A Study on the Evaluation of Industrial Solid Waste Management Approaches in Some Industries in Aba, South Eastern Nigeria

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Abstract

Industrial solid waste is a serious health concern in Aba, South East Nigeria. This study was undertaken to assess the approaches of some industries toward some aspects of waste management in Aba. Interviews, observation and questionnaires administered to industry executives and waste managers were used to generate data for the study. The result from the field research showed that majority(47.39%) of the solid wastes stream were compostable while far less (4.69-9.90%) recyclable waste were generated. The result revealed that open ground was the most prominent storage facility used and only 42.50% of the industries undertake some form of treatment of waste before storage. The industries studied employ more than one method of waste disposal and it was mostly carried out with open trunk and wheel barrows. Waste contractors were engaged by 52.50% of the industries and wastes were equally deposited in dump sites (45.00%), rivers (12.50%), composited (20.00%)or incinerated(25.00%). There was inadequate provision of protective measure in most of the industry. The respondents acknowledged enjoying medical check which was however not regular and in some cases in poorly equipped health centers and drug stores. The awareness of respondents on the consequences of improper waste management was high (75.50%) while the level of attendance of health and safety treatment training was average (46.25%), however, none of the industries had health policy plan. It is recommended for the improvement of the function of the waste management regulatory body, Abia State Environmental Protection Agency(ASEPA) and commitment of the industries and the general public toward industrial solid waste management.

Key words: Solid waste, Industries, Management processes, Aba, Nigeria

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1.0 Introduction

In industrial production, many materials are employed to manufacture products and because of the scale of the production, a lot of waste is generally produced. The component categories

usually include: compostable (includes food, yard, and wood wastes); Paper; Plastic; Glass; Metal; and other (includes ceramics, textiles, leather, rubber, bones, inerts, ashes, coconut husks, bulky wastes, household goods).[1][2][3]

The improper management of solid waste poses health hazards to the residents causing diseases such as bronchitis and cancer.[4] High level of industrial discharge has effect of upsetting the ecological balance of nature. The microbial degradation of waste in water bodies lead to depletion of oxygen and fishes and other aquatic organisms which require oxygen for survival are thus affected.[5] In the extreme cases there is dislocation of socio-economic system of an area.

As a result of the size of the problem, industrial companies employ waste managers to focus solely on the issue of proper and effective disposal of waste. Industrial waste management involves collection, transport, processing or disposal, management and monitoring of industrial waste material. Management of non – hazardous, residential and institutional waste

in Nigeria is usually the responsibility of local/state government authorities while management of hazardous commercial and industrial waste is usually the responsibility of the generator.[6][7,][8]

The problems relating to management of industrial solid waste is associated with lack of infrastructural facilities and negligence of industries and environmental regulatory body to take proper control.[9] Most major cities in Africa have an established municipal waste collection system. Collection is carried out by human- and animal-drawn carts (wheelbarrows, pushcarts), open-back trucks, compactor trucks, and trailers. Collection rates across the continent range from 20 to 80%. Common feature of the municipalities is that they are ineffective, underequipped and poorly maintained (often vehicle immobilization rates reach as high as 70%), inadequately funded and poorly staffed.[3] The large industries (industries with huge infrastructure, high man-power requirement and influx of capital asset) located in identified industrial areas respond to industrial compulsion as imposed by the pollution control laws by having some arrangement to dispose their solid waste. However, the problems persist with small industries. They find it easy to dispose waste here and there, thereby mixing industrial, residential and commercial waste and making it difficult for local bodies to collect such waste though it is not their responsibility.[11] The situation is disturbing since it is estimated that small scale units put together generate as much waste as the large industries [9] overwhelming majority of landfills in Africa are open dumps.[3] These facilities are generally located at the perimeter of major urban centers in open lots, wetland areas, or next to surface water sources. Though many municipalities have statutory requirements for the construction and maintenance of landfills these are generally not enforced. In most instances the landfills are owned and operated by the same public agency that is charged with enforcing the standards. Often a lack of financial and human resources, coupled with absent enabling policies, limit the extent to which landfills can be built, operated, and maintained at minimum standards for sanitary practice.

There is no significant waste recovery and reuse activities in Nigerian cities. In most cases, scavenging plays an important role on the economic survival of a number of industries (e.g., steel, pulp and paper).[2] Waste pickers work on dumps and even landfills, while some build squatter colonies on the edges of dumps, sometimes with disastrous consequences. Waste pickers are involved in a small-scale recovery and reuse operation.

The assessment of industrial waste management problems greatly varies depending on the nature of industry, their location and mode of disposal of waste.[12] Sound waste management cycle helps in reducing the adverse impacts on the human health and environment, while enhancing the lifestyle and developing the economic state of the country. In order to offer an appropriate solution for better management of industrial solid waste in industrial town like Aba in South- East of Nigeria, assessment of the approaches of industrial waste management is essential. This study aims to evaluate some industrial waste management approaches of some industries in Aba.

2.0 Study Area

The study was carried out in Aba in Abia State of Nigeria. Aba is located at longitude 7°19¹E and latitude 5°10¹N. It has a population of 839,000 and accounting for four of the seventeen Local Government Areas in Abia State.[13]

Aba known as 'Japan of Africa' is the commercial and industrial center South East of Nigeria, situated at the bank of river Aba. There are many large and scale industries and four major markets.

The solid waste management is carried out by private establishments and Abia State Environmental Agency. The landfill is situated at the outskirts of the town;

however there are numerous dump sites. Most roads are filled with refuse which leads to flooding especially during the rainy seasons. The waste provides breeding ground for vectors of human diseases and source of unpleasant odour.

There are many private and government owned hospital and healthy centers. There is very ineffective public pipe borne water supply system.

3.0 Methodology

The researcher adopted several instruments in data collection for this study in 2009. Planned questionnaires (including questions on nature of waste, storage of waste, collection, and method of disposal, treatment and waste manager's welfare) were administered to waste managers, personnel and managers of industries. Furthermore additional data and information were collection from direct observation, interview with responsible persons. Secondary data were obtained from literature on the subject. A total of 192 respondents were sampled from twenty five small scale and fifteen large scale industries made up of 8(20,00%) extracting,9(22.50%) hospitality, 15(37,50%) manufacturing 4(10.00%) construction and 4 processing industries. Ethical considerations such as informed consent and confidentiality of personal information in the interview were observed.

The percentage volume of the waste generated by the companies is shown in Table 1.

Table 1: Types of the solid waste generated

Type of waste	Volume(%)
Plastics	12(6.25)
Papers	19(9.90)
Glass	9(4.69)
Aluminum scraps	19(9.90)
Metal scraps	20(10.41)
Compostable(eg.food and wood)	91(47.39)
Water sachets and cellophane packages	22(11.45)

Wastes that can be readily composited had the highest volume of 47.39% while 4.69% was recorded for glass. Other percentage volume encountered were metal scraps 10.41%,paper and aluminum 9.90%,cellophone containers 11.45% and plastic 6.25%. The response on the storage facilities used by the industries is shown in Table 2.

Table 2: Types of storage

Types of storage	Small scale Industry N=25 (%)	Large scale industry N=15 (%)	Total N=40 (%)
Uncovered drum	6(24.00)	3(20.00)	9(22.50)
Open ground	14(56.00)	8(53.33)	22(55.00)
Concrete bays	0(0.0)	0(0.00)	0(0.00)
Pilled against a wall	2(8.00)	1(6.66)	3(7.50)
Covered bin	3(12.00)	3(20.00)	6(15.00)

Open ground was the most prominent(55.00%) storage facility used by the industries followed by uncovered drums(22.50%).The result revealed that higher percentage of small scale industries employed both facilities. None of the industries stored their refuse in concrete bays. Covered bin and pilling against a wall accounted for 7.50% and 15.00% of the storage facilities used.

The result of interview and questionnaires on the preliminary treatment of waste before disposal by the industries is illustrated in Table 3.

Table 3: Preliminary treatment of waste before disposal

Questions	Types of industry			Total
	Small scale(%)	Large scale(%)		(%)
Any waste treatment	No	Yes	No	Yes
No Yes				
	18(72.00)	7(28.00)	5(33.33)	10(66.66)
23(57.50) 17(42.50)				
Types of treatment	N=7			N=10
N=17				
Segregation	7(100)			10(100)
17(100)				
Recycle/Reuse	2(28.57)			3(30.00)
5(29.410				

The result revealed that 42.50% of the industries undertake some form of treatment with 28.00% of large and 66.66% of small scale industries involved. All the industries that reported treatment of waste carry out segregation while only 29.41% recycle or reuse their waste. The methods of disposal of waste by the industries sampled are displaced in Table 4.

Table 4: Method of disposal of waste

Disposal method	Types of industry		
	Small scale N=25 (%)	Large scale N=15 (%)	Total N=40(%)
Waste collection contractor	11(44.00)	10(66.00)	21(52.50)
Deposited at waste dump	8(32.00)	5(33.33)	18(45.00)
Solid to other industries	2(8.00)	6(40.00)	8(20.00)
Deposited in the river	5(20.00)	0(0.00)	5(12.50)
Compositing	5(20.00)	3(20.00)	8(20.00)
Incinerating	8(32.00)	2(13.33)	10(25.00)

The industries studied employ more than one method for waste disposal(Table 4). Twenty one (52.50%) of the industries(10 large scale(66.00%) and 11(44.00%) small scale) employ contractors for waste disposal. Eight(32.50%) industries deposite their waste at the municipal dump while 20.00% of the industries either sale or composite their industrial waste. Only 5(12.50%) small industries deposite their waste in river while 10(25.00%) carry out on-site incineration in make-shift incinerators

Measures	Number of respondents		Total
	Small scale N=82(%)	Large scale N=110(%)	N=192(%)
Handkerchief	80(72.72)	17(20.73)	97(50.52)
Respirator	0(0.00)	10(12.19)	10(5.20)
Nose guard	30(27.27)	65(79.26)	95(49.47)
Overall clothing	12(10.90)	55(67.07)	67(34.89)
Jungle boot	17(15.45)	63(76.82)	80(41.66)
Hand gloves	23(20.90)	74(91.24)	97(50.52)

Table 5: Preventive measures available to waste managers

Table 5 shows the preventive measures available to waste managers. From the result, 97(50.52%)of the respondents acknowledge the use of hand kerchief and handgloves.Jungle boot and nose guard were provided to 41.66% and 49.47% of the respondents respectively, while only 34.89% of the respondents had overall clothing. Incidentally, only 10(5.20%) of the respondents from large scale industries acknowledge the use of respirator. Generally, large scale industries performed better in the provision of preventive measures except in the provision of unconventional handkerchief (72.72%) by small scale industries. The respondents' response on prophylative measures available in the industries shown in Table 6.

Table 6: Prophylative measures available to waste managers

Variable	Number of respondents		Total
	Small scale N=110	Large scale N=82	
Regular medical checkup	O(0.00)	0(0.00)	0(0.00)
Once a week	0(0.00)	17(20.73)	17(8.85)
Once a month	14(12.72)	35(42.68)	49(25.52)
Once a quarter	25(22.72)	21(25.60)	46(23.95)
Occasionally	41(37.27)	6(7.31)	47(24.47)
Not at all	30(27.27)	3(3.65)	33(17.18)

Percentage in parenthesis

None of the waste managers had regular medical checkup while 17(8.85%) from large scale industries had weekly check up(Table 6). Forty six(23.95%) and 49(25.52%) had quarterly and monthly medical check up respectively. Respondents who reported occasionally check were 47(24.47%) of which respondents from small scale industries accounted for 87.23%(41/47).Unfortunately,33(17.18%) of the respondents of which majority, 90.90%(30/33) are from small scale industries have not had any formal medical check up. The table 7 refers to the response of respondents on the availability of referral for medical check up to waste managers.

Table 7: Response on referral available by the industries to the waste managers

Variable	Frequency(%)		
	Small scale N=80	Large scale N=79	Total N=159
Company clinic	7(8.75)	53(67.08)	60(37.73)
General hospital	18(22.50)	18(22.78)	36(22.64)
Health center	8(10.00)	8(10.12)	16(10.06)
Near by drug store	6(7.50)	0(0.00)	6(3.77)
Not available	41(51.25)	0(0.00)	41(25.78)

Sixty (37.73%) of the respondents were referred to company clinic of which 89.33%(53/60) are workers of large scale industries. The result showed that 22.64% respondents attended government general hospital while 10.06% attended of the health centers .Only 6(7.50%) of respondents and from small scale industries workers were referred to drug stores .Similarly, 41(25.78%) who reported no referral to health facility were worker from small scale industries. Table 8: Response on the awareness of health consequences of industrial solid waste and attendance of waste and attendance of health/safety training on waste management

Table 8

Variable	Number of respondents from the industries		Total
	Small scale N=110	Large scale N=82	N=192
Awareness of health Consequences of waste	71(64.54)	73(89.02)	144(75.00)
Attendance of health And safety training	30(27.27)	59(71.95)	89(46.35)
Health policy	0(0.00)	0(0.00)	0(0.00)

Percent in parenthesis

The result illustrated in table 8 shows that 75% of the respondents were aware of the health impact of improper waste management, however only 46.35% of the respondents had attended health and safety training on waste management. Unfortunately, only 27.27% of worker from small scale industries had opportunity for the training.

Discussion

The industrialization of Aba has assisted in building self reliant population and also in uplifting of Nigerian economy. However, the huge waste generated has caused serious problems relating to environmental pollution. The problems relating to the disposal of industrial solid waste are associated with lack of infrastructural facilities, negligence of industries and lack of commitment to take proper safeguards.

The Abia State Environmental Protection Agency has not been able to enforce the legal provision and make industries legally responsible for safety of all concerned. The component category of the waste is semilar to other reports from several authors in different cities.[1][10][11][14][15] The result shows that compostables recorded the highest volume of 45.75%. The high organic content suggests possible value as composting material. Composting is mainly practiced by the hotels and eateries. This process converts waste to manue for agricultural purposes. However, the benefits are mostly not achieved as segregation is mostly not practiced to remove the non-degradable materials thereby producing low quality compose .As a result, the viability of this scheme is hampered by poor demand of the end markets for their products. The waste stream indicates limited potential commercial value for the recovery of metals, glass, and plastic. This limitation does not deter the uncoordinated and unhygienic scavenging of waste in Aba.

The analysis of the type of storage for industrial waste showed that little attention was paid to proper storage as the wastes were mostly exposed in uncovered container. The result in the study is similar to the observations of other authors.[6][16][17][18][19] The hazardous and non-hazardous waste are mixed and are expected to produce health problems among the workers and handlers of waste and the general population.[4]. The waste storage sites constitute foci for vectors of diseases, source of our pollution and possibly avenue for poisonous leacheates to contaminate underground water.[21][22]. Equally, the unrestricted access to dumpsites by unauthorized persons pose health risk. [23][24] Unfortunately, the hygienic covered bins were used by only 15% of the Industries. This trend was observed in the large and small scale industries revealing an institutionalized disregard for the regulation on the use of covered containers for waste storage.

Preliminary treatment of waste is necessary in reducing the volume of hazardous waste and the key to achieving sound industrial waste management thereby encouraging source recovery, possible reuse and health risk reduction. [27] The 57.5%

prevalence recorded in this study among industries without any form of pretreatment is noteworthy, with 66.6% of them being large scale as against only 16.0% small scale industries. It is estimated that scale units put together generate as much waste as large units [9] as most of the small scale industries do not reduce their waste thereby contributing enormously to the waste problem.

Investigations revealed that the recycling plants engaged by 5% of the industries were purely for paper recycling only. This limitation means that the small recyclable waste is not recovered and the concept of waste to health is completely neglected.

In Aba, the approach is to dispose waste as cheaply as possible, without much concern as to what happens once the waste leaves the production premises. The industries surveyed in this study employ more than one means for disposal of waste. The waste collection contractors used by 5% of the industries are in most cases engaged with disregard to their capability. The wastes are manually handled. There are few mechanical aids for waste management. Stored waste is shoveled by hand into open trucks or lorries encouraging fly-tipping and often waste are taken to disposal sites impropriate for the type of waste concerned. These unhygienic practices are common in other cities in Nigeria.[23] [6][11][8] The reasons attributed to these include financial limitations, corruption and illiteracy.

The result revealed that in 32.5% of the industries, industrial solid waste are intermingled with domestic waste making it difficult for waste disposal agency to manage. The health implication of this practice is magnified by the fact that non-hazardous waste assumes toxic nature once mixed with hazardous materials. [23][24]

Five (20%) of small scale industries acknowledged deposition of waste in the river side thereby causing pollution and ecological disruption.[5][25] Fortunately, the large scale industries which naturally produce most of the hazardous waste do not deposite their solid waste in the river. The small scale industries may have been lacking in action to dispose off it's waste and upload it's statutory responsibility due to lack of education, awareness and trained personnel to manage the waste in the industries, as well as paucity of fund available to create a proper waste management system.

It is a common knowledge that in Aba, small scale industries do not seek the consent of the regulatory body, Abia State Environmental Protection Agency on waste disposal and equally their un-wholesome activities are ignored to the detriment of the inhabitants. It was clear from the survey and interviews that it is likely that the volume of solid waste will steadily increase as the owners are not accountable to higher authorities nor are the workers adequately informed. The results of this study are similar to those of other studies conducted in other countries.[26]. The government should monitor these industries so that they can be responsible with their waste management.

In the ten industries that carry out incineration, the process is carried out in make-shift on site incinerators operating at temperature below 800^{o}C, consequently inhabitants that live near the industries are exposed to dioxin, and furan or other toxic pollutants. [27]. The result further revealed that the industrial waste mangers use several protective measures. The large scale industries faired better with 10 (12.1%) of the respondents acknowledging to have used recommended air respirator. However, the use of handkerchief in the light of availability of hygienic and cheap nose guard is embarrassing. The companies' executives need to be educated on the benefits of adequate protective measures for their workers. The improvement of the workers welfare will have direct and positive relationship with their productivity.

Medically, it is advised that waste mangers or handlers subject themselves to prophylactic measures to amenoriate unnecessary health problems [28]. Even though most of the respondents in this study acknowledged undertaking some form of prophylactic measures, none had regular

medical check-up and as much as 17.1% mostly from small scale industries have not had any form of medical check.

Respondents from large scale industries (37.7%) are mostly referred to the company clinic while the less financially buoyant small scale industries refer a sizeable (22.5%) number of their workers to the government general hospitals. Fortunately, the medical bills are settled partially or in full by the companies depending on the amount.

The high percentage of referal available may be a reflection of 75% awareness of health consequences of industrial solid waste. On the frequency of attendance of health and safety training programme, respondents from large scale (71.1%) were better exposed to contemporary health and safety regulations and guideline even though the industries have no health policy plan.

Conclusion

The results from the present study have indicated that waste management from the industries studied is inadequate. The situation is worst among small scale industries. Companies need to be responsible for their industrial waste management. The small and large scale industries should be required to seek authorization from Abia State Environmental Protection agency under relevant rules; equally the agency should be committed in enforcing the relevant rules. Towards this, law should be promulgated to tax the industries. The tax will help offset the environmental damage by going towards environmental restoration, protection and spreading information to increase knowledge on these issues. It is possible that through the efforts of ASEPA and industries, a mechanism could be evolved for better management.

The industries should be made to undertake the detailed risk assessment of the waste. A policy should be formulated based on reduce, reuse, recover and dispose by the industries. Companies are expected to improve their waste and environmental performance and efficiency on a regular basis.

Segregation should be done at the point of waste generation and can be achieved through proper training, cleaning standard and tough enforcement. Industrial waste should be collected and transported in safe containers. The open dump site should be closed and municipal should work in conjunction with the industrial sector towards development of specific sanitary landfill for the treatment and disposal of waste. Facility should be installed to extract gas which can be burnt to generate the needed electricity in Aba.

Personnel handling wastes of the industries should be made to wear appropriate protective clothing. Mechanical methods for handling waste should be adopted where possible and people should be educated about the dangers of manual handling of hazardous waste. Recycling plants as in developed countries should be built to convert some of the waste to useable materials and become a source of employment and income to the industries and the society [29]. The uncontrolled incineration should be discouraged, rather hygienic and well structured incinerators should be established outside the city to take care of the combustibles.

Generally the government should promote environmental management system in all industries through awareness programmes training and demonstration projects which should cover all stakeholders concerned. There should proper budget allocation for waste management activities and most importantly industries should be encouraged to employ professionals.

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