Resource Recovery through RDF: Current Trends in Solid Waste Management in the Philippines

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Abstract

Solid waste management has always been about collection and disposal of garbage. We have currently moved on to a more efficient collection and disposal by using Engineered Sanitary Landfills in the Philippines. However, with the increase in population and the consequent increase in solid waste generation, we are now running out of spaces to establish solid waste disposal facilities. A global trend in solid waste management is towards resource recovery rather than disposal of waste. Resource recovery is no longer limited to recyclable materials such as tins, glass, paper, plastic and rubber. Resource recovery now involves the recovery of all solid waste materials, including residual waste. This is the value of RDF or refuse-derived fuel. RDF uses highly combustible residual waste, such as plastics and some biodegradable materials as fuel for cement kilns. It is currently being used by giant cement manufacturers Holcim and La Farge, consisting about 10% of the fuel they use in their cement kilns, which still uses an estimated 90% coal.

The use of RDF, however, as a waste-to-energy technology must still be closely monitored under RA 9003 or the Ecological Solid Waste Management Act 2000 as well as the Clean Air Act. It remains to be an incinerating technology that requires equipment for flue gas cleaning system to prevent air pollution. If RDF can be maintained as a clean technology and recovery of RDF-qualified waste materials can be increased, resource recovery from solid waste will become more efficient, then someday, we will finally be able to achieve zero waste.

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1. Introduction

Solid waste management is among the most significant challenges being faced by the world today. The rapid increase in population all over the world brings about too much consumerism and overproduction of materials due to a perceived demand and other factors. Amid all these, we leave behind all sorts of solid waste that degrades our natural environment.

In the Philippines, where the population has already exceeded 100 million in 2015, and an average solid waste generation rate of 0.5 kg per capita per day, it can be estimated that an average of 50,000 MT per day is being generated, of which, 35,000 MT/day are collected (Gilbert and Ramos, 2012). The rest end up in places other than the designated disposal facilities. In Metro Manila alone, where the estimated rate of daily solid waste generation is pegged at 0.7 kg per capita, this metropolis generates an estimated amount of 8,345 MT daily plus an estimated amount of 55 MT per day of healthcare waste (Gilbert and Ramos, 2012). Even with a national policy on solid waste management (Republic Act 9003), the state of solid waste is such that the local chief executives seem to be at a loss on how to deal with it on a daily basis. The traditional method of door-to-door collection and hauling to the final disposal facility can no longer be sustained. Modern solid waste management requires more than daily collection and disposal.

It is a gargantuan task which must be carefully planned, implemented, and enforced in a sustainable manner so that more materials can be recovered.

There are three technical options in treating municipal solid waste, incineration, landfill and most recently, RDF - refuse-derived fuel. Landfill is the most acceptable option in the Philippines as a means for final disposal since incineration is already banned under RA 9003 because of the toxic emissions coming out from such facilities. More recently, the use of RDF as a means to divert portions of municipal solid waste is being used, albeit to a limited extent. RDF is largely used by international cement manufacturers operating in the Philippines such as Holcim and La Farge, as well as by Cemex.

This paper deals with the state of solid waste management in the Philippines and RDF as a viable option for resource recovery, showing available and accepted technology currently used in managing solid waste. This paper also highlights the best practice of a partnership of companies in dealing and treating solid waste using RDF.

2. Review of Literature

Since this paper is a product of practical implementation of municipal solid waste management and not an academic research, desktop review of electronic reference sources have been conducted. There is a large volume of literature regarding RDF and solid waste management over the internet, including news on RDF plants being planned, constructed or being launched in the Philippines. However, there are not many scientific papers that deal with studies on RDF, and only a few are academic papers.

In the Philippines, there has been no scientific or academic studies conducted regarding this technology since this is a relatively new technology here. Most of the literature available are blogs from the websites of service providers. Several of these have been perused since they were helpful in understanding RDF and some are used as references for this paper. Most of these references explain RDF as a process, some extolling the benefits of this waste management option. For example, some are found from news sources, describing the use of RDF in an area by cement manufacturer such as that of Sabillo (2013), concerning the use of RDF by La Farge, in Payatas landfill. A report by Foth and Van Dyke (2001) for the Ramsey/Washington Counties Resource Recovery Project on the comparison of potential electricity production from RDF and LPG mentions that it takes 11 tons of RDF to power one household for a year, which needs 14 tons of MSW in comparison to 750 tons of MSW to produce LFG which, when converted into electricity, could provide enough electricity to power one home for 20 years.
An interesting study was conducted by Buhner (2013) and gives a very interesting comparison among landfilling, RDF and incineration. Analysis of the three methods of managing solid waste revealed that RDF has the least GWP (global warming potential); incineration, the worst; and landfill, in between. As for water polluter, he found that landfill is the worst water polluter; and in terms of toxicity, incineration is the worst because it has double the emission of a landfill and three times that of RDF. In terms of truck fuel consumption, he found that Recycling + RDF consumes the most truck fuel, concluding in the end that waste prevention is the best option. In an earlier article, Buhner (2012) tackled three (3) alternative ideas for waste management in developing countries, wherein he analyzed the solid waste management tradition of people in developing countries.

Lastly, a masters’ thesis regarding RDF technology in Thailand was conducted by Nithikul, J (2007), wherein he concluded that majority of cement industries in Thailand are ready to use RDF at 40% fuel substitution without any plant modification. However, other industries cannot process RDF yet since they don’t have sufficient pollution control equipment.

3. Approach and Methodology

Primary data gathering was conducted during personal visits to Payatas Landfill Site, wherein La Farge-Mundo Verde joint venture is operating and RDF baling site for the cement kiln of La Fangeand conducting interviews with key informants. Visit to the Pasig City RDF Plant, which was launched last June 2015 by IPM Corporation (through EcoEdge Resources Corporation) in cooperation with the Metro Manila Development Authority (MMDA) and the Pasig City, was also conducted and key informants were also interviewed. Presentations concerning the specifications of the facility were also taken as data for this study. Photo-documentation was also done for both sites.

Secondary data was gathered from the National Solid Waste Management Commission (NSWMC) as well as from some officers of IPM-EcoEdge, and BEST Inc.and from online sources.

4. Background on the State of Solid Waste Management in the Philippines

Republic Act 9003, also known as the Ecological Solid Waste Management Act 2000 mandates solid waste segregation at source. It also mandates the local government units (LGUs) to create their respective Solid Waste Management Boards, formulate their ten-year Solid Waste Management Plans, building of materials recovery facilities (MRFs) and final disposal facilities (such as Engineered Sanitary Landfills). RA 9003 was signed into law in 2001. Hence, it has been 14 years since the law came into effect. However, there has been very little change in solid waste management. A huge percentage of the population are still ignorant about the law, about solid waste segregation, and do not understand the fact that mismanagement of solid waste contributes to a lot of environmental degradation, and a factor in street flooding during the monsoon rains. Only a handful of LGUs were able to establish their sanitary landfill facilities such that, until todate, many LGUs are still struggling to comply with appropriate final disposal facilities. In other words, they are still maintaining open dumpsites. Others which were able to build their own engineered sanitary landfill are facing a full landfill and operating them either as open dump or controlled dumpsite. This situation highlights the inefficient solid waste management among LGUs in the Philippines, which requires more stringent measures in order for solid waste to be better managed as a form of resource. Figure 1 below shows an open dumpsite that used to be an engineered sanitary landfill (ESLF).

Other local government units were not able to come up with the required Engineered Sanitary Landfill (ESLF) due to lack of budget and open spaces by which to put their sanitary landfill site, due to the NIMBY (not in my back yard) attitude of the constituents. In the Philippines, most lands are privately owned and just a small portion is publicly owned. These small portions are either allocated for the LGUs” offices, public open spaces for recreation (plaza) and other public infrastructures. Hence, this factor contributes to the difficulty in finding a suitable site for their respective landfill. The current practice is to collect and dump in their old dumpsites, which has not been closed up to the present. Figure 2 shows an example of an old dumpsite that has been in existence since the early ‘80s.
This typical scenario is happening all over the country. In one city, a transfer station was located in the middle of the city close to two (2) public markets and a middle-class residential development, for lack of space to site it. It has recently been closed due to insistent public clamour because of the accompanying negative environmental impacts of the facility (see Figure 3). Now the city has lost its transfer station and they have also lost control of private garbage collectors which are collecting for private residential developments, in terms of waste disposal. In a recent interview, the informant said that they have no idea where these private collectors dispose their waste since only the public garbage trucks are accounted for.

Other LGUs have a similar problem and burden - the lack of space with which to dispose their waste as well as the lack of budget to invest in a better solid waste management technology.

Also, illegal dumpsites are rampant and are mostly found among informal settlements which have no access to public services on garbage collection. People who do not understand the negative impacts of open dumping and dump anywhere, practiced inadvertently, contribute to the degradation of the environment. In Metro Manila, solid wastes that are thrown on the streets find their way to the storm drainage and exacerbate flooding conditions. These
garbage materials find their way into Manila Bay. Other coastal cities suffer from a similar situation. These scenarios are proof that even with the presence of Ecological Solid Waste Management Act, solid waste management is a gargantuan task which requires several solutions and options for treatment all at the same time.

4.1 Compliance to RA 9003

The local government units have to comply with the requirements and stipulations of the national policy on SWM such as 1) ten-year solid waste management plans, 2) solid waste management boards, 3) materials recovery facilities (MRFs).

However, looking at the compliance of all the provinces, cities, municipalities and barangays (smallest local government unit) leaves much to be desired. For example, in the creation of their respective 10-year SWM Plans, the rate of compliance is less than perfect as shown the figure below:

![Fig. 4: Rate of Compliance in submission of Ten-year SWM Plans per Region (Source: Ildefonso. 2014).](image)

The rate of compliance does not show the true picture on how RA 9003 is enforced. Some best practices are being done sporadically all over the country but most of them cannot be sustained based on many factors, mainly budgetary ones, although attitude and behaviour towards solid waste cannot be discounted. This is why waste reduction goals are at a minimum and most of the stipulations in the Ecological Solid Waste Management Act are at a minimum of compliance fourteen (14) years after it has been signed into law, especially with regards to the construction and operation of Engineered Sanitary Landfills. Table 1 below shows the rate of compliance to the engineered sanitary landfill as the primary option for disposal of garbage.

At the lowest level, the barangays (villages), the smallest political unit in the Philippines are mandated to enforce RA 9003. They are supposed to have established their own materials recovery (MRFs) facilities as stipulated in the law. However, just like the ESLFs, the establishment of MRFs have been complied with to a limited extent. Various factors such as space for siting the facility, as well as budgetary requirements and others has affected the implementation. Table 2 below shows the extent of compliance on MRF establishment.
Table 1. Key information on SLFs in the Philippines from 2008, 2010, 2013 and 2014 (Source of data: Ildefonso, 2014).

| Parameter                          | 2008           | 2010           | 2013           | 2014           | Unit   |
|-----------------------------------|----------------|----------------|----------------|----------------|--------|
| Population                        | 88,543,800     | 92,337,852     | 98,449,090     | 100,420,642    | capita |
| Number of operating SLFs          | 21             | 29             | 73             | 137            | SLFs   |
| Number of LGUs* with access to SLFs| 63             | 78             | 130            | 154            | LGUs   |
| Percent of LGUs with access to SLFs| 3.86           | 4.77           | 7.96           | 9.42           | %      |

*LGUs here refer to cities and municipalities. There are 1,634 LGUs in the Philippines

Table 2. Number of MRFs reported to NSWMC 2008 to 2014

| Parameter                          | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|-----------------------------------|------|------|------|------|------|------|------|
| Number of MRFs                    | 2,438| 6,141| 6,958| 7,329| 7,713| 8,486| 8,656|
| Estimated % of Barangays* with MRFs| 5.8  | 14.6 | 16.6 | 17.4 | 18.4 | 20.2 | 20.6 |
| Number of Barangays/LGUs served by MRFs| 2,701| 6,744| 7,938| 8,323| 8,843| 9,624| 10,327|
| Estimated % of Barangays served by MRFs| 6.4  | 16.0 | 18.9 | 19.8 | 21.0 | 22.9 | 24.5 |

*There are 42,028 barangays in the Philippines

5. Current Trends in SWM Technology in the Philippines

There are various attempts from several developed countries such as Canada, UK, the USA, other European countries, Japan and South Korea to bring in their waste to energy technologies in the Philippines to help solve the growing problem on solid waste. Many studies have also been conducted regarding the state of solid waste management, in various projects such as Pre-feasibility and feasibility studies to determine the capability of LGUs as well as help them in choosing the best option of managing solid waste particularly on the final disposal facility. However, with the ban on incineration, only the establishment of engineered sanitary landfill as well as any waste to energy which uses non-burn technology are allowed for final processing of solid waste.

Recently, however, the use of RDF (refuse-derived fuel) has been approved by the government (Department of Energy) as an accepted technology to help the country’s waste diversion goals. In a press release by the Department of Energy (DOE) in June 2013, it has given the go-signal for the operation of a Refuse-derived fuel processing plant in the province of Rizal “amidst the backdrop of a perennial garbage problem in the cities and provinces around the country.” This facility, now being operated by the Green Alternative Technology Specialists, Inc. (GATSI) is said to have been designed to process municipal solid waste into pellets, which will be used as a substitute for coal as fuel. In 2005, the country’s cement industry used 20% of the country’s coal supply. In an interview with a representative of Geocycle (the waste management brand of Holcim in the Philippines), it was mentioned that about 10% of fuel currently being used in their cement kilns is from RDF and 90% is coal. La Farge also uses 10% RDF and 90% coal in its cement kilns in the Philippines.

5.1 Refuse-Derived Fuel (RDF)

What exactly is RDF? According to the definition of the U.S. Environmental Protection Agency (EPA), “RDF is the product of processing municipal solid waste to separate the combustible and non-combustible portion into a form that can be effectively fired in an existing or new boiler.” RDF converts energy from non-recyclable but combustible waste material into a material that can be used as substitute of traditional fuel such as coal. RDF technology was developed in the US in the early ’70s and is now considered as a “proven technology.”

RDF is also known as SRF or solid recovered fuel in the EU (Huggard and Lanfranchi 2002), wherein SRF is defined as “fuel prepared from non-hazardous waste to be utilized in waste incineration or co-incineration plants.” In the Philippines, RDF is mainly used in cement kilns.
6. Case Study: IPM-La Farge Partnership

6.1 Payatas Landfill Site, Quezon City

The RDF facility in Payatas is being operated by the Mundo Verde Corporation, which is a consortium of PEG Southeast Asia, IPM-ESI (Environmental Services, Inc) and waste management consultant BEST, Inc (Basic Environmental Systems Technology, Inc), cement manufacturer La Farge Industrial Ecology International SA.

Currently, Quezon City collects 1, 205 tons per day of municipal solid waste, which are disposed to the landfill in Payatas (Gilbert and Ramos, 2012). The RDF facility, which began operations in January 2013, produces an amount of 50 tons per day refuse-derived fuel (an estimated amount which could rise up to 150 TPD). The project was conceived as part of La Farge’s sustainability goals of increasing the use of alternative fuels through the use of RDF from the municipal solid waste. The RDF produced is used to supply the Luzon-based cement plants of La Farge Republic (ICR Newsroom, 2013).

Based on a waste characterization study, the following are the types of waste disposed in Payatas, which shows that about 52% of the materials are usable for RDF and 48% are unusable for RDF but some of the unusable materials are recyclable materials such as metal and glass.

![Figure 5. Types of waste in Payatas. (Source: Gilbert and Ramos, 2012)](image-url)
The following figures give a glimpse of the RDF facility in Payatas, Quezon City.

![Fig. 6. Payatas RDF facility](image1)

![Fig. 7. Baling Area](image2)

![Fig. 8. Solid waste sorting area](image3)

### 6.2 Sandoval, Pasig City

The RDF facility in Sandoval, Pasig City was built in 2014 and commissioned in January 2015, subsequently was launched in June 2015. It is a product of joint venture agreements among IPM together with BEST, Inc. (Basic Environmental Systems and Technologies, Inc.) and La FArge Industrial Ecology International, which established Ecoedge Resources Corporation, which operates and manages the facility.

The facility was constructed with the support of the Pasig City government, which supplies solid waste, and with the Metro Manila Development Authority (MMDA), providing the disposal facility for residual waste in a sanitary landfill. This new RDF facility has an input rated capacity of 600 tons of waste a day and can produce a maximum of 150 tons per day of RDF, depending on the quantity and quality of waste received. The RDF bales are made from combustible materials produced from mechanized sorting and segregating operations. Combustibles include materials such as plastic, paper, rubber, leather, textile, dry fabric, wood and leaves (25-35% of the MSW are combustible materials). The facility is running 2 shifts, 7 days a week. It currently employs sixty (60) people but this could grow to eighty (80) people with the 3rd shift. Among the employees, forty (40) live in Pasig while the rest live in nearby areas (Ramos, 2015).
The RDF is used as alternative fuel raw material (substitute to coal) for cement co-processing of cement plants of Lafarge in Norzagaray, Bulacan and in Rizal province. Each ton of RDF used in cement plants replaces 600 kg of coal. The compacting of RDF after shredding and the densification of discharged waste after sorting allows the reduction by 40% the number of trucks leaving the platform compared to a pure waste transfer station (Ramos, 2015). The high temperature and the gas treatment system of the cement kiln guarantee emissions without any secondary pollution. The RDF facility is environment-friendly and complies with 3Rs of waste management. It produces an alternative form of fuel to reduce dependence on fossil fuel, generates new avenue for employment, and helps extend the life of engineered sanitary landfills. It also provides a better and safer alternative to the processing and handling of wastes (Ramos, 2015). RDF reduces and even eliminates leachate production, as well as offers lower prices for alternative forms of fuel for use of industrial plants (Aguinaldo, 2015). As an alternative energy source, RDF helps lessen the problem of power shortages, decreases carbon footprint as it reduces the fossil fuel usage of plants, decreases the risk of garbage slide in sanitary landfills and helps increase the effectivity of the city’s solid waste diversion program (Aguinaldo, 2015).

The figure below shows the RDF in Sandoval, Pasig City:

![Fig. 9. The new Sandoval RDF Facility](image)

7. Analysis and Discussion

Implementation and enforcement of RA 9003 is a difficult and complicated task that requires more than simple solutions of collection and disposal. While the LGUs try to implement the main stipulations of reduce, reuse, recycle, it proves to be easier said than done. Solid waste generated on a daily basis by citizens, which are mostly uninformed of the negative consequences of their solid waste behaviour of dump and dump anywhere take its toll on the enforcement authorities as well as on the environment.

With the engineered sanitary landfill as the main option for disposal, it comes to a point where practically all suitable spaces that can be allocated to this type of disposal site are already used up and generally becomes unfriendly to the environment when one thinks of cutting down trees or allocating a portion of the farmlands to give rise to a solid waste disposal facility. The use of RDF as another option to manage solid waste by way of diverting a large portion to be used as an alternative fuel greatly helps in disposal of waste, where there are limited places for landfill sites especially in highly urbanized cities with high population growth, such as the cities in Metro Manila. RDF, together with the RA 9003 of reduce, reuse and recycle and waste segregation schemes greatly helps in reducing the volume of waste. This is because, with solid waste segregation already in place, most of the combustible materials used in RDF are already residual waste, such as those used as wrappers and all other packaging waste that are found to be non-recyclable.
In big cities such as Quezon City and Pasig City, RDF facilities can be located in brownfield environments and can use infilling strategy, where there are locations which are previously occupied by other industries. In the case of Payatas, the RDF facility is located within the landfill area. In Pasig City, the facility is situated in a vacant lot which was previously a warehouse and away from major residential developments.

This is not to say here that RDF is the best option for disposal. It is just among the many options to treat residual waste, and can be an option to prolong the life spans of the landfills as well as to provide additional renewable fuel sources. In the final analysis, when it comes to discussion on toxicities that are harmful to the environment and human health, waste prevention still comes as the best option.

8. Conclusions

Based on the case study presented vis-a-vis the state of solid waste management in Metro Manila in particular and the Philippines in general, refuse-derived fuel (RDF) presents a solid waste management option that can definitely reduce the volume of waste in highly urbanized areas where the volume of waste is very high.

RDF technology offers an option for managing municipal solid waste at a sustainable level. It can be said that this technology is here to stay whether we like it or not. The government has already allowed it, with certain guidelines on emission levels of certain toxic substances that are harmful to human health. With the advent of this technology, several more are waiting to be constructed in other places in the country, if only to reduce the solid waste being disposed into the landfill.

9. Recommendations

There is currently no available research conducted regarding the use of RDF technology in the Philippines in comparison to landfill sites. It is therefore recommended here that a study regarding this be conducted in the future to determine the pollution control of emissions, toxicity, and many other negative things attributed by some groups to this kind of waste management technology. Also, due to the adverse consequences in terms of emissions of toxic substances, environmental monitoring for these sites must be stringent in order to protect the ambient air quality of the surrounding areas. The government must seriously implement waste segregation scheme at source as stipulated in RA 9003 in order not to lose valuable recyclable materials to these RDF facilities. If all these can be done, zero waste can become a possibility.

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