Mobile Solid Waste Incineration Project for the Case Study of Şırnak - Trash, Animal and Agricultural Waste-Mobile Co-Incineration

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ABSTRACT

Evaluation of Bio-waste for Sirnak Province in the context of solid waste management and aimed to create a mobile solid waste incineration system. In some plants burning solid waste management practices based on gasification and pyrolysis process it can be operated as interdependent as mobile or integrated. The implementation of bio-waste collection and waste separation methods the amount of solid waste to be recycled or composted will affect the amount produced. In Sirnak that approximately 120 thousand tons of solid waste generated and neighboring Siirt and Hakkari projecting a mobile mind similar waste incinerators in the province were studied in this work. Thus, waste and biomass waste streams that can be done in the conscious of the waste classification of the area, alongside environmental impact, recycling waste, such as energy recovery benefits will be provided.

Mobile solid waste management, recycling, composting or waste of energy technologies are included. In this case, the classified as waste products should be investigated and should also be aware of the processing, depending on the market of products obtained from these requirements.

Mobile waste management, design, integration and demonstrate flexibility in terms of existing business and to reach the village social, it is necessary to adapt the best economic and environmental conditions. This type of solid waste management including waste incineration and mobile units / economic and environmental conditions in the integrated system provides the flexibility to change waste diverted to other treatment systems.

Keywords: mobile incineration, co-incineration, biomass, agricultural waste combustion,.

1. INTRODUCTION

Evaluation of Bio-waste for Sirnak Province in the context of solid waste management and aimed to create a mobile solid waste incineration system. In some plants burning solid waste management practices based on gasification and pyrolysis process it can be operated as interdependent as mobile or integrated. The implementation of bio-waste collection and waste separation methods the amount of solid waste to be recycled or composted will affect the amount produced. In which approximately 120 thousand tons of Sirnak and neighboring Siirt and Hakkari solid waste generated in a mobile considering similar waste incinerator project in the province were studied in this work. Thus, waste and biomass waste streams that can be done in the conscious of the waste classification of the area, alongside environmental impact, recycling waste, such as energy recovery benefits will be

provided.
In relation to mobile units will be integrated within the system in the study, environmentally sustainable economic combustion system is designed. including the power generation unit designed combustion air, supply water, and soil pollution and minimize the negative effects such as environmental waste loss. The integrated mobile system is economically sustainable low operating costs, management in general is expected to be moved to the appropriate economic and Sirnak.
In order to meet the energy needs and reduce greenhouse gases, this century has become an important research topic of alternative clean and renewable energy sources. This is a mobile incineration projects based on biomass waste and litter; clean, renewable and sustainable energy sources as an alternative to optimal combustion.
consumption of natural resources in energy production is increasing in parallel with today's rising energy needs. Manufacturing of low thermal value is limited in terms of quantity of biofuel to open. of bio-waste derived products due to the economic technology allows evaluation with technologically advanced combustion systems. Environmental norms biogas production, biowaste compliance with pyrolysis or gasification plant allows today the production of liquid and gaseous fuels needed by modern technology. Penetrate less dense Eastern and Southeastern Anatolian region since the settlement, especially bio-waste in the province of Sirnak and neighboring provinces, the pyrolysis method in the production of liquid and gaseous fuels to cleaner fuels and energy production will enable the development of the South-East Anatolia Region and also for industrial development and diversification will improve. [1-5]
flexible and regional targets for a mobile solid waste incineration are environmentally and economically;
• 4 is made of garbage separation tons / hour mobile facility for the acquisition of secondary materials are processed,
• purification of biological substances and Biyoatık market value is to be converted to compost or to obtain energy producing methane gas by anaerobic digestion,
• thermal treatment systems by reducing the amount of waste to be sent to landfill, becoming inert and energy to obtain
• The use of waste in the landfill and land reclamation can be listed as a reduction of at least pollution.

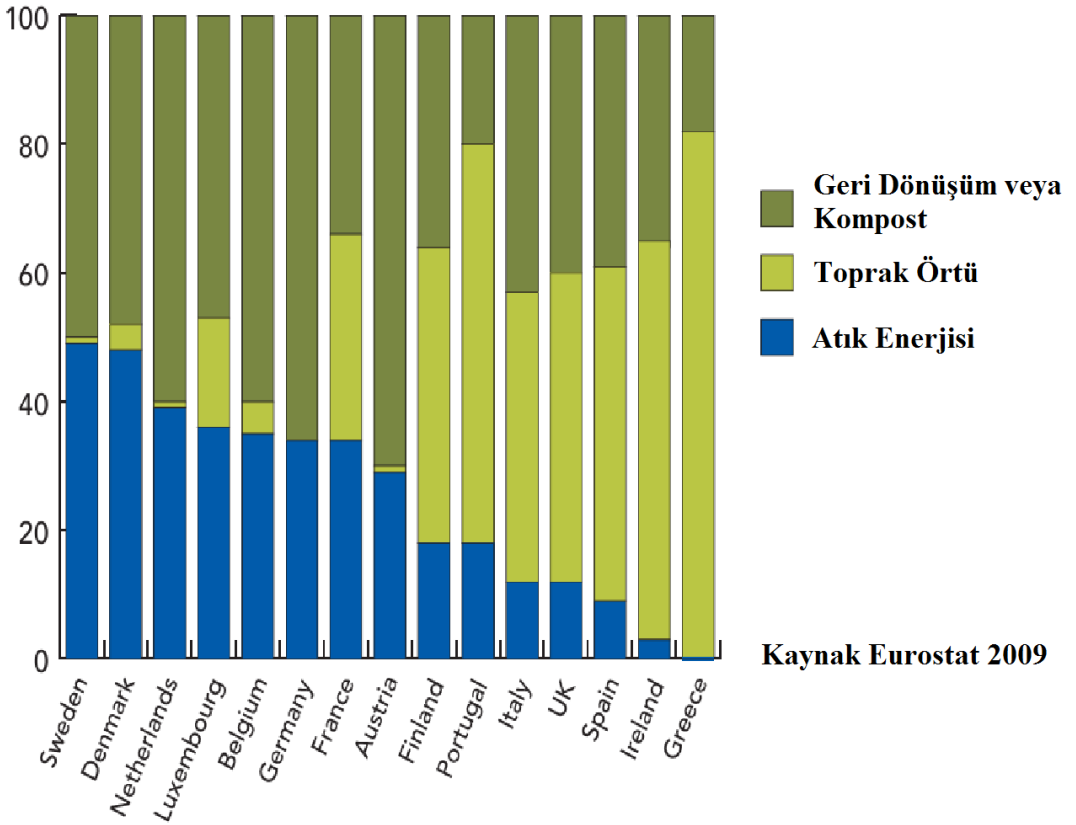

Figure 1.Waste to Energy Production and Distribution of countries according to the European Waste [2]

Mobile solid waste management, recycling, composting or waste of energy technologies are included. In this case it must be classified as waste products can be controlled and should also be aware of the processing, depending on the market of products obtained from these requirements. These markets are also likely prices will be sensitive to the quality and quantity of supply. solid waste waste quality distribution of Sirnak province, is also seen in Table 1.

Mobile waste management, design, integration and demonstrate flexibility in terms of existing business and to reach the village social, it is necessary to adapt the best economic and environmental conditions. This type of solid waste management including waste incineration and mobile units / economic and environmental conditions in the integrated system provides the flexibility to change waste diverted to other treatment systems. (Figure 1)

Mobile waste incineration system in large-scale regional basis should be planned. The need for a number of waste disposal option, in particular the quality and quantity of recycled materials, the benefits of economies of scale or the demand for energy and compost are among the reasons to conduct large-scale plans. . [6-11] according to the working population of less than 500,000 mobile applications in a variety of solid waste incineration can be successfully implemented. applied to the combustion system of this scale it will depend on the amount of available waste and properties. Basic operations mainly;

Table 1. Central province of Sirnak, the nature and distribution of solid waste 2013.

Waste Type	The quality of Solid Waste		
	Heat Value,kJ/kg	***Theorical, 1000ton/year***	***Current, 1000ton/year***
Plastik	17200	2,1	1,9
Karton	17600	2,4	1,9
Hayvan Küspesi	13400	20	18
Odun Atık	18600	60	43
Yanabilir evsel atık	13000	12,2	9,5
Toplam	17000	96,7	74,3

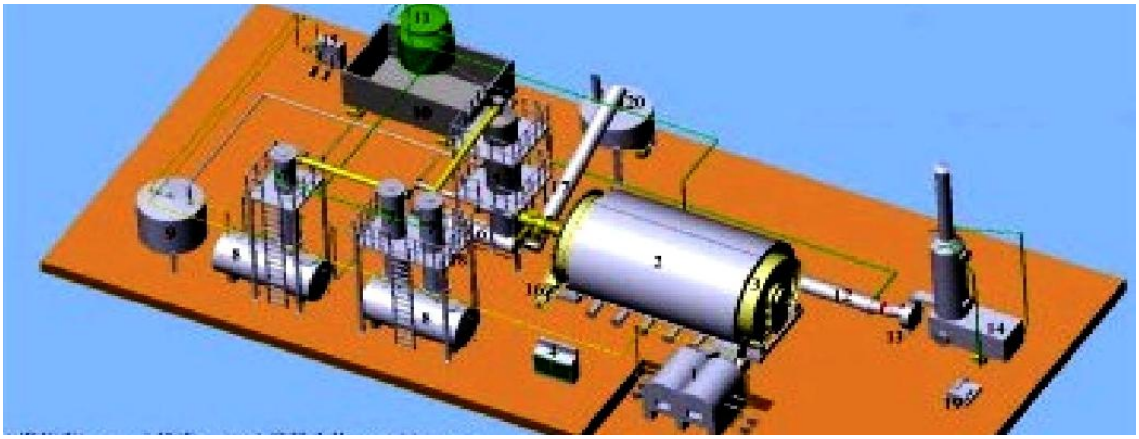

Figure 2. Mobile Combustion units, drying, pyrolysis, and Integrated Gasification Combustion Boiler System

• Landfill
• Biological Treatment
• Treatment
• Solids Recycling
• The compost Biyogazlaştır
• Regular store
• Use of gas and
• Incineration Units [10-18] mobile feasibility study of the project is also examined.

The scope of this study, regional biomass waste and Sirnak Şırnak asphaltites to 5MW of electricity production by primary energy source to evaluate biomass. Designed in co-combustion of biomass resources and legal and institutional private stoker, it was proposed by providing economic and environmental impact assessment. However, Sirnak biomass energy sources to use technological solutions to improve coal combustion pollution place.

2. The biomass waste of Eastern Anatolian, Southeast Anatolian Region - Sirnak Province

solid fuel for heating in winter at high rates in the East and Southeast Anatolia, consisting mostly of high-altitude city in Turkey is consumed. Also thermal power plants in particular Şırnak asphaltites and Afsin Elbistan power generation and lignite are performed. With a large land area of ??this region is more rare than the regional population distribution of the western provinces. This is for agricultural, Forestry and animal biomass potential can not be considered to be discarded. fertile land in the region in corn, cotton and grain cultivation are

as preferably. Even stubble burning process is subject to the land being left fallow. calorific value of the waste corn crop area was determined to be about 17 kJ / kg. A total of 26 million tons of biomass waste for the 2012- 2013 period, Turkey has increased. Calorific value of corn while the largest proportion of waste by 43.4% when compared on the basis, this ratio was 16.1% in 19.6% of waste wheat and cotton waste. The total calorific value of the waste, fruit pulp 5 PJ / year was. the largest proportion of peanuts and nuts in the shell and the rate is 55.8% of the total agricultural and other sources of biomass waste olive pulp of fruit waste is exposed to 25.9%. Turkey cattle, sheep and poultry, the total caloric value of about 4.8, 0.3 and 0.7 PJ years, was determined to be, respectively.
agricultural waste resources, especially in Eastern and Southeastern Anatolia, plants and animals poses a significant potential as waste. This waste is approximately 28% in value of 12% and 42% of animal waste from agricultural waste Forestry waste. Organic matter in the biomass pollution and provide clean energy for the production of energy production in the region and contribute greatly to the evaluation of solid fuel heating. Of biomass waste supply the world's energy consumption is approximately 15% occur in developing countries. The energy made from biomass in 2009 is approximately 43% and 20%, respectively, the US and the EU27. The aim of this study was to evaluate in Turkey, with an altitude of 1440 Şırnak asphaltites and mainly coal region of Sirnak and garbage, to evaluate agricultural and animal biomass burned for energy and waste heat. This waste of resources and environmental, will provide both economic and social benefits.

Table 2. Biomass waste of Southeastern Anatolia Region and the environment, quality of garbage and animal waste distributon.2013

Waste type	***Heat Value,kJ/kg***	***Theorical, million ton/y***	***Current, million ton/y***
Plastics	18200	0,6	0,4
Paper	17600	2,4	2,3
Animal waste	13500	2,1	1,9
Agricultural Waste	18700	3,7	2,8
Total	16400	8,8	7,4

Table 3. Southeastern Anatolia animal meal quality bio dağılımı.2013

Waste type	***Heat Value,kJ/kg***	***Theorical, million ton/y***	***Current, million ton/y***
Cow waste	13200	0,14	0,12
Sheep waste	13600	0,46	0,4
Poultry waste	13500	0,12	0,1
Total	13400	0,72	0,62

In Turkey, the Ministry of Agriculture and Rural Affairs of annual and perennial agricultural waste Table 2 also represents statistics from local authorities such as the veriliğine. agricultural production in our country is widely waste left in the land. Cereal straw fodder, are considered to be litter. Waste cotton stalks, corn stalks, sunflower stalks, hay and tobacco stalks such as municipal waste product released in 2013. The total amount is given in Table 2. real value for the province of Sirnak are set out in Table 3. East and Southeast Anatolia Sirnak field crops and the distribution has been a total waste of other waste annually. 17.2 kJ of heat value of waste corn stalks, peanut shells waste for about 16.8 kJ / kg and the total heat value / kg. Some, respectively, 33.4% corn stalks, wheat straw are 27.6% and 16.1% cotton stalks. Sirnak province, these values ??were based on the total respectively in

Eastern and Southeastern Anatolia, 11.4% corn stalks, wheat straw are 14.6% and 16.1% cotton stalks. Sirnak province and around the Table 4 as well as waste based on the amount of animal waste calorific value and the number of animals was defined as the amount of animal waste. Cattle, the annual amount of waste as given in Table 4 for sheep and poultry wastes about 24,000, 11,000, 8,000 tons. 12% and 30% may be used. Turkey has come to open a total of 26.5 million tons of waste in Forestry and forest, the total annual amount of shrubs and wood waste, 624.000 tons respectively, are 380,000 tons and 290,000 tons. 30% and 49% may be used in total. There is 65% solids content of forest waste and Sirnak province have been identified can be used by 45%. Thus, the annual total of Sirnak total annual waste heat value of beef for the province, sheep and poultry wastes about 48MJ, 22MJ agricultural wastes, has been found to be 7 MJ to 13MJ and municipal waste disposal for Forestry waste.

3. Mobile Incineration of Waste System Components

Mobile / integrated combustion systems relatively flexible and can be adapted to the needs of variable fuel quality is fuel combustion systems. In real application of stationary fuel quality to be achieved as a full range of fluid and grate firing system. However, environmental impact is minimized depending on combustion and fuel. Bio-waste (ALFA MACHINE AND BOİLER AS) and the burning of bagasse chicken MİMSAN company manufactured the fluidized bed combustion system for improved combustion and energy production within the scope of R & D and has recommended to municipalities [13-15]. Integrated solid waste management in the framework of combustion systems can provide a co production with biogas energy. integrated energy is produced by burning biogas plant with the following facilities designed mobile system. (Figure 2)

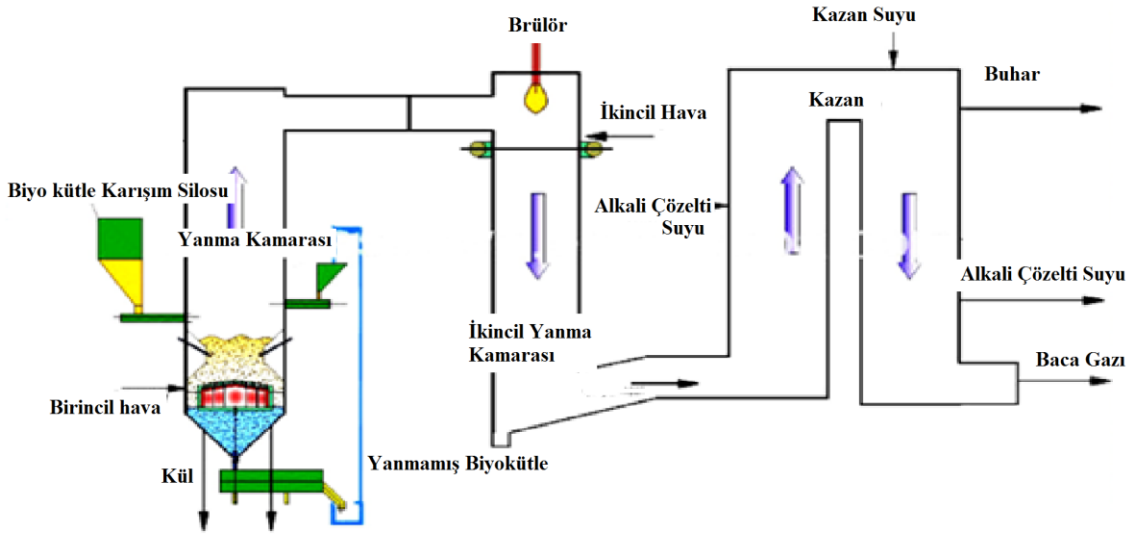

Figure 3.The fluidized bed combustion of biogas and solid waste [3]

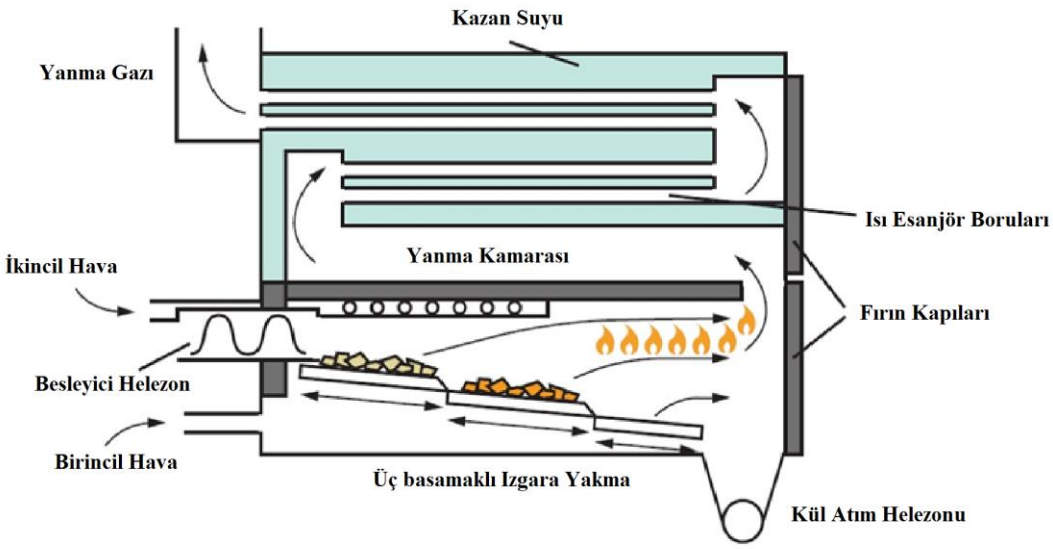

Figure 4. Alfa Boiler and Machinery Mobile biogas and solid waste incineration boiler [3]

• Litter Decomposition of metal waste and Pet Waste
• Classification of waste and biomass drying and storage pool,
• Biogas Anaerobic Bio Conversion of Waste
• Mobile Combustion
• Energy production

In some countries, integrated solid waste incineration are considered more advantageous. But in our country in the living area and city with a population less intensive mobile systems has provided economic benefits. Recycling of scrap metals separation from or household waste usually has constituted a cost-intensive process. However, bio-waste and municipal solid waste resource recovery from the combustion system has made it feasible.

4. MATERIALS & METHODS

4.1 Projected Waste - Combustion Analysis

In the experiments, Şırnak asphaltites is the sample used, Figure 2, coal reduction of sample burned fractions were weighed chemical analysis of temperature, as shown to the reactor continuously combustion analysis tub was performed in an oven in Table 4. 900 ° C increased on the photo are possible. Test results for biomass pellets and coal sample of Figure 3 is shown.

As shown in the figure, in the burning test, the effect of the addition is determined desulfurization and lime on emissions hydrated, the reactor temperature is 500 ° C and only% of MgO clay pellets and slaked lime mixed expanded 10 weight ratio of 950 ° C and ranged from waste Examples 4 coal samples sulfur by burning the hold-up was subjected to analysis to determine received. Experimental results are shown in Figure 5.

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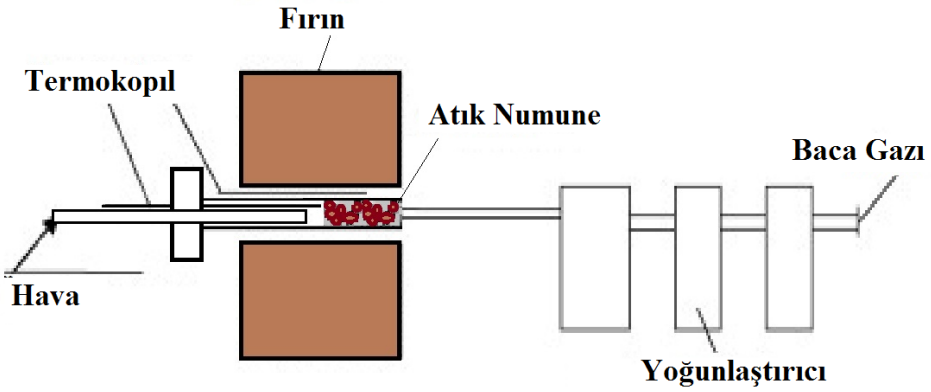

Figure 5. Burning laboratory test arrangement**.**

Table 5. Analysis of bio-waste and garbage incineration tests used in the project (in dry air base).

Weight(%)	Wood	Garbage	Cow waste	Poultry waste	Corn waste
Nem	41.26	29.26	24.2	21.6	10.26
Kül	1.07	9.7	4.25	3.34	1.07
Sabit Karbon	25.08	25.08	25.08	25.08	45.08
Uçucu Madde	74.59	74.59	64.59	64.59	54.59
Isı Değeri (kcal/kg)	1430.1	1630.5	1760.8	1930.2	3780.2

Proximate analysis of the biowaste combustion varies depending on the humidity as shown in Table with heat efficiency. The ideal dry corn waste was seen as waste heat yield 3780kcal / kg.

5. RESULTS & DISCUSSION

Laboratory dried waste 50 gm samples were subjected to TGA analysis combustion. The test results are shown in Figure 7. In Figure 7, the reactor temperature above 900 ° C with respect to the amount of combustion is after pyrolysis. This increase in the burning rate of Sirnak landfill waste 28% / min beef pulp 52% / min and chicken cake at 53 %/ min in the corn stalks were 68% / min. Burning fuel as coal dust and combustion kinetics of Şırnak asphaltites used 10% sample weight ratio of the mixture is reduced by 25%. The combustion experiments stoker boiler is used for and obtained similar results.

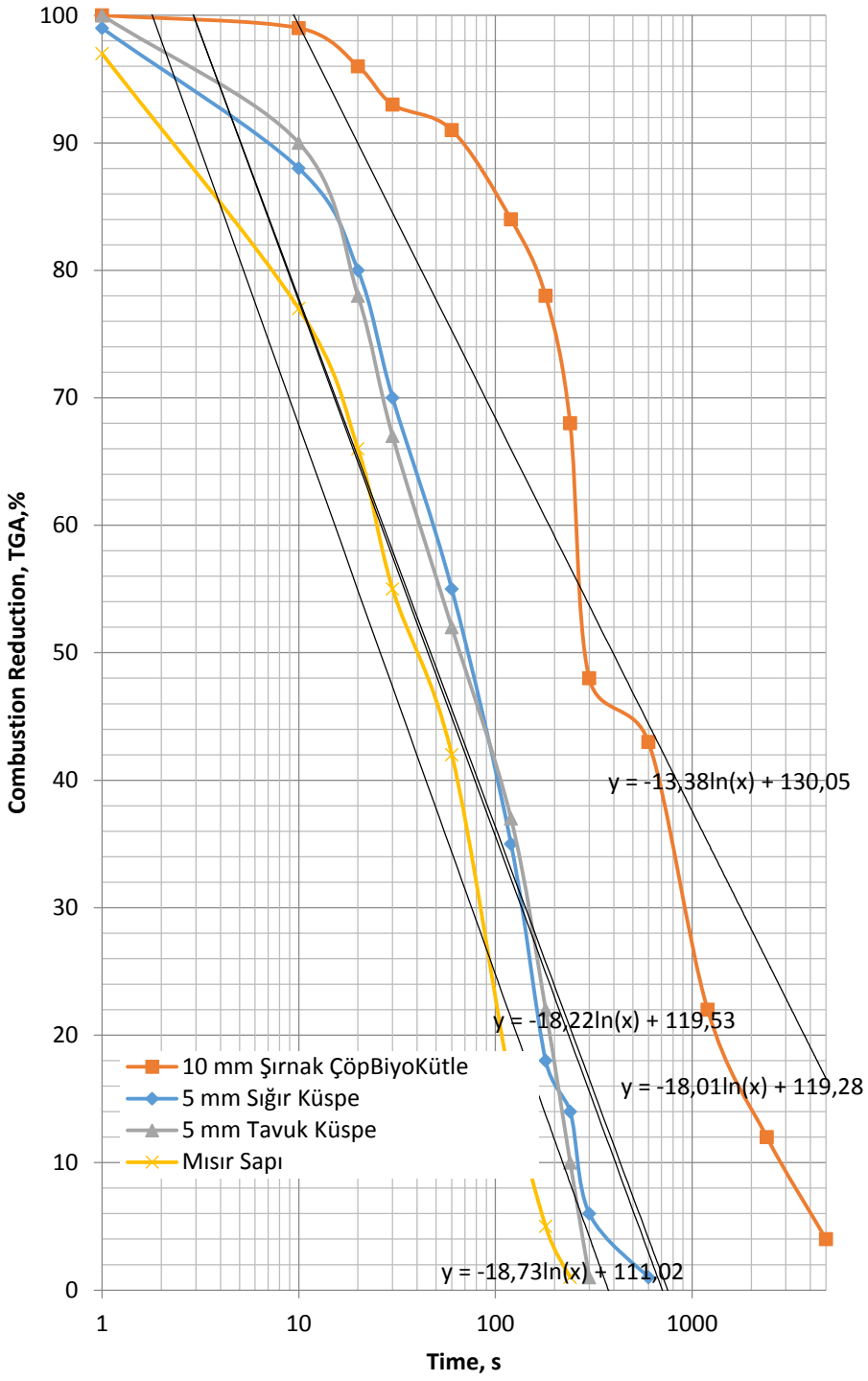

Figure 6. TGA combustion kinetics of exchange of bio-waste

Biomass waste and coal Stoker used for incineration incinerator system will also allow the retention of toxins in the solid combustion chamber with alkaline participating in the fuel, as it allows the combustion of 1000 ° C toxin (Figure 7). incineration 850 ° C with stirring with 10 wt% of lime only, these values ??are determined. Keep dry and also combustion flue gas are also provided efficiently (Figure 7).

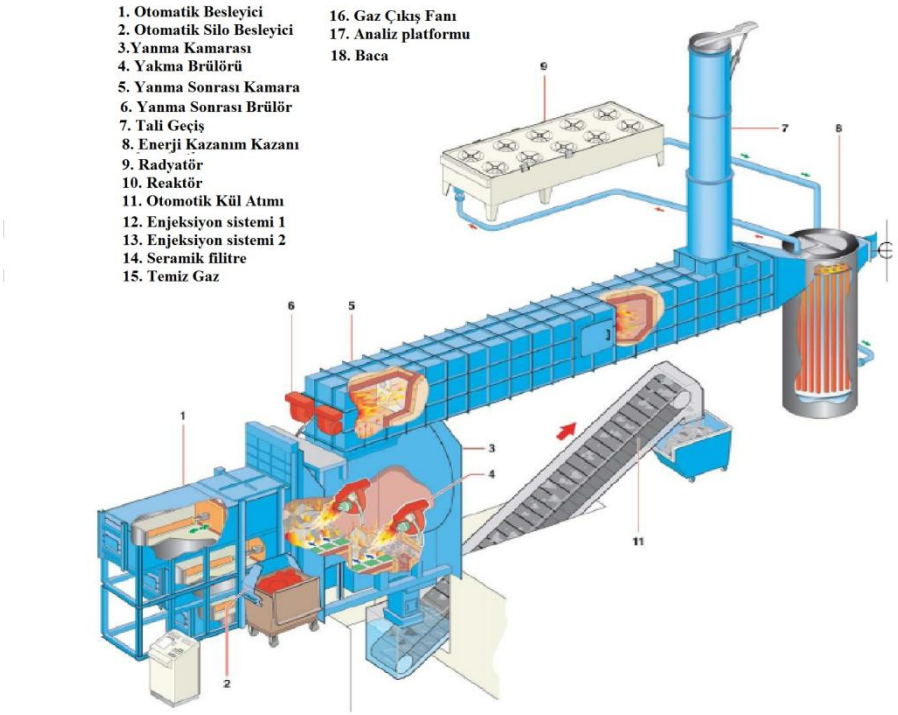

Figure 7.Entegr to / Mobile biogas and solid waste incinerators [8]

Investment costs both mobile and 500 thousand tons / year capacity unit for the integrated plants is determined depending on the price of the company (see Table 5).

Table 5.Entegr to / Mobile biogas and solid waste incinerators investment costs

EQUPMENT PRİCES, $	***Mobile 25000 ton/y***	***Integrate 500.000ton/y***
Havada Kuru Biyo atık silosu: 4 adet	*20.000*	*60.000*
Havada Kuru Çöp Atık silosu: $	*10.000*	*60.000*
Toz Karışım Atık silosu: 4 adet	*5.000*	*15.000*
Balya Çöp Atık silosu: $	*5.000*	*15.000*
Toz Kömür silosu: $	*5.000*	*15.000*
Yakma Fırını Besleme Bandı: $	*5.000*	*45.000*
Toz Kömür Brülörü 2 adet: $	*2.000*	*20.000*
Biyo atık Fırın Besleme Helezonu: $	*1.000*	*15.000*
Biyoatık Kurutma Fırını: : $	*40.000*	*400.000*
ALFA KAZAN YAKMA STOKERİ -10 mm: $	*500.000*	*4.400.000*
İkincil Yakma Brülörleri : $	*20.000*	*200.000*
İKİNCİL YANMA (ALFA KAZAN) ÜNİTESİ :	*100.000*	*1.200.000*
*Kül Atık Helezonu 2 Adet: 2*50 000$*	*10.000*	*100.000*

Biyo atık Ufaltıcı 10 mm 1 Adet: $	*20.000*	*150.000*
*GazSiklonları 4 Adet: 4*100 000$*	*40.000*	*400.000*
*Kül atık Bandları: 12*50.000 $*	*10.000*	*150.000*
*Santrifüj Toz Tutucu 2 Adet: : 2*150.000 $*	*30.000*	*300.000*
Fırın Fanı	*60.000*	*600.000*
*Toz Tutucu Torba Filitre : 12*50.000 $*	*60.000*	*600.000*
*TozTutma Ünitesi: 3*250.000 $*	*150.000*	*750.000*
*Alkali reaktör 6 Adet: 6*150.000 $*	*90.000*	*900.000*
*Şlam Alkali havuzu 3 Adet: 3*50.000 $*	*15.000*	*150.000*
*Şlam Pompaları 4 Adet: : 4*50.000 $*	*20.000*	*200.000*
*CAT Dozer 2 Adet 2*500.000 $*	*500.000*	*1.000.000*
*FORD KAMYON 30 TON 3 Adet 3*400.000 $*	*500.000*	*1.200.000*
OTOMASYON SİSTEMİ VE ÜNİTESİ	*200.000*	*1.200.000*
BİNA VE ARSA	*500.000*	*4.500.000*
PROJE MÜHENDİSLİK	*1.400.000*	*4.400.000*
TOPLAM :$	*4.318.000*	*23.045.000*

Integrated facility capital investment cost of 500 thousand tons / year capacity of $ 23 million, while 1 million tons / year capacity for exit doubled. Already region for high-capacity incinerators are not considered due to the impossibility of obtaining funds is not feasible. Mobile 25b tons / year capacity plant, depending on the companies' unit costs is determined as $ 4 million (see Table 5).
Mobile plant and integrated plant operating costs were calculated based on the present prices. As Table 6 also given mobile plant labor, it will provide advantages in terms of reactive maintenance. Mobile plant operating cost approximately 25 TL / ton is defined as garbage. This integrated facility cost 63TL / ton rose to landfills.

Table 6.Inttegrated / Mobile biogas and solid waste incinerators investment costs

Operating Cost,TL	**Mobile 2Container-25.000 ton/y**	**Integrated 500 thousand ton/yıl**	**Integrated 1million ton/yıl**
Worker	4	14	7
Logistics	11	10	8
Electricity	1	2	2
Alkali	1	4	3
Maintenance	2	12	6
Equipment	4	12	6
Social Expenses	1	5	3

Engineering	1	3	2
Total	25	62	37

Mobile plant and integrated plant operating costs and energy production (70% and 60% thermal efficiency fuel efficiency) was calculated to be connected. mobile plant as given in Figure 8, while in a period of their capital investment in 22 months, after a period of 36 months will generate more revenue for the integrated plant operating costs will be advantageous investment capital back to paying (Figure 8).

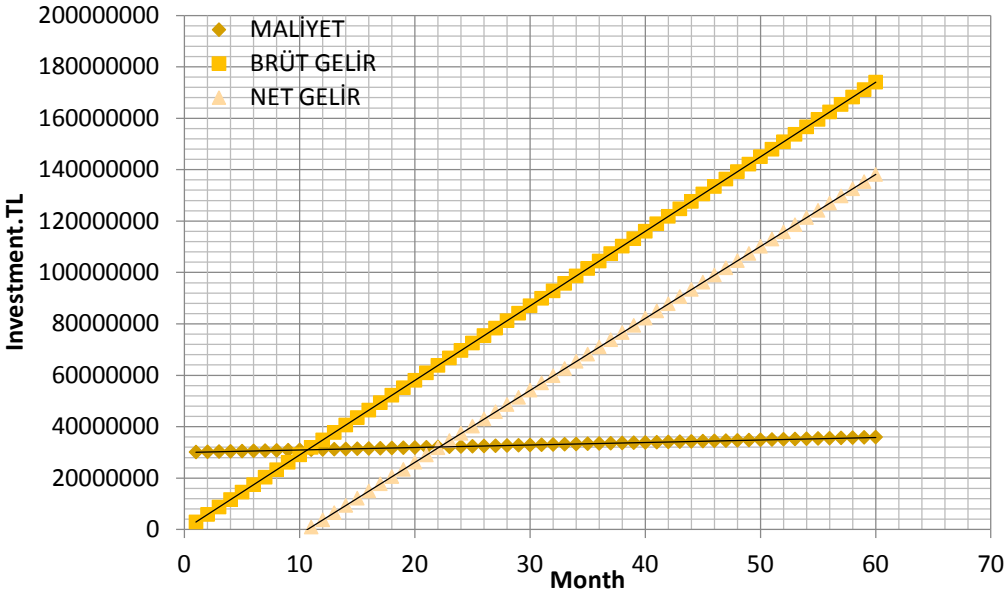

Figure 8. Mobile biogas and monthly earnings change of solid waste incineration plant investment

CONCLUSION

Some incentives are provided in the Electricity Market Licensing Regulation. law on renewable energy sources "license for electricity production from renewable energy sources" No. 5346 dated 05.10.2005 has been declared the decision in the official gazette. The law also allowed the private sector to renewable energy projects, operated by the private sector and provide incentives for investment in such facilities. Sirnak regional development and feasibility and profit situation of the province and its surroundings are in a troubled region when analyzed in terms of investor confidence.
However, the burning of wood waste in waste incinerators can be of great benefit to municipalities. Gaziantep, Malatya and solid waste processing and incineration plants, such as agricultural wastes of Osmaniye province has become useful. Can Sirnak province as mobile garbage incineration plants with waste converted to energy and central heating in winter season the fuel consumption of thousands of households minimized.
Region close to 4-5% weight ratio of cement and lime plant fuel or filling material is available thermal power plants waste gas pollution, reducing the potential for fuel

substitution rate of 10% by weight of brown coal power plants.
This study also suggested that mobile co-incineration of waste gas treatment applications with ease and be able to provide ecological benefits such as special hazardous waste incineration. transported to the incinerator in neighboring provinces there may be oil waste. The spread of biogas plants in the region will make it possible to somehow be positioned and gas sales. The result is a combination of both combustion systems, private, municipal and industrial cooperation by providing optimal combustion plants, waste sorting, recycling and evaluation boards.

REFERENCES

[1] Richard A. Denison, John Ruston, 1990, *Recycling and Incineration: Evaluating the Choices*

[2] *Frank Kreith, George Tchobanoglous*, 2002, *Handbook of Solid Waste Management*

[3] Ron Isaacson, *1990, Methane from Community Wastes (Elsevier Applied Biotechnology Series)*

[4] *Karakaya, İ.,2008,* İstanbul için stratejik kentsel katı atık Yönetimi yaklaşımı, Yüksek LisansTezi , İTÜ FBE Çevre Müh.Böl.

[5] Anonim, 2009, Orman Genel Müdürlüğü'nde Biyoenerji Konusunda Yapılan Çalışmalar, Orman Genel Müdürlüğü, Biyoenerji Çalışma Grubu, Orman ve Enerji, Ankara, www.ogm.gov.tr

[6] Kahveci, O.,2008, Orman biyokütlesinden yakıt ve enerji üretimi, TC. Çevre ve Orman Bakanlığı Orman genel müdürlüğü

[7] Anonim 2014,Tarım ve Köy İşleri Bakanlığı İstatistikleri, www.tarim.gov.tr

[8] Anonim, Türkiye İstatistik Kurumu Verileri, 2014, www,tuik.gov.tr

[9] Akpınar, N , Şen, M, Kentsel katı atıklardan enerji üretimi**,** Enerji Enstitüsü

[10] Cherubini, F. Bargigli, S. Ulgiati, S. 2009, Life cycle assessment (LCA) of waste management strategies: landfilling, sorting plant and incineration, Energy, 34, pp. 2116–2123

[11] Mahmoudi, S.. Gholamian, E. Zare V, 2015, Exergy analysis of a new configuration of trigeneration system based on biomass gasifier, ECRES2015, Antalya

[12] Anonim a, 2015, Mobile incinerators, http://www.incinerators-ati.com/mobile-incinerator.php, ATİ Şirketi

[13] Anonim b, 2015, Yakma Kazanları, **www.alfakazan.com.tr**, Alfa Kazan ve Makine AŞ,Ankara

[14] Anonim c, 2015, Kalina Cycle, **www.imparator enerji.com.tr**, İmparator Enerji, GeoPower, İstanbul

[15] Anonim d, 2015, Akışkan Yataklı Yakma Kazanı, **www.mimsan.com.tr**, Mimsan A.Ş. , İstanbul

[16] Anonim e, 2015, http://www.atlasinc.dk/

[17] Anonim f, 2015, http://www.santes.com.tr/

[18] Anonim g, 2015, http://www.ottusa.com/mobile_systems/mobile_systems.htm