COMPARATIVE CHARACTERISTICS OF REFUSE DERIVED FUEL FOR USE IN CEMENT KILNS

E. Shcherbina[1], Y. Fursa[2], I. Narkevitch[1]

[1]*Belarusian State University, ISEI BSU,*
Minsk, Republic of Belarus
[2]*Republic Research Unitary Enterprise «Bel RC «Ecology»,*
Minsk, Republic of Belarus
egorsherbina@gmail.com

Refuse-derived fuels (RDF) are a category of alternative fuels produced as byproducts from the process of waste management plants. RDF can be utilized for heat and power production contributing to the waste hierarchy. The application of certification quality management schemes in the waste management fuel production processes, along with the use of a new terminology, solid recovered fuels may enhance public acceptance and promote the thermal utilization of this resource in industrial facilities.

Keywords: alternative fuel, refuse derived fuel, municipal solid waste, cement kilns.

Since the 1970s, various types of waste have been successfully used as alternative fuels in cement kilns in Europe, Japan, the USA, Canada and Australia. The use of alternative fuels could considerably contribute to reduce: the impact of waste on the environment, safe dispose hazardous waste, greenhouse gas emissions, reduce waste management costs and save resources for the cement industry and boiler plants.

Alternative fuel or RDF is a fuel produce from Municipal Solid Waste. The composition of RDF includes high-calorie waste components such as plastic, paper, cardboard, textiles, rubber, leather, wood, etc. RDF could be used as main or additional fuel in kilns of cement plants, thermal power plants, metallurgical kilns.

The use of alternative fuels should follow the hierarchy of waste including. In addition, production of RDF should be integrated into waste management programs, support strategies for improving use of resources and not hamper efforts to reduce waste. Following certain basic rules, it is guaranteed that use of alternative fuels does not increase emissions of pollutants from boilers plant and cement kilns.

The main consumers of RDF are, first of all, cement facility and metallurgical furnaces. The equipment of such enterprises allows fuel combustion at high temperatures resulting in reduction of the amount of harmful substances in emissions. However, it is necessary to take into account the fact that during the combustion process there are some technical difficulties on which the quality of the combustion process depends.

Issues the production of RDF fuel in the Republic of Belarus is legally reflected in the Concept for the Creation of Capacities for the Production of Alternative Fuel from Municipal Solid Waste and its utilization (approved by the Council of Ministers of the Republic of Belarus No. 664 of August 22, 2016). The aims concept is the determination the conditions and ways for the use of municipal solid waste as an alternative fuel with use in cement facilities.

According to the Concept:

Pre-RDF – residues in MSW after extraction of fine fraction up to 80 millimeters in the form of organic and non-combustible components, as well as extraction of the main types of secondary material resources which are of main value for their further use.

RDF is a solid fuel made from pre-RDF designed to generate energy. The characteristics of RDF are determined according to the national standards or the technical conditions for the fuel producers.

As a result of the comparative analysis of the characteristics and cost of RDF and traditional fossil fuels, the calorific value of alternative fuel exceeds peat and is almost equal of coal (Table 1).

Table 1

Types and quality of fuel

№	Type of fuel	Caloric content kcal/kg	In standart unit	Comparable prices, euro
1	Natural gas	8 000	1140 m^3	183
2	Coal	6 200	0,89 t	37–42
3	Peat briquetting	3 500	0,5 t	24
4	RDF	4 200 – 5 200	0,74–0,6 t	10

In addition to reducing costs of the use of fuel and energy minerals, the use of alternative fuels is an environmentally friendly way of waste management and leads to the reduction in greenhouse gas emissions, which makes a significant contribution to the fulfillment of the obligations of the Republic of Belarus under United Nations Framework Convention on Climate Change and the Paris Agreement.

The processing solid municipal waste in alternative fuels is considered important and perspective in world practice, since the combustion of this fuel has negative impact on the environment as compared to traditional fuels. The use of RDF also reduces the consumption of natural resources and the area of landfills sites for waste disposal. In addition, the price of alternative fuel is much lower than the price of fossil fuels.

BIBLIOGRAPHY

1. Концепция создания мощностей по производству альтернативного топлива из твёрдых коммунальных отходов и его использования (утверждена Советом Министров Республики Беларусь № 664 от 22.08.2016).

2. *Таланова, Ю. П.* Использование RDF-топлива в промышленности строительных материалов / Ю. П. Таланова, Е. К. Сергиенко, А. Б. Бахмат // Актуальные проблемы экономики строительства: Материалы 73-й студ. науч.-техн. конф. – Минск, 2017. – С. 54–57.

3. Waste-to-Energy Options in Municipal Solid Waste Management, GIZ, A Guide for Decision Makers in Developing and Emerging Countries. – 2017. – P. 26–30.

4. *Mutz, D.* Co-processing Waste Materials in Cement Production. The GTZ-Holcim Public Private Partnership / D. Mutz, V. Nandan // International J. of Environmental Technology and Management. – 2006. – Vol. 17 (2–4). – P. 300–309.

NEWTON'S GENIUS

S. Yakshevich, V. Demidchik, V. Krasovsky

Belarusian State University, ISEI BSU,
Minsk, Republic of Belarus
Fgh4311@gmail.com

This article about Newton's genius, and about his contribution to science.

Keywords: Cambridge, genius, skill, acceleration is force divided by mass (F = ma), any action causes an equal resistance, the law of gravity.

The genius of Isaac Newton is in the word itself. In the years when Isaac studied at Cambridge, he was the main quality that developed his genius-the desire to get to the truth, to the heart of the matter.

In its 23 years he already possessed the skills of integral and differential calculus, he also became a Professor of mathematics at Cambridge University. His work was limited to not only classroom lessons, he also met at various meetings, which were necessary for the proper management of College in 17 century?

And one day in the fall, before the meeting, Newton walked through the Park and saw the Apple tree from which an Apple fell. Without any reasoning in his brain flashed the thought that the fall of an Apple and the movement of the planets in their orbits must obey the same universal law. To come to him, Newton was necessary to sweep away the detritus of the old Aristotelian philosophy, adopt the philosophy of "mechanical" and then something to reject and it make correct inferences from the comparison of terrestrial and Celestial movements, develop a theory and repeatedly reaffirm its coincidence calculated and real celestial phenomena.

In 1671 he was able to create a new model of the telescope-big sizes and better quality.

Awesome and truly a great man for the entire history of mankind was Isaac Newton. Without his discoveries, our world will certainly was quite different. First and foremost, it is the first time Newton demonstrated that white light contains all other colors. And this discovery has impacted not only on physics, but in astronomy and many other sciences.

However, the most important discoveries of Newton's three laws of mechanics are considered:

1) acceleration is force divided by mass (F = ma);

2) any action causes an equal resistance;

3) the law of gravity.

At first glance, these laws are simple and obvious. However, the absence of these simple to Newton laws an insurmountable wall stood in the way of development of mankind. And, of course, because all sciences interrelated, this barrier has affected not only the physics, but also in mathematics, astronomy, even in philosophy and economics.

But opening these was given to the Newton does not just. Only thought, the search and painstaking labor allowed Newton to come to their great and important discoveries.

Since the discoveries of Newton, many scientists consider him almost the most important and great man both for the world of science and for the whole of humanity as a whole. And Newton's achievements were rec-