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An overview to current status of waste generation, management and potentials for waste-to-energy (Case study: Rasht City, Iran)

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ABSTRACT

This paper presents an overview of the current municipal solid waste (MSW) management in Rasht City, Guilan Province, Iran, followed by evaluating the potential for waste-to-energy. The data of different MSW functional elements were collected from previous works, available reports, interviews and meetings with specialists in the field. About 800 tons MSWs are generated in Rasht per day, of those, over 75% are organic wastes followed by paper and cardboard comprising 5.9%. The daily theoretical energy contained in the city MSWs was estimated to be over 591.62 megawatt hour (MWh, over 215942.54 MWh per year). Almost 500 tons of daily MSWs are directly transferred to Saravan as the biggest landfill in north of Iran with an area of about 30 ha, while the remaining portion is treated in the Guilan composting plant. Landfill mining calculations showed that we could recycle about 3008947, 36793, 61443 and 18366 tons of plastics, textile, wood and rubbers collected from Saravan landfill respectively. A simple assessment of waste-to-energy potentials from organic wastes using operational conversion coefficients revealed that by employing the combination of waste-to-energy and gas turbine technology, an estimated energy of 227.668 MWh can be produced from the Rasht daily food wastes. Although MSW management in Rasht has been improved over the last decade owing to the establishment of waste recycling and composting organization, however it is still far from the standard situation due to lack of comprehensive waste management planning, financial resources and infrastructures.

Keywords: Municipal solid wastes; Landfill mining; Waste management; Waste-to-Energy.

INTRODUCTION

Municipal Solid Waste (MSW) is generally a combination of household and commercial refuses of living communities (Rajkumar *et al.* 2010). Solid wastes include all the waste materials resulting by the procured activities on cities (Tavakoli & Bagheri Zonoz, 2014). The quantity and composition of MSWs are dependent on several factors such as population and income level of the community, dietary habits, consumption patterns, lifestyle standard, commercial activities and the degree of industrialization (Rajput *et al.*, 2009; Kaushal *et al.*, 2012; Late & Mule, 2013; Gupta *et al.*, 2015). The stream of MSWs generally consists of organic material (degradable or partially degradable material) (Oloruntade *et al.* 2013), such as food waste, wood waste, paper, textiles, and inorganic material (non-degradable material) such as glass, plastics, metals, leather, rubbers (Alamu 2011; Jha *et al.* 2011; Gupta *et al.* 2015; Bhushan *et al.* 2017). However, the composition of MSWs varies greatly from place to place and from time to time.

The sources of MSWs can be residential, commercial, institutional and industrial. Noteworthy, the industrial, agricultural, medical and radioactive wastes, as well as sewage sludge are included in general term definition of MSWs (Government of India 2017). Municipal solid waste management (MSWM) is one of the major issues in the world. MSWM encompasses the functions of collection, transfer, resource recovery, recycling and treatment (Henry *et al.* 2006).

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The most common treatment and disposal options for MSWs are composting, mechanical and biological treatment, recycling, waste-to-energy (WTE) and landfilling (Psomopoulos *et al.* 2009). Developing countries are facing even stronger pressure on dealing with the continuously and very rapidly increase of wastes caused by rapid population growth, urbanization, rapid industrialization and economic development (Suocheng *et al.* 2001; Damghani *et al.* 2008). Solid waste management systems in developing countries deal with many difficulties, including low technical expertise and lack of financial resources which often cover only collection and transfer costs and leaving no resources for safe final disposal (Collivignarelli *et al.* 2004; Moghadam *et al.* 2009). There are several researches in which the inappropriate management of MSWs in developing countries has been reported (Moghadam *et al.* 2009; Karija *et al.* 2013; Mohanty *et al.* 2014). In these countries, open dumping and uncontrolled landfilling strategies are commonly used as the principal waste disposal methods due to the high investment costs of the municipal solid waste technologies (Ngoc & Schnitzer 2009, Tun *et al.* 2018). These inadequate treatments of MSWs, can result in disastrous environmental and human health consequences in these countries (El-Fadel *et al.* 1997; Medina 2010; Karija *et al.* 2013; El-Salam & Abu-Zuid 2015; Gonçalves *et al.* 2018).

In recent years, waste-to-energy technologies (WTETs) have become efficient method in dealing with increasing amount of MSWs worldwide (Stehlík 2009; Tang *et al.* 2015). WTETs are energy recovery applications that employ waste processing technologies to produce energy or valuable materials from waste materials (Lam *et al.* 2016). These technologies are also promising especially for developing countries because of their high capability in waste management, energy production potentials, economy, and mitigation of environmental issues (Tan *et al.* 2015, Moya *et al.* 2017). WTETs have been commercially deployed, especially in Europe, Japan, Australia, China and USA (Bag *et al.* 2017). There are several available WTETs including incineration, anaerobic digestion, pyrolysis, refuse-derived-fuel , gasification and landfill gas utilization (Boonpa & Sharp 2017; Moya *et al.* 2017). Selection of the suitable WTET for a community depends on the criteria such as amount and composition of generated wastes, economical level of community, environmental regulations and available energy markets. These WTETs have been thoroughly described and compared in previous studies, in addition to discussing their advantages and limitations (Pavlas & Touš 2009; Münster & Lund 2010; Pham *et al.* 2015).

Environmental impacts are of the most important results of urban development in the Southern Caspian Sea region (Azimi 2003). Rasht City is located in north of Iran, in which most of MSWs produced are directly transferred to landfill and buried without any pollution control or energy recovery, while only a small part is managed by composting (Behrooznia *et al.* 2020). Based on environmental assessments, Ghanbari *et al.* (2012) reported that the Saravan landfill (located adjacent to Rasht) is in unacceptable condition. There are several problems due to the improper MSW disposal in Rasht including irritating smells, increasing population of stray animals along with the environmental and health impacts such as soil and groundwater contamination by waste leachate. Lack of financial resources, infrastructure, suitable planning, management, and public awareness were reported as the main challenges of MSW management in Rasht (Moghadam *et al.* 2009).

Available enough information about the current status of the MSV quantity, composition characteristics, and managing the community behaviour is one of the key elements for developing a successful MSW management system. The aim of this study was to investigate the current status of the MSW generation and management, as well as the potential of WTET applications in Rasht, Iran. In order to collect the desired data, a combination of field study, interviews and data from literature were used. Calculations were carried out on the collected data concerning to the MSWs in Rasht as well as the literature-reported coefficients to find landfill mining and energy recovery potentials.

MATERIALS AND METHODS

The study area

This study was carried out during summer 2018 in Rasht City, the capital of Guilan Province, north of Iran. It is located at 49˚36' E and 37˚16' N and also is 5 m above sea level (Fig. 1). Due to the proximity to the Caspian Sea, Rasht has a humid climate with an average annual humidity of approximately 81.2% and average annual precipitation of about 1000 mm. The population of Rasht has increased from 600,000 in 2006 to about 680,000 in 2016 according to the census of Statistical Center of Iran (SCI, 2020). The economy of the city mainly includes retail shops and services, manufacturing industry, construction, transportation, education, administrative and tourism (Kaveh *et al.* 2018). The municipality of Rasht is responsible for all aspects of solid waste management.

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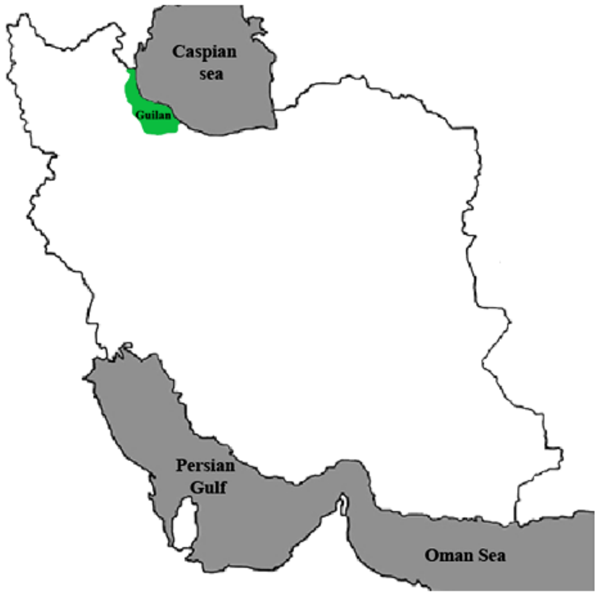

(a)

(b)

Fig. 1. a) Location of Guilan Province in Iran, b) Location of Rasht in Guilan Province

Data collection

The data required in this study were obtained through various means. The current status of waste generation and management data in this city were collected through direct interviews with the expert personnel of waste management organization of Rasht (RWMOR), and also the Guilan composting plant. Data on waste production and management trends in recent years, the WTE conversion coefficients, and the efficiency of different waste generation technologies were obtained from related literature (Abduli *et al.* 2007; RWMOR report 2007; Moghadam *et al.* 2009; RWMOR report 2017; Behrooznia *et al.* 2018). In order to calculate the energy production potential of daily generated wastes and also the potential recovery of useful materials from landfill and mathematical calculations were performed according to the amount of wastes, as well as the WTE and landfill mining coefficients.

RESULTS AND DISCUSSION

Current state of waste generation and composition in Rasht

Knowledge about the amount and elemental composition of waste fractions of generated wastes is necessary for assessment of any MSWM (Ghinea *et al.* 2016). According to the direct interview with the experts of RWMOR office, the daily waste generation of Rasht City is about 750 tons and the per capita citizen of daily waste generation is estimated to be about 1100 g. While in 2000, the generated MSW of this city was reported to be about 420 tons/day (Moghadam *et al.* 2009) showing an increase of about 68% in 18 years. A summary of MSW components in Rasht city during different years is shown in Table 1. The data recorded in 1995, 1998, and 2007 were extracted from previous studies and reports (JKC Report 1995; Alavi Moghaddam & Sadeghcheh 1998; RWMOR 2007), while those in 2018 were obtained from waste composition analyses performed by the experts of RWMOR. Organic wastes form the highest portion of the total MSW produced in Rasht. However, the amount of organic wastes decreased from 88% in 1995 to 75% in 2018. This is mainly due to the fact that the consumption of unprocessed foods by inhabitants has been gradually decreased during this period. However, the food wastes still constitute a lot of MSW due to insufficient dietary habits which in turn loses a great deal of wealth. Organic wastes account for the main part of MSW in many cities (Henry *et al.* 2006, Al-Khatib *et al.* 2010, Oloruntade *et al.* 2014, Saidan *et al.* 2017).

More details of the current composition of MSW in Rasht obtained by directly interviewing the experts of Recycling Organization of Rasht Municipality, are presented in Table 2. The theoretical energy contained in the Rasht daily MSW was determined based on the estimated energy contained per kg of each type of MSW according to Psomopoulos & Themelis (2014), calculating to be over 591.62 MWh per day or 215942.54 MWh per year.

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Given the average per-capita electricity consumption in Iran to be about 2850 kWh (WorldData 2020), the yearly potential of MSW-driven energy is almost equal to the amount of electrical energy consumed during a 40-day period in Rasht. These values reveal the commercial importance of implementing WTE projects in this city.

Table 1. The composition rate (%) of generated MSW in Rasht reported by different studies.

Components	JKC Report (1995)	Alavi Moghaddam & Sadeghcheh (1998)	RWMOR (2007)	Present study
Food and organic wastes	88.4	88.3	80.2	75.2
Paper and cardboard	3.5	3.5	8.7	5.9
Metals (all types)	0.6	0.6	0.7	1
Textiles	2.0	2.5	0.4	0.4
Glass	0.7	0. 9	0.2	1.7
Rubber and plastics	3.5	3.2	9	6.9
Wood	0.1	0.2	0.4	0.3
Construction waste	0.1	0.1	-	0.2
Others	1.1	0.7	0.4	8.4
Sum	100	100	100	100

Table 2. The daily- generated MSW amount, rate and its extractable energy in Rasht.

Components	Amount (kg day^{-1})	Proportion (%)	Energy (kWh kg^{-1})*	Energy (kWh day^{-1})
Food wastes	564000	75.2	0.96	542067.10
Paper and cardboard	44250	5.9	0.26	11308.34
Metals (all types)	7500	1	0.00	0.00
Textiles	3000	0.4	0.02	58.33
Glass	12750	1.7	0.00	0.00
Plastics & Polyethylene terephthalate (PET)	15000	2	0.62	9333.34
Rubber	1500	0.2	0.62	933.33
Nylon	35250	4.7	0.62	21933.35
Wood	2250	0.3	0.01	31.25
Construction waste	1500	0.2	0.01	8.33
Others	63000	8.4	0.09	5950.00
Total	750000	100	--	591623.39

* from Psomopoulos & Themelis (2014)

Current waste management systems in Rasht

Fortunately, MSW management system in this city has improved over the last 10 years after the establishment of an organization responsible only for this purpose. Several studies have been conducted to improve MSW management in Rasht during the last 20 years. The projects for source separation of wastes and also the construction of a composting plant with a nominal capacity of 250 tons/day are two main activities in this city during recent years (Lemus-Mondaca *et al.* 2015, Lakshmi *et al.* 2019). However, the main waste management approach is still landfilling.

a- Landfilling

Nowadays, sanitary landfills can be designed to be an environmentally-acceptable means of waste disposal providing a proper performance (Rogoff & Screve 2011). About 500 tons of unseparated MSWs generated in Rasht every day, are directly transferred, and inappropriately piled in Saravan landfill without any pre-treatment. Moreover, about 200 tons of the rejects (the MSW whose organic and recyclable materials are separated) from Rasht recycling and composting facility are disposed daily in the Saravan landfill. In addition, about 500 tons of the MSWs from some neighboring cities including Fuman, Shaft, Sowmeh Sara, Khoshkbijar, Lasht-e-nesha, Koochesfahan and Anzali, are received daily in Saraven landfill. The large and steady stream of waste dumped at the site has led to a pile-up of waste as high as 70 m (Karimpour-Fard 2018).

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The Saravan landfilling site is located 20 km south of Rasht (37°4′17.94″N; 49°37′52:70″L) and is surrounded by Saravan forest (Asadollahfardi *et al.* 2010). The site was established in 1984 and supposed to be temporary, but in recent years, it has become the biggest landfill in northern Iran (Anonymous 2019). The landfill has four parts (called phases A, B, C, and D) of which three parts (phases A, D, and C) have been closed after reaching their capacity. The characteristics and amount of wastes deposited in these three parts, were evaluated and reported by Research and Technology Office in University of Guilan (RTOUF 2014). Information about the fourth part (D), was obtained via direct interviewing with the expert members of RWMOR. The overall results including starting and closure times, and estimated deposited MSW in each phase are presented in Table 3.

The part D, which is under operation since 2010 and still under operation, has an estimated area of 18×10^4 m^2 and the estimates weight of deposited MSW in this section is about 9650000 tons. This extra-large amount of untreated waste landfilling shows that there is a very low level of waste management in Rasht.

Table 3. Four phases of Saravan landfilling site.

Section	Start of operation	End of operation	Area (×10000 m^2)	Estimated depth (m)	Estimated MSW volume (m^3)	Estimated MSW weight (tons)
A*	1983	1991	5.3	2-3	930000	560000
B*	1991	2003	2.2	10-15	1900000	1142000
C*	2003	2010	4.7	20	3300000	1973000
D	2010	In operation	18	40	10000000	5980000
sum	--	--	30.2	--	16130000	9655000

*from RWMOR (2010)

b- Composting

Although landfilling maybe the most economical solution in the short term, its long-term impacts on the environment and its sustainability are problematic (Perrot & Subiantoro 2018). Currently, there is only one operating composting plant in Guilan Province. Rasht composting site is located in the 10th km of Rasht - Lakan Road and spread over an area of 7 ha. This semi-mechanized facility was established in 2005 with the MSW capacity of 250 tons/day. In 2014 the daily capacity of this site increased to 400 tons/day (Behrooznia *et al.* 2018). Daily, about 200 tons MSWs Rasht are transferred to the composting facility and the other 200 tons are gathered from other municipalities of Guilan Province (e.g. Bandar-e Anzali, Fuman, Sowmeh Sara, and Shaft). The proportion (%) of outputs in Guilan composting plant are presented in Fig. 2. In addition, the schematic graph of the MSW processing line in this plant is shown in Fig. 3. The MSW collection and transport trucks discharge the wastes in the MSW reception area and different manual and machinery separation methods are applied to separate organic wastes to be composted. The rejected materials consist of dry and inert ones (e.g., PETs, plastics and glass) which are sold to the recycling factories outside the Guilan Province, while unrecoverable wastes are transferred to the Saravan landfilling site.

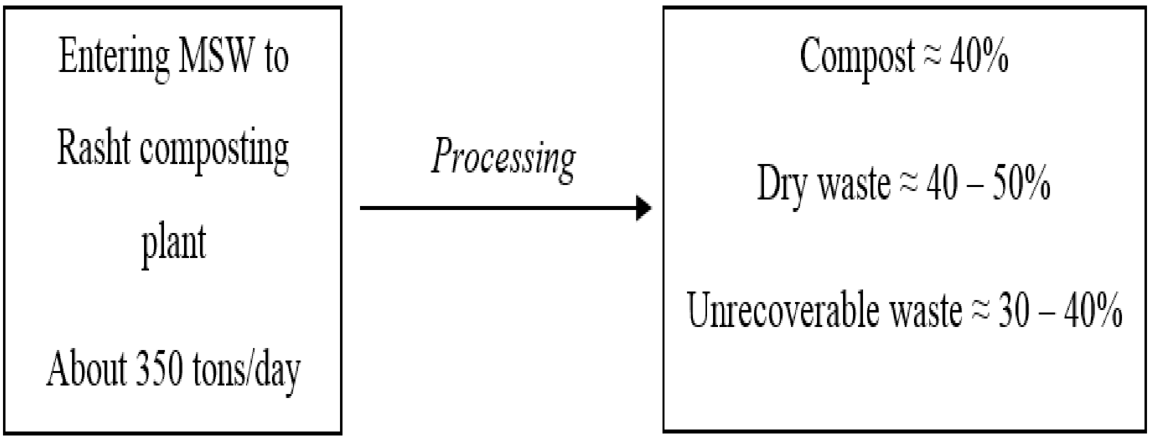

Fig. 2. The inputs and outputs in the Rasht composting plant

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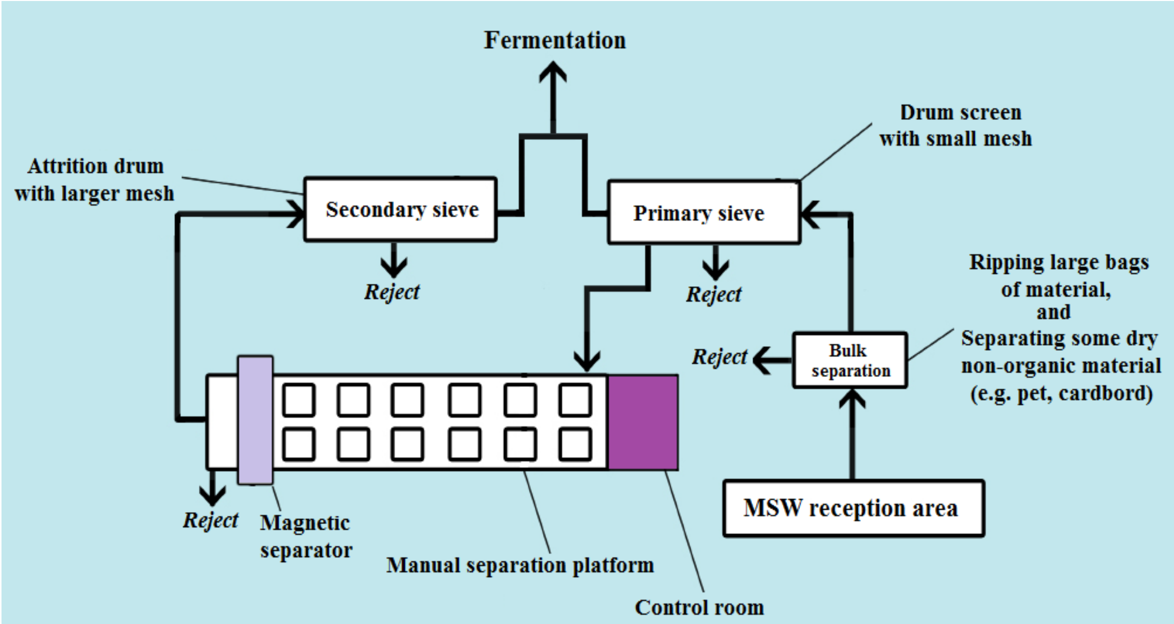

Fig. 3. Processing line of composting plant in Rasht

c-Waste source-separation

Recently, the waste source-separation project is being implemented in some areas of Rasht and only about 7 tons/day of recyclable wastes produced in the city (including metal, PET, glass, paper, cardboards and other MSWs, excepting food and organic wastes) are separated at source. Food and organic wastes in the studied area are collected by trucks of non-separated wastes and transferred to the composting plant or disposal landfill. The separated papers and cardboards are transferred to a cardboard production factory in the industrial zone of Rasht. Other separated materials are sold to waste recycling factories outside the Guilan Province.

Potential of landfill mining for material recovery

Landfill mining is defined simply as the process of extracting materials and solid natural resources from the previously deposited wastes in landfills (Krook *et al.* 2012, Wagner & Raymond 2015, Menegaki *et al.* 2018). Although the primary aim of landfill mining is conservation and clearance of dumpsite space, however, other objectives can be reached here including reduced contaminants and also economic revenues. A typical landfill mining project consists of several operations including partial or full excavation of deposited wastes, separation of waste compositions and screening, as well as the material and energy recovery (Annepu 2012).

There are thousands of tons of reusable and recyclable materials leaved deposited in Saravan landfill site exhibiting its great potential of landfill mining. The recyclables excavated from the landfill, including plastics, metal, glass can be sorted and sent to the recovery facilities. The waste stabilized prior to landfill mining is recovered as compost (Joseph *et al.* 2007). The mined compost could be sold to be used for non-edible crops. Additionally, refuse-derived fuel could be produced using high-energy non-recovered wastes.

These landfill mining measures can eliminate a large amount of deposited wastes and clean a wide area of this landfill. It has been revealed that about half of the landfill damped-material can be recovered and reused (Joseph *et al.*, 2007). Table 4 shows the amount of materials could be excavated from four phases of Saravan landfill. The proportion (%) of different compositions were calculated according to Charnnok *et al.* (2014).

As shown in Table 4, an approximate amount of 3 million tons of plastics could be excavated from the landfill. The extracted plastics can be sold at about 290 $ per ton, resulting in the potential earn of about 870 million $. Another major product of landfill mining in Saravan site is soil-like materials (7 million tons) which can be used as compost for agricultural fields. However, this mined compost should be examined for exceed existence of substances such as mercury, chromium and lead which limits its permission for culturing edible plants.

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Table 4. Composition of materials in a typical landfill and calculations for Saravan landfill

Landfill phase		Waste composition								sum
		A (>10 year)		B (>10 year)		C (5-10 year)		D* (4-5 year)		
Solid waste type		%	tons	%	tons	%	tons	%	tons	tons
Combustible waste	Plastic	22.1	123760	22.1	419900	21.9	432087	34.0	2033200	3008947
	Textile	0.2	1120	0.2	3800	0.1	1973	0.5	29900	36793
	Wood	0.4	2240	0.4	7600	1.1	21703	0.5	29900	61443
	Rubber	0.1	560	0.1	1900	0.2	3946	0.2	11960	18366
Non-combustible waste	Soil-like material	76.3	427280	76.3	1449700	74.9	1477777	63.8	3815240	7169997
	Stone	0.7	3920	0.7	13300	0.6	11838	0.3	17940	46998
	Metal	0.2	1120	0.2	3800	0.5	9865	0.3	17940	32725
	Glasses	0.1	560	0.1	1900	0.6	11838	0.4	23920	38218

* The disposal age of phase D in Saravan landfill was assumed to be 4 to 5 years.

Potential of WTE

MSW is a huge and endless source of energy which beside its energy potentials, can reduce environmental pollution. There are several possible WTE systems, including anaerobic digestion of organic wastes, pyrolysis, gasification and incineration (Dhar *et al.* 2017) for converting biomass and organic wastes to bioenergy.

Anaerobic digestion is the process of decomposition of organic materials by microorganisms in the absence of oxygen, producing biogas (Riya *et al.* 2018). Even though, it is a proven technology, however, still there are some technical difficulties in operating reactors for solid organic wastes (Kondusamy & Kalamdhad 2014). Anaerobic digestion is advantageous due to its cost and environment-friendliness, however it is the most limited approach, since is unable to treat non-biodegradable materials, such as plastic wastes (Perrot & Subiantoro 2018).

Pyrolysis is defined as chemical decomposition of materials by heat in an oxygen -free atmosphere. Pyrolysis can be used as a feedstock recycling technique for hydrocarbon wastes to converting carbonaceous material into fuel gas that can be used as a substitute for natural gas (Lam *et al.* 2016, Boonpa & Sharp 2017). The pyrolysis of organic wastes, for producing bioenergy and biochar, has recently gained considerable interest as a recycling option, becoming an alternative strategy for composting and other biological waste treatments (López-Cano *et al.* 2018). Gasification is a modified type of pyrolysis with a limited supply of oxygen, and the resulting oxidation produces enough heat to make the process self-sustaining (Lombardi *et al.* 2012). Advanced gasification in which plasma torches are employed, is one of the best WTETs, since it is more energy-efficient than the others, and also leads to lower carbon emissions as well as more available by-products, with the potential for minimal outputs going to landfill (Williamson 2011).

Waste incineration, as the most mature technology to extract energy from wastes (Lombardi *et al.* 2015), can treat almost any type of waste (Perrot & Subiantoro, 2018). It is a popular technology in the developed countries as a smart measure for the disposal of municipal waste and generating free energy (Sadi & Arabkoohsar 2019). It is a good way to reduce the amount of waste going to a landfill which can reduce waste size by 80% (Anttila 2017). Although gasification and pyrolysis technologies are able to treat all kinds of wastes with less environmental impacts and also lower costs than waste incineration, however, the formers are less mature than the latter one (Perrot & Subiantoro 2018).

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Hybrid of WTE and gas turbine (WTE-GT) combined cycles is a way to increase the energy efficiency of WTE plants. MSW incineration plants can be employed in integration with combined steam gas cycles to use the exhaust gases of the turbine for superheating the steam generated in the WTE boiler. Operation of the WTE boiler at a lower steam temperature, and more energy recovery from the WTE power plant in the steam turbine are among the advantages of this technology (Themelis 2006, Branchini 2015, Lombardi *et al.* 2015).
As shown in Table 2, food wastes are the largest portion of MSW in Rasht City. The main component of food wastes in Rasht are boiled rice, bread pieces, fruits, and spoiled or discarded vegetables. The estimated energy potential of the generated food wastes in the city is about 2018923.04 MJ per day, revealing that any plan for implementing WTE projects in Rasht should consider food wastes as the main input stream. So, in this study, we considered the food and organic wastes in order to assess WTE potentials.
According to Perrot & Subiantoro (2018) for calculating the potential energy production using incineration, anaerobic digestion, gasification, and pyrolysis technologies from food wastes, we multiplied the operational energy production efficiency values of these WTETs by the total amount of the above-mentioned energy potentials (presented in Table 5).

Table 5. Potential amounts of energy generation from food wastes using different WTETs in Rasht.

	Incineration (Conventional)	**Incineration (WTE-GT)**	**Anaerobic digestion**	**Advanced gasification**	**Pyrolysis**
Energy production efficiency (%)	21	42	10	35	20.5
Daily energy production potential (kWh day^{-1})	113834.1	227668.2	54206.71	189723.5	111123.8

The highest energy efficiency belongs to WTE-GT integrated with incineration technology with an estimated energy production amount of 227.668 MWh per day. On the other hand, the annual energy production potential of food wastes in Rasht using this technology is about 83098.89 MWh, which could be extracted using a combined power and heating plant. The generated low enthalpy steam will feed specific heat energy consumers (e.g. food industry).
Noteworthy, the contract for constructing a waste incineration facility was signed between Rasht municipality and a holding company involved in the environmental issues and renewable energy in form of Build-Operate-Transfer in 2012. The throughput of Rasht incineration facility was designed to be 600 tons of waste per day (four lines with 150 tons per day capacity in each line) to produce 9 MWh electricity (ttsgroup 2019). Unfortunately, the project is being suspended at this time due to limitation of financial resources.

CONCLUSION

In the present study, we assessed the current conditions of waste generation and management in Rasht, as well as some calculations on WTE and landfill mining potentials. The waste generation in the city has been increased intensely in last two decades and still the most common waste management system remained to be direct landfilling in uncontrolled manner. However, the present situation has been improved since the establishment of an organization responsible only for solid waste management over the last decade. Source separation of wastes and construction of a composting plant are the two main activities of the Rasht municipality in recent years, as the capital of the province is leading the efforts in a more sustainable waste management in the area. In addition, the results exhibited that the potential for waste–to-energy is considerable and can be a solution to enhance the resource efficiency in the province, instead of waste management.
This approach can also decrease the amount of inputs to landfill. Landfill mining of Saravan site is also a great potential for reusing the recyclable materials and reducing the amount of dumped wastes. Lack of resources and infrastructure are the main challenges of MSW management in Guilan Province, which should be considered through a suitable planning and sufficient budgeting.

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مروری بر وضعیت فعلی تولید، مدیریت و توان بالقوه تبدیل پسماند به انرژی (مطالعه موردی: شهر رشت، ایران)

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چکیده

این مقاله، مروری بر مدیریت فعلی پسماندهای جامد شهری و ارزیابی توان بالقوه تبدیل پسماند به انرژی در شهر رشت، استان گیلان، ایران را ارائه می‌دهد. داده‌های مختلف مربوط به اجزای اصلی پسماندهای جامد شهری، از تحقیقات قبلی، گزارش‌های موجود، مصاحبه‌ها و جلسات با متخصصان در این زمینه جمع‌آوری شد. روزانه حدود ۸۰۰ تن پسماند جامد شهری در رشت تولید می‌شود که بیش از ۷۵٪ آن پسماندهای آلی هستند. این در حالی است که بیشترین پسماند تولید شده بعدی متعلق به کاغذ و مقوا با سهم ۵/۹٪ است. انرژی نظری روزانه موجود در پسماند جامد شهری رشت بیش از ۵۹۱/۶۲ مگاوات ساعت تخمین زده شد که معادل با بیش از ۲۱۵۹۴۲/۵۴ مگاوات ساعت در سال است. روزانه بیش از ۵۰۰ تن پسماند جامد شهری مستقیماً به دفنگاه پسماند سراوان منتقل می‌شود که بزرگترین دفنگاه پسماند در شمال ایران با مساحت بیش از ۳۰ هکتار است. باقیمانده پسماند جامد شهری روزانه در کارخانه کمپوست سازی گیلان فرآوری می‌شود. محاسبات استخراج مواد از دفنگاه پسماند نشان داد که حدود ۳۰۰۸۹۴۷ تن پلاستیک، ۳۶۷۹۳ تن منسوجات، ۶۱۴۴۳ تن چوب و ۱۸۳۶۶ تن لاستیک را می‌توان از محل دفن زباله سراوان بازیافت کرد. ارزیابی ساده توان بالقوه تبدیل پسماند به انرژی از پسماندهای آلی با استفاده از ضرایب تبدیل عملیاتی نشان داد که با استفاده از روش ترکیبی فناوری تبدیل پسماند به انرژی به همراه توربین‌های گازی می‌توان انرژی تقریبی ۲۲۷/۶۶۸ مگاوات ساعت را از پسماندهای غذایی روزانه رشت تولید کرد. اگرچه مدیریت پسماندهای جامد شهری در شهر رشت طی دهه گذشته به دلیل ایجاد سازمان بازیافت و کمپوست پسماند بهبود یافته است، اما به دلیل عدم وجود برنامه‌ریزی جامع مدیریت پسماند، منابع مالی و زیرساخت‌ها، هنوز از وضعیت استاندارد دور است.

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