, Bailie et al. [3] and Kiely [4] posited that MSW comprises small and moderately sized solid-waste items from houses, businesses and institutions. The composition and type of refuse vary from location to location, as well as from householder to householder [4,6]: hence solutions should be location specific. Even domestic refuse from a single house will vary from week-to-week and from season-to-season. MSW is a complex mixture of biodegradable and non-biodegradable substances. “Nigeria has no records showing the types of

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