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Petrochemicals: Upstream to plastic industry using ideas, methods, developments and procedures in developing countries

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Plastic still remains today the real driving force of the petrochemical industry. Petrochemical is a branch of Chemistry that employs hydrocarbons, Oil and Gas as raw materials. This scientific research work clearly reveals that the petrochemical industry produces polymers (Plastics, Synthetic Fibres and Rubber), Detergents, Fertilizers, Fine Chemicals as well as alternative fuels. It dwells extensively and specifically on Petrochemicals and Petrochemical Products which are in great world over. It enumerates the chemistry of plastic formation and various characterization tests and typical feed characterization as evaluated in the carbon black processing unit and the routine test conducted. The research concludes that Polymers is the product that account for the bulk of petrochemical output and technology breakthrough, economies of scale and competition between producers have sustained this trend of which the reversal does not appear to compromise the future of plastic, while growth prospects remain good. The research recommend that since some saturation could appear above consumption, a level at which problems of waste, pollution and recycling becomes important and should be taken into consideration for the better future of our environment.

Key words: Petrochemicals, upstream, plastic/petrochemical industry, polymers, plastic formation.

INTRODUCTION

The term “Petrochemicals” is generally applied to the branch of chemistry that employs hydrocarbons, oil and gas as raw materials. It occupies a leading position today in the field of chemistry, but an even greater one in the history of material progress in the twentieth century. The petrochemical industry produces polymers (plastics, synthetic fibers and rubbers), detergents, fertilizers and fine chemicals, as well as alternative fuels. This enormous range of products and the degree of domestic comfort that they offer could never have been achieved with natural products alone (Masseron, 1990) (Figure 1).

Chemistry and the petrochemical industry

The petrochemical industry is concerned with large scale production of petrochemicals and petrochemical products: which includes Rubber, Solvents, Paints, Dye,

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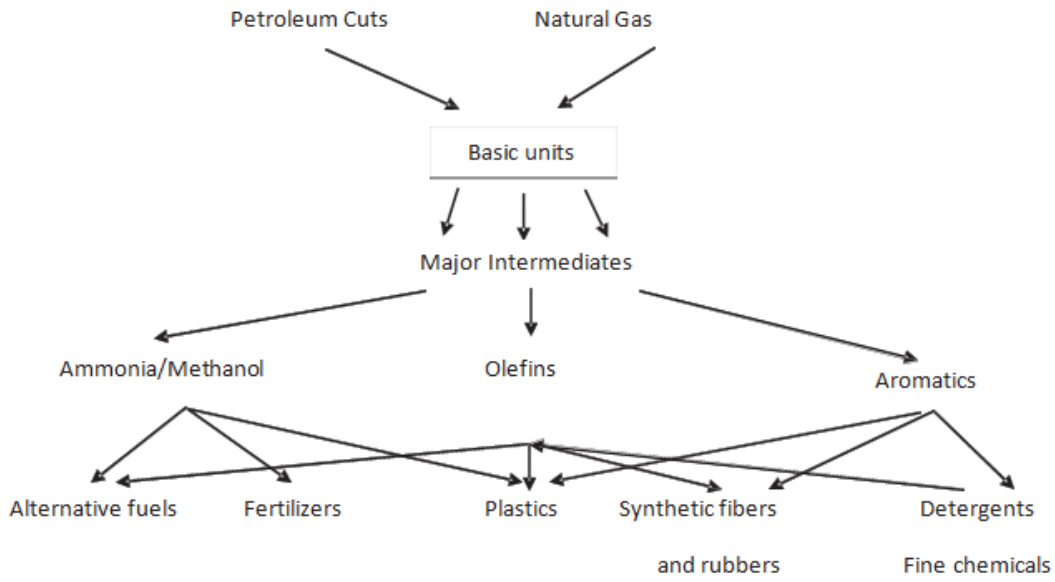

Figure 1. Petrochemical industry produces polymers.

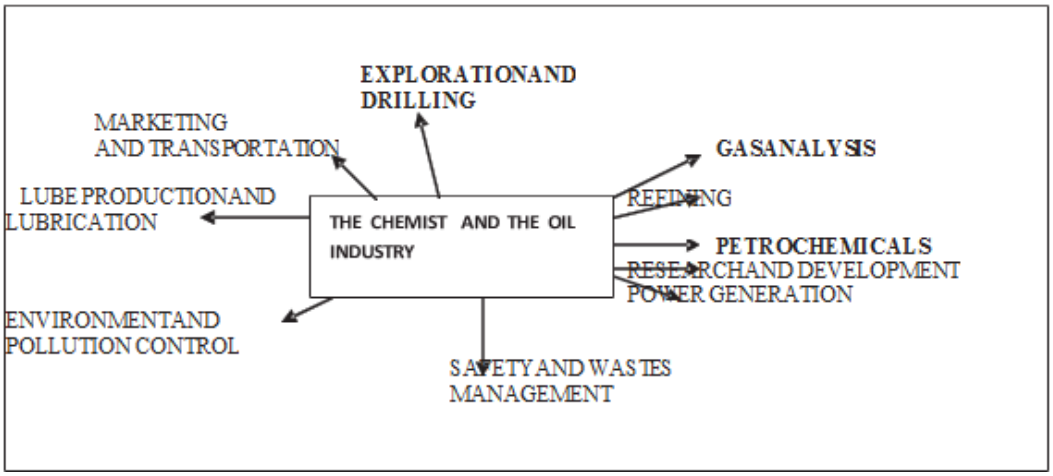

Figure 2. Shows an illustration of the chemist reaching at to the various division of the oil industry.
Source: Nkang (2001).

Drugs, Agricultural input such as (Fertilizers, Insecticide, Herbicides and Pesticides), Pharmaceuticals etc (Ogodo, 2008). The products of petrochemicals are used in several Companies such as: Paper Industry: where the naturally occurring cellulose in plants gives only a low grade news print papers, consequently, some appropriate products are incorporated into the cellulose to produce the well desired high quality glossy paper:

(i) Solvent Industry: Where indispensable solvents such as Ethanol, Methanol, Ether, Petrol, acetone as well as Benzene (all Petroleum Products) are used as raw materials.

(ii) Production of Plastic containers of various shapes, dimension and sizes.
(iii) Several Products generated from the Petrochemical Industry are involved in the manufacture of drugs
(iv) Production of Fertilizer is heavily dependent on refinery products and several other Industry (Igbuku, 1999; Ogodo, 2007, 2008; Ogodo and Esemuede, 2011) (Figure 2).

The Nigerian petroleum and petrochemicals/chemical industry

At present the Petrochemical Industry in Nigeria can be

Table 1. Typical composition of drilling mud's.

Chemicals	Functions
Barite, Calcium Carbonate	Weighing agents
Bentonite, Xanthan, Polyacryl	Viscosifiers Amides
Lignosulphonate, Tanin	Dispersants (Deflocculating Agent)
Carboxynethylcellulose, Starch	Fluid Loss Additives Polyacrylates
Emulsifiers, Sodium Dichromate	Specialty Chemicals

said to be virtually at an infant state of development. What we have is an assortment of small to medium scale downstream Plants that process about 80% imported plastics or Petrochemical to produce a variety of consumer products, and three Petrochemical Plants(namely Polypropylene and Carbon Black in Ekpan near Warri and Linear AlkylBenzene Plant in Kaduna) producing less than 20% basic raw materials for the downstream industries (Nkang, 1999). Between 1970 and 1978, the number of plastic processing factories in Nigeria increased from 12 to120. Plastics consumption rose from 43,400 tonnes in 1972 to 124, 300 tonnes in 1978. Most of the factories were engaged in technically non – exacting operations such as simple injection and compression moulding, film and pipe extrusion to fabricate household wares such as jerry cans, buckets, film for packaging, floor tiles, footwear and synthetic rubber products etc.

The most obvious unwholesome features of these polymer processing factories is not only their high dependence on imported raw materials but also the total absence of facilities for the manufacture of technical components and sophisticated machinery and automobiles. Such products are invariably imported into this country at high cost. These high levels of foreign exchange depletion have in no small way led to our present economic difficulties and the rather precarious position of our local manufacturing industries, especially those dependent on petrochemical raw materials (Nkang, 1999).

IDEAS AND METHODS

Upstream

Exploration and drilling

In the exploitation or production of crude Oil, the optimum use and interplay of chemicals and additives is a desideratum for success of production activities especially in the modern techniques of Enhance Oil Recovery (EOR). The Chemist is thus well integrated in the art of Petroleum Engineering, usually called the Production Chemist7 (e.g. Seplat Petroleum). He is expected to find solution to the myriads of chemicals oriented problems encountered in the course of drilling. These include well stimulation which is concerned with evaluation and identification of chemicals (acids, toluene and additives) that will enhance oil recovery from reservoirs. In drilling fluid engineering, the Chemists has to design the correct drilling mud composition that will ensure the balance and control of formation pressure to avoid blow-outs. Table 1 shows typical composition of drilling mud's as used in the industry. The Chemists is also involved in the design of well casing and additives for use in the cement mixture thus further reducing the risk of blow-outs (Ogodo and Esemuede, 2011; Nkang, 2001; Ogodo, 2008).

Gas analysis

In furtherance of Upstream activities, Chemists also determine various gaseous composition. With the creation of the Nigerian Gas Company Ltd as a subsidiary of NNPC and the construction of the Escravos - Lagos Pipeline, the need for stringent monitoring (gas transmission) becomes more paramount. Gas sent as feedstock to the Egbin NEPA power Station must meet certain specification with respect to Methane, Ethane, Propane and Butane composition. This analysis is performed by Chemists using the Gas Chromatograph. The hydrocarbon composition enables such significant parameters as the Calorific value to be determined. Besides, Chemists determine the Moisture Content and Dew Point (which is the temperature at which moisture condenses into water droplets (Nkang, 2001). The dew point is a very important parameter for gas transmission as the moisture contained in gases can together with the hydrocarbons form solid gas hydrates which may end up blocking pipes and filters. The moisture content of gases can also be directly linked to corrosion problems. The control of these phenomena which can negatively impact on operational activities is achieved through Chemists (Nkang, 2001).

Development and procedures

Petrochemicals

Petrochemicals as the name implies are chemicals

Table 2. Typical propylene specification.

Component	Specification
Propylene	94% mole (min.)
Propane	6% “(max)
Hydrogen	10 -12 ppm wt.
Nitrogen	100 pp Max
Methane	20 – 50 ppm
Moisture	1 ppm wt. Max
Ethane	25 ppm max
Ethylene	30 – 50 ppm max
Butylenes	5 ppm wt. max
Butanes and Heavier	100 ppm wt. max
1, 3 Butaliene	10 ppm wt. Max
Cyclopropane	10 ppm wt. Mx
Carbondioxide	1 ppm wt max
Carbon monoxide	1 ppm wt. Max
Carbonyl Sulphide	25 ppb
Sulphur	1 ppm.

Table 3. Typical decant oil or carbon black feedstock characterization.

Component	Specification
Propylene	94% mole (min.)
Propane	6% “(max)
Hydrogen	10 - 20 ppm wt.
Nitrogen	100 pp Max
Methane	20 – 50 ppm
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Carbondioxide	1 ppm wt max
Carbon monoxide	1 ppm wt. Max
Carbonyl Sulphide	25 ppb
Sulphur	1 ppm.

derived from petroleum and at the bench scale were originally developed by Chemists (Ogodo, 2008). The contribution of the petrochemicals industry to enhance living standards worldwide and the multiplier effects so created are positive attributes, which can rightly be claimed by Chemists. In the Nigerian petrochemical scene, the Chemists have equally proved their mettle in their various roles in Poly- propylene, Carbon Black and Linear, Alkyl Benzene Plants (Nkang, 1999, 2001).

Polypropylene

In Propylene Polymerization the Chemists first ensures that the Quality of the raw materials are in conformity with the standard specification as stipulated by Plant licensors. These raw materials include Propylene (main raw material) and other additives and catalyst materials. A typical Propylene specification is shown in the Table 2 (Nkang, 2001).

Typical propylene specification

Raw propylene from the refinery is passed through the purification unit to meet the above specification which is the polymerization grade quality. Chemists thus monitor the efficiency of the purification unit. consequently, evaluating the extent of Hydrogen Sulphide, and Carbonyl Sulphide removal, among others (Nkang, 2001).

Carbon black

Chemist in Carbon Black processing unit ensure that the main feedstock Decant Oil meets design specification and also control the quality of the intermediate and final products in order to obtain marketable products with desired and specified quality. A number of tests are thus performed at various stages of manufacture and storage. Typical feedstock characteristics as evaluated by the chemist is as shown in Table 3. For purpose of production control, samples of Carbon black are taken from various Plant outlets and routine test conducted. These include:

Iodine Adsorption No: For surface area control
(i) Sieve Residue: To evaluate particle size and presence of foreign matter e.g gift.
(ii) Dibutylphthalate Adsorption: For evaluation of Carbon Black internal structure.
(iii) In addition to the above tests, Rubber compounding tests are also performed prior to shipment or evacuation of final product.

Plastics

The plastics “revolution” only truly began immediately after the Second World War. Production grew from 1950 to 1973 at a steady and sustained rate of 15% per year, increasing from 1 Mt in 1950 to over 40 Mt in 1973. Plastics still remain today the real driving force of the petrochemical industry, with a growth rate that is likely to remain higher than 4% per year. Low weight, constantly improving mechanical (rigidity or flexibility), chemical (corrosion resistance) and thermal properties, adjustable to the user's needs, reinforcement feasible by glass or carbon fiber, these attributes have all helped to open up many markets for these new materials, including building,

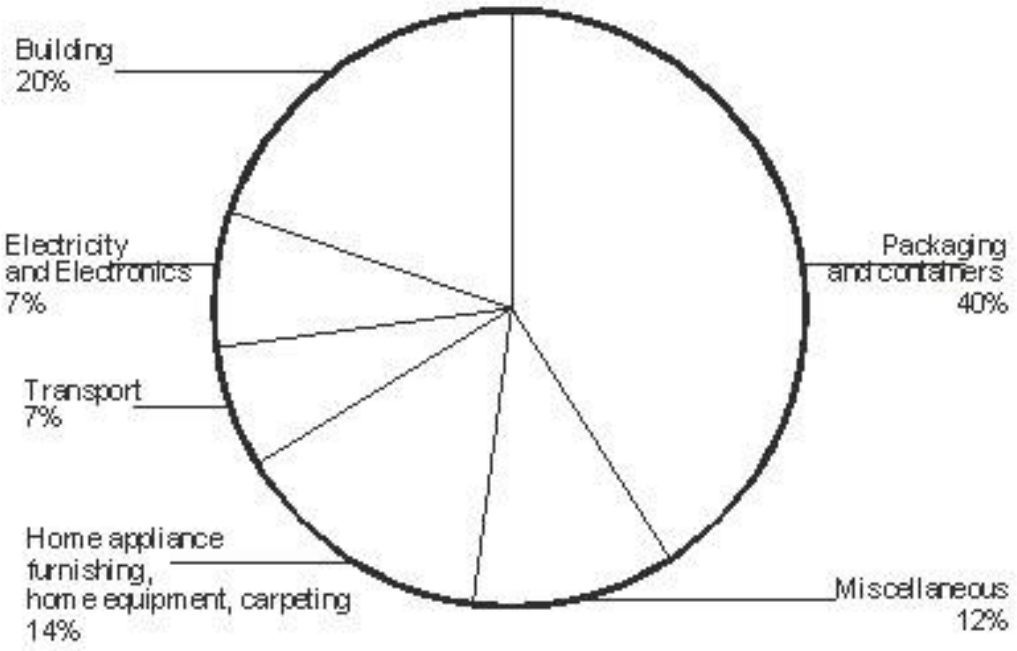

Figure 3. Developments in developing countries.

packaging, home appliances, electronics and the automobile, in which they have partly replaced conventional materials such as steel, glass and wood. Technological breakthroughs, economics of scale and competition between producers have sustained these trends and caused a steady drop in prices (PVC cost 440 $/t in 1960, 255 $/t in 1970, and them then 300$/t in mid-1989), of which the reversal does not appear to compromise the future of plastics (Masseron, 1990).

WIDE VARIETY OF MATERIALS

The wide variety of sources, structures and properties make it difficult to classify plastics. A distinction is drawn between thermoplastics, which lend themselves to extrusion and hot molding, and thermoset resins, which harden irreversibly under the action of heat. The former, with two-thirds of total tonnage, include polymers such as polyethylenes and polypropylene (for sheets and moldings), PVC (flexible or rigid for pipes, films, anti-corrosion linings of storage tanks), polystyrene and its derivatives (for household objects), and polyamides for many industrial uses. Thermosets include alkyd, epoxy, urea formaldehyde and phenolic resins (for paints, adhesives, reinforced materials), silicones and polycarbonates (Masseron, 1990). The polyurethane family offers many varied materials, ranging from glasses to foams. The sectors using plastics also vary widely according to country, and can be summarized in 1986/1987 (Figure 3).

Highly concentrated production and consumption

Per capita plastics consumption figures vary considerably from one country to another, without any right link with the level of development. It may be observed that the two biggest consumers are Germany and Belgium, with about 100 kg/year. The world average is very low, with 16 kg/year per capita, despite the rapid growth of consumption in a number of developing countries (including Brazil). Production and consumption are hence very concentrated in the industrialized countries, including Western Europe, which has been in first place since 1967, with about 70% of world consumption, Total world consumption of plastics reached 86 million tons in 1988 (Masseron, 1990) (Figures 4 and 5).

Uses

An evolving market

In the absence of new uses, the market for any plastic gradually becomes saturated. Thus the growth in the quantities of PVC employed in electrical engineering is barely more than that of the user sector. A new breakthrough in 1965, PVC for food (Masseron, 1990). Packaging temporarily reversed the trend, with a market that became saturated but which is expanding in the area of pipes, for instance. Plastics also compare with each other, with polystyrene and propylene sharing the household products field, for example. Among the industries not yet saturated which are likely to use large

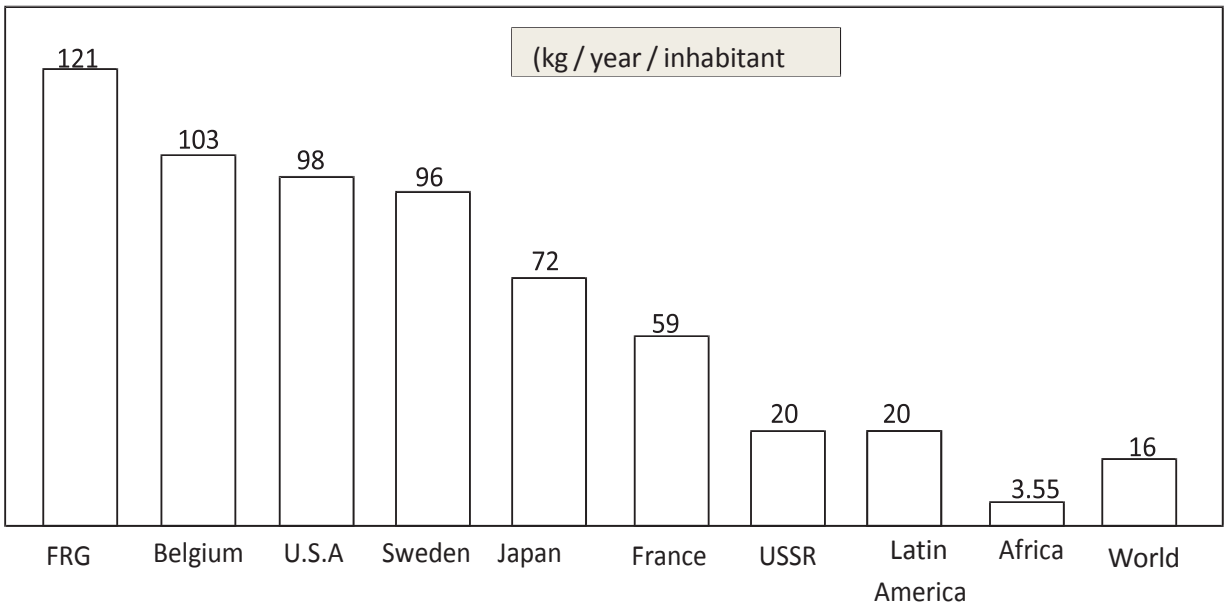

Figure 4. Plastics – Consuming Countries in 1987 (kg/year per capital).

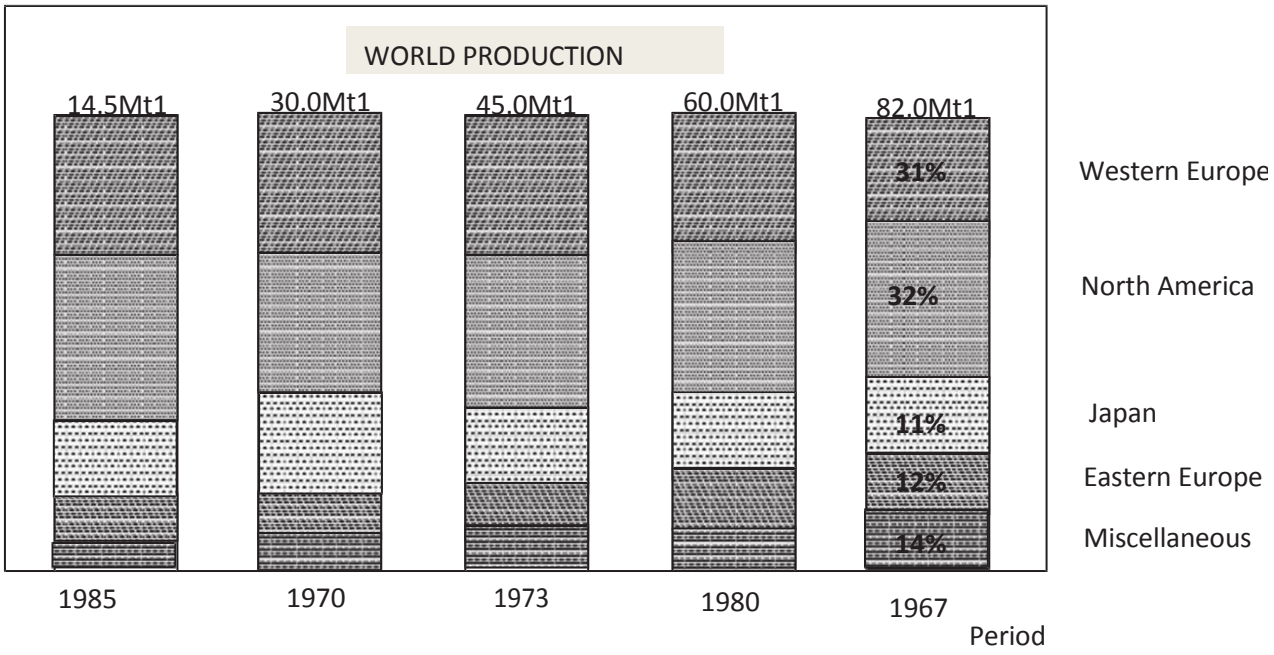

Figure 5. Plastics – Producing Areas.
Source: Japan Plastic Industries Federation and Miscellaneous.

amounts of plastics in the future is the automobile industry, which, in addition to upholstery, inside fixates and the dashboard, offers outlets for plastics, especially reinforced ones, in the structural components and the body. The trend is impressive. From 20 kg in 1965 to 95 kg in 1980, the American car could incorporate 130 to 150 kg of plastics, i.e. more than 12% of its total weight. Even in France, this proportion has already reached 9 to 10%, and even 11% in 1995, for certain car models (Result 25, Citroen BX). In other areas, telecommunications, aerospace, the petroleum industry, and biomedical applications demand increasingly high

performance synthetic materials with very high added value, opening up markets for “technical” plastics, certain elastomers/thermoplastics and composite materials.

Growth prospects for plastics remain good, with an annual rate 4% in the industrialized countries (1988/1993). Some saturation could appear above consumption of 100 to 120 kg per capita, a level at which problems of waste, pollution and recycling also become important. The developing countries are likely to witness steadier growth which could raise African composition to 16kg/year per capita and South American composition to over 30kg/year in year 2000. World production of plastics was accordingly around 130 to 140 Mt in year 2000. The share of the western Countries (North America, Western Europe and Japan) in this production could drop by 3 to 5 percentage points in year 2000, in favor of the Middle East, Latin America and Asia/Oceania (Masseron, 1990).

Some properties of plastics

Plastics are complex compounds produced by either polymerization or condensation of various chemicals. It includes Polyalkene such as Polythene, Polyvinyl Chloride (PVC) and Polystyrenes. Plastics have various qualities, which make them useful to man. These include, high resistance to oils, greases, and fatty acids, having good tear strength …. Fold endurance, 'excellent resistance to weak mineral acids, unaffected by inorganic salt solutions, … and do not corrode in the electrical sense (Akumagba, 2001). Certainly, these are valuable qualities needed in any durable utility material and it is these that have made plastics the ubiquitous choice material in applications in all spheres of our life. Ironically, these same desired qualities have turned out to be properties that present problems when its usefulness loses value and needs to be disposed.

Plastic in Solid Waste: Implications for Solid Waste Disposal in Nigeria

Some types of synthetic materials began to appear in solid waste collections. One of such synthetic materials is plastic, a product of Petrochemical origin (Akumagba, 2001). Thus, plastic remain and accumulate where they are when other components of solid wastes have long decomposed (Akumagba, 2001).

Plastic wastes

By 1915, record shows that in Nigeria, the consumption of plastic had reached 1 kg /head in the time, Nigeria was only muting the idea of a Petrochemical Industry and all plastics were imported when Petrochemicals came on stream in the U.S.A, it was predicted that plastics apparently will be the fastest growing outlets for some Petrochemicals. This prediction holds true for Nigerian now that the Petrochemical Industry concerned with the production of raw materials for plastic production has come on stream. However, even from imported raw materials presently used in plastic production today, plastics are already everywhere in Nigeria. This can be seen from the application of large quantities of plastic in all sections of the economy: Agriculture, Building, Fashion, Automotive, Pharmaceuticals, Home items and so on with a consistent increase in plastic production and application, comes a commensurate increase in the quality of plastics discarded as refuse into the environment by man. Nigeria at the moment has no such data on plastic waste but the enormous quantity being discarded into the environment annually can only be best appreciated after a visit to a few solid waste dump in our towns and cities where large quantities of plastic wastes may be identified in a single large refuse dump or in the various back street where low income families resides (Akumagba, 2001).

Implications of the properties of plastics to current solid wastes disposal method in Nigeria

The current disposal method of solid waste in common practice in Nigeria is such that depends entirely on elements of nature to eliminate it from the environment. Such natural agents depended upon to do this task include:

1. Macro-decomposers and Micro-decomposers to bring about biodegradation of solid wastes over a period of time.
2. Erosion and /or corrosion process or action of natural acids which will bring about the gradual disintegration of any waste not subject to biodegradation and its eventual disappearance from the environment.

However, to be able to decompose a material present in solid waste, a micro-organism (Fungi and bacteria), besides the required external conditions must have the capability of utilizing that material as a carbon source. Plastics have proved unassailable to micro-organisms as a source of nutritional carbon making it not biodegradable by micro-organism. Also because plastic are resistant to weak acids and inorganic salt solution and does not corrode, they do not undergo swift degradation from the action of these agents.

This amount to one fact that plastics remained (even when buried) in the environment, long after other solid waste components have disappeared under natural conditions. The higher the molecular weight of the polymer the less the likelihood of biodegradation …… (and) the lack of rapid breakdown of most plastics is a problem in refuse disposal (Akumagba, 2001).

This authorities in Nigeria applying the present method of solid wastes disposal, which depend completely on

nature to eliminate it from the environment have to contend with this fact that the plastic materials components of the waste is not vulnerable to their chosen agent of disposal term. Here in lies the major implication of the presence of plastic in solid wastes disposal in current practice in Nigeria. In addition since plastics in solid wastes do not readily degrade, but accumulate, their presence in large Quantities have some other environment and aesthetic implications9.

Fire –Spread hazard

Reduce the quality of tie-up land resources that may be used for farming or recreation.

1. Constitute an eye –sore as litters in the streets.
2. Possible blockage of water drainage routes that may lead to flooding
3. Retard percolation of water through the soil thereby affection soil fertility
4. Reduce soil microbial activity and microbial nutrient recycling and therefore tie-up available carbon in nature.

Suggestions for tracking the problems
The overall thrust here is to:

(i) Reduce the quality of plastics in the solid wastes to be disposed or
(ii) Make plastic items that are easily degradable or
(iii) Develop effective and efficient methods of solid wastes disposal that can take care of plastics along with other components of the waste.

The following are plausible suggestions:

1. Reducing the quantity of plastic wastes: this can be achieved through reducing at user source of the quantity released into the environment. For example a polythene film bag for conveying commodities from the market may be re-used several times after washing instead of discarding it or in some cases the container can be returned to the producer for a taken price (e.g. Bottle crates)
2. Making plastic items that are easily degradable. This may be achieved by impregnating carbohydrates or other such biodegradable substance into plastic items during production (as fillers). This will serve as spots that will be easily biodegraded and thereby quicken the disintegration of the plastics in the environment. Another alternative is the production of plastics that could be partly chemically disintegrated, say, ultra violet light, into smaller molecules that are then more easily decomposed by micro -organism.
3. Recycling of plastic in the waste. Possibilities now exist for recycling discarded Plastic. Plastics can therefore be scavenged from waste dump and recycled to produce fresh plastic product.
4. Applying an effective and efficient Solid Waste Disposal Methods. Whatever the method chosen, it must be such that will rapidly get rid of plastics along with other components of the solid waste. For example burning in a well designed incinerator may provide the answer. An alternative may be to convert the solid waste along with plastics containers into Reused Derived Fuel (RDF) which can then be used to generate useful heat. This may seem far-fetched considering the level of our present technology but records shows that it has been in use successfully since 1974 in U.S.A (Akumagba, 2001).

Environmental Waste Managements

In addition to hiring services to dispose of waste properly, many Local Governments and Industries also employ Environmental Waste Consultants to create innovative, financially sound ways to reduce the waste produced by their community or operation. These consultants create environmental waste solutions, such as recycling, and re-use efforts, to reduce the amount of waste that is sent to landfills or otherwise disposed of consultants also work with waste management services to determine proper disposal methods and quantities to meet the Local Communities Waste disposal needs without damaging the environment. In an effort to control waste and environmental damage, many unique environmental waste solutions have been created landfills area common waste management solutions in many parts of the world (Daboner, 2014).

Plastic /Pure water sachet recycling technology

This Technology present the best form of managing plastic waste products including pure water sachets that typified the entire Nigerian hands cape. The Machine is capable of recycling several tones of pure water sachets and other plastic waste that are in abundance in the state into a peletized plastic products which is in very high demand, the pellets is used in several other applications for the production of new plastic products like plastic hangers, shopping bags, conduct pipe, also an exportable commodity for international market for instance; this machine is capable of providing direct employment opportunities for about Nine Thousand (9,000) people in Abia State alone, if at least 2 machines are installed in each of the 17 Local Government Areas of the State. It will interest you to know that, the cost implication of the entire technology is very low, while it has very high return on the investment. Plastic recycling plant at Olushosun for the conversion of water sachet into garbage bags – the Government introduced a buyback programme for water sachet, cartons (Tudararo-Aherobo, 2014).

Glass recycling

A U.S based company – container Recycling Alliance, has a facility that can sort and process approximately 800,000 tons of glass annually. It services all major glass bottle container manufactured in U.S. The company reported a net income of 503 Million Us Dollars from revenue of 11.3 billion U.S Dollars in year 2001. This feat can also be achieved this past of the world. In Carro Egypt, recycling of various types of waste has led to the establishment of very vast small and medium industries enterprises that employed several thousands of workers. It is equally pertinent to mention here that most of the equipment that can recycle most waste generated in this part of the world is available in this country (Tudararo-Aherobo, 2014).

Conclusion

The problems of plastics in solid wastes accumulation due to non-degradation when other components have long disappeared is here with us and quite noticeable therefore the earlier we begin to recognized and attend to the problem of plastic in our solid waste, vis –a- vis the method of solid waste disposal impracticable in Nigeria, the better it shall be for us, our future generation and the environment (Akumagba, 2001).

Chart 1. Different Plastic items (from Warri Market Surveys).

1. Plates
2. Tea cup and saucer
3. Spoon
4. Cups and tumblers
5. Jugs
6. Trays
7. Bottles
8. Jerry cans and barrels
9. Bucket
10. Bag
11. Shoes and footwear
12. Table covering and mats
13. Rain Coat
14. Pipes
15. Canopy-Covering
16. Wall clocks
17. Radio and Television Casings
18. Video and Audio Tapes
19. Chairs
20. Toys
21. Baskets
22. Ceiling Tiles
23. Machine Parts
24. Car Upholstery
25. Car Battery Casing
26. Packaging for Drugs
27. Polystyrene Packaging Casings
28. Water Tanks
29. Electrical Insulation
30. Plastic Film for Green House
31. Mattress

All aspect of human endeavours are associated with waste generation (Ogodo, 2004). Sustainable development, cannot happens without an efficient waste management system as affirmed by Section I Paragraph 12 (g) of the General Assembly Resolution 44228 of the United States incorporated into Agenda 21 which States that environmentally sound waste management must go beyond the mere safe disposal or recovery of wastes that are generated (Ogodo, 2006B). There is need to issue waste Management guidelines that is implemented and practicable and waste management technologies adopted in Nigeria to reflect Nigeria's present level of development and specific requirement and standards that are determined by technological, environmental and economic criteria12. A look at many of our major cities would reveal the abundance of refuse and waste that line the roads, river banks, markets, and motor parks, in addition to those in the traditional refuse dumps. To effectively keep our streets clean, there is the urgent need to convert most of these refuse into useful products such as fertilizers, cooking gas etc. This is a big challenge to environmentalist, other scientists as well as other stakeholders (Ogodo and Idehen, 2006A).

The first Phase of the Petrochemical Plant are in Warri and Kaduna in Addition to the Commissioning of the Four Refineries. With the coming on stream of the National Fertilizer Company (NAFCON) at Onne there is massive Financial input into Agricultural Section aimed at achieving self sufficiency in Food Production. It is generally recognized that in any modern economy the three sectors; Agriculture, Iron and Steel and Petrochemical / Chemicals interlock to effect rapid industrial developments and raise the standards of living of the citizens of the Nation, hence economic independence (Nkang, 1999).

Problems and Prospects

The Polymer and Carbon Black Plants for the Phase I Petrochemicals have been commissioned. Also the Phase II (Eleme Petrochemicals) comprising the Olefins Complex and another Polypropylene Plant have been commissioned. Substantial funds have to be sourced and made available for PhaseIII comprising (BTX) Benzene Toluene and Xylenes Complex. This will be the precursor for the birth of true Petrochemical downstream industries. The development of this Country's Petrochemical industrial base has suffered setback since the seventies mainly because successive governments have pursed that laudable objective with less than total commitment. The financial and opportunity losses to this nation arising from indecision of the executive are simply staggering.

The estimated cost of the entire Petrochemical Complex in 1970-1974 development plan has escalated to more than 800% in the current plan. It is realistic to expect even more outrageous upwards revisions project costs so long as precious time is lost. If the basic Petrochemicals Industry had been established here in the seventies, it is most likely that a reasonable industrial base would have been achieved in this Country by now (Nkang, 1999).

In forecasting the prospects of Petrochemicals in the Industrial development of Nigeria towards the beginning of this century, one only needs to draw attention to the impressive records of achievements of other developing countries similarly endowed with indigenous petroleum. Notable example is Mexico that started a total production more than 100,000 tonnes of five different basic Petrochemicalin the early sixties. The Mexican Petrochemical industry increased total productions to nearly 2 Million tones in 26 different products by 1970 and by 1981 a total production of 9million tons of 40 different products had been achieved. What has been achieved in Mexico is also possible in Nigeria if the requisite political will and motivation is present especially in the light of the present democracy (Nkang, 1999).

The Old Port Harcourt Refinery was Commissioned in 1965. The Warri Refining and Petrochemicals Company was Commissioned in 1978. To optimize it's gaseous and Fluid Catalytic Cracking (FCC) bottom Products Polypropylene Plant and the Carbon Black Plant respectively were Commissioned in 1988. The Kaduna Refining and Petrochemicals Company was Commissioned in 1980. It has the Linear Alkyl Benzene (LAB) Plant among others units. The New Port Harcourt Refinery is a modern Plant, Commissioned in 1989 with Polypropylene Plants (Nkang, 1999). NNPC had (Until recently) the Monopoly of Petroleum Products Supply to over 7000 retail outlets mostly operated by the Seven Sisters – Agip, ElF, Mobil, Chevron, Shell, Exxon and Texaco (Nkang, 1999). In conclusion, economic independence implies ability and capacity to shun foreign powers working through IMF or World Bank. It implies ability to be self sufficient in food and Agriculture. Ability to support transportation. Ability to defend ourselves from foreign aggression. This was Hilter's strategy before he commenced the 2nd Word war. Nigeria can be in that position and a sound and carefully planned chemically industrialized development strategy is the only way to complete economic independence (Nkang, 1999).

RECOMMENDATIONS

1) People should recycle as much as possible to reduce waste. Many major cities offer recycling for plastic, paper and glass products (Daboner, 2014).

2) Plastic/Pure water sachet Recycling Technology present the best form of Managing water plastic waste products including pure water sachets that typified the entire Nigerian Landscape.

3) Plastic recycling plant at Olushosun for the conversion of water sachet into garbage bags …. the Government introduced a buy back programme for waste sachet, cartons, paper and glass (Tudararo-Aherobo, 2014).

In Cairo Egypt, recycling of various types of wastes has led to the establishment of very vast small and medium industries/enterprises that employed several thousands of workers (Tudararo-Aherobo, 2014).

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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