Effects of Waste Management in Beverage Industries: A Perspective

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Abstract
In attempt to eliminate wastage in the beverage industries a lot of reformations have been carried out in the past. Some of these reformations involve redesigning of operation process and repackaging of the content using scientifically improved materials. Packaging of beverages has been done using glass bottles, plastic, nylon and metal can. Although each of these packaging materials has one short coming or the other but not without few advantages. The beverage industry exhibits gigantic potential to minimise waste and shot the loops of recycling. Great commitment to waste reduction and recycling will provide extensive financial and countless environmental benefits. Concentrating on waste management can help to address raw material cost increment and sustainability of production. This paper seeks to investigate the sources of waste in beverage industries and several techniques that have been used to minimise them.

Keywords: Waste; Beverage; packaging; Industry; Production

1. Introduction
Eradication of waste has been a daunting challenge in the beverage industry. Beverage industries are faced with many problems. One unique problem is that of a short shelf life relative to other manufacturers when production is excessive [1]. Although a lot of strategies have been put in place to minimise waste, but these have failed to meet the set standard of the waste regulatory bodies. The beverage industry specialises in the continuous production of drinks for human consumption. Production can be unbearably tasking because of the incessant daily demands. The drinks either come in bottles or cans. This is a function of the initial design of the production line. The cans and bottles could also come in the form of plastic or glass. The containers could be cold filled; hot filled; conventional or natural. A lot of factors are put in place in the production of containers because of the inherent characteristics of the liquid content. By request, some beverages are catalysed alcoholic while some are not. Continuous demand specifications have resulted in diverse innovations in beverage plant design, beverage processing and packaging to fit the demand of the consumers. Substandard packaging comes in different forms [2]. It could be through human error or improper design of production plants. Whatever the case, destruction of products is affected by the monitoring bodies.

There has been endless search for better packaging of beverages over the years. Different types of beverages with various packaging techniques have been produced in ancient time. The beer and sodas produced in the twentieth century were known for high acidity and somewhat higher enclosure pressure. They were made available in cans due to the interior liner technology that was able to preserve the flavour from being contaminated via chemical reactions with the metal can.
Those interior liners were either plastic or waxy substances that have the ability to remain intact for a long period of time without reacting or adulterating the liquid content of the can over a period of time. The level of adulteration varies for different non-alcoholic and alcoholic beverages [3]. Before the twentieth century, beverages were made available in glasses or barrels. The use of can from the twentieth century was borne out of the desire for lighter weight material. Unlike the glass bottles and barrel, cans were found to be space saving. The ancient beverage cans are made with crown cork instead of pull tabs and were not meant to be refilled after usage. Cans with standard pull tabs have become the predominant packaging material for beverages all over the world because they are more durable than glass bottles which break easily when they come in contact with external forces [4].

Canned beverages require special opening tool before the content can be consumed, since they are factory sealed. The typical cylindrical, flat top and bottom can require a piercer commonly known as church key. The key is designed at the top rim of the can with a finger size hole. Pulling the key cuts, the triangular hole inscribed on the can top to access air and pour freely. Some of the cans developed in the twentieth century have caps that could be opened and emptied like the bottle. The top was made of a conical taper linked with a small diameter cap. The cans were sealed with the same crimped caps placed on bottles and this required opener tool.

The can tops were referred to as "cone tops". These cone tops were categorised as high profile, low profile, or j-spout. Another type of beverage can is the "crowntainer" made from drawn steel with a bottom cap. These beverage cans were designed by Crown Cork & Seal (now known as Crown Holdings, Inc.). They are one of the leading producers of beverages and cans. Up until now, various beverage industries use cans and cone tops for packaging their products. These beverages are packaged in simple cylindrical cans form to avoid cumbersomeness of handling by consumers and provide easy access to the beverage in the can [5].

The awareness of waste reduction in beverage industries has led to many of the improvements demonstrated in the sector. A lot of waste reduction techniques have been put in place to ensure effective optimization of beverage packaging. This was achieved by incorporating a series of waste reduction criteria subjected to extensive and open dialogue between producers and consumers [6]. In spite of the numerous waste reduction strategies it has been difficult to completely overcome waste that result from the metallic taste of the interior liner of can beverages. This is common with beverages that contain a lot of acidic sodas. Nevertheless, the distributors still prefer the can beverage over the glass bottles because of the ease of transportation and storage as a result of their compact shape, size and weight. More so, most consumers desire can beverages because it save them the time wasted in making deposit and returning of the glass bottle to the retailer for reimbursement of the deposit made. Apart from bottles, some materials have also been used for packaging of beverages in recent time.

Aluminium container was designed for packaging Coca-Cola caribou coffee beverage in 2008 in an attempt to curb wastage. Today most beverage cans are made of aluminium in most part of the world especially in the United State of America. However, in most part of Europe and Asia more than half of the beverage cans are made of steel while about 45 percent of the cans are made of aluminium alloy. In some cases, the steel cans have aluminium tops. In some parts of the world, consumers save their aluminium cans for bulk purchase by the scrap metal dealers. All these are returned and recycled by melting to produce new stock of cans. Aluminium therefore is one of the
cost-effective materials for the manufacture of cans for the beverage producing industries [7]. Efforts to achieve primary aluminium led to the conversion of bauxite into alumina via the Bayer process [8] after which aluminium is extracted from the alumina for further processing into the desired shape of can via cold or hot drawing. Generally, modern cans are produced via mechanical cold forming technique which starts by punching of a flat blank from a stiff cold rolled sheet. The sheet used is either alloy 3104-H19 or 3004-H19 which contains 98 % Al, 1 % Mn and 1 % Mg to enhance formability and strength [9].

1.1 Sources of waste in beverage industries
The beverage industries have experienced series of transformations all over the world, but waste is one of the challenges faced by the industries, waste generated from excessive production, defective production, waste of waiting, waste during transportation, carelessness on the part of the production line operators, over or under processing waste [10]. Complete extermination of these wastes has become necessary due intervention of Government policies on environment and health. Elimination of waste will minimise running cost and optimize profit margin [11] [12]. Waste auditing is one of the waste management tools that have been employed to minimise waste. This is simple appraisal of the nature and quantities of waste that is being generated in the beverage industries and has helped to decide the collections of materials or containers required for beverage production. It also identifies materials that can be recycled. Since all beverage industries are not the same, the quantity of waste and recyclables varies. The use of waste stream that fits each production beverage industry is paramount [13].

1.2 Primary waste-generating activities and benefits of waste reduction in beverage industries
There are lots of waste generating activities in the beverage manufacturing companies. The main environmental loss or wastes in beverage industries include: losses in the production line including broken packages and spilled beverage. Other waste generating activities in the beverage industries includes: Raw Material Wastes, Packaging on incoming beverages and wastes during filtration process which contribute to the water waste and liquid treatment sludges. The beverage industries have been responsible for the on-site generated waste and putting together of the out-going products that end up as waste [14]. Reduction of waste can be highly beneficial to the beverage industries. This will influence all aspect of production and an eco-friendly atmosphere for continuous production that is void of regulatory agencies uneasiness. Waste reduction in beverage industries reduces materials purchase cost; it enhances the employee and employer satisfaction by creating a working environment which arises from effective management of waste. Waste reduction also reduces the environmental impact of waste and destruction of resources and minimises the cost of waste disposal or destruction. The budget for waste destruction can be channelled towards the funding of other sectors of the business [15].

2. Considerations for waste management improvement and waste hierarchy in beverage industries
The implementation and improvement of waste management often require foremost planning and change in the operation mode of the industry. This may involve training the employee and creating awareness on the use of new and existing equipment as to achieve minimal waste. More so, reduced wastage is more likely to be achieved when there is a set target on the part of the management on the minimum required waste in every production. This can be achieved by setting their priorities
right in the need of raw materials. Generally, avoidance of waste delivers satisfactory financial and environmental dividend which can be made a culture having the right management on board [16]. The waste hierarchy presents a structure for controlling waste in the beverage industry. This also enables the delivery of maximum profit all year round. The waste hierarchy are:

- Avoidance of waste
- Reduction of waste
- Reuse of waste
- Recycling of waste
- Disposal and Destruction of waste [17]

2.1 Waste reduction via tenacious processing and packaging operation

Lack of sufficient line, change in formulation and lack of adequate maintenance can result in processing waste in beverage industries. The onus lies on the plant managers to reduce waste by utilizing the workable strategies of preventing product loss and promoting efficiency of production [18]. Waste reduction can be achieved by a visionary plant manager by designing the plants efficiently to accommodate equipment that can help in drastic reduction of waste. Designing to minimise water consumption is also vital in the reduction of waste, e.g. processing a litre of beverage with ten litres of water. The water usage can be minimized by installing equipment that requires minimal cleaning with higher efficiencies in other areas [19]. In the beverage industry, the choice of packaging is vital as it affects the environment and impacts greatly on the transportation and storage. Some of the beverages can only last for two weeks and electricity is required to keep them chilled during transportation, home storage and display at home by the retailers [20]. As a result of this, a container that can protect the beverage without the use of refrigeration is required along the chain to reduce waste and prevent the use of energy that is needed for chilled storage and transportation [21].

3. Some vital waste and production control tools in beverage and other manufacturing industries

Series of lean manufacturing tools have been used as production control and waste identification tools in food and beverage industries. These are wastes due to production beyond demands, waste as a result of wrong processing, waste due to over inventory and wastes that result from defective raw materials. It is expedient for a socially responsible organisation to adopt continuous waste elimination strategies instead of the regular reduction approach [10]. Among others, the most widely used lean manufacturing tools are Value Stream Mapping (VSM), Just-In-Time (JIT), Line Balancing and Six Sigma.

3.1 Value Stream Mapping (VSM)

Value Stream Mapping has been used as a lean manufacturing tool in different sectors like the health care, construction industry, service call centers transportation, mining, architecture, food and beverage industries. Although the implementation of Value Stream Mapping in the production sector is still evolving, its potential has been explicitly demonstrated by many authors [22]. A value stream actually flows from the position of demand to the end of all activity after products and services must have been made available. In an industrial setup, the overall value stream is usually defined from the point order is made to the point of product delivery and to the point of payment by the customer. Value stream mapping as a lean tool visualizes the flow and communication within the production process. VSMs are illustrated as picture to explain the
manufacturing and waste reduction process. The process is simple but logical because it involves the representation of the current reality and the goal that will be achieved in future [23]. Food wastes and losses in supply chain have been reduced using Value Stream Mapping. Compilations of several studies reveal that Value Stream Mapping is compatible with other lean tool for the reduction of food waste and nutrient losses [24]. VSM was applied on a crank shaft manufacturing system within an automobile manufacturing plant. It was able to reduce the manufacturing lead time by 40 %, reduced defects and higher processing efficiency [25]. The VSMs have the advantages of the clear exposure of waste that is available in the production process. It is also able to map the entire process and capture the flow of materials as well as information flow. The VSM is able to capture material information and this can be easily drawn on paper. Some of the draw backs of VSMs are: inability to function well in a high-variety production setup. It only works perfectly with sequential manufacturing process but performs badly with parallel processes [26].

3.2 Just-In-Time (JIT)
This is a production concept that was executed by Japanese producers to exterminate waste of man power, capital, materials and inventory that exist in a manufacturing system [27]. The goals of JIT concept are: reception of supplies just in time to be used, Manufacturing of products just in time to be made into subassemblies, Production of subassemblies just in time to be assembled into ready to use products, Production and delivery of finished products just in time to be sold [23] [28].Traditionally, Products are produced in batches in a traditional manufacturing system, positioned in inventory and utilized when the need for it arises. This system is known as push system. The reverse of this is the JIT. It is a pull system because the parts are produced based on order i.e. the manufacture of product matches the demand for it. In JIT production, no stockpiles are required because the product manufacture are inspected and used within a short period of time. This enables the employee to maintain steady production control. They are also able to detect products with defect within the production time so as to set aside quality products [29]. Execution of JIT concept demands that all phases of manufacturing operations be re-examined from time to time and monitored so as to eliminate all unnecessary operations and all resources that are not value adding. The JIT approach emphasises commitment and dedication toward the production of exceptionally high-quality products, putting away idle resources, good team spirit in the execution of task and quick response by management to challenges that arise during production or packaging [30]. The JIT has low inventory carrying costs, quick knowledge of defects during production, minimal inspection and re-amendment of components produced, production of exceptionally high-quality products at low cost [31] [32]. However, products cannot be produced repeatedly; stable production level is required and flexibility in the manufacturing of product is limited. More work still has to be done when JIT is used with Kanban [27]. Kanban is often a printed card in a transparent plastic with certain information like the part number and quality. This involves the pulling of products to the logistics or manufacturing sequence as required [33]. Kanban is sometimes known as the pull system. A Kanban system may either be a single or dual card system [34]. The dual card system functions well in a production line with very low-down time and highly trained operators. A single card system is more suitably used in a batch production process with a higher change over time. Simplicity of operation is one of the attributes of a single card. The single card system is also referred to as Withdrawal Kanban while the dual system is sometimes referred to as the Production Kanban. The modification of the
system has been carried out in many applications and facilities to enhance effectiveness of the system [35].

3.3 Line Balancing
Process pattern is an important feature in industrial manufacturing. In a job shop manufacturing system, equipment that carry out the same function spaciously combined in the workshop e.g. all the grinding machines are combined in the grinding shop while all the milling machines are put together in the milling shops. In contrast, in the flow-line production system, the equipment is organized according to the technological order of operation [36]. This processing layout is more suitable for mass production whereas job shop manufacturing is often used for mini batch production. The flow line production system can be installed if the following pre-condition is fulfilled: production of regulated products, production with high volume, demand for stable product and supply of material on a continuous basis. As a result of successive layout, a flow-line production system is usually structured as an assembly line consisting of work stations arrayed along a conveyor of related material handling equipment. The manufactured products are continuously launched down the conveyor belt and gradually transferred from one station to the other. A certain part of the total work is performed at each station and the challenge faced in optimally dividing the assembly of work among the work stations is referred to as assembly line balancing problem. The line balancing problem comprises two aspects: determination of the expected number of stations on the line and designation of tasks to each station with the aim of optimizing efficiency by reducing idle time and spreading it equally across workstations so as to enhance productivity [37].

3.4 Six Sigma
The Six Sigma is a business philosophy that concentrates on elimination of defects using basic processing knowledge [38]. It combines business, engineering and statistical principles to achieve a worthwhile result. They can be applied across all disciplines including marketing, sales, production, design and administration. This system unlike most lean manufacturing tools focuses on defect reduction instead of waste reduction. The only drawback of Six Sigma technique is that the implementation requires statistical and advanced scientific knowledge to function. This limits the empowerment of the employee; opposing the lean theory that says “employee’s empowerment is the major pillar of quality control”. With the Six Sigma, the flow concept is linked closely to the lean manufacturing and the structure of every department affect the flow of a product. This implies that any product defect is linked to the layout of the plant [39] [40].

4. Conclusions
Elimination of waste in beverage industry has become a national and global issue as it affects the economy of nations. The cost associated with Government levies and licenses for destruction and recycling is enormous. Therefore, the search for techniques that can completely eliminate waste in beverage industries in continuous. Lean manufacturing tools have been successfully applied in literature to minimise waste in the beverage industries.

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