



SOLID WASTE MANAGEMENT IN THE CONSTRUCTION INDUSTRY (A CASE STUDY OF PORT HARCOURT METROPOLIS)

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ABSTRACT

The construction industry generates large quantities of waste and contributes to the problems of environmental sanitation in Nigerian cities. Across Nigeria, proper procedures for managing construction waste are absent and collection and disposal are left to developers and their contractors. Solid waste management embraces all administrative, financial, legal, planning, and technological functions involved in solutions to all problems of solid waste. The main purpose of this paper is to examine waste management in the construction industry, using Port Harcourt Metropolis as a case-study. This paper also compares construction and demolition waste management in Nigeria with that in developed nations. The methodology adopted is the questionnaire, which was administered to officials of the Rivers State Environmental Sanitation Authority, Managers of construction sites and government contractors responsible for waste collection and disposal. Findings revealed that construction practitioners do not adopt waste minimization, reuse and recycling strategies and waste is not separated before disposal as it is practiced in developed countries. It was recommended that the government should introduce a disposal tax to reduce the volume of waste generated and encourage reuse and recycling such waste.

Key words: Solid waste management, construction industry, construction and Demolition waste.

INTRODUCTION

Wastes are generated in all stages of the production of goods and services. Wastes are essential parts of the process of production in somewhat the same sense that the emission of carbon dioxide by human is part of the process of breathing (Isirimah, 2000).

Waste is defined as materials of solid or semi-solid character that the possessor no longer considers of sufficient value to retain. (Gilpin 1976; Cited in Uchegbu, 1998) As stated in (Galagher, 2000) the EC framework Directive defined waste as “Any material where the holder has an intention to discard the material as no longer part of the normal commercial cycle or chain of utility”. Waste can be any garbage, sludge, gaseous, and other discharged

materials resulting from various community activities. Waste consists therefore of discarded materials resulting from domestic and community activities and from industrial, commercial and agricultural operation.

Waste management, in all its ramifications, is a planned system of effectively controlling the production, storage, collection, transportation, processing and disposal or utilization of wastes, in a sanitary, aesthetically acceptable and economical manner. It includes all administrative, financial, legal and planning functions as well as the physical aspects of waste handling (Gilpin 1976; cited uchegbu 1998).

The construction industry covers a wide range of loosely integrated groups and submarkets whose output varies but basically consists of the production, alteration or repair of durable buildings and capital goods involving the use of land combined with other scarce resources.

The industry is engaged in three general types of activity:

- (i) Residential building of apartment, flat and other structures.
- (ii) Non-residential construction of commercial, industrial and certain types of institutional buildings and
- (iii) Public works involving such activities as the laying of infrastructure of roads, reservoirs, bridges, sewers etc. (Balchin 1977).

Objectives of the paper

The objectives of this paper include the following:

- (i) To examine waste management in the construction industry, using Port Harcourt as a case study.
- (ii) To compare construction and demolition waste management in Nigeria with that in developed nations.

Description of the study area.

The study was conducted in Port Harcourt, capital of Rivers State. Port Harcourt is located in the Southern Part of Nigeria and is one of the fastest growing cities in the country. The population of Port Harcourt is over 1 million according to the state Statistical Agency.

Port Harcourt is the centre of the oil industry in the country and has the head offices of the major oil companies. Thus, the city has an important position in the national economy. With the oil terminal of Bonny and the new Port complex at Onne, Port Harcourt constitutes the second largest Port complex in Nigeria, after Lagos.

Port Harcourt Metropolitan area has two local Government Areas PHALGA and Obio – Akpor. Construction activities are on the increase particularly in the outskirts of the city.

A BRIEF REVIEW OF RELEVANT LITERATURE

The review of Literature is subdivided into five sections covering concept of solid waste management, functional elements of waste management system, sources of solid waste, classification of solid waste, and types of construction and demolition waste

Concept of Solid Waste Management

As cited in (Isirimah, 2002), Tchobanoglous 1993 defined solid wastes management as the discipline associated with the control of generation, storage, collection, transfer and transport, processing and disposal of solid wastes in a manner that is in accord with the best principles of public health, economics, engineering, conservation, aesthetics and other environmental considerations and that is also responsive to public attitudes.

In scope, solid waste management includes all administrative, financial, legal, planning, and engineering functions involved in solution to all problems of solid wastes (Isirimah, 2002).

Functional Elements of Waste Management System

The problems associated with the management of solid wastes in today's society are complex because of the quantity and diverse nature of the wastes, the development of urban areas, the funding limitations for public services in many large cities, the impacts of technology and resulting limitations in both energy and raw materials (Isirimah, 2002).

According to Isirimah (2002) activities associated with management of solid wastes from the point of generation to final disposal have been grouped into the six functional elements:

- Waste generation.
- Waste handling and separation, storage and processing at the source
- Waste collection
- Separation, processing and transformation of solid wastes.
- Transfer and Transport
- Disposal.

Sources Of Solid Waste

The principal sources of Solid Waste in an urban area are:

- Municipal (from street sweeping, sewage, waste from schools, markets and other institutions)
- Domestic (garbage, rubbish and often large waste from homes)
- Commercial (from stores and offices)
- Industrial (from manufacturing plants)
- Mining (from coal mining, strip mining etc.)

- Construction and Demolition (new construction sites, road repairs, renovation sites razing broken pavements)
- Agriculture. (Gobo, 2001)

Classification of Solid Waste

According to Gobo & Ubong 2001 A typical detailed classification of solid waste are as follows:

1. Garbage – putrescible waste from food, slaughter houses, canning and freezing industries, etc
2. Rubbish – non putrescible wastes, either combustible or non-combustible. Combustible wastes, either combustible or non-combustibles would include metals, glass, ceramics, stones, dirt, masonry and some chemicals.
3. Ashes – residues (such as cinders and fly ash) of the combustion of solid fuels, for heating and cooking or the incineration of solid waste by municipal, industrial and apartment house incinerators.
4. Large wastes – demolition and construction rubble, automobiles, furniture, refrigerators, and other home appliances, furniture, refrigerators, and other home appliances, trees, tires, etc.
5. Dead animals – household pets, birds rodents, zoo animals, etc
6. Hospital Waste – anatomical and pathological wastes from hospitals.
7. Sewage treatment process solids – screenings, settled solids, sludge
8. Industrial solid waste – chemicals, paints, and explosives.
9. Mining Waste – tailings, slag heaps, culm piles at coal mines.
10. Agricultural wastes – farm animal manure, crop residues etc.

Types of Construction and Demolition (C&D Wastes)

According to (Nunes et al 2006) Pinto (1999) Stated that the basic guidelines of construction and Demolition waste sustainable management are:

- (1) total facilitation of C&D waste disposal
- (2) Integral separation of collected solid waste and
- (3) Charge in collected waste disposal by recycling. Construction and Demolition waste materials include: asphalt, tar and related products, concrete, bricks, roofing and insulation materials, metals, plastics, soil, pipes, lumber, steel; and wood. (Gallagher, 2000)

RESEARCH METHODOLOGY

Two types of data were used for the study, both primary and secondary data. Secondary data were obtained from literature.

The primary data were obtained through the administration of structured questionnaire to officials of Rivers State Environmental Sanitation Authority; site Managers of construction

sites and contractors responsible for waste collection and disposal in the city. REFCOL is a major contractor of waste collection and disposal in Port Harcourt.

Although the data were obtained in 2000 it was upgraded in 2007 through observation and data obtained from professionals in the construction industry such as Estate Surveyors and Valuers, Architects, Civil Engineers, Managers of construction sites and officials of Rivers State Environmental Sanitation Authority (RSESA). Data were also obtained through a Telephone interview with the General Manager of RSESA. Special/ Adviser to the Governor on environment

Questions in the Questionnaire include method of waste collection, means of transportation, and method of waste disposal, agency responsible for waste management in the city, waste reduction, reuse and recycling and other questions.

Data on C and D waste management in developed nations were obtained punching from literature.

RESULTS AND DISCUSSION OF FINDINGS

Discussion of Findings were based on six broad areas. These include: waste generation, waste separation, storage and collection, waste transportation, waste disposal, waste reduction, reuse and recycling and C&D Waste management in developed Nations.

Waste Generation

The data revealed that the quantity of C&D waste generated in the city is not known (see table 1). The data also revealed that the volume of waste generated does not attract any fee. C&D waste attracts a fine only when it is dumped on the road and gutters and the RSESA impound construction equipment on site. The study revealed that the fine depends on the volume dumped on the road. This situation is not peculiar to Port Harcourt alone but it is common to most cities in Nigeria. By comparison, the quantity of waste generated per person per day is well documented in developed nations like USA, Japan, Germany and others.

According to Nunes et al (2006), Boranga, 2005 stated that each inhabitant of Germany (2001) generated 0.90kg waste each day, while the amount in Japan (2001) was 1.2kg per inhabitants, in the USA (2004) it was 2.0kg per inhabitants, and in Canada each inhabitant produced 1.7kg waste each day.

The data on the amount of waste generated in a city is needed for planning and efficient management of waste. The amount of waste generated include broken sandcrete blocks, concrete, roofing materials, ceramics, wood etc.

Solid Waste Separation, Storage and Collection in Port Harcourt.

The study revealed that solid waste is not separated before disposal. The municipal solid waste is co-mingled. C&D waste are co-mingled with other municipal solid waste. Even the C&D waste is not separated before disposal. (see table 1). Collection of C&D waste is undertaken by Contractors free of charge.

Safe, sanitary refuse, practices begin with proper storage. This is usually the responsibility of the user or owner of the premises at which the refuse is produced. In Port Harcourt refuse collection points are observed. Wastes from homes, commercial, institutions are dumped at the centres awaiting collection by the sanitary authority or their contractors. The study revealed that there are 30 refuse contractors responsible for the collections of waste in the city, the contractors include Palisco, Iomo, RTK, REFCOL, Fugudes, Industrial support, Glorious, Mesgh Ako & fidelity Socrates and Henry Joseph.

The refuse storage, while awaiting collection, is generally poor and observation shows it generally covers one side of the road (especially those near city centres and markets) Malodours, flies and moisture are common observations resulting from improper storage (Gobo & Ubong; 2001).

Frequent collection of refuse is necessary to prevent unsanitary and unsightly conditions. In Port Harcourt refuse is reported to be collected at least two times a week/per station. But this frequency may be the expected and not the actual as most times, refuse pile up for about two weeks awaiting collection at a point. The present strategy of getting contractors involved in refuse collection and disposal is working out well as refuse heaps are reducing remarkably at the points. (Gobo & Ubong; 2001).

In the past, sanitation authority had collection vessels with covers (bins) that were placed in strategic locations for the dumping of waste and were then emptied from time to time. These were said to have been imported from Western Germany. The high cost of maintenance and spare parts have made the authority to discontinue and withdraw containers to their premises.

The currently used method is dumping on the ground at the collection centres. From here, pair loaders and tippers are used by contractors for the collection and disposal at the final designated sites which may be a swamp or a burrow pit (Gobo & Ubong; 2001). The study revealed that the situation has not changed as refuse heaps are common sight on the roads and collection centres. The survey also revealed that the refuse is collected from the collection points weekly.

Waste Transportation

The study revealed that C&D waste and other municipal waste are transported with trucks and tippers. The study also revealed that the Rivers State Environmental Sanitation

Authority (RSESA) and their private contractors are responsible for the transportation of both C&D waste and other municipal waste generated in the city.

Most of the trucks used for the transportation of waste are without cover. During transportation waste from these trucks litter the streets which is unsightly and a health hazard. The trucks with cover are those provided by Niger Delta Development commission (NDDC). The practice of using trucks without cover is a health hazard and should be discontinued.

Waste Disposal Practices in Port Harcourt

The study revealed that in Port Harcourt, the most widely and commonly used method of waste disposal is the open dumps system. Literature sources give a number of different solid waste collection and disposal methods that are possible. These include:

- Open dumps
- Sanitary landfills
- Municipal Incinerators
- Miscellaneous method (composting), hog feeding, ocean dumping, salvage operations (Gobo & Ubong; 2001).

In Port Harcourt, Environmental Sanitation Authority is responsible for the collection and disposal of solid waste in the metropolis. The data shows that the authority uses open dump method at four final disposal sites located in the town. These include Whimpey Dump Site, Abuloma Dump Site, Elemenwo Dump Site, and Igwuruta Dump Site. All these dump sites are not covered with earth material after each days operation but the exposed to flies and rodents to proliferate.

The study revealed that C&D waste are dumped into gutters and roads. The environmental impacts of these illegal practices are traffic congestion and flooding. Flooding results from blocked drains with C & D waste and other municipal waste. The study also revealed that there no engineered sanitary landfill in Port Harcourt. (see table 1)

Waste Reduction, Reuse and Recycling

The study revealed that presently there are no waste minimization practices by both the government and construction practitioners. The study also revealed that small portion of C&D waste is reused in Port Harcourt. The uses include filling of Pot holes on the road by concerned individuals, construction of temporary structures (Bacha) for low-income earners in informal settlements and some Ikwerre land owners, and frying of yam, fish, akara (beancake) by mamaput. The materials commonly reused include broken blocks, corrugated iron sheet locally known as zinc, louvre glasses and wood.

Recycling is an important factor in helping to reduce the demand on resources and the amount of waste requiring disposal by land filling. Recycling in this paper refers to

reprocessing and the manufacture of new product. The study revealed that presently, there is no recycling of C & D Waste in Port Harcourt, as it is practiced in developed nations.

Construction and Demolition Waste Management in Developed Nations

The first objective in the government's strategy for more sustainable waste management is to reduce the production of waste consistent with economic sustainability. In developed Nations like the US and others, reduction of the generation of construction and demolition (C&D) waste is and has always been an important principle of good engineering design and construction, and includes measures such as:

- avoid excavating unnecessary spoil which can be left in place.
- design out problems of waste disposal where possible
- avoiding unnecessarily restrictive or default specifications for materials by specifying actual performance requirements, thereby allowing suppliers and sub-contractors an incentive to reduce waste to gain commercial advantage;
- designing for maintenance not just construction
- using no-dig or trenchless technologies
- separating excavation wastes as they arise for subsequent re-use; and
- designing in re-use after demolition.

Over 16% of total UK waste arisings is estimated to originate from construction, renovation and demolition activities. Based on a 1990 review; 11 of the 24 million tones of C & D Waste produced in the UK was re-utilized. The introduction in 1996 of landfill tax has changed industry practice somewhat, but not to the significant extent the government wanted. The majority of re-utilization occurs in urban areas, near to major sources and markets. Uses include general fill, and some road sub-bases of this total amount, about 30% is used in the construction of access roads to landfill sites. Blacktop planning of which there are around 7-8 million tones arisings per annum are generally all re-used, primarily in pavement construction, as road base mix aggregate (up to 30% may be blacktop planning's) in landfill capping and, to a lesser degree, in embankments. Gallagher, (2000)

Reuse and recycling occupy second and third positions after reduction in the hierarchy of waste management options. It is estimated that in the UK, a recycling rate of around 45% has been achieved for construction and demolition waste; by contrast the Netherlands, Belgium and Denmark, have achieved 90%, 87% and 81%, respectively. (Mason, 2000).

According to Gallagher and Needham (2000), in Netherlands there is a tax on extraction of primary aggregates and levy on land fill and legislation and standards encouraging secondary aggregate use. They also stated that in Denmark, there is no tax on waste for recycling. A primary aggregates tax was introduced, there is no tax on secondary aggregates and land filling of combustible wastes was banned from 1 January 1997, further encouraging recovery of C & D waste.

The approach to waste management within these countries has demonstrated that C & D waste has a very high recycling potential. To achieve these levels of recycling they have

taken the steps of restricting or banning the landfilling of this type of waste. In 1997, the Dutch banned the disposal of re-usable C & D waste so only certified demolition organizations are allowed to dispose of materials deemed not to be recyclable.

In 1996, the UK government introduced the landfill tax. A principal aim of the tax was to promote waste minimization practices by making the main disposal route, landfill more expensive. In the recent Ecotec report, ‘Effects of Landfill tax – Reduced Disposal of inert wastes to landfill’, it was concluded that there has been an increase in the recycling of C & D waste, which was not possible to quantify. In reality, there is limited information as to what the current level of C & D waste arisings are, and this is being addressed by the Environmental Agency through a survey into construction waste arisings. (Mason, 2000)

The success of any recycling initiative depends upon a market for C & D Waste being available. In turn, this depends upon the next user’s confidence in the material with respect to its quality, sufficiency, price, location and timely availability.

CONCLUSION AND RECOMENDATIONS

The aim of sustainable construction is no minimize the waste generated and maximize the quantity of materials reused and recycled. A number of initiatives demonstrate that more sustainable waste management practice can bring economic and environmental benefits and lead to commercial advantage. (Gallagher, 2000).

The study revealed that, presently there are no waste minimization practices by both the government and construction practitioners. The study also revealed that the volume of C & D waste generated in the city is not known as it is properly documented in developed nation.

The method of waste disposal is open land dumping. There are no engineered landfills in the city. The study also revealed that only a small portion of C & D waste generated is reused and there is presently no recycling of C & D waste in Port Harcourt.

Based on the findings of the study the following recommendations are made:

- The agency responsible for environmental matters should establish a department or body that will provide adequate data on the volume of C & D Waste generated in the city.
- The C & D waste should be segregated from other waste before disposal
- Construction practitioners should try and adopt waste minimization practices as is being done in the developed nations.
- C & D Waste should be reused and recycled in Nigeria as it is done in the developed nations.
- A tax should be imposed on the volume of waste generated in order to encourage waste reduction.
- Educate the public on the importance of waste reduction, reuse and recycling
- Engineered land fills should be constructed in the city

Table 1.: Waste management in Port Harcourt.

	Yes	No
Is the volume of C & D Waste generated in city well documented?		No
Does C & D waste generated attract a fee?		No. Attracts a fine when damped into gutter and on the road
Are C & D waste reused?	Yes (a small portion)	
Is there any subsidy from government for waste reduction?		No
Are the C & D Waste recycled?		No
Is there any sanitary landfill in Port Harcourt?		No
Is there any sanitary landfill under construction?		No
Are the C & D Waste separated from other waste before disposal?		No
What are the uses of the C & D Waste?	Filling of pot holes on the road, construction of Bacha houses, used by mama put for frying of yam, akara (bean cake) fish on the road side	

Source: Telephone Interview with General Manager of RSESA May, 2007, and field survey, 2000.

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