

Generation and disposition of municipal solid waste (MSW) management in Thailand

An essay by

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EXECUTIVE SUMMARY

The disposal of municipal solid waste (MSW) has become an important issue in all countries. However, it is usually hard for governments of developing nations to deal with MSW management issues because of lack of information and adequate data collection. Since Thailand is currently experiencing MSW problems due to its fast economic development and population growth, it is necessary to understand the status quo of MSW generation and disposal in Thailand. This was the objective of this study. The study collected data of MSW generation volume in Thailand and compared them with the analysis of other key indicators, such as Gross Domestic Production (GDP) and population, of Thailand and neighboring countries. The results showed that MSW generation tends to increase with GDP and population increases.

The MSW data was also broken down in terms of MSW composition and rate of generation by geographic area and waste type. The study found that the MSW generation is concentrated in Bangkok and the urban areas of Thailand. Also, the study compiled data on the means for disposing MSW from interviews and site visits. It was found that 68% of the Thai MSW was not treated properly.

After a visit of a mechanical sorting and anaerobic digestion facility and several interviews with Thailand's MSW disposal regulators, the study found that the inadequate maintenance of the MSW disposal machine and lower revenue stream than expected in feasibility study have resulted in the closing of most of Thailand's disposal stations.

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1. Scope of the study

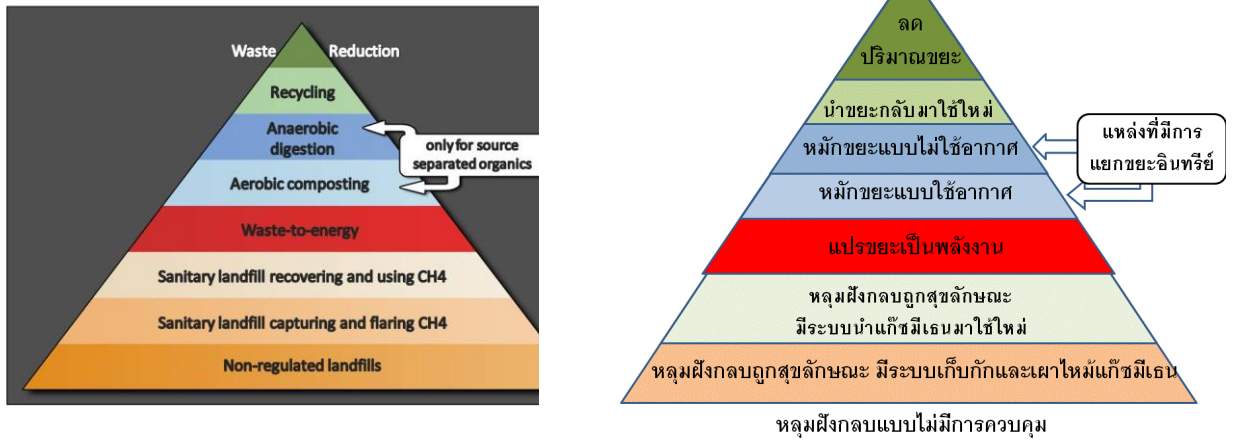


Figure 1: Hierarchy of Sustainable Waste Management¹ (Thai version by Chak Cherdstirkul)

This study takes into account of the concept of hierarchy of sustainable waste management as shown in Figure 1. The top of the pyramid is the most preferable methodology, which are waste reduction, recycling, anaerobic digestion, aerobic composting (Windrow), waste to energy, sanitary landfill and non regulated landfills, respectively.

2. Introduction to Thailand

¹ Waste to Energy Research And Technology Council<<http://www.seas.columbia.edu/earth/wtert/index.html>>



Figure 2: Map of Thailand²

Thailand is located in Southeastern Asia, bordering the Andaman Sea and the Gulf of Thailand, southeast of Burma. Its total land area is 510,890 square kilometers and its population 66.7 million (July 2011 est.). The national GDP (Power Purchase Parity) is: USD609.8 billion (2011 est.) or about 5% of China GDP and Thailand per capital GDP USD 9,700 (2011 est.) or 15% more than China GDP per capita. Administratively, the country is divided into 77 provinces³.

3. Current MSW management in Thailand

The most recent analysis of the current generation of solid wastes in Thailand is shown in Table 1.

² The World Factbooks. Central Intelligence Agency. 12 December 2011 < <https://www.cia.gov/library/publications/the-world-factbook/geos/th.html>>

³ The World Factbooks. Central Intelligence Agency. 12 December 2011 < <https://www.cia.gov/library/publications/the-world-factbook/geos/th.html>>

Table 1: Sources of generation of solid wastes in Thailand (2002)⁴

	Total Waste generation (1000 tons/year)	Total minus reuse and recycling (1000 tons/year)	Largest –producing provinces(& of total)
Municipal Solid Waste	14,400	12,800	Bangkok (27%) Nakhon Ratchasima (3.3%) Samut Prakan(2.3%) Khon Kaen(2.1%)
Medical Waste	21.3	21.3	Bangkok(21%) Chiang Mai(3.9%) Nonthaburi(3.4%) Nakhon Ratchasima(3.0%)
Industrial Hazardous Waste	963	788	Samut Prakan(19%) Bangkok(18%) Pathumthani(11%) Samut Sakhon(7%)
Industrial Non-Hazardous Waste	5,890	1,271	Samut Prakan(13%) Bangkok(11%) Samut Sakorn(8.5%) Patumthani(5.2%)
Community Hazardous Waste	372	182	Bangkok(34%) Nakhon Pathom(2.6%) Nonthaburi(1.4%) Pathum Thani(0.8%)

As shown in Table 1, municipal solid waste (MSW) was the largest source of solid wastes; in 2002, more than 66% of the company’s total annual waste generation or about 14,400,000 tons is MSW. Figure 3 compares the generation of MSW in Thailand with other Asian nations. It can be seen that, on a per capita basis, Thailand MSW ranked 5th in the ASEAN⁵ (Association of Southeast Asian Nations) region in 2001 as shown in Figure 3. This figure also shows that the per capita generation of MSW in the ASEAN region, with the exception of Brunei has a direct correlation with GDP per capita.

⁴ The World Bank, “Thailand Environment Monitor 2003”. 1 January 2004. P1

⁵ A group of 10 countries in South East Asia region. Its members are Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam.

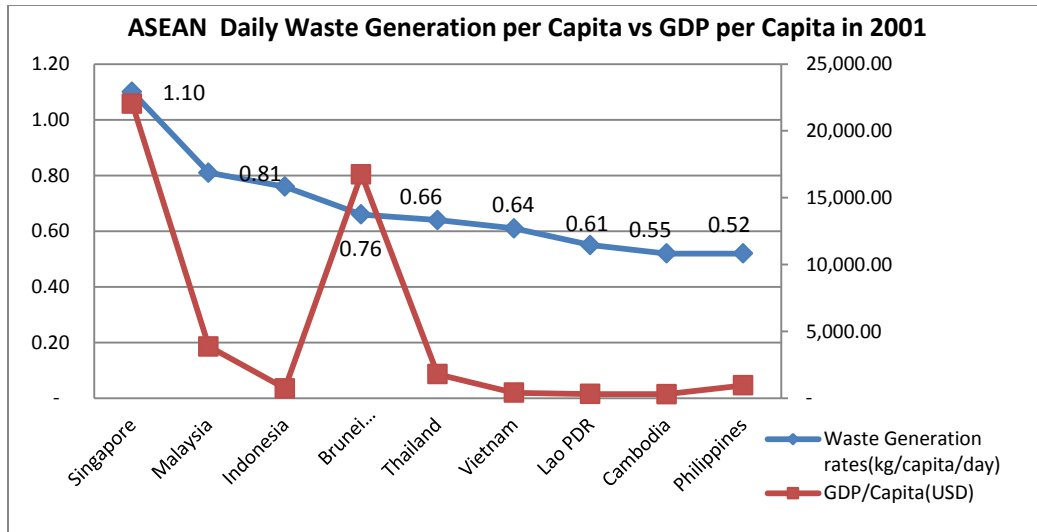


Figure 3: Per capita waste generation⁶ vs GDP⁷ in nations of the ASEAN region in 2001

Figure 4 shows that Thailand's generation of MSW increased with population from 2001-2010. During the same period, Thailand's generation of MSW increased with real GDP growth as shown in figure 5.

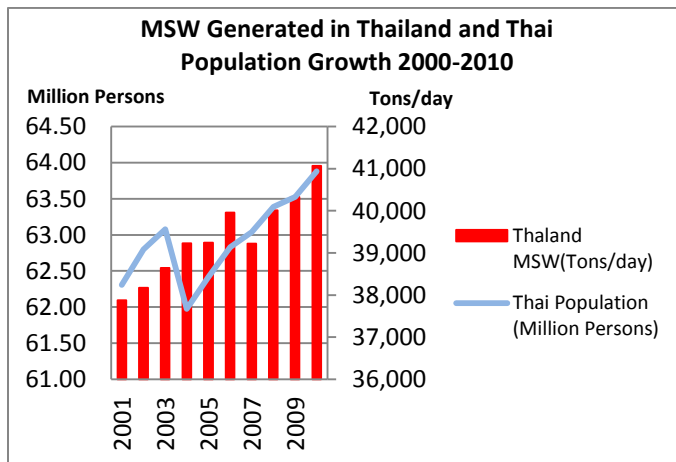


Figure 4: Comparison of MSW generation⁸ and population growth¹⁴ in Thailand⁹

⁶ The Worldbank. 5 April, 2012. <<http://data.worldbank.org/indicator/NY.GDP.PCAP.CD/countries>>

⁷ Ngoc, U. N. and H. Schnitzer (2009). "Sustainable solutions for solid waste management in Southeast Asian countries." *Waste Management* 29(6): 1982-1995.

⁸ Thai Pollution Control Department's website. 7 April 9, 2012. <http://www.pcd.go.th/info_serv/waste_wastethai48_53.html>

⁹ National Statistical office of Thailand. 5 April 2012.

<http://service.nso.go.th/nso/nsopublish/BaseStat/tables/00000_Whole%20Kingdom/1.1.3.xls>

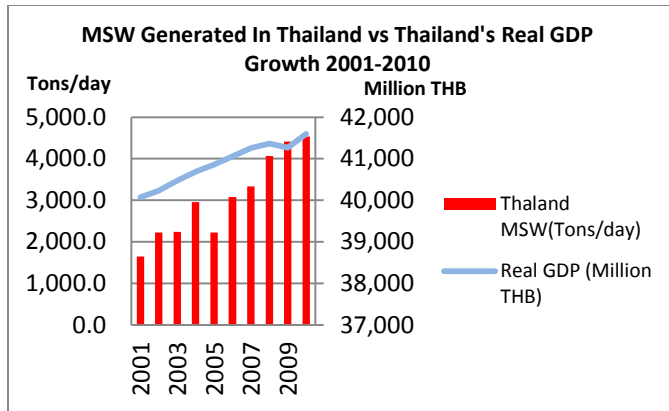


Figure 5: Comparison of MSW generated in Thailand¹⁰ to real GDP Growth¹¹

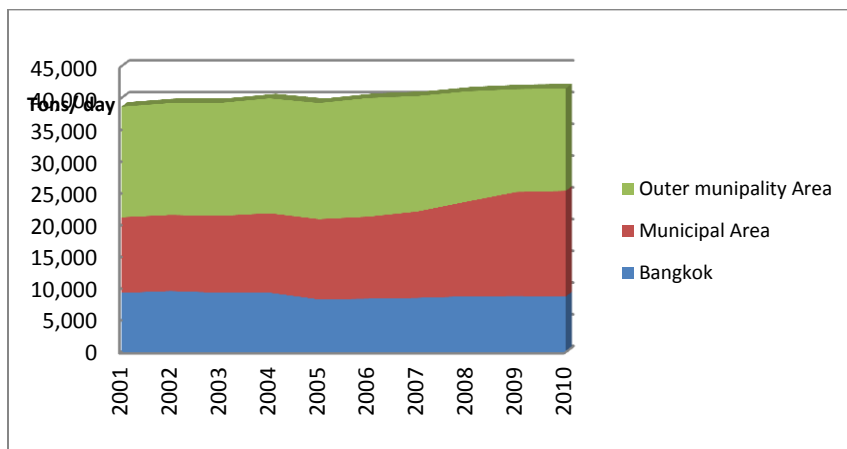


Figure 6: Distribution of MSW generation by region¹²

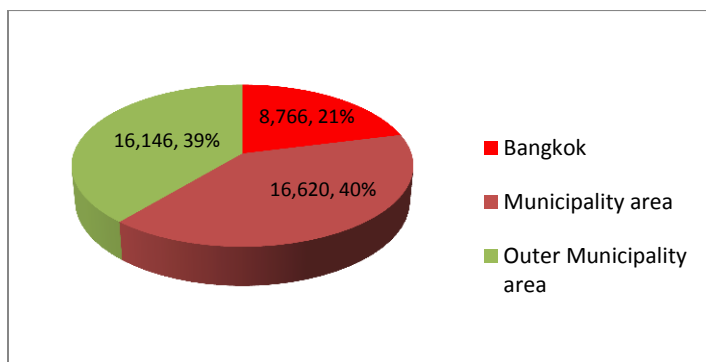


Figure 7: Distribution of MSW generation by urban and rural areas in 2010¹³ (tons/day)

¹⁰ Thai Pollution Control Department's website. April, 2012. <http://www.pcd.go.th/info_serv/waste_wastethai48_53.html>

¹¹ Bank of Thailand. 7 April, 2012 <<http://www.bot.or.th/English/Statistics/EconomicAndFinancial/EconomicIndices/Pages/StatMacroEconomicIndicators.aspx>>

¹² Thai Pollution Control Department's website. 7 April, 2012. <http://www.pcd.go.th/info_serv/waste_wastethai48_53.html>

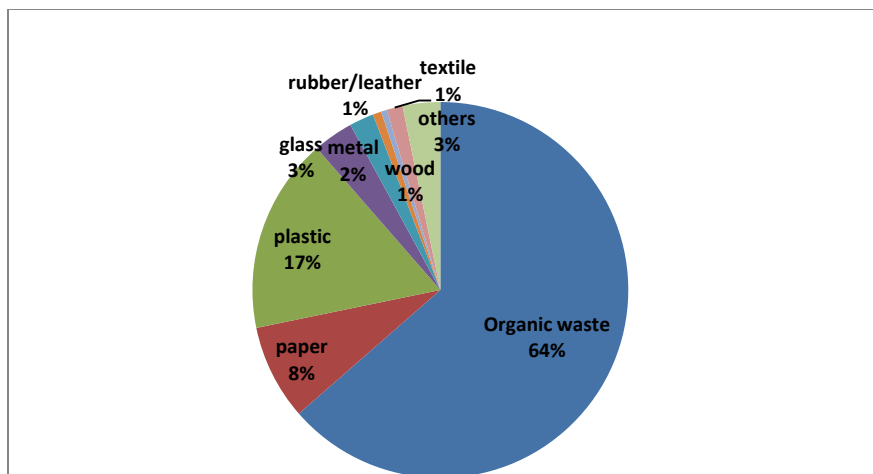


Figure 8: Characterization of Thailand MSW composition in 2004¹⁴

Figure 6 shows that Bangkok and the other urban areas of Thailand (municipalities area) generated about 61% of Thailand's MSW in 2010 and the rural areas the remaining 39%. The major component of MSW component in Thailand is organic waste from food (64%). Plastic and paper ranked second and third, respectively (17% and 8%)

Table 2: Thailand MSW breakdown by means of disposal¹⁵

Thailand MSW in 2008	Annual Country Waste (tonnes)	% of total
Recycling	1,650,000	11.0%
Anaerobic digestion	29,200	0.2%
Windrow composting	36,500	0.2%
Incineration	142,350	0.9%
Sanitary landfilling	1,420,000	9.4%
Open dumps	11,751,950	78.2%
Total	15,030,000	100.0%

As shown in Table 2, in 2008 most of Thailand's MSW was disposed improperly. According to Thailand's Pollution Control Department's staff, about 78% of Thailand's MSW was disposed in non-regulated

¹³ Thai Pollution Control Department's website. 7 April, 2012. <http://www.pcd.go.th/info_serv/waste_wastethai48_53.html>

¹⁴ Pollution Control Department, Ministry of Natural Resources and Environment "Municipal solid waste character observation and analysis in all municipalities project", 2004, <<http://infofile.pcd.go.th/waste/Reportwaste.pdf?CFID=8235539&CFTOKEN=60317797>>

¹⁵ Analyzed and updated from Supat Wangwongwatana, PHD, Director General, Pollution Control Department, Thailand "Thailand Policy and Strategy for Waste Management", 2010.

open dumps¹⁶. Only 9.4% of the waste generated was recycled while about 10% of the MSW in Thailand was properly treated in sanitary landfills and other proper technology facilities.

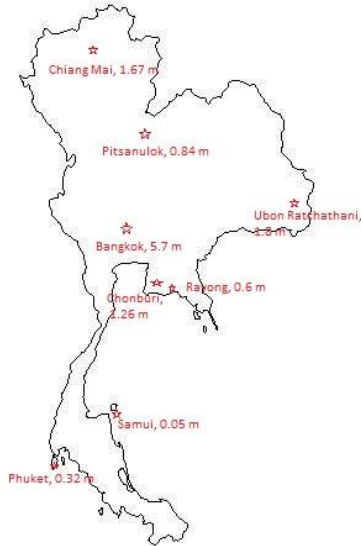


Figure 9: Map showing Thailand’s main MSW disposal facilities and population of province in 2008^{17 18 19 20}

An estimated 7500 tons of Bangkok MSW, 700 tons of Chiang Mai, and 200 tons of Ubonratchathani MSW are disposed daily in sanitary landfills. These three provinces encompass Thailand’s sizable cities with population bigger than 1.5 million. In 2008, two of Thailand’s major tourist islands, Phuket and Samui operated two MSW incinerations. Although Phuket and Samui are relatively small in terms of population, Phuket and Samui are tourist destinations with 5.3 million and 0.8 million visitors per year, respectively²¹. However, the 150 ton/day MSW disposal plant in Samui has been closed, thus, there is currently only one 250 tons/day of MSW incineration plant operating in Phuket.

A number of provinces and municipalities have tried to install and operate MSW anaerobic digestion plants. However, most of them have failed, including the major investment of about USD 26.5 million (THB 800 million) in a 240-320 tons MSW/day in Chonburi, thus leaving only one 80 tons/day anaerobic digestion plant in Rayong in operation.

¹⁶ Statistics and Pollution Control Department(PCD)’s estimation

¹⁷ National Statistical office of Thailand. 5 April 2012.

¹⁸ <http://service.nso.go.th/nso/nsopublish/BaseStat/tables/00000_Whole%20Kingdom/1.1.3.xls>

¹⁹ National Statistical office of Thailand, Suratthani. 10 April 2012<http://surat.nso.go.th/surat/Table/sttrpt53_1.xls>

²⁰ Samui population data from 2009 due to unavailability of data

²¹ Department of Tourism, Ministry of Tourism and Sports, Thailand, 10 April 2012,<http://www.tourism.go.th/2010/upload/filecenter/file/stat_jan53/update_south51.xls>

GTZ Thailand²², an environmental German organization, has helped set up an MSW processing plant in Pitsanulok, a small city in lower north of Thailand. This plant receives 32,850 tons of MSW per year with about 7,300 tons of organic waste. The plant could reduce the non organic waste down by 17% and the remaining could be sold as RDF to other manufacturing plants and be sent to the land fill, while the plant would generate around 3,650 of compost product.²³

4. Rules and Regulations

Table 3: List of agencies involved in MSW Regulation

	Department	Division	Role
MONRE	ONEP	Office of National Environmental Board	<ul style="list-style-type: none"> Formulate policy and plan for environmental conservation and administrative management
MONRE	ONEP	Office of Environmental Impact Evaluation	<ul style="list-style-type: none"> Appraise EIA on government and private project
MONRE	PCD (Pollution Control Department)	Solid waste and night soil management section	<ul style="list-style-type: none"> Monitor MSW management by municipalities
MOPH	Department of Health		<ul style="list-style-type: none"> Issue MSW management standard and monitor management by municipalities
MOIN	Department of Industrial Works	Registry division	<ul style="list-style-type: none"> Give license for new factory*
MOI	Department of Local Administration		<ul style="list-style-type: none"> Supervise BMA and other local municipalities
BMA	Department of public cleansing	Technical and planning division	<ul style="list-style-type: none"> Provide legal advice on MSW disposal waste project
Municipalities			<ul style="list-style-type: none"> Responsible for disposing of MSW & give license to private sector
MOE	Department of Alternative Energy Development and Efficiency		<ul style="list-style-type: none"> Give subsidy to waste to energy project

²² www.gtz.de/en/index2.htm

²³ Blackwood ventures Thailand's research

MONRE = Ministry Of Natural Resources and Environment
MOIN=Ministry of Industry
MOI = Ministry Of Interior
ONEP = Office of Natural resources and Environmental Policy and Planning
BMA = Bangkok Metropolitan Administration
MOE=Ministry of Energy

Thailand's MSW is managed mainly by three ministries and also by each area's local government. The first is the Ministry of Natural Resources and Environment through its Office of Natural resources and Environmental Policy and Planning and the Pollution Control Department. The Ministry of Public Health controls MSW management through its Department of Health. Finally, the Minister of Industry's Department of Industrial Works issues licenses to MSW treatment facilities. Furthermore, the Bangkok Municipality and each area's local government, under the supervision of Ministry of Interior, control MSW treatment/disposal in each area. Finally, the Ministry of Energy will be involved in providing subsidies to waste to energy projects.

5. Past problems with introduction of waste management technologies

As shown earlier, only 20 % of Thailand's waste is being treated properly, Most of the properly treated MSW goes to sanitary landfills of Bangkok, Chiang Mai, and Ubon Ratchathani. There have been very few MSW incineration facilities in Thailand; plants in operations are in Phuket (250 tons/day)²⁴ and on Samui Island (150 tons/day) that stopped operation in 2009. A number of "integrated" systems, composed of sorting system and anaerobic digestion were installed in Chonburi, Rayong, and Koh Chang Island; however, some of them are no longer in operation at this time.

From interviews with Thai MSW treatment operators and PCD staff, many of Thailand's MSW treatment projects failed because of mechanical breakdowns, which may have resulted from inadequate maintenance of the plant. Since Thailand has a different type of waste composition from the countries where these technologies have been developed, the design of the plant machinery may not suit Thailand's MSW.

Moreover, these MSW treatment projects always yield lower revenue than expected in the feasibility study. One of the problems that the MSW treatment operator always experience is that the revenue stream from the recycles is limited due to the abundance of Thailand's scavengers, who always compete in collecting the recycle materials with the project.

Also, such waste facilities usually cannot collect as high disposal fee from the community as much as expected, because the local government, which is responsible for the collection, is reluctant to increase the disposal fee since it would affect their popularity in the future election.

²⁴ Increase to 600 ton/day in 2012 and 900 ton/day in 2014

6. A case study: The Rayong Municipality Integrated system

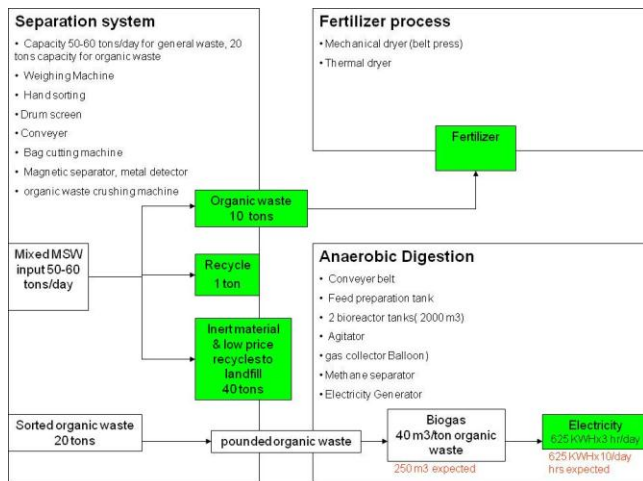


Figure 9: Flowsheet of the Rayong Municipality integrated system²⁵

Rayong is a coastal province in the east of Thailand. The municipality owns and has contracted a private company to operate their integrated waste disposal system. The plant is composed of a sorting system, aerobic composting, and anaerobic digester with biogas collection and -electricity generation. The system capacity is designed for 60 tons of MSW per day plus 20 tons of organic waste per day.

According to the Blackwood Ventures study in 2007²⁶, the anaerobic digester could process 20 tons of well sorted organic waste per day. Also, the biogas tank should yield up to 250 m³ and yield 625 kWh of electricity for 10 hours per day. However, at the time of the visit in 2007, the system only generated 625 kWh for 3 hours per day.

The operating problems of the system were:

- The organic waste sorted out from the Mechanical sorting apparatus could not be used in the Anaerobic Digestion process because plastic and metal wastes could not be sorted out of the organic waste completely
- There was too low Carbon/Nitrogen ratio in the compost product. Also, instead of generating methane, the organic waste generated ammonia gas, which was suspected to be the reason of breakdowns of the electricity generator.
- Too low concentration of solids in the digester tank: instead of 15-20% of 2000 m³, there were only 2% solids; this was the reason of the low volume of biogas generated.

²⁵ Blackwood ventures Thailand, "MSW Management in Thailand including Co-Processing", 5 May, 2007.

²⁶ Blackwood ventures Thailand, "MSW Management in Thailand including Co-Processing", 5 May, 2007.



Figure 10: Rayong Municipality 's biogas tank²⁷



Figure 11: Rayong Municipality's MSW processing plant²⁸

7. Conclusions

Thailand's MSW volume will likely increase with growth in economic development and population, which has been the trend of the historical data of Thai GDP and population growth, from 2000-2010

Thailand's MSW generation seems to be concentrated in the capital and other urban areas (Municipality) and only 39% of the country's MSW generation is generated in the rural areas.

Also, Thailand was not able to dispose most of the country's MSW in a proper way in 2008; only about 31% of MSW was treated properly with sanitary landfill as the most popular methods (19%).

The problem of most of Thailand's MSW disposal solution is lack of adequate machinery and plant maintenance, resulting from improper technology adoption and principally inadequate project income to support the project, due to inability to collect the disposal fee as initially planned.

²⁷ Blackwood ventures Thailand, "MSW Management in Thailand including Co-Processing", 5 May, 2007.

²⁸ Blackwood ventures Thailand, "MSW Management in Thailand including Co-Processing", 5 May, 2007.

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