About waste disposal problem in Russian Federation

T M Abdullin¹, R G Sabirzyanov¹, I R Gilmanshin¹,², N F Kashapov¹, S I Gilmanshina¹, A I Galeeva³ and E M Gadirova⁴

¹Kazan (Volga Region) Federal University, 18 Kremlyovskaya str., Kazan 420008, Russian Federation
² Kazan National Research Technical University named after A N Tupolev, Kazan, Russia
³Kazan State Power Engineering University, Kazan, 420066, Russian Federation
⁴Baku State University, AZ 1148, Baku, Azerbaijan

Abstract. The article discusses the problems of waste disposal methods that do not cope with the task of environmentally friendly disposal of municipal solid waste (MSW). The comparison of destruction and thermal destruction methods (plasma gasification in particular) are given.

The collection of MSW without sorting and further disposal (> 90%) leads to land degradation (over 50 000 ha of land are occupied by landfills in Russia). In consequence, an increase in waste disposal to the environment (the amount of solid waste exceeds the capabilities of natural ecosystems). Incineration was achieving the target for a while, but now due to an increase in the amount of waste, its diversity and large accumulation utilization by the methods described above, inevitably carries with it a serious threat to the environment.

Purpose:
- Identification of optimal waste disposal methods in the Russian Federation.

Tasks:
- Analysis of waste management in the Russian Federation
- Comparison of destruction methods

Table 1 and 2 show more detailed statistics.

| Waste availability at the beginning of the reporting year | Waste generation for the reporting year | Receipt of waste from other organizations | Processed waste | Recycled waste |
|-----------------------------------------------------------|----------------------------------------|------------------------------------------|----------------|---------------|
| Russian Federation | 36,275,388,506.63 | 6 220 638 | 183 466 | 17,864,225.18 | 2 053 938 |
| | 9 | 673,598 | 440.52 | 1 | 132,872 |

Content from this work may be used under the terms of the Creative Commons Attribution 3.0 licence. Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI.
Published under licence by IOP Publishing Ltd
Table 2

| n | Wastedisposal | Transfer of waste to other organizations | Availability in the organization at the end of the reporting year |
|---|----------------|----------------------------------------|---------------------------------------------------------------|
|   | Total          | for processing                         | Forrecycling                                               |
|   |                |                                        | Forneutralization                                          |
|   |                |                                        | for storage                                                 |
|   |                |                                        | for burial                                                  |
| RussianFederation | Sixteen7801 68.018 | 12,908,93 0,117 148,490 669,849 9,932,511 544 73,718,66 1,092 30,585,22 9,509 38 073 356 129,573 |

How much of all the waste is stored in specialized facilities for a period of more than eleven months for utilization, neutralization, disposal as well as the methods used in waste management in the Russian Federation can be found in Figure 1.

Figure 1. Information about waste management in E production and consumption in the Russian Federation for 2017 (in thousands of tons)

![Figure 1: Information about waste management in E production and consumption in the Russian Federation for 2017 (in thousands of tons)](image)

- **Waste disposal** - isolation of waste that is not subject to further disposal in special storage facilities in order to prevent the ingress of harmful substances into the environment. (as amended by Federal Law of December 30, 2008 No. 309-FZ, of December 29, 2014 No. 458-FZ)

- **Waste disposal** - the use of waste for the production of goods (products), works, services, including the reuse of waste, including the reuse of waste for its intended purpose (recycling), their return to the production cycle after appropriate preparation (regeneration), and extraction of useful components for their re-use (recovery). (as amended by the Federal Law dated 12.29.2014 N 458-FZ)

- **Disposal of waste** - reducing the mass of waste, changing its composition, physical and chemical properties (including incineration and (or) disinfection at specialized facilities) in order to reduce
the negative impact of waste on human health and the environment. (as amended by the Federal Law dated 12.29.2014 N 458-FZ)

Waste management looks clearly ineffective.

Consider the problems of basic methods of waste disposal and disposal methods in general.

Problems of used methods of waste disposal in the Russian Federation:

• Combustion in special kilns or in open dumps, leading to air pollution from combustion products.
• Burial in burial grounds, which leads to subsidence of the soil and pollution of groundwater, as well as the intensive formation of methane that can explode at the slightest spark
• Storage of garbage in specially designated landfills, which occupy vast territories, creates a threat to air traffic, attracting flocks of birds
• Recycling to secondary raw materials (the problem with this method is the lack of separate garbage collection)

With such problematic methods, waste stocks (availability in the organization at the end of the reporting year 38 073 129 tons. ) It is necessary to introduce new methods and technologies.

Figure 2. Waste disposal methods

Russia already uses unsuccessfully the burial and storage - it takes and poisons the land for a long time. Chemical methods are used effectively only to separate fractions and in the presence of mostly undivided garbage - this is a big problem. Thermal methods are used effectively with a wide morphological spectrum, but not environmentally friendly or costly. The solution for thermal methods and consider them.

The main technological approaches in the implementation of the thermal method are:

• Pyrolysis
• Gasification
- Direct combustion

Direct combustion is an inefficient process of obtaining thermal energy. Higher efficiency is ensured by the use of: some types of wood, solid waste from agro-industrial complex and solid domestic waste, peat. Direct combustion in a steam boiler with the further use of steam in a steam turbine is the traditional way of generating electricity. The disadvantages of this technology include the high cost of equipment for small power plants with a capacity of less than 1 MW, large dimensions, significant fuel consumption, etc.

Pyrolysis is the process of thermal processing (450-1000°C) of raw materials under conditions of oxygen deficiency, with the possibility of further separation of various fractions of fuels. The raw material base can be brown coal, shale, peat, coal oil sludge, solid household and industrial waste, wood waste, sludge, hydrolyzed lignin, waste from agro-industrial enterprises (manure, dung, husk, straw), etc. The decomposition of the organic components of the waste in an oxygen-free atmosphere, after which the resulting concentrated gas mixture (HS) is sent to the afterburning chamber, where the transfer of toxic substances into less harmful ones. Combustion products contain harmful substances CO and NO2. Which are removed with flue gases and have a harmful effect on the atmosphere and the environment. Gaseous substances: nitrogen monoxide NO and nitrogen dioxide NO2 are formed in all combustion processes, but more often in the form of oxide. Sulfur dioxide is formed by the oxidation of sulfur dioxide. The final product of the reaction is an aerosol or a solution of sulfuric acid in rainwater, which acidifies the soil.

Gasification - the transformation of the organic part of solid or liquid fuels into combustible gases during high-temperature (800-1200°C) heating with an oxidizer (oxygen, air, water vapor, CO2, or, more often, a mixture of them). The resulting synthesis gas can be used directly to produce thermal or electrical energy or for their simultaneous production by cogeneration using gas generators combined into one energy complex with water boilers or diesel electric generators. This filter technology is complex without plasma and has a large number of filters.

Plasma gasification - for solving a wide range of tasks, one of which is the conversion of any type of waste, including bio-waste, hazardous waste, into electricity / synthetic fuel (diesel fuel, ethanol) and other useful materials (a ton of waste is 1–1.3 MW / hr of electric power), which provides complete (more than 99.99%) degradation of all components of MSW in inert atmosphere at high temperatures (up to 5000°C) transfer of the organic part of the waste into a gaseous state, free from toxic components and nonorganic part - in the glass-like slag compound. For example, from 1 ton of solid waste consisting of 73% of MSW, 7% of rubber waste (mainly car tires) and 20% of coal get 40 kg of resin used in the boiler room, and 1500-2000 m³ of wet gas. The use of plasma gasification is inherently associated with the Kyoto agreement to reduce the impact on the human atmosphere. The impact on nature and man is 10-15 times lower than world standards for MPCs.

Table 3
Comparison of thermal destruction methods

| Destruction | Plasma gasification | Conventional gasification | Burning |
|-------------|---------------------|---------------------------|---------|
| Temperature | More than 1200°C    | Less than 1200°C          | Less than 1000°C |
| The presence of resins and furans | Not | thereis | Lot |
at the exit

| Ash content | 1 % | 10 % | 30% toxic |
|-------------|-----|------|----------|
| Waste type  | Any            | In addition to certain inorganic materials | In addition to certain inorganic materials |
| Sorting     | Not required   | Is required                          | Is required |
| Flue gas emissions | Low | Average | High |

Conclusion.
Plasma gasification is the most suitable method among the investigated ones. Because the hazardous cause to environment of it is much less due to decrease of the dioxins and complex compounds formation and ash residue comparing to the combustion of MSW.

Literature

[1] Shashkov IV 2015 *Utilization and recycling of solid household waste* Publishing house FGBOU VPO "TSTU"

[2] Gilmanshin IR, Abdullin TM *Of medical equipment / medical systems /

[3] Federal Law of December 30, 2009 No. 384 *Technical Regulations on the Safety of Buildings and Structures*

[4] Sabirzyanov RG, Gilmanshin IR, Kashapov NF, Gilmanshina SI, Galeeva AI, Galeev IA, Krainova DR 2018 *Material and technical base of the laboratory for the thermal destruction of production and consumption waste for the training of specialists in the field of waste management IOP Conf. Ser. : Mater. Sci. Eng. 412 012061*

[5] Federal Law of July 22, 2008 No. 123-FZ *Technical Regulations on Fire Safety Requirements*

[6] Ershov A G, Shubnikov VL 2014 *Thermal waste disposal: theory and practice, myths and legends* Journal of MSW No 5 pp47 – 52

[7] *On Environmental Protection* 2002 Federal Law No 7

[8] Kashapov NF, Gilmanshina SI, Galeeva AI, Galeev IA, Krainova DR 2018 IOP Conf. Ser. : Mater. Sci. Eng. 412 012001

[9] On Production and Consumption Wastes 1998 Federal Law No 89

[10] Bilitowski B 2007 *Waste incineration: the German experience Municipal solid waste* No 1 Pp 47 - 49

[11] On the sanitary and epidemiological well-being of the population1999 No 52

[12] Federal Law of November 23, 2009 No. 261-FZ “On Energy Saving and on Increasing Energy Efficiency and Amending Certain Legislative Acts of the Russian Federation”

[13] Gilmanshin IR, Kashapov NF, Gilmanshina SI, Krainova D R, Sabirzyanov R G 2018 Thermal destruction of production and consumption wastes Proceeding of the IXth International Scientific and Technical Conference "Innovative machine-building technologies, equipment and materials - 2018 "(IMTOM-2018) pp 242-246

[14] Law of the Russian Federation 1992 No 2395-I “On Subsoil”

[15] Water Code of the Russian Federation 2006 Federal Law No 74-FZ

[16] Gilmanshin I R, Kashapov N F, Gilmanshin S I, Krainova D R, Abdullin TM 2018 *Methods of research of plasma gasification technology of medical waste and production and consumption waste Proceedings of the IX International Scientific and Technical Conference “Innovative machine-building technologies, equipment and materials - 2018 "(IMTOM-2018) pp 237-241*

[17] Bernadiner M N, Bernadiner IM 2011 *High-Temperature Processing and Disposal of Liquid, Pasty and Solid Industrial and Medical Wastes Ecology and industry of Russia* pp 19 - 21