

Conversion of Plastic and Sawdust Wastes Into Construction Materials

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Abstract

The good will of house to all initiative by Government has been face with serious setback due to the high cost of building materials. This is what necessitate the conducting of this research work forthe recycling and conversion of plastic and saw dust wastes into construction materials. Moreover this approach would in addition to making these materials affordable as well as promoting a hazard free environment. The First operation would be getting the amount of both plastic and sawdust to be used for the work and make necessary preparation. Plastic waste would first of all be collected, washed and then placed in a purpose made container in an incinerator system for burning using charcoal with an air blower in order to facilitate the process, this would be achieved using a temperature reader attached with the incinerator system. A simple chained lifting pulley would be used to empty the liquid content from the container in a separate place which would be mixed with sawdust and allow so as to be cooed for some time .The two constituents would be mixed together and cut in to pieces to form light weight gravels, which would be used for light weight concrete production, back fillings ,, landscaping, land fill process etc. this will be repeatedly done depending on the amount of work to be carried out, time, cost and the required quality.

Key Wards: *Environment, Construction, Plastics and Wood Wastes*

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I. Introduction

Waste is defined as any unavoidable material resulting from domestic activity or industrial operations for which there is no economic demand and which must be disposed of (Sridhar 1996). In Russia, it is said that there is no precise word for waste but the usage is that “a material waiting to be reused”. There are a variety of wastes, liquid or solid, emanating from human activities. Among the liquid wastes, sullage, sewage, livestock and industrial wastes are known to be hazardous to the environment among communities.

Construction activities are being carried out on a daily basis especially building construction. This construction activity uses a lot of materials with varying prices with both chemical and physical properties in various ways. This therefore makes it very difficult for people to own their own houses. Agarwal (1981) noted that the difficulty in the provision of housing is as a result of high cost of building materials which has contributed to make ownership of houses more and more difficult for the poor, especially in developing countries Nigeria inclusive. According to Ogunsawo (2001), the non utilization of the sawdust creates disposal problems, which are burdensome.

It can be observed that a lot of wood, sand stone, metal, water, polythene etc are used during construction activities. This wood comes from trees in the forests. As the trees are continuously being used or converted into logs and subsequently timber, the forests are depleting. It is therefore important to find ways of recycling these wastes to be used instead of using the normal costly construction materials after undergoing some processes several types of waste are generated during our daily activities including household waste, non-toxic industrial waste (types, discarded metal parts and fittings, plastic packaging and containers), waste oil, filters and solid waste. Waste disposal need be carried out in accordance with Nigerian Government requirements which should form part of the Company’s waste disposal protocols. Owonubi and Badejo (2000) have noted that activities of sawmills have continued to increase with the increase in the number of sawmill industries and other wood based industries. The Company would monitor waste generation and disposal condition and should conditions warrant, the Company would implement additional waste minimization, treatment and disposal measures for waste, all these waste management would be easier and profitable as it will contribute to making of our houses and other domestic construction purposes. Solid, non-hazardous waste would be disposed in a landfill process construction within an area to be developed to host the proposed waste rock disposal facility. A waste is considered hazardous if it demonstrates one or more of the following characteristics -- ignitability, corrosively, reactivity or toxicity which can best be eliminated by the spirit of conversion and recycling not only to avoid their hazards but put them for reuse .

The need and economic importance of the development of small scale foundries and incinerator system for burning melting, casting, forging of solid waste and other metallurgical for construction and other civil engineering purposes become necessary. The continuous dependence of Nigeria on imported spare parts and service parts for industrial machinery not only limits the development of indigenous technologies in the metallurgical and foundry industries and hence retards the chances of technological independence but also saps away the country's foreign exchange earnings. In view of this, the fabrication of open hearth furnace based on locally available materials could provide a very good push forward in starting and the importance of this to substantial components of federal government transformation agenda for sustainable economic development cannot be over emphasized. This can be seen in the Nigerian iron and steel industries such as the Ajaokuta steel complex in Kogi State and the Aladja complex in Warri, Delta State (Nasir and Bashir, 2000).

II. Literature review

All the researches of related literatures on waste management and the environment hazards contributed by plastic and wood sawdust have been dully and fully explored. Sawdust is a byproduct of cutting, grinding, drilling, sanding, or otherwise pulverizing wood with a saw or other tool; it is composed of fine particles of wood. It is also the byproduct of certain animals, birds and insects which live in wood, such as the woodpecker, ant etc. It can present a hazard in manufacturing industries, especially in terms of its flammability. Sawdust is the main component of particleboard. A major use of sawdust is for particleboard; coarse sawdust may be used for wood pulp. Sawdust has a variety of other practical uses, including serving as much, as an alternative to clay asbestos roofing, ceiling sheet . Until the advent of refrigeration, it was often used in icehouses to keep ice frozen during the summer. RMRDC (2002) asserted that sawdust was in commercial quantity and can be used for production of building materials. It has been used in artistic displays, and as scatter. It is also sometimes used to soak up liquid spills, allowing the spill to be easily collected or swept aside. As such, it was formerly common on wood working and wood makings DANIEL M. T. (1999).

2.1 Materials Selection

Materials are selected based on designed and metallurgical properties of] the materials such as machineability, formability, weldability that greatly influence the construction methods and other joining methods. Other factors considered are cost of the materials; and mechanical properties of the materials. However cost of recycling and final conversion has also been fully taken in to consideration.

2.2 Wood

Wood is the hard fibrous substance composing mostly of the stem and branches of a tree or shrub and covered by the bark. The inner core of the wood is called the heartwood while outer layer is called the sapwood .

2.3 Uses of wood:

Wood is one of the most useful and versatile materials available. It has been found suitability for general use due to the advantages it has over other materials.

Some of the various uses of wood are listed below:

■ It is used as fuel: Wood has valuable qualities as a fuel and is clean, efficient and renewable energy source. Wood fuel may be available as firewood, charcoal, chips, sheets, pellets, and sawdust.

Basically, when burnt, they provide a great amount of heat energy. This energy can be used for cooking and heating, and occasionally for fuelling steam engines and steam turbines that generate electricity.

■ Construction: Wood is an important construction material since human began building shelters, bridges and boats. It has found use in the construction of scaffolds, mould, frames, interior doors, roof construction and exterior cladding.

2.4 Sawdust as waste product

Generally, wood is biodegradable . Before a desired finished product is derived from wood, it has to go through so many processes. Some of these conversion processes include falling down of the tree, debarking, sawing, sanding, milling, lathing, drilling, chipping and carving. During the conversion process, off cuts are generated which pose as nuisance and are seen as having limited use to human being. These off cuts produced tend to attract pests and micro-organisms to wherever they are found. They cause infections and sicknesses to human beings if found around the home.

2.5 USE OF SAW DUST

Uses of Sawdust Sawdust is generally considered a waste product in Nigeria. However, some efforts have been made in the utilization of this waste product in other countries. Arends and Donkershoot-Shouh (1985) have stated the uses of sawdust to include fuel use, agricultural uses, uses in building materials, uses in chemical industries and miscellaneous uses. Sawdust used with resin can be molded into chair backs, toilet

seats, furniture parts and containers among many other things. Arends and Donkershoot-Shouq (1985) explained that sawdust is also briquetted so as to decrease its bulk and increase the heating value when used as fuel while it is used as litter, bedding, fertilizer, soil conditioner and feeds in agriculture. Sawdust is used to provide both thermal and noise prevention in buildings. It is used for wood concrete and wood granite to produce board plates and fiber boards. It is also used as climate control on fresh concrete surfaces. BMP Association Ltd (2008) used a mixture of organic components and concrete to produce light-weight concrete called sawdust concrete. The organic elements used were waste wood like sawdust, chips and other cuttings. The sawdust concrete was found to have several unique characteristics which made it competitive among other building materials. These characteristics include that it is made of green, ecologically pure stuff; it controls interior humidity level; it is fire proof, it is not subject to mold and fungi attack; and it is light. It is also compatible with cement, stucco, different finishes, stains, lacquers and vanishes.

2.6 AVAILABILITY OF SAWDUST

Sawdust comes from the saw milling activities and the activities of wood processing based industries. Arends and Donkershoot-shooq (1985) have stated that enormous quantities of sawdust are produced annually all over the world. Similarly, Owonubi and Badejo (2000), have also stated that the volume of wood waste generated in Nigeria increases yearly, and that the volume of sawdust creates disposal problems which are of concern to all wood industries, government and the general public Badejo and Giwa (1985) gave the estimated volume of sawdust in 1981 to be 1.72million m³. Owonubi and Badejo (2000) however, reported that wood wastes increased to 3.87million m³ in 1993. Out of these wood wastes estimates, sawdust accounts for about 10-20%. The generation of wood wastes and hence sawdust continues to increase dramatically. A study conducted by Raw Materials Research and Development Council (RMRDC) (1997), established that Nigeria had 1252 sawmill industries in existence by 1996. In a later study RMRDC (2003b), further reestablished that by the year 2003 it would multiply by 200%. Daniel Momngu Tiough 3 Nigeria had 1325 sawmills located in different parts of the country. RMRDC (2002) asserted that sawdust was in commercial quantity and can be used for production of building materials. The questions however are: i) How many building products so far, have been produced using sawdust? ii) Why do we still have so large and numerous sawdust hills around our sawmilling and wood based industries? Investigations from other countries have also shown abundance of sawdust. Harkin (1969) attested that a planer mill in America produces about 600 pounds of dry residues per a thousand board feet, which gives the total amount of air dry wood fines originating from U.S.A. industries alone to exceed 15million tones a year. Zziwa, Kizito, Banana, Kamboggoza, Kambuga and Sseremba (2006), established that 18-20% of log volume in Uganda is sawdust. They also stated that sawdust is one of the major under-utilized by-product from sawmilling operations in Uganda. They therefore suggest that finding an appropriate use of sawdust would help to reduce production costs and increase the profitability of saw milling operations in Uganda's plantation forests. This suggestion will help Nigerian saw millers too, if economic use of sawdust is found.

2.7 SAWDUST MANAGEMENT

Disposal of solid waste is the ultimate step in a waste management system. In advanced technologies, disposal is preceded by some engineering activities such as sorting and quantity reduction (white et al., 1997). This is done in order to sort out materials that can be turned into some economic value. Several method of disposal waste exists. The choice of any method depends on a number of factors. These factors according to Eerd (1997) include: characteristics of the solid waste to be disposed, cost consideration (i.e. how much is available and how much the method could cost), availability of disposal site (cost of land for example) and cost of labour and technical implication of the methods. There are many sawmills owned and operated by small entrepreneurs in Minna, Niger State of Nigeria. The amount of wood waste generated from sawmill industries operated by smallholders has now become a problem to the local environment. Even though part of the waste is used as domestic fire wood for household needs and brick making industries, a large part of the wood wastes like log-ends, bark, and majorly sawdust remains unused in sawmill requires disposal. In order to clean up the factory area, most sawmills just burn and/or dump the wood waste to the earth. Open Dumping and burning the wood waste eventually causes the emission of Green house gas (GHG) especially methane (CH₄) and carbon monoxide due to decomposition and combustion respectively (Tillman, 1978). For 100 kg wood waste dumped, there would be approximately 8 kg of CH₄ emission to the atmosphere (National Technical Experts, 2004).

III. Methodology

3.1 Materials used: As mentioned earlier sawdust would be mixed with boiled plastic waste to a predetermine ratio or quantity. The mixture would be carried in iron made container and emptied, this would be

allow for cooling so as to attain its workability. The process would be repeated until desired quantity is achieved using the chimney and charcoal placed on a fire treated bricks.

IV. Results

4.1 The Proposed incinerator system with chimney stack

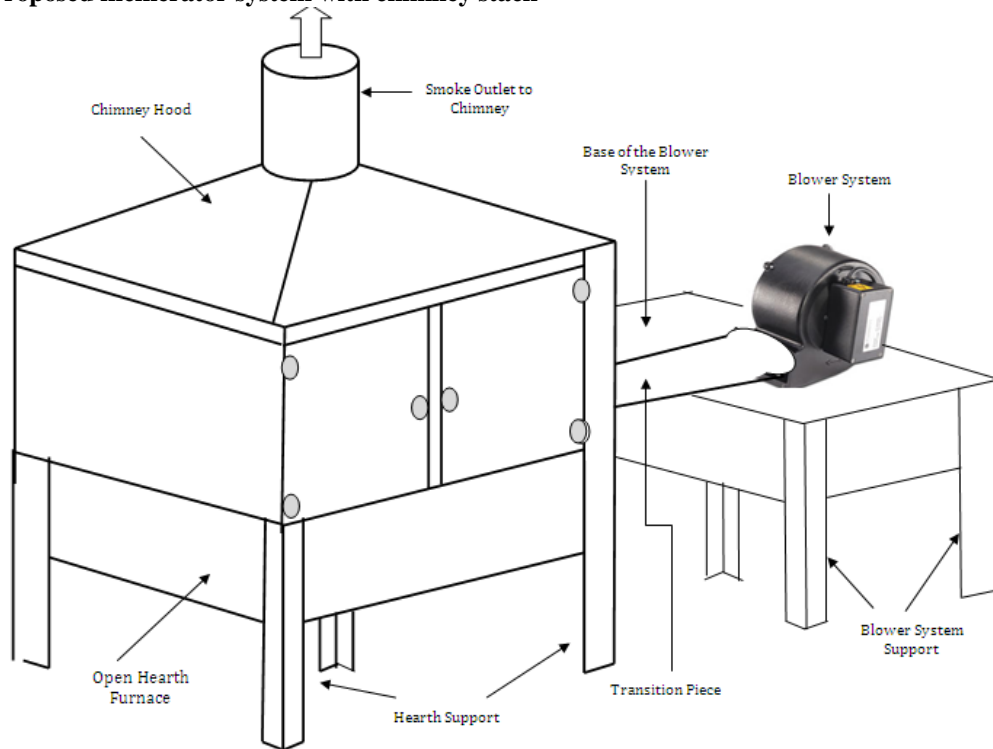


Figure 1: The Proposed incinerator system

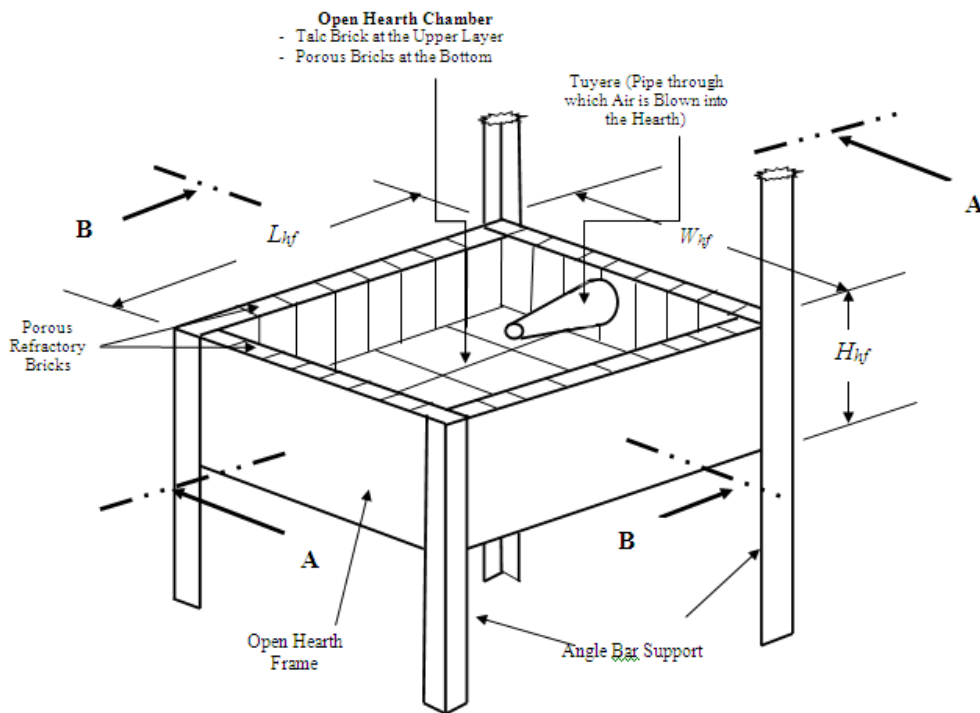


Figure 2: Isometric View of the Hearth Frame Chamber



Miller Tripod and Man Handler Hoist/Winch (EUR) for lifting and emptying the burnt plastic waste to be mixed with saw dust

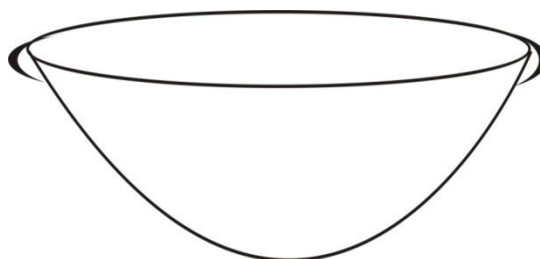


Figure 2: Purpose made Aluminum container

V. Conclusion

In conclusion this research work has a good start and made all necessary provision for further researches. All the materials used are wastes found from our daily activities which have little or bigger harm to our environmental safety. This research has good advances on both building industry, Government and the environment.

VI. Recommendations

All the tiers of Government and the construction industry need to put outright focusing commitments to uplift the level of researches which are aimed at converting our local products and our daily wastes in to useful construction materials. Researchers should put more efforts in how to get cheaper materials from our domains and to bring out their resourcefulness..

Regulatory organizations also need to be part of final productions of such researches in order to maintain both the national and international standards.

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