Demand for MBT Installations in Poland for the Year 2020

Andrzej Jędrczak

1. Introduction

In order to fulfil the requirements of the directive on the landfill of waste [1] in Poland, after January 1st, 2013, the whole stream of waste from households and municipal infrastructure must be subjected to the mechanical-biological treatment or thermal treatment [7].

In the National Waste Management Plan 2014, a provision was made that in the waste management plants with a capacity sufficient for receipt and treatment of waste from an area inhabited by 150,000 – 300,000 people, the preferred method of waste treatment is its mechanical-biological treatment, and in the case of agglomerations or regions covering more than 300,000 inhabitants, its thermal treatment [13].

The mechanical-biological treatment (MBT) of waste is a good and proven solution for management of rest waste; it meets the BAT requirements and allows the objectives specified in the directive on the landfill of waste to be accomplished [5]. The interest in this technology is also a consequence of its perception by its supporters as a way of avoiding the incineration of waste. The success of the possible MBT configurations, however, depends

on the possibilities for management or final treatment of the final products of the process, whose mass may exceed 60 % of the waste mass at the input to the installation.

Analysing the trends for the development of the waste treatment methods in the EU countries, an increase in the share of thermal methods of treatment of rest waste at the expense of mechanical-biological methods is observed. In Sweden and Denmark, the priority is the energy recovery from waste by its direct incineration in combined heat and power engineering plants for waste (with the power capacity exceeding 90 %), constituting an integral element of municipal district heating systems [10]. According to Obermeier [6], the total capacity of the municipal solid waste treatment installations in Germany will be stabilised in the years 2010-2015 at the level of about 35,000 000 Mg/a, including the MBT installations - about 6,000 000 Mg/a, incineration plants – about 18,000 000-20,000,000 Mg/a, co-combustion systems – about 1,300 000 Mg/a and waste-derived fuel power plants – from 7,000,000 to 10,000 000 Mg/a. The MBT installations are not to be developed, they will rather be closed down and turned into waste-derived fuel generation installations for waste-derived fuel power plants. Even the stand of the Alliance 90 / The Greens Parliamentary Group in Germany [14], fighting against waste incineration plants in the 80-ties, is unhesitating at present with regard to the issue of MBT and waste incineration. The German experiences so far have demonstrated that the mechanical-biological methods must be treated as the temporary stage in waste management. The rational final solution for management of waste from selective collection is its incineration.

The article presents the state of waste management in Poland in the year 2009 and the anticipated rest waste masses received from the inhabitants, as well as the demand for the efficiency of installations for their treatment until the year 2020, resulting from them.

2. The state of municipal waste management in Poland in the year 2009

2.1. The quantity of biodegradable municipal waste

In the year 2009, the mass of generated municipal waste was estimated at 12,100,000 Mg. In general 10,050,000 Mg of municipal waste (263 kg per 1 inhabitant) was collected [3]. The biodegradable waste (BDW) (Figure 1) constituted about 54.7 % of the collected waste mass. 789,000 Mg of waste was collected selectively, including 352,000 Mg of waste regarded as biodegradable. The greatest quantity of collected waste per 1 inhabitant included glass (5.2 kg/M), green waste (4.7 kg/M) and waste paper (4.0 kg/M), whereas the hazardous waste constituted the smallest quantity (about 0.03 kg/M) [3].

2.2. Biodegradable waste treatment installations

It follows from the data included in the Central Waste System (CWS) that 42 green waste and bio-waste composting plants were operating all over the country at the end of the year 2009. At least 51,900 Mg of waste was treated there, including, 46,400 Mg of green waste (89.3 % of raw material mass), 4,300 Mg of bio-waste (8.3 %) and 1,300 Mg (2.5 %) of municipal waste listed in other subgroups. The capacity of these installations ranged from 10 Mg/a to 15,000 Mg/a, with the mean value of about 3,000 Mg/a.

The green waste was also treated in 32 sewage sludge biostabilisation installations (in the quantity of over 22,200 Mg/a) and in 40 MBT installations (52,600 Mg).

40 MBT installations were operating all over the country at the end of the year 2009.

At least 700,000 Mg of waste was treated there, including 410,000 Mg of municipal solid waste (58.6 % of the treated waste mass) and 204,200 Mg of waste from mechanical treatment of waste other than the one listed in 19 12 11 with the code – 19 12 12 (29.2 %). The capacity of the installation ranged from 1,200 to 125,000 Mg/a, with the mean value of about 20,000 Mg/a.

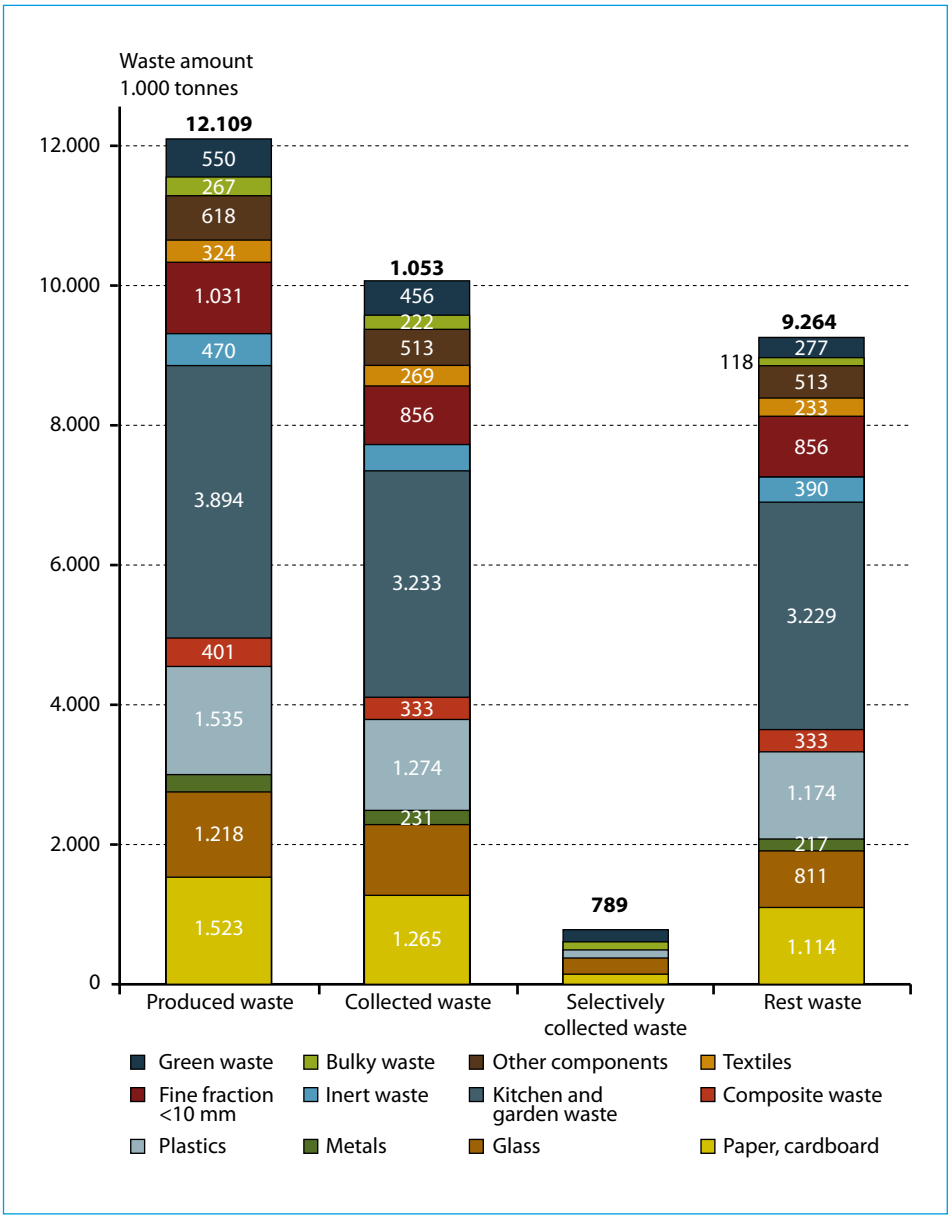

Figure 1: Municipal waste masses generated, collected in total and collected selectively as well as rest waste in the year 2009

Also, one municipal solid waste incineration plant was functioning, that is, the Municipal Solid Waste Treatment Plant located in Warsaw, in the area of the Targówek district. The plant receives 60,000 Mg/a of municipal solid waste for complex treatment, of which 47,000 Mg is directed to incineration.

To sum up, 121,000 Mg of green waste and 820,000 of unsorted municipal waste were treated in the installations in the year 2009. However, the presented data must be treated as very rough. The information collected by the marshal offices for the needs of the provincial waste systems, which are submitted to the minister of environment as the institution maintaining the CWS, is incomplete and often does not present the actual state. On the one hand, the types and quantities of the treated waste were not specified for all the installations included in the base. On the other hand, the declared treated waste masses in some installations seem to be overestimated. The data included in the CWS differ significantly from the ones reported by the Central Statistical Office, according to which, in the year 2009, the biologically treated municipal waste covered 508,000 Mg. It must be emphasised that a great part of the operated installations did not meet the requirements for composting and mechanical-biological treatment of waste specified in the Guidelines concerning the requirements for the processes of composting, fermentation and mechanical-biological treatment of waste [11].

3. The forecast of changes in the quantity of produced biodegradable municipal waste in the years 2010-2020

Based on the forecasts drawn up by PhD. Eng. Ryszard Szpadt and the author of a paper ordered by the Ministry of Environment, Table 1 presents the anticipated masses of generated municipal waste, the expected levels of selective collection for the selected waste components and the mass of collected rest waste in the years 2010-2020, as well as the mass of BDW included in it [4]. It was assumed that 83 % of the country's population was covered by the waste receipt in the year 2010 and in the years 2013 and 2020 – 100 % of the inhabitants.

The waste generation ratio per one inhabitant is expected to grow up to the level of 323 kg/(M•a) in 2010, 337 kg/(M•a) in 2013 and 377 kg/(M•a) in 2020, and in consequence, the quantity of the produced municipal waste will grow from 1.2 to 1.6 % per year. The BDW mass will amount to: 6,730,000 Mg in the year 2010, 6,930,000 Mg in the year 2013 and 7,570,000 Mg in the year 2020.

The fundamental objective with regard to the biodegradable municipal waste management in the upcoming decade will be to obtain the required levels of biodegradable waste landfilling reduction in the years 2013 and 2020, and the required levels of reuse and recycling of the selected municipal waste in the year 2020 (50 % of waste paper, glass, metals and plastics from households) [2].

4. The demand for the biodegradable treatment installations in the year 2010

The masses of municipal waste produced, collected and landfilled in Poland in the year 2010 have not been known yet. The recent data provided by the Central Statistical Office refer to the year 2009 [3].

It follows from the provided forecasts that about 12,350,000 Mg of municipal waste was produced all over the country in the year 2010, and included 6,730,000 Mg of BDW (Table 1).

Table 1: The anticipated masses of municipal waste, rest waste and biodegradable municipal waste [thousand tonnes], in the years 2010, 2013 and 2020

Specification	2010					2013				2020			
	Produced waste	Collected waste	Recovery level %	Selectively collected waste	Rest waste	Produced waste	Recovery level %	Selectively collected waste	Rest waste	Produced waste	Recovery level %	Selectively collected waste	Rest waste
Paper, cardboard	1,567	1,303	12.5	163	1,140	1,654	15	248	1,406	1,889	50	945	945
Glass	1,238	1,029	21.0	216	813	1,285	25	321	964	1,413	50	706	706
Metals	284	236	8.0	19	217	288	15	43	245	288	50	144	144
Plastics	1,576	1,310	9.5	124	1,186	1,652	15	248	1,404	1,886	50	943	943
Composite waste	411	342	0.0	0	342	433		0	433	503		0	503
Kitchen and garden waste	3,930	3,267	1.5	49	3,218	3,999	5	200	3,799	4,252	20	850	3,401
Inert waste	486	404	0.0	0	404	525		0	525	627		0	627
Fine fraction < 10 mm	1,045	869	0.0	0	869	1,079		0	1,079	1,178		0	1,178
Textiles	333	277	14.0	39	238	348	15	52	296	388	15	58	330
Wood	48	40	0.0	0	40	54		0	54	70		0	70
Hazardous waste	93	77	3.5	3	74	100	10	10	90	120	50	60	60
Other fractions	503	418	0.0	0	418	550		0	550	687		0	687
Bulky waste	274	228	47.0	107	121	284	48	137	148	318	50	159	159
Green waste	560	466	50.0	233	233	582	70	407	175	646	90	582	65
Total	12,348	10,265	9.3	953	9,312	12,835	13.0	1,666	11,168	14,265	31.2	4,447	9,818
Biodegradable waste	6,726	5,592	–	464	5,127	6,933	–	881	6,051	7,571	–	2,406	5,165
Share of biodegradable waste in waste, %	54.5	54.5	–	48.7	55.1	54.0	–	52.9	54.2	53.1	–	54.1	52.6
Mass of biodegradable waste allowed for landfill, thousands of Mg/a	–	–	–	–	3,281	–	–	–	2,188	–	–	–	1,531
Mass of biodegradable waste requiring treatment, thousands of Mg/a	–	–	–	–	2,069	–	–	–	3,864	–	–	–	3,634
Mass of residua waste requiring treatment, thousands of Mg/a	–	–	–	–	3,758	–	–	–	7,131	–	–	–	6,907

Not all the inhabitants of the country were covered by the disposal. In the year 2009, the municipal waste was received from 79.1 % of the population. It was assumed that the share of inhabitants covered by the disposal in the year 2010 increased to 83 %, and the mass of collected municipal waste amounted to 10,270,000 Mg, including 5,590,000 Mg of biodegradable waste.

The base level of biodegradable waste mass, which was produced in Poland in the year 1995 was established in the National Waste Management Plan 2006 and amounted to 4,380,000 Mg [12]. This quantity resulted from the assumed unit mass BDW generation ratios in the base year: for municipal areas – 155 kg/(M•a), and for rural areas – 47 kg/(M•a).

In the year 2010, the landfilling of 75 % of the BDW mass produced in the base year, that is, 3,290,000 Mg was allowed.

The required decrease in the landfilling of BDW is as follows: 5,590,000 – 3,290,000 = 2,300,000 Mg. Assuming that the effectiveness of the selective collection of material components in the year 2010 increased by 20 % in comparison with the year 2009, (mean annual growth in the recent five years amounted to 27 %), the mass of selectively collected waste should amount to 950,000 Mg, of which 460,000 Mg constituted BDW. The remaining 2,300,000 – 460,000 = 1,840,000 Mg of BDW had to be subjected to treatment in rest waste. The rest waste contained 5,590,000 – 460,000 = 5,130,000 Mg/a of BDW, which constituted 55.1 % of its mass (Table 1).

A decrease in the mass of landfilled BDW by 1,860,000 Mg requires the treatment of 3,340,000 Mg of rest waste (1,860,000•100/55.1) by means of thermal and mechanical-biological methods. Assuming very optimistically that the total mass of the treated municipal waste in the existing installations amounted to about 1,000,000 Mg, it was still to little to fulfil the obligation of reduction of landfilling of the biodegradable waste in the year 2010, which followed from the landfill directive.

The required efficiency of the municipal solid waste treatment in the year 2010 should be even greater in the case of receipt of municipal waste from 100 % of the population (in accordance with the National Waste Management Plan 2006; by the year 2007, 100 % of the country inhabitants was supposed to be covered by the disposal). Then, the BDW mass requiring treatment would amount to (6,730,000-3,290,000-460,000) =2,980,000 Mg, and the capacity of the installation for municipal solid waste treatment, containing such an amount of biodegradable waste, should amount to 5,410,000 Mg (2,980,000•100/55.1). The theoretical demand for the additional capacity of the MBT installation (with the assumption of covering 100 % of the population with the waste receipt) would amount to about 4,400,000 Mg.

5. The demand for the biodegradable waste treatment installations in the year 2013

The anticipated mass of municipal waste produced in the year 2013 will amount to about 12,840,000 Mg. It will contain 6,930,000 Mg of BDW (Table 1).

In the year 2013, the permissible landfilling of biodegradable waste will amount to 2,190,000 Mg. The required decrease in biodegradable waste landfilling is 6,930,000 – 2,190,000 = 4,740,000 Mg. Assuming that the efficiency of material component collection will increase to the level of 5 % for kitchen and garden waste, up to 15 % for paper, plastics and metals, 25 % for glass, up to 15 % for textiles, 10 % for hazardous waste, 40 % for bulky waste and up to 70 % for green waste, 880,000 Mg of BDW will be collected in the year 2013 and the remaining 4,740,000 – 880,000 = 3,860,000 Mg must be subjected to treatment in rest waste.

The rest waste will contain 6,050,000 Mg/a of BDW, which constitutes 54.2 % of its mass (6,050,000•100/11,170,000) (Table 1).

A decrease in the mass of landfilled BDW by 3,860,000 Mg requires the treatment of 7,120,000 Mg of rest waste (3,860,000,100/54.2) by means of thermal and mechanical-biological methods. This should be the capacity of the municipal solid waste installations in the year 2013 provided that the waste is received from 100 % of the population.

However, attention must be paid here to the lack of a possibility to landfill the untreated waste after January 1st, 2013 [7]. Therefore, the treatment of part of the municipal waste after the selective collection, which follows from the necessity of limiting the landfilling of BDW, is insufficient. The whole mass of rest waste, that is, about 11,000,000 Mg/a would need to be directed to treatment. This issue needs to be settled in the regulations of the new waste act and in the executive ordinances.

6. The demand for the biodegradable waste treatment installations after the year 2020

In the year 2020, the mass of generated municipal waste will amount to about 14,270,000 Mg. It will contain 7,570,000 Mg of biodegradable waste (Table 1).

Assuming that the effectiveness of the selective collection of paper, glass, plastics, metals and bulky waste will increase to the required level of reuse and recycling (50 %), and with regard to bio-waste up to 20 %, hazardous waste – up to 50 %, green waste – up to 90 %, and that the textiles will be maintained at the level of 15 %, 4,450,000 Mg of waste will be collected in the year 2020, including 2,410,000 Mg of BDW. The remaining 7,570,000 – 2,410,000 = 5,160,000 Mg must be subjected to treatment in rest waste.

The rest waste in the amount of about 9,820,000 Mg will contain 5,160,000 Mg of BDW, which constitutes 52.6 % of its mass (Table 1).

The permissible biodegradable waste landfilling will amount to 1,530,000 Mg, and the required decrease in the BDW landfilling is 5,160,000 – 1,530,000 = 3,630,000 Mg.

The decrease in the mass of landfilled BDW by 3 630 000 Mg requires the treatment of 6,910,000 Mg of rest waste (3,630,000•100/52.6) by means of thermal and mechanical-biological methods. This should be the capacity of the municipal solid waste system in the year 2013 provided that the waste is received from 100 % of the population. The demand for the capacity of the rest waste treatment installation in the year 2020 will be smaller than in the year 2013 by about 210,000 Mg/a.

The share of thermal and mechanical-biological installations in the achievement of the required reduction in the landfilling of biodegradable waste

The results of the presented calculations show that the year 2013 will be fundamental for reduction of landfilling of the biodegradable waste and it is practically necessary to ensure the construction of the rest municipal waste installations with a capacity of about 7,000,000 Mg/a for this year, which will also ensure the achievement of the required decrease in the landfilling of biodegradable waste in the year 2020 without the need for their expansion. The capacity of these installations may be decreased through an increase in the selective collection of biodegradable waste, especially bio-waste.

Within the framework of the Operational Programme – Infrastructure and Environment (OPIaE), the construction of 9 thermal municipal waste treatment installations with a capacity of about 1,900,000 Mg (state as of August 2010) is planned. The mean capacity of the s installations will amount to 185 000 Mg/a (from 94,000 to 250,000 Mg/a). The Office of the Capital City of Warsaw and Zakład Utylizacyjny Sp. z o.o. (Waste Disposal Plant) in Gdansk resigned from applying for union funds from the OPIaE, but the latter one will take advantage of the financing in the future. Taking into account also these projects, the total capacity of the incineration plants will increase to about 2,400,000 Mg. The degree of advancement of these investments is very diversified. The possible optimistic deadline for launching some of them is the year 2014. Most of them should be put into operation by the year 2015.

The construction of large thermal waste treatment installations with a capacity of over 200 000 Mg/a, servicing the areas inhabited by 500,000 people, is economically justified. The lower limit of capacity for the incineration plants assumed in the National Waste Management Plan 2014 seems to be too low. In principle, for such large agglomerations, there is no other option, mechanical-biological treatment does not ensure such a high degree of waste treatment, and requires greater capacities of the landfills for storage of stabilisate. However, it is possible and expedient to create such projects also for complexes consisting of smaller agglomerations, counting at least 500,000 inhabitants in total, and to include the smaller agglomerations in large incineration plant projects. In this way, it will be possible to cover a greater population of the country with the waste incineration.

If all the planned incineration plants with a capacity of 2,400,000 Mg/a were built, and assuming that the capacity of the existing MBT installations and those under construction is at the level of about 1,300,000 Mg/a, it would be necessary to build the new MBT installations for the treatment of the remaining 3,300,000 Mg of waste.

Assuming that the MBT installations will be built for the regions with 150,000 to 300,000 inhabitants, where 45,000-90,000 Mg (70,000 Mg on average) of rest waste is treated (in accordance with the recommendation of the National Waste Management Plan 2010), about 50 additional installations must be built necessarily by the end of the year 2020.

The structure of the treatment installations for municipal solid waste, remaining after the selective collection, with the dominant share of the MBT, would not be favourable, however, taking into account the experiences of other European countries, but above all, the main objectives of waste management:

- accomplishment of the recycling standards;
- maximum reduction of landfilling, including the biodegradable waste;
- maximum production of energy from waste.

The MBT installations must, in principle, be treated as temporary installations, constructed for the purpose of ensuring reduction of landfilling of the biodegradable waste, in the situation when the installations for selective collection of bio-waste are not developed, and it is not possible to construct waste incineration plants with sufficient capacity. The installations should be turned into bio-waste biological treatment installations, if its selective collection is developed.

The constructed mechanical-biological installations should also ensure energy recovery from waste to the maximum extent, and for this reason it is favourable to combine the installations for biodegradable fraction fermentation and fuel production from coarse fraction, or to deliver the coarse fraction for energy recovery in the future incineration plants. The energy from municipal waste is, to a significant extent, the energy from renewable sources (about 42 % of the total chemical energy of waste) [8].

The development of fuel production from municipal waste is connected with the necessity of appropriate capacity of the installations for their incineration in order to produce the energy. The cement plants in Poland are a significant player on the market of waste-derived fuel, however, their capacities for receipt of waste-derived fuel are limited by many factors;

- the quantity of burnt fossil fuels and the acceptable degree of their replacement with waste-derived fuel,
- the quality of fuels, including their calorific value, content of detrimental components, content of biomass. The cement plants are interested, above all, in two types of fuels; with high calorific value (above 20 MJ/kg) and/or with high share of biomass in view of the possibility to deduct the CO2 emissions.

Other industrial branches have not shown interest in waste-derived fuel so far, which follows mainly from the technical and technological limitations. For these reasons, many power plants fired with waste-derived fuel were built in Germany, however, these power plants must meet the emission requirements just as is the case with the waste incineration plants. Because of the more homogenous composition of fuels, it is possible to apply highly effective fluidized bed boilers and semi-dry gas treatment technologies, which would not be acceptable in the municipal waste incineration plants. The total costs of preparation of the waste-derived fuel and its burning in power plants are higher however, than the costs of direct burning of the waste in incineration plants [9].

7. Summary

The results of the presented calculations show that the year 2013 will be fundamental for reduction of landfilling of biodegradable waste, and the construction of municipal solid waste treatment installations with a capacity of about 7,000,000 Mg/a must be ensured practically for this year, which will also ensure the achievement of the required reduction of biodegradable waste landfilling in the year 2020 without the need for their expansion. The capacity of these installations may be decreased through an increase in the selective collection of biodegradable waste, including bio-waste.

One must be aware, that the settlement year – 2013, will come already in three years. Therefore, it is necessary to build (very fast) 50 new MBT installations, directed to production of stabilisate for landfilling, with a possibility of their expansion for the purpose of production of waste-derived fuel after creation of the market for recovered materials and high-calorific fractions. Also, it is necessary to expand and adapt the existing installations to the established criteria for admission of stabilisates after MBT to landfilling, as well as to implement the incineration plant projects quickly.

The development of the MBT installations in Poland is the necessity, however, the mistakes committed so far during the design of the existing plants would need to be avoided. It seems necessary to perform an evaluation of the existing MBT installations in Poland in the aspect of the obtained results of waste treatment, including the degree of its stabilisation, technological parameters, efficiency and operational problems. The results of the evaluation will allow the specific technical and technological solutions to be recommended for application in Poland. Particular attention must be paid to the possibilities of producing waste-derived fuels, their quality and the possibilities of energy recovery from the produced fuels. (the necessity of construction of the waste-derived fuel power plants).

8. Literature

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