Energy Potential of Solid Waste in Eldoret Municipality and Kisumu City

Omuterema Stanley Oluchiri

A Thesis submitted in Partial Fulfilment of the Requirements of the Degree of Master of Philosophy of the School of Environmental Studies
(Physical Sciences Division)

Moi University

Eldoret

August 2003

ABSTRACT

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Waste-to-energy conversion technologies have changed the traditional approach to the solution of the problem of scarcity of energy. One such technology applied in developed countries is the use of Municipal Solid Waste (MSW) to generate energy. In recent times, some developing countries have successfully used this alternative.

This study was aimed at assessing the potential of MSW in Eldoret Municipality and Kisumu City as an energy source. Specifically, the study was designed to find the quantities of the various types of solid waste within Eldoret and Kisumu, compare these wastes from the two places, to find the energy value of the wastes, and identify the potential consumers of such energy within the areas of study.

Quantities of MSW reaching the tipping grounds were evaluated by use of collecting-vehicle weighing devices and physical methods involving density and volume of the delivered waste. MSW density and volume changes over the period of the research (16^{th} December 2000 to 16^{th} June 2001) were used to determine the mass of waste that is left uncollected by the local authorities. Masses of 5-wheelbarrow waste samples, taken daily at the tipping grounds were used to find the fractions of different waste types in the MSW. Laboratory analyses were used to determine the energy values of the wastes. Various physical and bio-chemical parameters of the MSW were evaluated. Together with secondary data, the results of the foregoing were used to estimate the amount and hence the energy capacity of landfill gas that could be produced by the waste in each of the stations. A questionnaire was administered to identify potential consumers of energy from the MSW in the places.

The study found that monthly averages of 2069.3 tonnes and 3276.4 tonnes of MSW were deposited at disposal sites in Eldoret Municipality and Kisumu City respectively. Nearly 62% of MSW in Eldoret was anaerobically digestible, and 19.48% was directly recyclable. The corresponding figures for Kisumu were 40.5% and 32.4% respectively. It was also found that 86.3% of the total waste in Eldoret was incinerable. The corresponding quantity for Kisumu was 68.1%. Through incineration of the waste in the available state, the MSW from Eldoret could produce an average of 43.66×10^5 MJ of energy per month while that from Kisumu could produce 62.17×10^5 MJ. The disparity in ratios of energy and waste quantities resulted from the varying quantities of the individual incinerable waste types (with different energy capacities) in the two places. The entire mass of solid waste in Eldoret could generate landfill gas with an average monthly energy capacity of 6.67×10^5 MJ. The corresponding value for Kisumu was 10.6×10^5 MJ. Fifteen firms from each of the stations participated in the study. In Eldoret, 66.7% of the firms supported the use of MSW-derived fuel as an alternative energy source. In Kisumu, the figure was 40%.

The study reveals that the economic value of the waste is high as an energy resource. The potential MSW energy consumer firms stand to save significant amounts of money that is

usually spent on imported fossil fuels if this alternative is exploited. With appropriate exploitation methods, such locally generated energy will also save many tonnes of fuel wood, which is widely used in many sectors of the economy. Most of the incineration residue (99%) is chemically stable. Some of it can be used in building and civil engineering works. The rest may be land filled. The slurry from properly managed landfill gas sites may be used as farm manure. Coupled with the fact that a cleaner environment is achieved when the recovery processes are done in the correct ways. It was concluded that MSW is a high potential energy resource for major urban energy consumers.

It is recommended that future studies in this area should consider MSW contamination adjustment, which was not done in this study. It is further recommended that more accurate methods for estimating the heating values of MSW that take into account the detailed composition of the waste (e.g. Cooper, ***et al.***, 1999 model) may be used in further research. In addition, there is need for more research into the costs of setting up the energy generation systems in the areas covered by the study.