DEVELOPMENT OF INDIGENOUS MANUFACTURING INFRASTRUCTURE IN NIGERIA:

A CASE STUDY OF THE PACE-SETTER ORGANIC FERTILIZER PLANT

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Abstract

This paper presents the overview of the research and development (R&D) of the Pace-setter organic fertilizer plant. The plant is owned, funded and managed by the Oyo State Government through the Ministry of Environment. The plant is located at the Bodija Market in Ibadan North local government area. The 10 tons/day capacity plant, designed and constructed using locally sourced materials, was installed and commissioned in the year 1998. About 35 - 50 tons/day of solid waste consisting of Market Refuse (MR) and Abattoir Waste (AW) generated within the market are used as raw materials for the production of organic fertilizer. The plant is semi-mechanised as sorting and turning are done manually while the processing of the compost into finish products is done mechanically. The processing plant consists of six different units: shredding, screening, pulverizing, mixing, pelletising and bagging. Two grades of organic fertilizer (A and B) are produced in the plant. Grade A is fortified, grade B is unfortified. Both grades are produced in either powder or pellet form. The estimated man-power and electric-energy requirement of the plant are about 25 persons and 70kW respectively. A 50 kg bag of grade 'A' organic fertilizer is sold for about N700, while the unfortified grade 'B' is sold for about N600 per bag. The plant has proven to be commercially viable in terms of employment and income generation and equally as sustainable solution to the problem of solid waste management.

Keywords: Organic fertilizer, solid waste management, manufacturing, infrastructure development, machine design

INTRODUCTION

Waste management, in most urban centers in Nigeria, constitutes a major problem. The astronomic rate at which waste is being generated exceeds the rate of storage, collection, transportation, and disposal. The handling and storage of solid waste at the point of generation is generally a problem as inadequate number of containers is provided [1]. Many states have also established boards or municipal authorities to handle the urban and city waste problem with enormous amount of money expended annually. Various technologies, such as direct incineration, composting, and wastes recycling to produce energy have been adopted to handle wastes in different parts of the country. Despite all these efforts, no significant improvement has been made in effective control and management of wastes in cities and peri-urban areas throughout the country. In Nigeria, insufficient data on solid waste generation and the characterization of the waste generated is another major challenge faced by the Government. Federal Ministry of Housing and Environment [2] reported the problems of solid waste management and environmental sanitation of fifteen cities and urban areas in the country. The cities and urban areas surveyed in the study are: Lagos, Ibadan, Kaduna, Port Harcourt, Aba, Onitsha, Oshogbo, Warri, Uyo, Jos, New Bussa, Gusau, Potiskum, Suleja/Abuja and Kano. The fieldwork report indicated a close correlation between the population and the standard of living with the quantity of solid waste generated.

Ibadan, one of the urban centres in South-western Nigeria, the second largest city after Cairo in the Sub-saharan Africa, is faced with critical problems associated with management of solid waste. The average rate of solid waste generation of 0.39 kg per capital per day, consisting of 70.1%, municipal wastes; 18.8%, industrial wastes; 9.7%, institutional wastes; 0.7%, others wastes have been reported for Ibadan [2]. An enormous quantity of market waste is generated daily from these markets with no attempt by Government to evacuate it for proper disposal and such wastes have been piling up for many years. There are 43 organized markets within the Ibadan municipality [3]. The solid wastes generated from these markets constituted the larger percentage of waste generated within the city. The high organic content of solid wastes generated particularly from the markets and the acute storage in fertilizer requirement favours the composting option as a sustainable alternative for the management of solid waste and soil fertility in Nigeria.

Presently in Nigeria, the average annual fertilizer usage of 12.8 kg/hectare of land is very low compared with Zimbabwe with 57.1kg and Western Europe with 231.4kg per hectare of land [4]. Obigbesan [5] reported the acute shortage in fertilizer requirement to maintain about 21 million hectares of farmlands in Nigeria. The fertilizer requirement of Nigeria was 1.2 million metric tonnes per annum for the period of 1985 – 1987. The demand has continued to increase since then. While the

country's total fertilizer supply increased from 750,000 tonnes in 1988 to 1.65 million tonnes in 1994, the supply drastically reduced to 835,000 tonnes in 1995. Of this total, only about 313,190 metric tonnes (37.5%) was produced locally, and the trend has continued since then [5]. Government removal of 30% fertilizer subsidies, the subsequent ban on importation of chemical fertilizers, and the constant breakdown of the existing five chemical fertilizer manufacturing plants have created scarcity leading to unaffordable prices of the chemical fertilizer. Hence, making chemical fertilizers to be beyond the reach of peasant farmers.

Composting technology, processing of organic wastes by micro organism degradation into reusable product such as organic based fertilizer, has been proposed to be cost and environmentally effective in meeting the needs for fertilizer and management of solid waste. Research on the use of organic manure for arable crop production is not a new practice in Nigeria. The existent dates back to more than half a century starting with the pioneering work of Hartley and Greenwood [6]. Since then, many researchers have focused on development of organic based fertilizer in Nigeria [7-9]. However, these research efforts are limited to laboratory or small scale. Therefore, to meet the current challenges due to population increase and the fast degrading soil fertility due to over cropping and pressing needs for better solid waste management strategy, there is a great need for the development of an appropriate, sustainable and indigenous technology for production of organic based fertilizer on commercial scale in Nigeria The developed indigenous technology and machinery have been patented under the Federal Republic of Nigeria Patent No. RP: 16646 with the title "Organic and Organo-mineral Fertilizer from Wastes". The team have equally received awards both from National and International bodies.

Description of Plant

Plant location The Pace-setter organic fertilizer plant, is owned, funded and managed by the Oyo State Government through the Ministry of Environment. The plant which was installed and commissioned on July 1998 is still being operated as a self sustainable project. The Pace-setter organic fertilizer plant is located in the heart of Bodija Market in Ibadan North Local Government area of Ibadan. Market refuse and abattoir wastes generated in the market have been accumulated over many years without evacuation has formed a big heap in the market (see Figure 1)

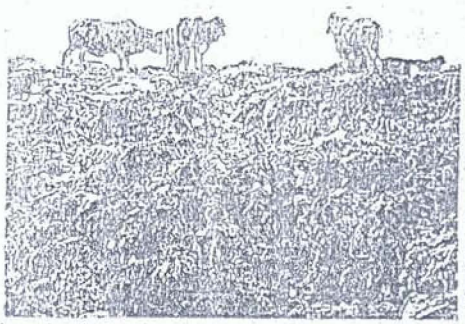

Fig. 1: A typical heap of market refuse and abattoir waste at Bodija market

Process design

The basic unit operation required for the production of the plant are collection and transportation of wastes, sorting, shredding, composting, curing, drying, screening, pulverising, mixing

and fortification, pelleting, and bagging. The process flow chart of the plant is shown in Figure 2.

Plant Layout

The plant layout of the plant is shown in Figure 3. The plant layout can be divided into four (4) sections: Administrative block; Waste reception and storage chamber; Composting chamber and Machine shop. Area view of the plant is shown in Figure 4.

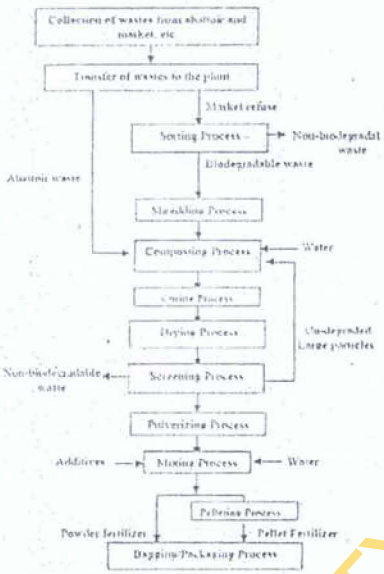

Fig. 2: Process flow chart of the plant

Man-power requirement

The estimated man-power for the plant is about 25 people, consisting of 20 daily paid or casual labourers and 5 permanent staff. The man-power requirement for each unit operation is shown in Table 1. The plant works on one shift of 8 working hours and one hour of break time for 6 days per week (Monday to Saturday).

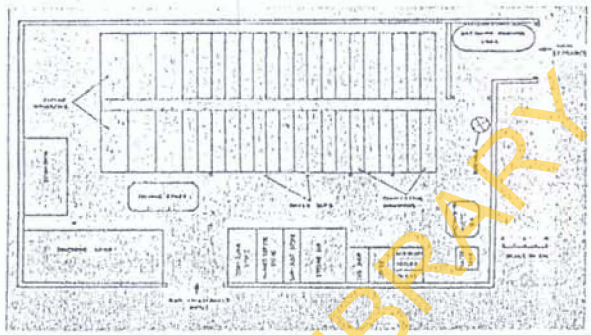

Fig. 3: The sketch of the plant layout

Table 1: Plant Man-power requirement

Casual Labour		Permanent Labour	
Process	Man-power	Process	Man-power
Collection and transfer	4	Security guard	2
Sorting o	4	Truck driver	1
Shredding	1	Technician	1
Charging and turning	5	Plant manager	1
Drying	1		
Screening	1		
Pulverizing	1		
Mixing	1		
Pelleting	1		
Bagging	1		

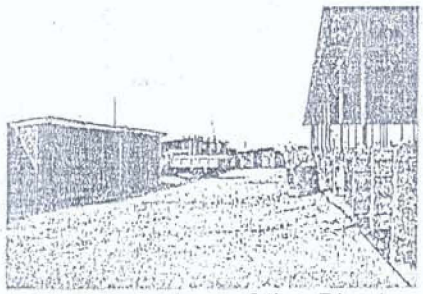

Fig. 4: A view of the Plant

Fig. 5: A view of the composting windrows

Fig. 6: A view of the machine shop

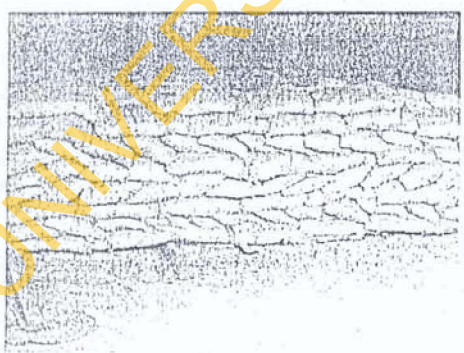

Fig. 7: Samples of 50 kg fertilizer

Chemical analysis of the fertilizer

Two grades of organic fertilizer (A and B) are produced in the plant. Grade A is fortified with additives such as mineral fertilizer (Urea), Rock phosphate and Bone meal, while grade B is unfortified. The proximate analysis of the products is shown in Table 2. The chemical analysis shows that the compositions of the products are within acceptable international standard for organic fertilizer.

Table 2: Chemical analysis of the organic fertilizer

Parameters	Composition (%)	
	Grade A	Grade B
Total Nitrogen (N)	4.424	0.883
Available Phosphorous (P)	0.504	0.604
Exchange Potassium (K)	0.152	0.323
Exchange Calcium (Ca)	0.028	0.034

Conclusions

The plant has proven to be commercially viable in terms of employment and income generation and equally as sustainable solution to the problem of solid waste management. A 50 kg bag of grade A organic fertilizer is sold for about ₦700, while the unfortified grade B is sold for about ₦600 per bag. The plan of replicating the plant in different parts of the country is being considered by different State Government and Non Governmental Organisations (NGOs).

Acknowledgement

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