Evaluating Recyclables in four selected industries in the City of Umhlathuze in the Province of Kwa-Zulu Natal.

T Chetty, Bell Equipment, South Africa, Traven.Chetty@za.bellequipment.com
R. du Plessis. Department of Environmental Sciences, University of South Africa, South Africa. dplesr@unisa.ac.za

ABSTRACT
A waste evaluation survey was done for four major industries in the City of Umhlathuze in the province of Kwa-Zulu Natal. These industries include a paper mill industry, a logistical based industry, a manufacturing industry and lastly a chemical production industry. This study evaluated the ways in which companies are practicing recycling for the various wastes produced on their sites. The objectives of this study were to analyze the types of wastes produced by these four industries, the quantities produced for recyclable and non-recyclable wastes, the methods of disposal and recycling, and lastly the improvements that have been made by the industries. The results showed that companies are being proactive where applicable and three of the four industries are ISO 14001 accredited, which indicates environmental management protocols are a serious factor together with continual improvement. However, it was revealed that there is room for improvements.

1. INTRODUCTION

By the turn of the twentieth century and the beginning of the industrial revolution, there was a major increase in waste production due to the developing nations and emerging industries. These industries included the likes of steel production companies, paper mills, metal smelters, increased mining operations as well as chemical production factories (Herbst and Fitzgerald, 2000). By the 1940's to the 1950's, the landfill concept was developed, using landfill sites to conveniently discard various wastes, without having proper knowledge of degradable qualities of waste products, for example, a plastic bottle which would take up to 1000 years to degrade (Herbst and Fitzgerald, 2000). By the 1970's, there was a major boost in the recycling scene due to the increasing costs of energy as well as the implementation of the environmental protection law and subsequent environmental awareness increase, particularly in the United States. Due to the environmental protection law, many countries have now deployed a similar act based on the United States Environmental Protection Act (Herbst and Fitzgerald, 2000).

The concept of recycling begins when there is a process to change material waste into new products. In this way materials are reprocessed, causing a reduction in energy usage as well as a reduction in air pollution and harmful greenhouse gases. The concept of “Reduce, Reuse and Recycle” is adopted internationally by all major corporations according to ISO 14001 (Reh, 2006). ISO 14001 is the International Organization for Standardization for environmental management. This standard establishes itself on the organization's needs to manage and organize waste within its company (King et al, 2005). The latest issue of ISO14001:2015 was released in 2015 and showed several improvements to this standard. This included environmental management must now be visible in the organizations strategic direction, there must be more proactive initiatives taking place for the organization in terms on environmental protection, life cycle attributes must be incorporated into the organization i.e. from development to end of life, and lastly, a greater commitment from leadership of the organization in terms of environmental management (Naden, 2015).

This study analyzed waste within selected companies located in the City of Umhlathuze, in particular, Richards Bay, with the principle of evaluating the waste minimization practices that major industries have been undertaken within their organization on the basis of South African legislation. This included National Environmental Management Act, 1998 (Act No.107 of 1998) and the National Environmental Management Waste Act, 2008 (Act No.59 of 2008) and following amendment acts that were released in June 2014 which includes the National Environmental Waste Amendment Act, 2014 (Act No. 25 of 2014). Furthermore this study will bring in local municipal by-laws analysis such as the water services by-laws, public health by-laws as well as environmental by laws.

2. BACKGROUND

The City of Umhlathuze is the third largest municipality in the Kwa-Zulu Natal province which covers an area of 796km^2 (The Local Government Handbook: The complete guide to municipalities in South Africa, 2014).This area has been chosen as the study area for this project due to the fact, there are several major industries in which to conduct the research as it is an industrial based town. The main economic drivers in the City of Umhlathuze are manufacturing plants (45% of income), with mining hosting over 11% of income in the area (The Local Government Handbook: The complete guide to municipalities in South Africa, 2014). The City of Umhlathuze is based on the largest deep water port in South Africa allowing for frequent shipping activity and major industries to thrive on this port for example, Transnet as well as Richards Bay Coal terminal which is the largest single export coal terminal in the world. The Umhlathuze municipality includes towns such as Richards Bay, Empangeni, Esikhawini, Ngwelezane, Felixton and Nseleni (The Local Government Handbook: The complete guide to municipalities in South Africa, 2014).The major economic powerhouse remains Richards Bay and the Empangeni regions, which includes a host of industries such as Bhp Billiton, Mondi Kraft, South32, Bell Equipment, Richards Bay Coal Terminal, Tronox to name a few. Due to the availability of raw materials such as aluminum, titanium, zircon and iron, this is the basis of income for the major industries around Richards Bay. The Industries around the Richards Bay region range from inter alia aluminum smeltering, chemical producing, steel production, machinery manufacturing, logistical and paper manufacturing. This study is based on four of those industries as discussed below.

3. PURPOSE OF THIS STUDY

The aim of this study is to evaluate the recycling practices in four selected industries in the City of Umhlathuze. These industries are Mondi Kraft (paper manufacturing), Bell Equipment (machinery manufacturing), Richards Bay Coal Terminal (logistics and transporting) and Foskor (chemical manufacturing). The objectives of this study includes analyzing information for each selected industry which includes the following: identifying all types of waste generated, quantifying the types of waste that can be recycled, investigating and evaluating the methods which are used for recycling of waste and recommendations to ways to improve recycling techniques. This will in turn allow industries to utilize this data and thus make appropriate improvements thereof.

4. METHODOLOGY

The first objective of this study was to investigate what types of materials are being recycled by the various industries. This was achieved by firstly, getting into contact with the waste departments of the 4 companies which are being evaluated. A background information review (process flow information) on the companies was done to understand the processes involved for the waste products that are being produced. The personnel was involved in a structured interviewed and agreed that the information will only be used for research purposes and a site appraisal was necessary to gather data (Tracy, 2012). Prior to the review of the industries, a legislative review was done in terms of the companies legislative requirements based upon recycling, the types of waste produced and environmental requirements. Observations of the sites visits were recorded with regards to all the waste materials that are produced by each industry and processes involved in producing this waste. During the interviews, reviews of the materials that are recycled and the materials that cannot be recycled were discussed. An evaluation was done on the materials that cannot be recycled to investigate which properties inhibit recycling, through internet reviews and journal reviews on previous studies and attempts to recycle the particular product. During the interview reasons why recycling cannot take place were established, i.e. service provider problem e.g. the lack of services to recycling such product or is it a manufacturing process by-product problem (Karamouz et al, 2006). Other information gathered included analyzing trends such as recycling difficulties experienced by other organizations for the similar waste material or exclusivity of waste to one organization as well as availability of service providers and feasibility of service. Information for these questions were gathered by interviews, questionnaires and checklists which were conducted upon a visit to the site. (Tracy, 2012).

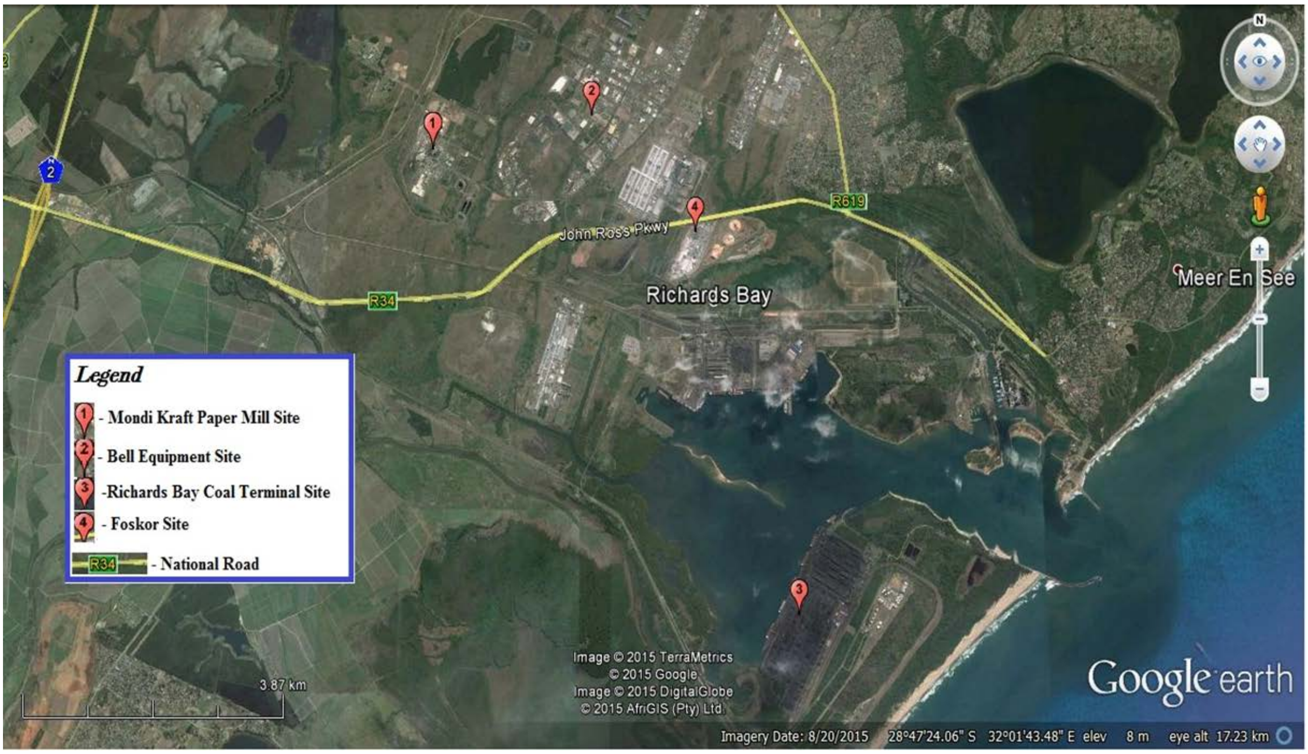
The second objective was to investigate the quantities of materials that are being recycled. This was gathered from the information given from the various industries through the structured interviews i.e. review of files where applicable, and waste management reports.

The third objective was analyzing how wastes are being recycled. A site visit is a critical factor at this stage as it was used to gather information of disposal methods that can be seen on site, i.e. waste holding areas- hazardous and non-hazardous, to landfill sites based in the industry, to what recycling techniques are practiced from these holding areas. Once this information was gathered, a report was compiled featuring a table that showcased the various recyclable waste types, the industry that produces the waste, and the method of recycling.

The final objective included investigating ways of improving recycling practices within the industries of the City of Umhlathuze, using the data that has been collected during the previous objectives goals. The purpose was to investigate and compare industries with similar types of waste streams and relevant techniques that are practiced for recycling for waste produced as well as the materials which cannot be recycled. The information provided was analyzed and reviewed for the effectiveness of current recycling practices with the various industries.

5. STUDY AREA

The image below depicts the area chosen for this study. It shows the location of the four industries that have been chosen. Foskor, Bell Equipment and Mondi are all located in the industrial zone of the City of Umhlathuze. There is easy access to transport systems and relevant services. RBCT is located at the Richards Bay port which is controlled by an independent entity, Transnet, relying on the sea and rail transport network provided by Transnet, hence the location of this industry at the Richards Bay Port and harbor.



Map 1: Richards Bay Industrial Area depicting sites of selected industries (Google Earth, 2015a)

6. DATA ANALYSIS, DISCUSSION AND RESULTS

6.1 MONDI KRAFT PAPER MILL

6.1.1 Background

Mondi is an international packaging and paper manufacturing company which spans across 30 different countries, with major establishments in central Europe, Russia, North America and South Africa. They employ 25000 individuals at their 100 operations across 30 countries and is currently a Johannesburg Stock Exchange listed company. Mondi features several products in its production line, including packaging paper, industrial bags, corrugated packaging to consumer packaging. In South Africa, they mainly base its operations on pulp, uncoated fine paper and containerboard paper (Mondi, 2015a).

Mondi Kraft (City of Umhlathuze) is located in Alton, Richards Bay which is an industrial zone and was commissioned in 1984 and produced 2 key products, The baycel, which is a premier grade bleached hardwood pulp made from 100 percent eucalyptus fiber and baywhite which is a white top Kraft linerboard, which forms the outer layer of cardboard materials and lines the corrugated inners of cardboard sheets. This organization takes pride in its sustainability through its Forest Stewardship Council (FSC) certification which ensures Mondi's products come from well-maintained sustainable forests which have environmental, social and economic benefits, as well as through its ISO (International Standards Organization) 14001 certification. This adds reassurances to Mondi's customers that the raw materials for its products are sourced responsibly and utilized to its potential to ensure limited waste. Mondi Richards Bay currently produces 720 000 tons of combined products per year. Their annual turnover exceeds 128 million Euros through its sale of 230 000 tons of bay white (Top Kraft Linerboard) product (Mondi, 2015b).

6.1.2. Waste Management at Mondi Kraft Paper Mill

Waste types and quantities

Mondi produced solid and liquid wastes only. Quantities of wastes were distinguished between recyclable and non-recyclable. The quantities of solid recyclables included: tree bark with a total of 750 tons, boiler ash with a quantity of 1500 tons which is the largest constituent of the recyclable solid materials. Scrap metal and paper forms part a small part at around 1 ton each. The liquid recyclable materials consist of effluent fiber of 3 000 tons per month and oils from machining processes of 15 tons per month. The quantities of effluent fiber that is non-recyclable are 1000 tons.

Non-recyclable solid waste materials include green liquors dregs (hazardous) as the largest constituent with a quantity of 3100 tons followed by fly ash (hazardous) with a quantity of 2000 tons; lime/ calcium carbonate with a quantity of 500 tons. Knots from timber and chemical bags (hazardous) are less with a quantity of approximately 1 ton each.

Reasons for wastes which are not recycled

With the information gathered, it was deduced that green liquors dregs has a high moisture content of over 50%. This waste stream also contains a high pH level of 12 and has a chemical composition of calcium + sodium (dominant constituent), magnesium, sulfur, carbon, iron, manganese, potassium, silicon, aluminum and copper. Dregs are produced at a rate of 5 to 6 kg per ton of unbleached pulp produced. These dregs are also usually treated further before they reached landfill sites for disposal (Sanchez and Tran, 2005). Fly Ash cannot be recycled due to non-feasibility for the recycler. Lime and contaminated chemical bags do not have any other uses yet. Lastly waste effluent fiber that is not suitable for use by recyclers are disposed of.

Methods used for recycling

In terms of the recyclable materials, these are the practices being used: tree bark is used as fuel for the biomass burner on site, effluent fiber is recycled by two service providers for different uses; an egg box manufacturer uses this material in its processes and Mpact recycling company which takes 800 tons and 2 000 tons respectively for use in their manufacturing process. Boiler ash is taken by recyclers to be used in block making while scrap steel and paper is taken by the Reclamation Group and Mpact recycling company respectively. Lastly oils are recycled by FFS refineries recycler.

6.2 BELL EQUIPMENT

6.2.1 Background

Bell Equipment is a globally based manufacturer of material handling equipment and has a range 50 different models of trucks and equipment. Their applications range from articulated dump trucks (ADT's) for mining purposes to dozers, dumper trailers, excavators and low profile ADT's. Bell Equipment has a host of other products as well which includes their ancillary range: from tractor loader backhoes, graders and all terrain forklifts, to their agricultural range- haulage tractors, tri- wheeled loaders, and forestry equipment such as feller buncher, loggers, and timber trucks to harvesting equipment such as cane loaders, articulated tractors, and tandem trailers. The ADT trucks are the core of the business model. Bell Equipment produces around 500 to 700 ADT trucks per year (Bell Equipment, 2015a). Bell Equipment is an ISO9001 accredited company which strives for top quality products to be built using high quality processes and equipment (Bell Equipment, 2015b).

Bell Equipment is based in Europe, United Kingdom, North America and Asia with its head office in South Africa, Richards Bay. They have a workforce of 3200 people worldwide with 2 main factories based in Germany and the main manufacturing plant based in Richards Bay (Bell Equipment, 2015a).

6.2.2 Waste Management at Bell Equipment

Waste types and quantities

The types of wastes that existed at Bell equipment was divided into two groups: solids and liquids which can be recyclable or non-recyclable as well as hazardous or non-hazardous. The quantities of the waste types outlined above were listed as follows: recyclable solids included carbon and low alloy steel/iron with an average of 225 tons per month, non-ferrous metals equate to 1 ton per month, wood quantities equated to 3 tons per month, while cardboard and paper equated to 7 tons and 1.5 tons per month respectively. Lastly empty oil drums average at around 2 tons per month. Most of the solid waste types are therefore recycled. Liquid recyclable waste included oil from machining processes (hazardous) which amounts to an average of 8 tons per month. Non-recyclable solids waste included fluorescent tubes (hazardous) which amount to an average of 0.1 tons per month, municipal general waste amounts to 20 tons per month and metal dust (hazardous) amounts to 3 tons per month. The non-recyclable liquid waste included waste thinners and thinners sludge (both hazardous) from painting processes amounts to an average of 3 tons a month.

Reasons for wastes which are not recycled

From the information received, it was gathered that fluorescent tubes are currently not recyclable due to their mercury composition which is extremely harmful to the environment and the atmosphere. The thinners waste and thinners sludge from painting processes are too hazardous for use and volatile i.e. flammable liquids. Municipal waste is classified as general waste that is not reusable, while metal dust is a hazardous waste as it constitutes of fine particles and are removed by a hazardous waste disposal company for safe disposal.

Methods used for recycling

The practices that are used for the recyclable wastes include the following: carbon, low alloy steel; non-ferrous metals and empty oil drums are recycled by the Reclamation Group who exports this waste to a market in India. Wood in the form of broken pallets is recycled by a local recycler. The recycler rebuilds these pallets and thus sells it back to the client. Cardboard and paper is taken by Mpact recycling while oil is being recycled by OilKol recycling services.

6.3 RICHARDS BAY COAL TERMINAL

6.3.1 Background

Richards Bay Coal Terminal is a logistics based industry and one of the leaders in coal exporting worldwide. They are situated in one of the world's deepest ports which can handle an array of large ships and volumes. In 1976, Richards Bay Coal Terminal was open with a capacity of 12 million tons of coal being exported per annum, which has increased to 91 million tons per annum and has a 24 hour operation of its site. Richards Bay Coal Terminal is a 276 hectare site with a stock yard capacity of 8.2 million tons of coal. Richard Bay Coal Terminal has a strong affiliation with Transnet, who provides the railway services that are able to transport coal from mines to the port and coordinate the shipping activity at the Richards Bay Port (Richards Bay Coal Terminal, 2014a).

Richards Bay Coal Terminal is an ISO 14001 accredited company in terms of environmental standards since February 2002. They obtained a Waste Management License in 2013, from the Department of Environmental Affairs with, in regards to their waste stored on site which amounts to more than 35m3 (Richards Bay Coal Terminal, 2015b) . They also have an Air Emission License due to the dust in the air that is produced by the coal transported (Richards Bay Coal Terminal, 2014c).

6.3.2 Waste Management at Richards Bay Coal Terminal

Waste types and quantities

Quantities of waste were divided into solids, liquids, gases and e-waste as well as recyclables and non-recyclables. The recyclable solid wastes produced included the following: rubbers from conveyors which equate to 20 tons per month, paper which equate to 4 tons a month, steel from conveyor maintenance, amounts to 10 tons per month, wood amounts to 0.5 tons per month, tyres also amount to 0.5 tons a month while coal spillage amounts to 20 tons per month. Coal spillages result from the settling ponds on the RBCT site, which are strategically placed to collect dust from coal. The dust collects at the bottom of these ponds in which coal spillages are formed. Recyclable liquid wastes included used oil (hazardous) of 4 tons per month. Recyclable e-waste (copper cables) amounts to an average of 5 tons per month. Non-recyclable solid waste included fluorescent tubes (hazardous) which equated to 0.4 tons per month in the crushed form while medical wastes (hazardous) amounts to 0.2 ton a month generated by an on-site clinic. Construction rubble amounts to 2 tons per month. Grit (hazardous) from the grit blasting processes amounts to 8 tons per month, while paint tins amount to 2 tons per month from general maintenance processes which is disposed at landfill. Non-recyclable e-waste includes batteries (hazardous) which amount to 0.2 tons per month, which is disposed of at the high hazardous landfill site. Lastly, non-recyclable liquid wastes include effluent (hazardous) which is discharged into the effluent treatment plant, which amounts to 180 tons per month.

Reasons for wastes which are not recycled

Some of the waste cannot be recycled is due to the hazardous factors of the wastes such as the crushed fluorescent tubes which contain mercury as well as the medical waste which cannot be recycled due to diseases and pathogens which is then incinerated. The effluent waste is sent to a macerator and there isn't any use for it yet, while batteries aren't feasible to recycle at the moment and it is disposed of at a high hazardous landfill site by a hazardous waste transporting company.

Methods used for recycling

The practices for the recycling of the waste streams generated included: rubber from conveyor processes is being recycled at TRC Belting Company which uses the waste product from Richards Bay Coal Terminal in their processes. Paper is recycled by Mpact Recycling Company, while steel is recycled by RED's Scrap Company. This company also recycles e-waste in the form of copper cables as well as wood, and tyres. The used oil is recycled by FFS refineries. Coal spillages are cleaned up and resold by Richards Bay Coal Terminal. The rest of the waste that is not recyclable is disposed of at high hazardous landfill sites owned by EnviroServ.

6.4 FOSKOR

6.4.1 Background

Foskor is the leading producer of phosphates and phosphoric acid in South Africa. Founded in 1951, their processes involve converting phosphoric rock into phosphoric acid or phosphate bases granules for fertilizers which are sold globally. Phosphate bearing ores are transported from the Phalaborwa mines along-side processed phosphate rock concentrate. A total of 84% of Phalaborwa production is railed to Foskor in Richards Bay, to produce 3 three main products at the Richards Bay production plant. This includes sulphuric acid, phosphoric acid as well as phosphate based granules which are used in fertilizers (Foskor, 2011a).

The acid that is produced is exported to countries such as the Netherlands, Mexico, Dubai, and India to name a few. The uses for these acids range from agricultural usages to cement in construction industries, to dental industries such as tooth whiteners, to chemical reagents (Foskor, 2011b).

6.4.2 Waste management at Foskor

Waste types and quantities

The quantities of these wastes that are produced were separated into recyclable and non-recyclable solids and liquids. Solid recyclable wastes included: scrap metal which averaged around 72.3 tons per month, hessian bags which average 1.33 tons per month, conveyer belts which averaged 1.57 tons per month while HDPE-high density polyethylene plastics averaged 2.86 tons per month. The last type of recyclable waste is the e-waste which averaged at 0.58 tons per month.

The solid wastes which are not recyclable included: sulphur ash (hazardous) with an average of 569.73 tons per month, asbestos (hazardous) with an average of 3.73 tons per month, contaminated sand/soil (hazardous) at 49.12 tons per month, oil contaminated waste (hazardous) at 1.62 tons, filter cake (hazardous) at 321.07 tons per month, scalling (hazardous) from cooling towers at 3.8 tons per month, waste grit (hazardous) from sand blasting processes at 22.03 tons per month, waste rock and sulphur (hazardous) at 21.1 tons combined monthly average, tank and weak acid solids (hazardous) at 7.7 tons per month, refractory bricks (hazardous) which average at 2.3 tons per month, catalysts which are vanadium pentoxide (hazardous) with a monthly average of 25.48 tons and lastly fluorescent tube (hazardous) waste is not recyclable and averages 0.33 tons per month. Liquid waste that is not recyclable includes 3 three lines that disposes effluent at sea. These lines are called the A, B and C lines. Foskor is licensed to a specific amount of effluent into sea and have to follow strict guidelines. Line A is called the buoyant line. This line is used for the dirty run off and high fluorine effluent disposal, and is limited to 5 000m3 of effluent per day. However, liquid waste that is recyclable is used back at the plant where possible and where fluorine is built up, it is disposed at sea to recharge the system. Lines B and C are called the dense line effluent- these lines are used for disposal of gypsum and water which is called a slurry. This line discharges 30 000m3 per day.

7. RECOMMENDATIONS

7.1 Mondi Kraft

The industry does its utmost to ensure that waste that can be recycled should be recycled based on the availability of recyclers as well as the feasibility thereof. It was found that there are two main constituents that are disposed of at landfill with high tonnages. These wastes include the green liquor dregs with a total amount of 3 100 tons and fine ash with 2 000 tons disposed of at landfill. These 2 two waste types are greater than the combined mass of any other industries in this study. Mondi Kraft remain the largest waste contributor in this study with a total mass of 6 600 tons of waste being disposed at either the Mondi landfill site or Dolphin Coast Landfill Management (DCLM) site. Based on this, there is room for improvement, as these combine to form 47% of the waste to landfill. Mondi is planning to reduce the green liquor dregs produced by upgrades to the liquor filters. These will be implemented by 2016. However there are also options which Mondi could investigate in the near future to reduce dregs to landfill or reduce the hazardous nature of these dregs when disposal to landfill occurs, entailing dregs washers and a filter press (Sanchez and Tran, 2005). The dregs washer is able to clarify the dregs and remove some of its hazardous qualities with the dilution of water in mixing tanks. However this option would increase the waste water usage. The filter option entails two methods: the vacuum filter and the pressure dregs filter. These filter options are able to create filter cakes. These filter cakes are less hazardous since the hazardous contents are pressed out, in which the water displaces the liquor. The filter press option is possibly an area where most improvements can be seen in which this is able to reduce the waste volume to landfill by up to 50% as compared to a normal filter. This process also produces cakes with a composition of around 50% percent solids dependent on the lime mud solids as well as the filter properties of the dregs (Sanchez and Tran,2015). In terms of fine ash, no feasible options exist at Mondi and based on the location of the site, there is no feasible recycler in the area, such as for the use in concrete (Thomas, 2007). Mondi Kraft actively strives to achieve compliance as part of their continuous improvement capabilities as per ISO 14001 requirements (King et al, 2005).

7.2 Bell Equipment

Bell equipment is the only non ISO 14001 compliant company in this study. Their waste as compared to the other industries are insignificant with their main constituent being carbon and low alloy steel such which amounts to 225 tons per month. The combined mass for disposal at landfill per month for all types of waste amounts to 21.1 tons per month. Projects are being explored in the near future to recycle sludge that is produced to further reduce the 0.5 tons per month while waste separation at source are being implemented to reduce the 20 tons of municipal waste to landfill. This will require more recycling initiatives on site such as High density Plastics for example. By the implementation of a sorting yard, waste to landfill can be reduced by 15%, as seen at Foskor. It is recommended that sludge disposal be reduced by means such as uses in fertilizer or compost, uses in the sealant/fillers industry if the composition of sludge allows it. Other uses that could be explored include the cement for building purposes which will allow paint sludge to be mixed with other chemicals such as caustic soda which is able to stabilize the sludge or Quick lime (CaO composition)(Ruffino and Zanetti, n.d). Another use to be considered is turning sludge back into usable thinners by a condensation process. Bell Equipment is also crushing fluorescent tubes for disposal to landfill. It is recommended a new method is explored into recycling this product as legislation as per National Environmental Management Act: Waste Amendment Act, 2014 (Act No. 24 of 2014) states fluorescent tubes must avoid being crushed and instead be stored in boxes to be recycled. In terms of the metal dust that is produced at the site, the company should explore the composition of this metal dust. Once the composition is known, a study can be done into the recovery of the constituents. An example of a recovery process is based on the Waelz Kinl method for the recovery of Zinc from metal dust (Alencastro de Araijo and Schalch, 2014). This is just one of the processes that can be used, and is one of the most common processes in the world. However it must be taken into consideration that this is based on availability of these technologies as well as the feasibility thereof.

7.3 Richards Bay Coal Terminal

Being a logistical based industry, RBCT does not produce as much as waste as the other industries with a total of 256 tons of waste produced while the majority of this being waste effluent which is treated at their own waste effluent plant. The hazardous wastes that are disposed of at landfill include medical waste, florescent tubes, batteries and paint tins, in which the latter can be reduced. Batteries can now be recycled for lead and heavy metals such as cadmium that are contained in it (Shweers et al, n.d). This can be explored by the industry in terms of local suppliers or recyclers in an effort to reduce hazardous waste being disposed of to landfill. The disposal of paint can be improved upon by a recycler who can sell it as metal scrap or use it as containers. It should be noted that if this route is followed, the cradle to grave principles are prevalent as the industry is liable for all waste that is produced by the site. This means that a reputable recycler should be contacted to shift liability from the company to the recycler. This will demonstrate RBCT taking initiatives to recycle all types of waste on site. With regards to the fluorescent tubes, as stated above for Bell Equipment, RBCT employees the similar route of crushing tubes regarded as hazardous, not only for the environment due to the mercury released but also for the personnel that are operating the crusher as mercury vapor that is released is highly hazardous to humans (Aucott et al,2003). Thus the industry should employ a store and collection method so that fluorescent tubes can be taken for disposal. Richards Bay Coal Terminal has the most potential to achieve zero waste to landfill. This is based on the fact that all the waste types produced at RBCT is recyclable as opposed to the other industries evaluated in this study. This should be a major feat for RBCT. Based on this study and the industries evaluated, they can be the first to achieve this.

7.4 Foskor

In this study, Foskor produced the most types of hazardous wastes disposed of to landfill. Their total waste production amounts to an average of 1 221.51 tons per month with sulphur ash and filter cake amounting to 72% of the total volume of waste (46% for sulphur ash and 26% for filter cakes). If this waste sent to landfill is reduced, the figures shown for Foskor will change drastically. Uses for sulphur ash is are currently being explored by the industry which shows commitment to reduce waste to landfill. This is driven by putting waste products back into the production process. By doing this it reduces the carbon footprint of the company as waste is being reused and reduced. Feasibility is a key factor to waste being recycled. Filter cakes that are produced generated due to in the production process, amounts to 321.07 tons which is disposed to landfill. The industries should undergo a chemical analysis study of these filter cakes. Once the chemical composition is known, further studies can be done on ways to reduce this waste to landfill or to reduce the hazardous potential of this waste as suggested in the evaluation of Mondi Kraft with the potential of washing of these cakes as well as methods to extract the chemical properties of the filter cakes such as the FASTMET process (McClelland and Metius, 2003). Another way this in which these filter cakes can be used is in composting however this method is also based on the determination of the composition of these filter cakes (Meunchang et al, 2004). Other hazardous waste types are not feasible to recycle as recyclers availability plays a major factor as well as the quantities together with the economic feasibility. In terms of unusable grit, of which 22 tons is disposed of at landfill, an investigation should be done into the use of this in asphalt concrete mix as a mixing agent together with the feasibility of this based on the location of this site (Means et al, 1991). With regards to rock and sulphur, an investigation should be done into the feasibility of this waste being used in other industries such as the mining industries, or other industries to control pH levels of other chemicals (Roig et al,2004). Based on this, there is potential to recycle waste that is disposed to landfill for Foskor, however the major factor is based on the feasibility of these recycling techniques. It is recommend that the possibility of outsourcing environmental solution companies which provided complete solutions or using more advanced technologies for steel recycling and paper recycling as well as various types of plastics (HDPE) be investigated. The same applies for advances in e- waste disposal techniques to outsource chemicals that can be recycled locally or shipped internationally. Another example of improving recycling practices was to educate workers and change the recycling mindset of the human community, this would drastically improve recycling as previously been proven and adapted in a safety environment for example, training would help further in implementation of new projects (Sammalisto and Brorson, 2008). Education and awareness is a key principle as defined in NEMA (National Environmental Management Act).

8. CONCLUSION

This study evaluated 4 major industries in the City of Umhlathuze region in Kwa-Zulu Natal: Mondi Kraft, Bell Equipment, Richards Bay Coal Terminal and Foskor and aimed to cover four aspects of recycling within these industries which included: types of wastes produced by each industry, the quantities of each waste by each industry, the methods for recycling of waste or disposal for each type of waste, and lastly the improvements to recycling for each industry. It was evaluated that Bell equipment is the only non ISO 14001 compliant company, while Mondi Kraft has the largest site and quantities of waste produce to the amount of waste that is sent to the landfill. Richards Bay Coal Terminal was found to be the least waste producing industry of the four with the most potential to achieve zero waste to landfill. Bell equipment falls second in the category to achieve zero waste to landfill with the exploration of recycling methods for sludge from painting processes to the separation of waste in a sorting yard to reduce the amount of municipal waste to landfill. It was evaluated that the feasibility to recycle many of the wastes that Foskor produces is questionable due to the fact that most technologies which are used to recycle the various types of waste don’t not exist in South Africa yet, or doesn’t exist within a feasible locality for Foskor to use. This study shows that although the industries do practice recycling where reasonably practicable, there is potential to achieve more recycling and reduce waste to landfill as far as possible. The major stumbling blocks involve the economic factor to recycle these products as there exist no enforcement mechanism to recycle based on the relevant legislation.

REFERENCES

Alencastro de Araijo J, Schalch V, 2014. Recycling of electric arc furnace(EAF) dust for use in steel making process, Journal of material and technology, Vol 3(3), Pg: 274-279

Aucott M, McLinden M, Winka M, 2003, Release of Mercury from Broken Fluorescent Bulbs, Journal of the Air & Waste Management Association, Vol 53(2), Pg: 143-151

Bell Equipment, 2015a, Bell Equipment Limited: Integrated Annual Report 2014, Retrived from http://www.bellequipment.com/apps/bell/bellza.nsf/0/6A78B3267FB7FAD842257E26003FC85D/$file/BELL_ir_14.pdf [Accessed on 22 September 2015]

Bell Equipment, 2015b, Bell: About Us, Retrieved from http://www.bellequipment.com/en/about-us [Accessed on 20 August 2015]

Foskor, 2011a, Profile: At a glance, Retrieved from http://www.foskor.co.za/pro_at_glance.php [Accessed on 21 October 2015]

Foskor, 2011b, Profile: About us, Retrieved from http://www.foskor.co.za/pro_about.php [Accessed on 21 October 2015]

Google earth, 2015a. Richards bay Industrial area, 28o 47’17.60’’ S 32o03’18.09’’ E, Elevation 7m

Herbst, S, Fitzgerald, J, 2000, Reaping the benefits of waste recycling, Pollution Engineering, Vol 32(4), Pages: 46

Karamouz M, Zahraie B, Kerachran R, Mahjouri W, Moridi A, 2006, Development of a master plan for industrial soild waste management. International Journal of Environmental Science and Technology. Vol 13(1), Pg: 229-242

King A A, Lenox M J, Terlaak A, 2005, The strategic use of decentralized institutions: Exploring certification with the ISO 14001 management standard, Academy Of Management Journal, Vol 48(6), Pg: 1091-1106

McClelland J M, Metius G E, 2003, Recycling Ferrous and nonferrous waste streams with FASTMET, Applied Technology Recycling, Vol 55(8), Pg: 30-34

Means J, Heath J, Barth E, Monlux K, Solare J, 1991. The feasibility of recycling spent hazardous sandblasting grit into asphalt concrete, Studies in Environmental Science, Vol 48, Pg: 553-560

Meunchang S, Panichsakpatana S, Weaver R W, 2004, Co-Composting of filter cake and bagasee; By-products from a Sugar Mill. Soil Microbiology Research Group, Soil Science Division, Department of Agriculture, Chatuchak, Bangkok, Thailand

Mondi Group, 2015a, Welcome to Mondi Richards Bay, Retrieved from http://www.mondigroup.com//desktopdefault.aspx/tabid-533/ [Accessed on 29 July 2015]

Mondi Group, 2014b, Working together for a sustainable future 2014, Retrieved from http://reports2014.mondigroup.com/downloads/working-together-for-a-sustainable-future-2014.pdf [Accessed on 15 August 2015]

Naden C, 2015. The newly revised ISO 14001 is here. Retreived from http://www.iso.org/iso/home/news_index/news_archive/news.htm?refid=Ref1999 [Accessed on 27 November 2015]

Reh L, 2006, Challenges for process industries in recycling, China Particulogy, Vol 4(2). Pg: 47-59

Richards Bay Coal Terminal, 2014a, Richards Bay Coal Terminal: Welcome, Retrieved from http://www.rbct.co.za [Accessed on 14 September 2015]

Richards Bay Coal Terminal, 2014b, 2014 Sustainability Report, Retrieved from http://www.rbct.co.za/wp-content/uploads/2014/12/2014-PRINTED-COPY-SUSTAINABILITY-REPORT-14-SEPTEMBER.pdf [Accessed on 16 September 2015]

Richards Bay Coal Terminal, 2014c, Sustainability: Environment, Retrieved from http://www.rbct.co.za/sustainability-6/safety-health-environmental-review/environment/ [Accessed on 15 September 2015]

Roig A, Cayuela M L, Sanchez-Manedero M A, 2004. The use of elemental Sulphur as organic alternative to control pH during composting of olive mill wastes, Chemosphere, Vol 57(9), Pg: 1099-1105

Ruffino B, Zanetti M C, n.d, Reuse and recycling of automotive paint sludge: A brief overview, DITAG, Land, Environment and Geo-Engineering Department, Torino, Italy

Schweers M E, Onuska J C, Hanewald R H, n.d. A pyrometallurgical process for recycling cadmium containing batteries. The international metals reclamation company, Ellwood City, PA

Sammalisto K, Brorson T, 2008. Training and communication in the implementation of environmental management systems (ISO 14001): A case study at the University of Gavle, Sweden. Journal of Cleaner Production, Vol 16(3), Pg: 299-309

Sanchez D, Tran H, 2005, Treatment of lime slaker grit and green liquor dregs, Tappi Engineering, Pulping and Environmental Conference, Philadelphia, PA

The Local Government Handbook: The complete guide to municipalities in South Africa, 2014, Uthungulu District Municipality, Retrieved from http://www.localgovernment.co.za/districts/view/24/uthungulu-district-municipality [Access on August 20 2014]

Thomas M, 2007, Optimizing the use of fly ash in concrete, Concrete Thinking For a Sustainable World. Portland Cement Association, Stokkies, Illinois

Tracy, S 2012, Qualitative Research Methods: Collecting Evidence, Crafting Analysis, Communicating Impact, John Wiley & Sons, Somerset, NJ, USA. Available from: ProQuest ebrary. [27 August 2014].