

Sources and Ways of Controlling Manufacturing Industrial Waste in the Northern Ghana

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ABSTRACT

Manufacturing waste forms part of industrial waste which is also rooted in solid waste. In Ghana, the ruling government has a flagship project known as one district one factory (1d1f). Most of these factories that are established and yet to be established are manufacturing industries. No doubt that these industries will generate lots of waste which must be managed properly. Also, the more factories are built, the more waste will be created. The main purpose of this paper is to identify and try to control the exact sources of waste generation on the production line of manufacturing industries. The method used was literature review, and interview of industry players. From the literature review, it was found that several sources of waste have been established such as municipal sources of waste, medical/clinical sources, agriculture sources, end-of-life-of automobile, industrial sources of waste, construction/demolition sources, and electronic sources of waste (eschooltoday, 2020, amauomo and baird, 2016) while the results from the interview session revealed that the exact point on the manufacturing line of the industry, which can be termed as sources of waste are; at the beginning, and sometimes the end of the production line. Observation on the production line also confirmed the perception of the factory hands, that at the beginning, and the end. Once the sources are identified, it is possible to control it. In conclusion, it was revealed that factory hands do not make critical observation on the production line. They agreed that if the sources are identified and controlled, it will reduce the cost of production which will increase their profit margin. It is therefore recommended that manufacturing industries should take much interest in identifying the sources of waste creation on their production lines. Also, they should take measurement seriously when feeding raw materials into the production line.

Keywords-- Sources of Waste, Industrial Waste, Manufacturing Industry, Waste Creation

the manufacturing industries waste management levies. It was further revealed from literature that most metropolitan, municipal and district assemblies do not look for the actual source of waste, but are always quick to take corrective measures which does not correct the wrong and also consumes a lot of funds in developing countries (Pongrácz, 2004).

Throughout literature, sources of waste have been identified in generic terms as municipal, industrial, medical, construction etc, but one critical factor which needs very much attention and most of the time ignored is the actual or specific source of a particular waste. Van de Klundert and Anschütz (2001) and Pongrácz (2006) established that, most municipalities react to waste without assessing the causes. They postulated that waste management must be proactive instead of reactive. For instance, in a plastic manufacturing industry, management will not consider studying the production line to identify the points or source of waste generation in their factory. They only think about the end product and quantities they can produce forgetting that studying the production line to identify sources of waste and reduce or try to eliminate them can reduce their production cost and increase their profit margin. For instance, if the factory normally uses one gallons of resin, and additives to produce about fifteen plastic buckets without any waste reduction, and at the end of the day, a quarter of gallon of the resin pour on the floor and become waste which could have been avoided. It means that if the quarter gallon which was wasted was saved, it could have increased the number of buckets to twenty. So, if the cost of a gallon is GHS20, it means they are losing GHS5 per gallon which could have produced an additional five buckets. Assuming one bucket cost GH5, they would have gained GHS25 which would have been wasted on the shop floor. Based on this backdrop, it is important to carry out this study to identify the actual sources of waste on the production line which industries can use during manufacturing to save them huge sums of money of production cost which would have gone down the drain as waste.

I. INTRODUCTION

Most part of the globe are struggling with waste management, especially manufacturing industry waste. Technological growth and industrialization of many towns and cities have increased the waste management challenge. Most of the developed nations are charging

II. METHODOLOGY

The study adopted purposive sampling to obtain information from stakeholders thus; industry players, factory hands and production managers. This is a review paper supported by interviews. Twelve industry players were interviewed. The results are shown in a narrative format in the results and discussions below.

III. RESULTS AND DISCUSSION

When the source of waste is known, then something can be done to prevent or reduce waste at the point of creation. Several research studies have been conducted on the sources and characteristics of waste as well as the possible adverse effect of inappropriate handling and best international practices (Amasuomo and Baird, 2016). There are several sources of waste; however, Eschooltoday (2015) identified the following as sources of waste: municipal, medical/clinical, agricultural, end-of-automobiles, construction and demolition, electronics and industrial. Hoornweg and Thomas (1999) also identified residential, which can be single or multifamily dwellings; industrial, which can also be light and heavy manufacturing; fabrication; construction site; power and chemical plant; commercial, which includes stores, hotels, restaurants, markets, and office buildings; institutional, such as schools, hospitals, prisons, and government centres; construction and demolition, which includes new construction sites, road repair, renovation sites, and the demolition of buildings; municipal services which can be generated from street cleaning, landscaping, parks, beaches, and other recreational areas; water and wastewater treatment plants; process (manufacturing) which can also be heavy and light manufacturing; refineries; chemical plants; power plants; mineral extraction and processing; and agriculture, including crops, orchards, vineyards, dairies, feedlots, and farms.

Municipal Sources of Waste

Hoornweg and Thomas (1999) describe municipal sources of waste as street sweepings; landscape and tree trimmings; general wastes from parks, beaches, and other recreational areas; and sludge. Similarly, Eschooltoday (2015) explains municipal sources of waste as including trash or garbage from households, schools, offices, market places, restaurants and other public places. They include everyday items such as food debris, used plastic bags, soda cans and plastic water bottles, broken furniture, grass clippings, product packaging, broken home appliances and clothing. Here it can be seen that there is difference between the two explanations of municipal source waste. This study combines the two as sources of municipal waste.

Medical/Clinical Sources of Waste

Eschooltoday (2015) explained that medical/clinical waste normally refers to waste produced from health care facilities, such as hospitals, clinics, surgical theatres, veterinary hospitals and laboratories.

They tend to be classified as hazard waste rather than general waste. Items in this group include surgical items, pharmaceuticals, blood, body parts, wound dressing materials, needles and syringes. Hoornweg and Thomas (1999) and Eschooltoday (2015) agree that medical and clinical waste are from hospitals and laboratories; however, but they labelled these types of waste as institutional waste. These two explanations are the same and this study is in agreement with them as source of medical/clinical waste.

Agricultural Sources of Waste

Hoornweg and Thomas (1999) explained agricultural sources of waste as spoiled food waste, agricultural waste, and hazardous waste (e.g., pesticides). This was supported by Eschooltoday (2015) who indicated that typically this is waste generated by agricultural activities. This includes empty pesticide containers, old silage wrap, out-of-date medicines and wormers, used tyres, surplus milk, cocoa pods and corn husks. It can be seen that the two explanations are almost the same and this study agrees with both.

End of Life Automobiles Sources

The study of Eschooltoday (2015) pointed out that when cars are old and not working any more, many people just leave them to rust in the fields. However, there is a better way to deal with them. In many cities, these vehicles are sent to the plant, where all the removable parts are taken out for recycling. The rest is flattened up and shredded into pieces for recycling. The last bit that cannot be used again is sent to a landfill. Hoornweg and Thomas (1999) did not have end-of-life motor vehicles as source of waste. The EU End-of-Life Vehicle (ELV) Directive states that vehicles must have a minimal impact on the environment at the end of their usable life. End-of-life vehicles generate around nine million tonnes of waste each year; therefore, reuse, recovery and recycling are important issues. As of January 2006, this legislation required that 80% of the vehicle weight must be reused and recycled, and this figure will increase to 85% by 2020 (McKechnie and Wegman, 2008). As far back as 1995, the target has been set for landfill. Gummer and Hague (1995) reported that the targets were to reduce the proportion of controlled waste going to landfill from 70% to 60% by 2005, to recover value from 40% of municipal waste by 2005 and to set a target for overall waste reduction by the end of 1998. The search through literature could not confirm if the reduction was achieved by 2005. Also, Larsen (2009) predicted the lifecycle of wind turbine blades made from glass-fibre reinforced plastic (GRP) and fibre reinforced plastic (FRP) to be 20 to 25 years. The question is what happens after that? Kasper (2008) said by 2020 land filled waste needs to be reduced to 35% of 2008 quantities, but there are many landfill sites in most part of Africa, especially in Ghana.

The profile of the UK's waste management industry has never been higher; the pressures on local authorities and the economy to reduce waste and maximize re-use and recovery, have never been greater.

Albers (2009) predicted that by the year 2034, around 225 000 tonnes of rotor blades made of glassfibre reinforced plastic (GRP) material are up to be recycled per year worldwide. This is perhaps since the demand for the use of GRP is increasing and there is no corresponding means of disposing its waste. Therefore, a form of steady increase is displayed for Europe and the world. Andersen *et al.* (2007) also predicted that from the year 2040, 380 000 tonnes of fibre composites will have to be disposed of each year. The point here is that, the figures mentioned above are only for wind turbine blades of aircrafts. If other products from GRP such as over aged water tanks or swimming pools are to be considered, then it is going to be more than that. This means that something must be done to increase reuse and recycling to reduce the quantities to be disposed of. t

Construction/Demolition Sources of Waste

Hoornweg and Thomas (1999) explained that this includes wood, steel, concrete, and dirt which is obtained from new construction sites, road repair, renovation sites, and the demolition of buildings. According to Eschooltoday (2015), construction waste is that which results from the construction of roads and building. Sometimes old buildings and structures are demolished to make space for new ones. This is particularly common in old cities that are modernizing. This is called demolition waste. Waste items include concrete debris, wood, earth, huge package boxes and plastic from the building materials and the like.

Electronic Sources of Waste

This is waste from electrical and electronic devices such as DVD and music players, TV, Telephones, computers, vacuum cleaners and the other electrical and electronic equipment in the home. These are also called e-waste, e-scrap, or waste electrical and electronic equipment (WEEE).

Industrial Sources of Waste

Hoornweg and Thomas (1999) explained sources of industrial waste as that from light and heavy

manufacturing, fabrication, construction sites, power and chemical plants. This results in housekeeping wastes such as packaging, food wastes, construction and demolition materials, hazardous wastes, ashes, and special waste. Eschooltoday (2015) explained that since the industrial revolution, the rise in the number of industries manufacturing glass, leather, textile, food, electronics, plastic and metal products has significantly contributed to waste production. Every household item was probably manufactured and possibly, waste was produced as a result, which needs to be controlled or managed properly.

The literature review above reveals that, there are different sources of waste such as municipal sources of waste, medical/clinical sources of waste, agriculture sources of waste, end-of-life-of automobile, industrial sources of waste, construction/demolition sources of waste, electronic sources of waste (Eschooltoday, 2020, Amauomo and Baird, 2016). All these does not identify the exact point of waste generation on the production line during manufacturing. In the effort to identify the exact point of waste creation, this study conducted interview for manufacturing industry players. The result shows that in most cases, waste is generated during production at the beginning and at the end of the production line. Details of this can be found in the next section.

Interview Session

This study was carried out to identify the exact point on the production line which can be termed as source of waste generation. After the literature review of sources of waste, the study decided to seek the perception of industry players with regards to sources of manufacturing industrial waste on the production line. This section gives details of the interview session with the industry players.

Table 1: Categorization and number of interviewees

Item	Categorization of interviewees	Code of interviewees	Number of interviewees
1	Production Managers of Industry	PMI	4
2	Environmental and Safety Officers	ESO	4
3	Factory Workers in Industry	FWI	4
Total Number of interviewees			12

Source: Researcher's interview survey (2019)

Table 2: Layout of the interview protocol (Industry players)

Theme number	Theme of interview questions	Question
1.	What the industry considers as the main sources of waste.	1
2.	Identification of a particular point in production line that generates more waste.	2
3.	Way of controlling waste at the point of generation.	3
4.	Determine the benefits to derive from controlling waste.	4
12.	General comments	12

Source: Researcher's interview survey (2019)

Responses from the Industries

Question 1: What do you consider as the main source of waste generation in your factory?

Aim: The aim of this question was to establish what interviewees consider as the main source of waste in their respective factories. If the source is identified, it can be controlled.

Response: All the four (4) production managers responded that the main source of waste in their factory is during production.

PMI emphasized that

"...any time we manufacture our products, waste is generated and that is the main source of waste in the factory, though there are other waste from containers of materials ..."

HSO also remarked that

"...the main source of waste in the factory is waste products from manufacturing process and containers of production materials..."

FWI also emphasized that

"...the main source of waste in the factory is during manufacturing and other activities in the factory and also containers of manufacturing materials".

Based on the responses from the respondents, it can be concluded that they perceive the main source of waste from the industry as a result of the product they produce, that is either a plastic, metal or cement product. Also, few of them see another source from the containers for the materials used in manufacturing.

Question 2: Which part of your production line do you think generates more waste?

Aim: The aim of this question was to identify the exact point on the production line where waste is generated. When that is identified, it will make it easier to control the source of waste generation.

Response: All the four (4) production managers in industries (PMI) responded that the part of the production line that generates more waste is the beginning of production.

PIM emphasized that

"...most of the waste is generated during the beginning of the production line".

ESO remarked that

"...the beginning of the production line

normally generates more waste".

FWI also emphasized that,

"...most waste is generated at the beginning of the production line because, when feeding the system, the materials pour on the floor, the packing cases become waste after feeding the materials. Also, at the end of production where trimming of excess material is done".

The aim of this question was to identify the exact point on the production line where waste is generated. The responses from the respondents show that the beginning of the production line generates more waste. Some said at the end of the production where there is trimming of excess materials.

Question 3: What are you doing to control the source of waste identified, if any?

Aim: The aim of this question was to find out whether the manufacturing industry is doing something on its own to control the identified source of waste.

Response: Almost all the production managers of the industries (PMI) said they did not take cognizance of that, except one who said he has been talking to the factory workers to be careful to reduce waste.

ESO also remarked that

"...No action has been to control the waste generation in the form of prevention or reduction except to collect it for waste management companies".

FWI also remarked that

"...they have been talked to by the production managers to try and reduce the waste".

Based on the responses of the respondents, it shows that a concerted effort has not been made to control the source of waste being generated from the beginning of the production line. It is felt that serious attention should be given to this aspect of the production so that waste can be prevented or reduced.

Question 4: What are some of the benefits you think you can get from identifying and controlling the source of waste?

Aim: The aim of this question was to determine the benefits of identifying and controlling the source of waste during the production process.

Response: All the four production managers from the manufacturing industry (PMI) responded that the benefit

they would get from identifying and controlling the source of waste is waste reduction. This means that they do not perceive a reduction in the cost of production or an increase in production.

ESO remarked that

“...the benefits they perceive to get from identifying and controlling the source of waste during manufacturing is reduction in waste or elimination of waste”.

FWI also emphasized that,

“The benefits they get in identifying and controlling source of waste during manufacturing is reduced in waste or elimination of waste”.

Based on the responses provided by the interviewees, it can be concluded that they perceive the benefits derived from identifying and controlling the source of waste as waste reduction or elimination. However, it is felt that there is a financial benefit which is overlooked but needs more attention. For instance, in a rubber manufacturing industry, management will not consider studying the production line to identify the points or source of waste generation in their factory. They only think of the end product and quantities they can produce, forgetting that studying their production line to identify sources of waste and reduce or try to eliminate them can reduce their production cost and increase their profit margin. For instance, they normally use one gallon of resin to produce approximately 15 buckets without any waste reduction. At the end of the day, a quarter gallon of the resin is poured onto the floor and becomes waste which could have been avoided. It means that if the quarter gallon which was wasted was saved, it could have increased the number of buckets to 20. Therefore, if the cost of a gallon is GHS20, it means they are losing GHS5 per gallon which could have produced an additional five buckets. Assuming one bucket costs GH5, they would gain GHS25 which would have been wasted on the shop floor. Therefore, it is necessary to study the production line to identify and control the sources of waste during production.

IV. CONCLUSION

It is concluded that, throughout literature, sources of waste are viewed in general terms such as; municipal source, medical/clinical source, agricultural source, end-of-automobiles source, electronics source, residential source, which can be single or multifamily dwellings; industrial source, which can also be light and heavy manufacturing, power and chemical plant source; commercial source, which includes stores, hotels, restaurants, markets, and office buildings; institutional, such as schools, hospitals, prisons, and government centres; construction and demolition, which includes new construction sites, road repair, renovation sites, and the demolition of buildings; municipal services which can be generated from street cleaning, landscaping,

parks, beaches, and other recreational areas; water and wastewater treatment plants source.

It was found through interview that, sources of manufacturing industrial waste can be found at the beginning of the productions line where materials fall on the ground and become waste, also, packing cases of the used manufacturing materials becomes waste. During the interview, it was also revealed that, at the end of manufacturing, where trimming of excess material is done, waste is generated which most industries does not pay attention to. If the exact point of source of waste is identified, it can reduce cost of production and increase profit margin of the industry.

RECOMMENDATION

It is therefore recommended all manufacturing industries should make it a point to identify the exact point of sources of waste on the production line during manufacturing.

Factory hands should be educated to make a concerted effort to reduce the sources of waste on the production line, if not eliminate it totally.

Factory hands should take measurement seriously when feeding raw materials into the production line.

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