



## ABSTRACT

End of Use tyre also know as end of life tyres, are form of tyres that have already used its life time and are no longer in use for the purpose they were made for. The used tyres have become threat to the environment because it does not under go degradation easily. As the population of the world is increasing with over 7.74billion people on earth The need for the use of automobile increases . In the year 2020 more than 2 billion tyres are being produced annually and research show that by 2026 more than 2.7 billion tyres will be produced annually. In Nigeria, More than 10 million tyres are used annually and this end of use tyres are

# A REVIEW OF THE IMPACT OF USED TYRES ON THE ENVIRONMENT AND PROPERTY VALUE

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## Introduction

**E**nd of life tyres refers to tyres that has ceased to perform its original function having exhausted all its re-use options. End of life tyres (ELT's) are not reasonable as a second hand purchase. They are special tyres of waste. They are municipal waste rather than hazardous waste.

Transportation is a very important sector. It drives socioeconomic and technological development. By the year 2050, population of the globe will exceed 9 billion and number of automobile will be about 2.4 billion, population increase urbanisation, standard of living, and demand for mobility have enlarged demand and supply of tyres.

According to the European Environmental Agency, pollution is the introduction of substances or energy into the environment, resulting in deliration effects of such a nature as to endanger human health, harm living resources and ecosystems, and impair or interfere with amenities and other legitimate uses of the environment (Mathew 2015).

Environment in the general term refers to every living and non-living things in a particular habitat. It includes land, air, water, plants and animals, buildings and other infrastructure, and all of the natural resources that provide basic needs and opportunities for social and economic development of man (Social Report, 2003). Rapport in Omar (1993) maintained that environmental quality deals with the physical environment as well as the perceived environment and defined as the material aspects of the physical which have certain effects on people. Environment in the context of this study is confined to the physical component of the environment, that is, the built environment which is basically everything that is humanly created, modified, arranged or



becoming problem to the environment if not property stored, handled and disposed. The common means for disposing the end use tyres are mostly landfill and burning. Which eventually courses environmental degradation like flooding, soil erosion and air pollution there by affecting the inhabitants of that area and in extension affects the Property Value , capital infrastructure and advanced effect to health and environment.

**Key word:** environment, used tyres, property value and waste management.

maintained (Choudhary & Adane, 2012) and such includes houses and infrastructure supporting the houses.

Value of real estate is a function of physical, locational and legal characteristics of the property (Ling & Archer, 2006), influenced by increase or decrease in population, change in age distribution of population, change in taste and fashion, change in technology, change in building methods, change in building cost, inflation and deflation, change in culture and planning control, institutional factor, location and complementary uses (Millington, 1979; Oyebanji, 2003).

Related studies (Jim & Chen, 2006; Chun-Chang *et al.*, 2013) have attributed increase in property values to improvement in environmental quality. However, with the present deplorable conditions of most neighbourhood infrastructure as evidenced in poor roads, broken water pipes and blocked drainages amongst others in Minna peri-urban areas.

To understand why scrap tyres are environmental hazards, it is important to understand the properties of tyres. A tyre is a rubber covering, pneumatically inflated and placed round a wheel to provide a flexible cushion and form a soft contact with the road (Uzo *et al.*, 2011) Tyres are manufactured for use in almost all forms of mechanical vehicles such as passenger cars, bicycles, tricycles, vans, trucks, airplanes, etc. The materials of modern pneumatic tyres are synthetic rubber, natural rubber, fabric, wire, carbon black and other chemical compounds. Most times, when tyres have served their original purpose, there are usually discarded in landfills or stockpiled or burned in open field. Proper management of end of life tyres (ELTs) is important in Environmental Management as well as Property Management. Globally, about one billion ELTs are reported every year. Its existence as solid waste which has a significant economic and health effect as a result of poor handling of the ELTs, majority of these waste tyres accumulate in landfills sites or are being illegally disposed off to the open land fields (Viglostry, Klurkon and Joze., 2017).

#### **Problems caused by End of Life Tyres**

Various studies quantify the global waste tyre problem at between 1 billion and 1.8 billion used tyres disposed-off worldwide each year. This represents approximately 2-3% of all waste material collected. The US alone sends between 246 million and 300 million end-of-life tires to waste annually.

The problem is also growing. With a rising population worldwide – especially among emerging middle classes in poorer countries gaining more access to vehicles – there comes an increase in vehicle use. As more miles are driven, more tyres are replaced and more waste tyres have to be dealt with



An estimated 48 million equivalent passenger unit (EPU) tyres reached their end-of-life in Australia in 2009–10. Of these approximately 66 per cent were disposed either to landfill, stockpiled or illegally dumped or categorised as unknown, 16 per cent were domestically recycled and 18 per cent were exported.

Apart from the costs to the community and governments through littering our landscapes and waterways, and taking up scarce landfill space, end-of-life tyres can be a source of health and environmental concerns; fires in stockpiles can release toxic gases; and tyre stockpiles provide breeding habitats for mosquitoes and vermin.

Proximity and Distance: One of the problems that lead to degradation of the environment and property value is as a result of distance. So many people chose to dump their refuse or unwanted materials in the drainage water ways which eventually lead to flooding and erosion in the affected areas thereby affecting the property value.

The menace of dumping end of use tyres increase the risk of land pollution, thereby affecting the quality of water by surface runoff.

Improper dumping of End of Use tyres serve as a habitat for mosquitos and other rodents which also affect our health.

### **Uses of End of Life Tyres**

#### **1. Creates New Products**

You can recycle waste tires into useful products. Particularly, you can derive fuel that is even more efficient than fuel derived from coal, from recycled tires.

#### **2. Reduces Volume of Tyre on Landfill Space**

Because of their large sizes and hollow shapes, tires take up plenty of space in landfills. By recycling tires, we are saving up space on landfills for other difficult waste recycling.

#### **3. Helps to Prevent Diseases**

When you discard old tires at home, you are providing an enabling environment for disease-carrying rodents. Waste tires accumulate stagnant water, which breeds mosquito and causes malaria, amongst others. Tires are also potential homes for snakes, rodents, and other vectors.

#### **4. They are Used as Ornaments on our homes eg flour caves and rubber tiles.**

#### **5. Prevents Fires and Pollution**

We must also mention that while tires serve as fuel, burning them leads to serious environmental pollution. Apart from being difficult to quench, they produce black, thick smoke. This, in turn, contaminates soil and water in the surroundings, causing serious damage to marine life, soil nutrients, and agriculture for many years.

### **Literature Review**

End-of life tyre (ELT) or scrap tyre refers to tyre that has ceased to perform its original function having exhausted all its re-use options. It is a non-reusable tyre in its original form. ELTs are not re-usable as a second hand purchase (David,2018) ELTs are a special type of waste. There are municipal solid wastes rather than hazardous wastes (Adewole, 2018) When it is decided that the used tyre is neither reusable nor reconstructable, it is discarded and the recycling or recovery process begins. Since the 1972 Stockholm Conference on the environment, environmental sustainability has been a recurrent theme in the face of increasing environmental pollution. Pollution is the introduction of substances into the environment whose by-products in time have harmful or negative effects on the environment. Environmental pollution arises because of man's activity that directly and indirectly affects the



environment. When a foreign substance is introduced into the environment in a high and unmonitored concentration, it becomes a pollutant and a threat to the environment. According to the European Environment Agency, pollution is the introduction of substances or energy into the environment, resulting in deleterious effects of such a nature as to endanger human health, harm living resources and ecosystems, and impair or interfere with amenities and other legitimate uses of the environment (Ben et al., 2013).

### **Traditional Methods of Scrap Tyre Disposal**

The increasing pollution caused by the increased use of automobiles and other vehicles has become a cause for alarm around the world. However beneficial tyres may be to mobility, scrap tyres negatively affect the environment when improperly disposed off. Below are examples of methods of scrap tyre disposal that negatively affects the environment.

#### **1. Landfilling/ Stockpiling**

Landfilling is one of the most common methods of scrap tyre waste disposal in the world. Yearly, millions of tons of tyre waste go into already overcrowded landfills. Tyres occupy so much land space in landfills due to their large mass. Tyres are basically non-biodegradable because of their complex chemical and physical composition. Thus, they could take decades to decay and are extremely difficult to compact in landfills because of their buoyancy. Finding suitable space for the appropriate disposal of scrap tyres constitutes a major problem in scrap tyre disposal. The increase in the production and consumption of automobiles has equally increased the incidence of illegal stockpiling. When tyre wastes are stockpiled, they tend to collect water and thereby provide suitable breeding ground for malaria causing mosquitoes. The negative environmental impact of landfilling or stockpiling of tyre wastes is huge. Although, landfilling is generally the cheapest and most convenient method of disposing of solid wastes such as ELTs, landfilling of whole or shredded tyres is entirely prohibited in some countries for reasons stated above. In the EU, landfilling of whole and shredded tyre is banned while in South Australia, whole tyres are banned. Landfill bans or restrictions when well planned and implemented with sufficient time for adjustments, can produce significant reductions in disposal of tyre wastes and increase resource recovery (Ijebor, 2016)

#### **2. Burning**

Scrap tyre burning offers ephemeral relief from scrap tyre menace and long term negative environmental impacts. Open burning of scrap tyres in dumpsites and landfills is a major occurrence in underdeveloped countries as Nigeria. Open burning of scrap tyres generates a thick black toxic smoke and large quantities of hazardous gaseous emissions. The thick black smoke and toxic residues emitted from burning tyres may cause environmental harm, nuisance and pose direct threats to the economy, public health and safety. More so, the toxins released from the smoke can contaminate soil quality, groundwater and surface water. Airborne emissions from the open burning of scrap tyres are common occurrence in Nigeria (FME, 2019). There is also the incidence of tyre fires. A Tyre fire is an event that involves the unintentional combustion of large quantities of tyres, typically in locations where they are stored, dumped, or processed. The toxicity is even stronger if this contains metals such as nickel and tin, which you get when you throw the whole tyre into the furnace. Tyre fires could cause asthma and respiratory complications, irritation, cough and chest pain, central nervous system depression, high blood pressure and subsequent heart disease; cancer and inflammation of mucous membranes. However, burning scrap tyres at industrial facilities during the process of pyrolysis



does not pose these health risks if conducted properly as it is an eco-friendly process (FME, 2019).

#### **END OF LIFE TYRE WASTE SITUATION IN NIGERIA**

The rapid increase in Nigeria's population growth and income growth has resulted in a corresponding increase in the importation and purchase of all forms of motor vehicles. This change in consumption pattern has caused an increase in the amount of scrap tyres generated periodically. The number of scrap tyres in Nigeria increases monthly thereby amounting to high concentration of this solid waste in environmentally harmful quantity. It is estimated that thousands of tons of scrap tyres are abandoned in various parts of the country. (FME, 2019) Many ELTs in Nigeria also end up in the waterways and on the streets. Many are also burned during festivities; as roasting material in abattoirs and in extrajudicial killings of suspected criminals. Tyres have been stock piled around the country for years both legally and illegally in landfills and open dumpsites. These open dumpsites, which are usually indiscriminately located near residential settlements, causes leachate to contaminate nearby soil, surface and underground water bodies that are relevant to the residents who completely depend on those resources. This situation is aggravated by the absence of a scrap tyre waste collecting system as well as designated specially constructed landfill sites in the country for tyre wastes. This further highlights the need for a comprehensive national solid waste management policy that would incorporate this present scrap tyre menace (FME, 2019).

Recycling is still a nascent concept in Nigeria and as such has not received much attention from the government. Material recovery or recycling operations are carried out mostly by the private sector that employ scavengers to sort refuse for a fee and salvage any recyclable waste material prior to the ultimate disposal of the waste. Presently there is no tyre recycling or resource recovery facility in the country. Thus, legislations, policies as well as technologies championing tyre recycling; resource recovery and addressing issues of tyre manufacturing, haulage, disposal, storage, processing, etc. are practically non-existent.

#### **GREEN TYRE RECYCLING OPTIONS TOWARDS SUSTAINABLE WASTE TYRE DISPOSAL**

Tyre recycling is the process of repurposing vehicle tyres that are no longer suitable for use on vehicles due to wear and tear or irreparable damage. The process of tyre recycling involves the collection and separation of tyre waste materials, the preparation of scrap tyres for re-use, processing, and re-manufacture; and the re-processing, re-manufacture and re-use of these materials. Since ELTs are difficult to dispose off, they could be converted into potential economically viable and sustainable products instead of being left to constitute environmental menace. This has spurred research into ways to successfully dispose of or recycle tyres into economically viable and sustainable products. Scrap tyres are indeed not only an environmental issue, but also as an economic benefit. The tyre and rubber waste recycling business is a very thriving industry. It is the major sector of the economy of the United States and it generates a whopping annual sum of 959.2 million dollars from registered and licensed Tyre and Rubber Waste Recycling companies in the country. The industry also employs several thousands of people. Despite the huge capital outlay, the market for recycled tyres is huge and can accommodate loads of investors. Tyre recycling is a very profitable venture. To convert the waste tyre into a valuable product, it must first be reduced in size and then recycled. Tyre recycling reduces the negative environmental impacts of tyre stockpiling, burning and landfilling. It has become a resource-efficient approach to tyre waste management and



pollution control. It makes for sustainable development as it not only protects the environment; it is both economically and socially beneficial. Popular tyre recycling methods practiced around the world are examined below:

### **1. Retreading**

Retreading used tyres is a form of tyre recycling. When a tyre's lifecycle comes to an end, the tyre tread depth reduces. At this point, the best course is to repair or retread the used tyre and then re-use it for the same original purpose for which it was designed. One of the best uses of ELTs is to retread them, but this process is quite expensive and very few countries resort to it. Retreading gives used, worn out tyres an extended useful life because during the process, about 80% of the original material value of a tyre is available for re-use. The U.K. has benefited from reusing and exporting retreaded tyre casings. The U.S. has taken advantage of the growing market in retreaded tyres because it is highly sustainable. According to the American Remanufacturing Industries Council and Future Marketing Insights, the cost of retreaded tyres is 30-5- per cent lower than that of a new tyre and generates huge income for the American economy. Retreads are definitely greener than new tyres and the retreading process produces less carbon emissions and uses far less oil than the production of a new tyre (Ben, 2013)

### **2. Material Recovery Or Waste Transformation**

When used tyres reach the end of their lifespan, their physical and chemical composition could be recovered before final disposal. The complex physical and chemical composition of tyres makes them a highly valuable resource for various secondary raw materials that may be recovered such as rubber, steel, powder and fibre. In the process of material recovery of tyres, whole tyres, which are the larger particles of waste tyres, could be shredded into rubber chips that are useful in civil engineering. Other smaller particles of tyres are converted into rubber granules and powder that are used in the market to sell car parts and components, compounds in bitumen or varnish. The market regarding bitumen production has increased considerably (Ben, 2013).

The process of waste transformation and material recovery in all its aspects saves landfill space and save the environment from attendant pollution. Recovery methods involve three main aspects: materials recovery, energy recovery and re-use in a whole or part form for miscellaneous physical purposes. The traditional method of stockpiling tyres or dumping in landfills is fastly becoming out of tune with modern and sustainable environmental practices. Efforts are now geared towards reducing the amounts of waste generated; thus, the emphasis on waste transformation, resource recovery and recycling (Ben, 2013).

This process of material recovery of waste tyres is truly sustainable and should be practiced by Nigeria. The UK has derived great environmental benefits in recycling and processing whole tyres, tyre shreds, rubber granulates and rubber powders. Several technologies are developed and practiced to encourage waste transformation and material recovery from scrap tyres. Such technologies are cryogenic, shredding and pyrolysis. Statistics of the European Tyre and Rubber Manufacturers Association (ETRMA) shows that about 95% of Europe's ELTs were successfully recovered through energy and material recovery processes. In the U.S., 4.39 million tonnes of waste tyres were recovered through energy and material recovery process (Ben, 2013).

### **3. Tyre shredding or Rubber Crumbing.**

Tyre shredding or rubber crumbing is usually the first procedure in the tyre recycling process. The process involves the reduction of used tyres into small manageable chips separated into major components of rubber and steel called crumb rubber. This form of recycling is



environmentally friendly, and allows used tyres to be used repeatedly. Tyre shredding or crumbing is done to provide a raw material in a form of rubber crumbs or to reduce the volume of tyres before landfilling.

Shredded tyres and Crumbed Rubber are also known as Tyre Derived Aggregate (TDA). They have many civil engineering applications such as barriers for collision reduction, for sound and impact absorption properties; as insulation in building foundations and road base material; highway crash barriers, sound absorbing walls, boat fenders on harbour walls. Also, entire homes 'green buildings' can be built with whole tyres by ramming them full of earth and covering them with concrete, known as earth ships. It is also used as sub-grade fill, light rail vibration and embankments, back-fill for walls and bridge abutments, sub-grade insulation for roads, landfill projects, and septic system drain fields, coastal protection and off-coast break water, erosion control on steep slopes or roadsides, rainwater runoff, blasting mats, wave action that protects piers and marshes, and sound barriers between roadways and residences. It is used as raw material in the rubber and steel industry; for flooring of indoor and outdoor sports courts, as roofing material, walk pads, carpet padding or underlay, dock bumpers, patio decks, railroad crossing blocks, livestock mats, sidewalks, rubber tiles and bricks, animal bedding, movable speed bumps, and curbing/edging, etc. The rubber can also be moulded with plastic for products like pallets and railroad ties. Rubber from tyres is sometimes ground into medium-sized chunks and used as rubber mulch. Rubber crumb can also be used as an infill, alone or blended with coarse sand, as in infill for grass-like synthetic turf products such as Field-turf (Ben, 2013).

#### **4. Pyrolysis Process or Energy Recovery**

Tyre Derived Fuel (TDF) popularly referred to as waste to energy process, is amongst the first market for scrap tyres on the global scale and remains the most beneficial and highly sustainable end use as supplemental fuel in Europe, Asia-Pacific and the United States. Pyrolysis is a thermal degradation process in which organic material is decomposed at high temperature usually from 500-600 degree celsius in either an oxygen-free or low-oxygen atmosphere. The purpose of pyrolysis is to break the tyre into its original components of oil, gas, solid residue (char), and low-grade carbon black, which cannot be used in tyre manufacture. Pyrolysis of scrap tyres offers an environmentally and economically feasible method for transforming waste tyres into heat and electrical energy. Pyrolysis of scrap or waste tyres (WT) is an attractive alternative to disposal in landfills, allowing the high energy content of the tyre to be recovered as fuel. The products of pyrolysis have properties that would allow their easy re-use. Using tyres as fuel produces equal energy as burning oil and 25% more energy than burning coal. Tyre pyrolysis plants are in use in several countries now, including the USA, Japan, India, and France. The black Carbon black produced by pyrolysis application (CBP) or rubber char is more economical compared to carbon black produced primarily from petroleum and is more price-efficient. It is to be used as a raw material in the following industries such as the electric cable jacketing, the conveyor bands; carrier bands; home and doormats; black nylon bags; hoses, doormats, rubber additives; cable jackets; automotive spare parts; heat isolation; black colorant in rubber materials; plastic pipes; black colourant in industrial rubber products, plastic pipes and fire fighting.

The pyro process converts scrap tyres into Pyro Diesel Oil (PDO). High grade Light Speed Diesel Oil (LDO) and Industrial Furnace Oil (IFO). Recovered LDO and IFO can be used to generate electricity and help mitigate the nation's power shortages. LDO and IFO are suitable fuel oils



for rural pump sets and gen sets. The U.S. EPA acknowledges tyre-derived fuels as a viable alternative to the use of fossil fuels so long as proper regulatory controls are in place.

The use of ELTs (whole tyres, half tyres, shredded rubber wood chips) is increasingly regarded as a valid alternative fuel in the cement industry. Since tyres are largely composed of hydrocarbons, they may provide an alternative non-fossil fuel resource when they are burned in special incinerators or kilns. Tyres may therefore be burnt to provide energy for the production of steam for vulcanisation, electricity, cement, lime paper, steel wires, zinc oxide and sodium sulphate. However, it is currently being challenge due to the steep fall in oil prices in recent years.

#### **5. Other ELT Repurposing Options**

Scrap tyres can be vulcanised when they have reached a point whereby their re-use option is exhausted. Then, the physical properties of the ELTs can be exploited beyond the original purpose mainly for aesthetic purposes. Used tyres in a whole condition or mashed, cut or sliced, can be utilised in garden beds as bark mulch or rubber mulch to hold in the water and to prevent weeds from growing. Rubber mulch is also good in playgrounds as it has elasticity, which gives it a springy quality when used in a thick layer. This makes it a natural choice for playgrounds, where the extra springiness provides additional safety for children when they fall off playground equipment.

#### **Follow Up Studies on Residential Property Value Determinants**

Some studies can be found in the literature with the objective of examining an influence of different factors on the value or sales price of residential properties. Nachmen (2007), Ventolo & Williams (2005), and Rodgers (1994) stated that the most important are adjustments due to the size, view, condition, and age of the residential property (physical characteristics of a property), appeal of architecture, the age of the building, and parking (or traffic). Buriskiene, Rudzkiene & Venckauskaite (2011) stressed the location and prestige of a property, the age of building, type of house (construction of external walls), ecological state of a district (air pollution and noise level) and other factors such as number of storeys, number of rooms and total useful area of a property. Nachmen (2007) also emphasised the location of the property (including the reputation of the neighbourhood) and convenience (including functional characteristics). Nachmen (2007) also emphasised the location of the property (including the reputation of the neighbourhood) and the convenience (including the functional characteristics). Ventolo & Williams (2005) have additionally investigated the impact of the type of heating and cooling as well as outdoor areas, such as the terrace and atrium. Rodgers (1994) has included in the adjustment process also ventilation, attic, and fireplace as important factors for a particular group of buyers. Eksioglu, Cetintahra & Cubukcu (2014) emphasised the importance of the environmental aesthetic value of a street.

Langerholc & Grum (2012) list natural factors among the most important factors influencing the value of property, which included not only noise, amount of sunlight, and view, which were already taken into account in estimating the value of residential properties, but also avalanche, flooding, number of foggy and clear days, odour, windiness, quality of air, and the occurrence of hailstorms and sleet.

Location of property according to neighbourhood is the most important factor in the evaluation of value and represents one of the most demanding elements of analysis, which was proven by Mbachu & Lenono (2005). Namely, 73.3 % of all interviewed property owners have specified that location is a very important factor in the value of a property.



Economic characteristics considered in the appraising of properties include negative environmental factors, such as the proximity of industrial facilities, busy roads, and business and shopping centres. The influence of busy roads on the value of apartments in Hong Kong was reported in 2010 by Jim and Chen. They found that the view of the road with heavy traffic reduced the value of apartments by 1.39 %. Another significant negative factor on residence value is noise. Total noise pollution is the result of the operation of all noise sources (e.g. roads, railways, industry sources) in a given area and represents the true burden of population and areas with noise. Areas of noise pollution are those that exceed the acceptable limit of the daily noise level (55 dB) and night- time noise (45 dB). (Epi Spektrum, 2009).

### **Conclusion**

After reviewing the literature, it can be concluded that many different types of factors have great impact on the value of residential properties. Because the value of residential properties depends on the type of influential factors and of the contribution of these factors to the value of a property.

End of Life Tyres have negative impact to the environment if not properly handled, because it results to erosion, flooding, reduction in quality of water, livelihood of the people, and negative impact on the value of Real Properties.

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