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Environmental Impacts of Polyethylene Generation and Disposal in Akure City, Nigeria

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Environmental Impacts of Polyethylene Generation and Disposal in Akure City, Nigeria

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Abstract - The environmental impact and seasonal variation of polyethylene (cellophane) generation and disposal in Akure City, Nigeria was investigated. Five daily markets, were randomly selected for data collection. In each market, two areas: one in the raw food section and the other in the processed food items section, each measuring 30 metres by 100 metres were demarcated for investigation. The result showed that polyethylene is generated more during the dry season months than the wet season months. The result also showed that table water sachet topped the list of cellophane wastes generated. This is because; it is cheap and consumed throughout the year with very little seasonal variation. Types of cellophane generation at home and market also displayed a very interesting pattern. The study showed that in the market, polyethylene for assorted items was the least (51,000), followed by biscuits (50,863), ice cream sachets (81,526) and table water sachets (96,853). On the other hand, the trend showed that, at home, polyethylene for assorted items was the highest (98,361kg), closely followed by biscuit wrapper (45,263), ice cream wrappers (35,514) and table water sachets (25,360). Cellophane waste poses various threats to public health and adversely affects flora and fauna as well as the environment especially when it is not appropriately collected and disposed. It is advocated that aggressive campaign and enlightenment of the masses on the threats posed by cellophane pollution should be carried out to prevent further damage to the environment.

Keywords : cellophane, pollution, environmental, impact, campaign, enlightenment

I. Introduction

Human activities generate many by-products which are generally seen as useless and discarded as wastes (Palmer, 1998). These massive amounts of wastes subsequently find their ways into the ground, air and water every year (Day, 1998). Increasing population growth accompanied by rapid urbanization and industrialization has resulted in dramatic increases in the volume of wastes generated by modern societies. Increase in economic activities and food consumption by humans and changing lifestyles generate a massive volume of domestic wastes which creates a critical problem in the developed and developing countries of the world (Palmer, 1998).

Solid waste management has emerged as a major environmental threat for cities in developing countries worldwide. In a survey released by UNDP in 1997, 151 mayors from around the world ranked solid waste disposal problem as their second most urgent urban challenges surpassed only by unemployment and followed by urban poverty (Agagu, 2008).

Solid waste management has gained notoriety in Nigeria today because of its visibility and the embarrassment it has constituted to the image of the nation (Agagu, 2008). Only few state capitals in Nigeria have been able to put in place fairly sustainable urban waste management programmes. It is therefore a common site to find mountains of waste scattered all over our cities for days or even weeks with no apparent effort displayed at getting rid of them, even with the attendant risk of air and ground-water pollution (Fig. 1).

Fig. 1 : Refuse mountain in a typical Nigerian City.

Considerable percentage of urban waste in developing countries is deposited either on the roads, or road sides, unapproved dump sites, in water ways drainage system, or in open sites which adversely affect environmental friendliness. In fact, solid waste poses various threats to public health and adversely affects flora and fauna as well as the environment especially when it is not appropriately collected and disposed (Geraldu, 1995). Besides the above mentioned effects of solid wastes, they result in emission of toxic chemical to the atmosphere and to the soil whenever they are degraded or burnt. The trees absorb these toxins through their root system which retards growth rates and consistently results to death (Addison *et al.*, 1991).

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Until recently, polyethylene (cellophane) papers do not have serious negative environmental problem in the developing countries simply because of the subsistent pattern, small scale agricultural and industrial production and, consequently, low quantity of waste generation. Besides, when generated, land was generously available for the disposal of waste. Hence simple disposal techniques such as return to land use of adjacent field, and indiscriminate burning and dumping were adopted for waste disposal (James, 1991; George *et al*., 1993). Unfortunately, these techniques could no more accommodate the present waste disposal problems because of rapid population growth and industrialization which are the two major factors competing for land (John and Williams, 1993). The two major factors have greatly increased the volume of polyethylene (cellophane) generation. If this is the present situation, it would mean that the coming generation will have to face and contend with unprecedented environmental problems and challenges.

In traditional African Society, with lower population figures, the native leave was sufficient for all that the individual needed to wrap (Jimoh, 2002). But the challenges of ever increasing population have made Nigerians to learn how to use the fairly improved means of wrappers such as the polyethylene bags. Polyethylene (cellophane) papers are currently being used in all forms and shades in Nigeria as wrappers ranging from biscuit, ice cream, table water, salt, and tapes (audio and video) to mention but a few. Cellophane bags are used virtually in all shopping centers, homes, markets, restaurants and farms in Nigeria (Ogunna, 1999). Polyethylene materials, which are derived from ethylene polymers, are products of the polymers industry at present. They posses certain qualities and properties which make them readily usable. These include high tensile, stiffness, compressive strength and impact resistance (Aziegbe, 2007). The high physical strength and properties are reproducible and predictable as well. They also retain their physical and chemical properties over a wide range of environmental conditions such as heat, cold and chemicals. They can resist mechanical stress for a very long period of time. Flame retardness is not an essential requirement but it has become an added asset lately. They are not biodegradable since they are unaffected by heat, cold and chemicals (Obediah, 2001). Polyethylene is found in the entire streets, nooks and crannies of Ondo State. They therefore pose serious environmental problems to inhabitants especially where solid wastes are deposited in both urban and rural areas. Urban waste disposal is the responsibility of various municipalities, local government and/or city co-operations (Ramasastry, 1988). In most developing nations, urban waste disposal systems are anything but functioning. Where they function however, they are grossly inadequate despite today's technological know-how and renewed efforts towards effective waste disposal. A lot of studies abound that focus attention on solid waste generation and disposal in Nigeria cities. Examples include Adedibo (1983) study of Ilorin and Offa, Kwara State; Adefemi and Awokunmi, (2009) study of Ado-Ekiti, Ekiti State and Fasinminrin, (2004) study on Akure, Ondo State. Studies of waste generation and disposal with a focus on the Nigeria landscape include Onokerhoraye (1984); Omuta (1988); and Oyinlola (2001). A central theme that runs through these studies cited is that they examined generally, solid waste generation and disposal systems. However, there are few research works on the environmental impact of polyethylene generation and disposal in Nigeria. Aziegbe, (2007) examined the seasonality and environmental impacts of polyethylene generation and disposal in Benin City, Nigeria. His work was however site specific. Till date, there is not known any research work with focus on the generation and disposal of polyethylene papers and its environmental impact status within the contexts of aesthetics and environmental in Ondo State and with particular attention to Akure City, Nigeria. This knowledge gap specifically represents the focus of this study. Essentially therefore, this paper investigates the seasonal variation in the generation and disposal of polyethylene papers in Akure municipal with a view to comparing the quantity of polyethylene generated and disposed off both at homes and market centers, and, also examines the risks posed by polyethylene to human health and environment.

II. Material and Methods

a) *Study Area*

The study area is Akure Municipal, the capital of Ondo State in South west Nigeria which lies at latitude 7 ° 16' North and longitude 5° 13' East. Akure has a population of about 483,300 out of the 140,003,542 inhabitant of Nigeria (Population census, March 2006 estimate). Akure has a land area of about 2,303 sq km and is situated within the Western upland area. The area has a general elevation of between 300 -700 meters above mean sea level. The average annual growth rate according to the 2004 estimate was 2.4%. Akure has been steadily increasing in population thereby putting pressure on the natural resources both land and water.

Akure city enjoys tropical climate with two distinct seasons. These are the wet season (April-October) and the dry season (November-March). It lies in the rain forest zone with mean annual rainfall between 1300mm-1600mm and with average temperature between 27.5^0-32.5^{0}C (Akinro and Olawale, 2007). The relative humidity ranges between 85% and 100% during the rainy season and less than 60% during the harmattan period. The relatively high temperature of Akure, no doubt, permits the demand for cold sachet water, ice cream as well soft drinks (minerals of all kinds) particularly during the dry season period.

The technique adopted for this study is largely quantitative and it utilizes data that is collected through household/market interview and administration of questionnaires using standard quantitative technique. Quantitative research allowed the selection of a representative sample from among the population to be investigated, which then allows an analysis that generate inferences for the entire population under investigation (New man, 2000).

Nine daily markets (Table 1) were randomly selected for data collection. In each market, two areas measuring 30 metres by 100 metres were demarcated in such a manner that one was in the raw food section and the other in the processed food items (provision stores) section.

Table 1: Names of Markets and Location

S/No.	Name of Market	Location
1	Oja Oba	Oba Adesida Road
2	Isolo Market	Isolo
3	Isikan	Isikan
4	Ilisa	Oke-lisa
5	NEPA	Adekunle Ajasin/Hospital Rd
6	Iloro	Oke-Aro
7	Mojere Spare Parts Market	Ilesa Rd
8	Araromi	Araromi
9	Maronu	New Stadium

In the Mojere market where there was no foodstuff section, the same two areas with the same dimension indicated earlier on were equally demarcated. In each market, one of the sanitation personnel was made to sweep the demarcated areas daily and was instructed to always sort the cellophane from other wastes. These were stored in special refuse collection bins, and were measured weekly. Furthermore, for the purpose of determining and comparing the amount of cellophane generated at homes and in the markets, 400 waste paper baskets were distributed to 200 respondents approached to participate in this study. Each participant was given 2 waste paper baskets. While one of these baskets was to be placed and monitored in the markets, the other is to be used at homes. For the purpose of standardization, the number of those in each store or household divided the cellophane generated. Data were collected from January 2009 to December 2009. The data were analysed using statistical inferences.

III. Results and Discussions

The monthly distribution of cellophane in all the markets combined is shown in Table 2. The pattern displayed showed a rise in cellophane generation and disposal from January to April, which had the highest peak of 18.8 kg. Thereafter, there is a gradual declining trend until August (9.2 kg), which experienced the least generation and disposal. The rise in trend continued again until the month of December, which had the second peak (15.1 kg). Seasonal variation showed that cellophane generation was generally high during the dry season months of November to March with the highest occurring in March (23.6 kg). There was a decline in the amount of polyethylene generated in the wet season

Table 2 : Variation in polyethylene generation and disposal

Month	Seasonal basis	Market basis
January	18.2	13.5
February	20.4	14.7
March	23.6	15.4
April	19.7	18.8
May	16.3	13.1
June	17.5	10.6
July	17.2	9.5
August	16.5	9.2
September	15.4	11.4
October	14.5	12.7
November	16.8	13.2
December	17.2	15.1

months of April to October with the lowest occurring in the month of October (14.5 kg). This is in agreement with the works of Akitikpi (1999) who reported similar result for Warri when he observed that solid waste generation is higher during the dry season than in the wet season.

The mean cellophane generated and disposed from the sampled markets in Akure is shown in Table 3. Mojere spare parts market generated the highest cellophane among the sampled markets with 58.60±7.8 kg per day. This was closely followed by Oja –Oba with 53.21±8.3 kg of cellophane per day. Maronu market had the least weight of cellophane generation and disposal with a mean value 32.65±1.4 kg per day.

Table 3 : Cellophane generated on market basis

S/No.	Name of Market	Cellophane generated (kg)	Standard Deviation	Rank
1	Oja Oba	53.21	8.3	2
3	Isolo Market	48.63	4.5	3
4	Isikan	45.14	5.1	4
5	Ilisa	43.22	4.8	5
6	NEPA	40.91	3.7	6
7	Iloro	38.74	4.3	7
8	Mojere	58.60	7.8	1
9	Araromi	36.74	2.6	8
10	Maronu	23.65	1.4	9

A similar pattern of monthly distribution of polyethylene was noticed in these markets. Some market like Mojere, Oja-Oba and Isolo Market are mostly affected by seasonal variation. All the markets recorded the peak of polyethylene generation in the month of

March (Table 2) but the least generation and disposal did not take place in a single month. While the least disposal occurred in the month of May in Araromi and Iloro markets, it was August and October in NEPA and Ilisa markets respectively. Mojere spare parts market ranked first in waste generation. The reason that could be responsible for this is that the market population comprised of mainly men who depend almost entirely on food items wrapped with polyethylene. Another reason may be because the market also serves as the motor park for transporters to Ibadan, Ilorin and other parts of Nigeria. Maronu and Araromi markets which recorded low cellophane generation are more of foodstuff markets where women traders dominate. Though, they use a lot of polyethylene in the sales of their foodstuff, most of these polyethylenes are not deposited in the markets but are taken home. Moreover, most women cook their food at home and bring them to the market in plastic food containers thus reducing the rate of consuming cellophane wrapped foods in the market.

The polyethylene collected were sorted and counted. The result shows that table water sachet topped the list, followed by cream and biscuit wrappers (Fig. 1).

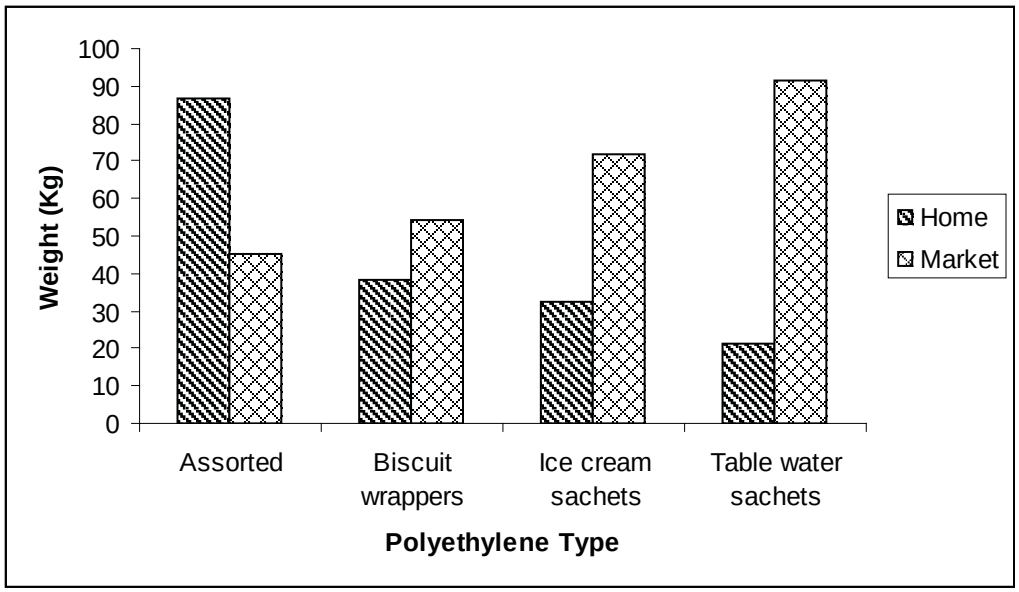

Fig.1: Comparison between polyethylene wastes generated at home and market.

Table water sachet topped the list because; it is consumed throughout the year with very little seasonal variation. Again, the studied markets have no public portable water system where the traders can get their drinking water. As a result, majority of them depend on the sachet water on a daily basis. Some traders who take their drinking water to the market from home soon discover that the water become too warm and unfit for consumption in the afternoons particularly on sunny days. Consequently, they resort to the cold sachet water that is being hawked all over the market. Ice cream wrappers exhibited the highest variation in this study. Their generation and disposal are readily compared both during the dry months and the heart of the wet season.

Polyethylene for assorted items also exhibited high seasonal variation. This implies that its demand and consumption is almost uniform throughout the year. Dede (2000) reported similar finding for Ibadan. She noted that among the non-biodegradable solid wastes generated, cellophane is mostly affected by seasonality. This kind of seasonality impact was reported for sachet water and newspaper in Warri (Odjugo, 2004).

Polyethylene generations are not restricted to markets and streets alone but are also generated at homes. Consequently, this study attempted to make some kind of comparison between the nature of polyethylene waste generated at home and, in the market. The same monthly pattern of generation was out-rightly higher for markets than homes. The possible reason could be that, at home most food is served with plates instead of wrappers. This has a way of reducing drastically the amount of cellophane generated as compared to the markets where most of the cooked food or snacks are served in polyethylene. Types of cellophane generation at home and market also displayed a very interesting pattern (Fig. 1).

Observations among polyethelene types generated in the market revealed that Table water sachets top the list with about 91.5 kg. This was closely followed by Ice cream sachets (71.8 kg), Biscuit wrappers (45.5 kg) and assorted polyethylene types (45.2 kg respectively in that other. Whereas, the trend of polyethelene types generated and disposed at home showed that polyethylene for assorted items was the highest (86.7 kg), closely followed by biscuit wrapper

(38.4 kg), ice cream wrappers (32.6 kg) and table water sachets (21.3 kg) respectively in that order. Cellophane for assorted items ranked lowest in the market because they are used in wrapping items in the market but disposed off at home having removed the contained items for cooking or storage. The generation of table water sachets was lowest at home but highest in the market. This is so because most homes have refrigerator where they can store water for it to get cool/cold. This finding is in agreement with Aziegbe's (2007) study in Benin, Edo State, Nigeria. Further analysis showed that an individual generated and disposed 0.16 ton of cellophane annually (Table 4).

Table 4 : Measured and Estimated amount of polyethylene generated in Nigeria.

Category	Estimated Population	Weight of Polyethylene (tons)
Individual*	Individual	0.16
Akure City**	483,300	7,539
Ondo State**	4,475,316	69,815
Nigeria**	140,003,542	2,184,055

* = Measured ** = Estimated

Source : Fieldwork, 2008

Using this individual mean, estimates were computed for Akure City, Ondo State, and Nigeria (the entire country). Akure City with estimated population of 483,300 (National Census, 2005) generated 7.5 thousand tones of cellophane. Ondo State on the other hand with 4.5 million people in the same year, generated about 70 thousand tones of cellophane, while the entire country with estimated population 140 million generated 2.2 million tones of cellophane. With these figures, one can begin to imagine the number or volume of cellophane being generated and disposed in Nigeria from environmental perspective.

Table 5 : Preference for Polyethylene over other wrapping Material

respondents	%
Polyethylene	78
Newspaper	13
Leaves	9

The questionnaire survey further reveals that 78% of the respondents prefer the use of polyethylene as wrappers to newspapers and natural leaves (Table 5). This is because they are cheaper and have high aesthetic value. About 13% and 9% showed preference for local newspaper and leaves as media for wrapping. The respondents who showed interest in newspaper as wrappers fell into the group of petty traders such as fast food sellers on the road sides. Those who showed preference for leaves were mainly were mainly the aged ones. The group identified added taste and aroma as reasons for their choice of local leaves. They also see the leaves as medicinal. It should be noted that much as these respondents would want to use local leave as wrappers, they also see the need for modern wrapping materials like cellophanes, newspapers, old textbooks and magazines among others. Basically, all the respondents agreed that they use the polyethylene for wrapping fish, crayfish, meat, boiled and raw rice, beans, eggs and numerous form of processed food. About 94% agreed that they use larger cellophane to carry goods from the market and shopping centers, to raising seedlings and flowers. On the frequency of using cellophane before disposal, all the respondents agreed that they use it for a number of times so long as the cellophane is in good condition. On the question as to why cellophanes are disposed off indiscriminately by the respondents, the most outstanding reasons given include lack of waste bins in private and public places/vehicles; poor attitude of Nigerians towards waste disposal and environmental sanitation, no adequate punishment for environmental violators/abusers. Personal observation and experience reveal that virtually every Nigerian is guilty of this indiscriminate waste disposal since both the educated and illiterate, rich or poor, old or young throw away any waste anywhere and anytime he is done with the content.

IV. Environmental Problems of Cellophane and Management

The environmental problems associated with cellophane are numerous and varied. For example, a glass bottle thrown into the sea takes 1000 years to decompose. In contrast, paper tissues decompose in only three months. A cigarette butt pollutes the soil or sea for upward of 5 years; plastic bags take 10 to 20 years; nylon papers (where polyethylene belongs) take 30 – 40 years; cans, 500 years; and polystyrenes, 1000 years (Awake, 2002). Nylon or cellophane is non biodegradable but its strength while in water or soil deteriorates with time. During the deterioration period, the chemicals with which, the cellophane is composed are gradually released and thus polluting the soil or water for upward of 40 years.

With this in mind, and going by the volume of cellophane dumped into our water bodies, and land, one became worried with the magnitude of environmental pollution in Nigeria in the coming years. One is not particularly certain, when exactly, the use of cellophane started in this country but, what cannot be disputed is that its usage and the concomitant environmental pollution has been on steady rise since the 1970s when rapid urbanization, bludgeoning socialization, serious cultural integration and technological development resulted in a shift in the average Nigeria life style. This shift in life style from the traditional to the Western ways of living and feeding, together with the placement of aesthetics over and above the use of natural leaves as wrappers, accounted for some of the basic reasons for the continued

patronage and use of polyethylene in Nigeria. Since polyethylene is not recycled in Nigeria or adequately disposed off, they are ever present on the landscape not-with-standing whether it is rural or urban. The environment is therefore, filthily coloured with all shades of polyethylene resulting in a drastic reduction of environmental aesthetics. This form of eyesore resulting largely from environmental abuse and degradation is worst in urban areas. The polyethylene is also capable of holding rain for days, weeks and months. These small pools of water are usually breeding ground for mosquitoes thereby increasing the incidence of malaria in Nigeria.

Presently, the type and magnitude of soil and water pollution in Nigeria is not fully known. However, there is the fear that if the situation is not checked immediately, chances are that our environment will become seriously unsustainable in the future. To guide against this, it is suggested that appropriate measures be put in place to properly dispose the non-biodegradable items.

In furtherance of these measures, it is advocated that aggressive campaign and enlightenment of the masses on the dangers of cellophane be carried out. This can be achieved through public lectures, jingles and adverts as the case may be. Hopefully, this approach will change their current attitude as it pertains to indiscriminate disposal of cellophanes. Government should provide public waste bins in strategic positions along the streets, and other public places. These waste bins should be collected and adequately disposed off regularly.

More personnel should be employed in the Ministry of Environment. Environmental Health Officers and equipments should be strengthened to be able to meet the demand of the present environment within the context of waste disposal. Currently, manpower and equipment are grossly inadequate in this ministry. People who are found to be physically abusing the environment should be arrested, charged and punished if found guilty. The hitherto monthly environmental sanitation programme as presently practiced in the State should be reinvigorated. It is equally advocated that the recycling aspect of the cellophane should be seriously considered. The government can do this by contracting cellophane collection and disposal out rightly. If this is done, and the people are aware that they will be paid for used cellophane, they will definitely be encouraged to preserve the ones used. This will create a means of sustainable employment for the women, children and the generally unemployed. Besides, our environment will be the better for it in terms of pollution and degradation.

V. Conclusion

Polyethylene generation was found to be higher during the dry season months (November – March) than the wet season months (April – October) with the least in the month of June. None foodstuff markets dominated by male traders who depend solely on wrapped food items with polyethylene had the highest cellophane generation. Cellophane generation was also higher in the markets than at homes. This is so because at homes, most food is served with plates and the consumption of table water and ice cream are considerably reduced. A larger proportion of the respondents prefer the use of polyethylene as wrappers, to newspaper and local natural leaves because of its cheapness, neatness and readily availability. Generally, respondents use polyethylenes for shopping, raising young seedlings, flowers and as, traveling bags. Some of the reasons given for improper disposal of polyethylene include environmental care-free attitude of Nigerians, non-availability of refuse bins in public and private places, as well as no punishment for environmental abusers and violators. Polyethylene is a major source of environmental degradation in Nigeria, and this form of environmental abuse is worst in the urban areas. The water held by cellophane serves as breeding ground for mosquitoes thereby increasing the incidence of malaria, which is the leading killer disease in Nigeria today. For a cleaner and sustainable environment therefore, massive awareness campaign and enlightenment about the danger cellophane poses to our environment should be vigorously carried out. Government should provide public waste bins in strategic positions for the collection of wastes.

The Ministry of Environment should employ more personnel. The government and individuals should look at recycling option of polyethylene

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