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UTILIZATION OF HOUSEHOLD WASTE-BASED SOLID FUEL

Shokhrukh Toshpo'latovich Khojiev
Tashkent State Technical University named after Islam Karimov, Tashkent, University St. 2A, 100095, Uzbekistan, karimov913q@gmail.com

Bakhriddin Tilovkabulovich Berdiyarov PhD
Tashkent State Technical University named after Islam Karimov, Tashkent, University St. 2A, 100095, Uzbekistan, mr.berdiyarov@gmail.com

Nodir Abdusamikovich Kadirov PhD
Tashkent State Technical University named after Islam Karimov, Tashkent, University St. 2A, 100095, Uzbekistan, abdusamig@rambler.ru

Bobur Mirsaid o'g'li Obido
Tashkent State Technical University named after Islam Karimov, Tashkent, University St. 2A, 100095, Uzbekistan, shohruhhojiyev@gmail.com

Mehmet Deniz Turan PhD
Firat University, Elazig, Turkey, mdturan@firat.edu.tr

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UTILIZATION OF HOUSEHOLD WASTE-BASED SOLID FUEL

Sh.T. Khojiev[1*], B.T. Berdiyarov[1], N.A. Kadirov[1], B.M. Obidov[1], M.D. Turan[2]
[1]Tashkent State Technical University named after Islam Karimov,
Tashkent, University St. 2A, 100095, Uzbekistan
[2]Üniversite Fırat 23200 Elâzığ, Merkez / Elazığ, Turkey

Abstract: *Waste, garbage is a mixture of substances, objects and their parts that have lost their consumer properties in the process use and intended for disposal. The purpose of the article is note the main current concepts of the distribution and plastic waste disposal problem and propose its promising solutions. In Uzbekistan, the number of solid utilities waste is 63 million tons per year (about 450 kg per person), up to 25 % of them can be plastic. Plastics are organic materials based on synthetic or natural polymers consisting of monomer units, combined into long macromolecules. The most common plastics are polyvinyl chloride, polypropylene, polycarbonate, polystyrene, polyethylene low and high pressure, etc. To ensure utilization of disposable items, a labeling system has been developed. Most types of plastics are usually well recyclable and recyclable. In Europe up to 50 % of waste is recyclable, and in Russia - no more than 4 %. The article discusses the problems of waste polymeric material decontamination and recycling, which are common among household and technical waste and difficult to dispose of and emit toxic substances into the environment. In particular, the composition, structure and properties of waste plastic bags with a thickness of up to 40 microns, which are increasing dayby day, have been studied and a rational method of their use has been proposed. The results of* *the research has shown that the waste of unsuitable polyethylene bags contains a source of fuel necessary for the metallurgical industry - hydrocarbons, which can be used as an alternative to traditional fuels used in metallurgical furnace and can be used as a heat energy source. It also provides with useful information on the theoretical foundations of processes that can helpincrease the economic efficiency of metallurgical plants. Also, the main technological parameters of polyethylene bag recycling and their incineration in metallurgical furnaces were identified. The cost effectiveness of using plastic waste as a fuel in metallurgical processes has been analyzed.*

Key words: *polyethylene bag waste, metallurgy, combustion, fuel, savings, recycling.*

INTRODUCTION. In almost all countries of the world, municipal solid waste per capita increases by 1% annually. This, in turn, does not negatively impact global environmental sustainability. According to expert estimates, more than 800 types of waste are currently registered and emission standards may increase in the future. The main source of environmental pollution is waste generated from materials used in energy, non-ferrous and ferrous metallurgy, chemical and construction industries. Ignoring them can lead to unexpected changes in natural resources and nature. This is because even natural foods can be absorbed and absorbed into the soil. For example, paper will rot only three months after it is dropped. It takes 400-450 years to completely separate plastic and plastic bags into biological components, and glass could disappear completely in a million years [1, 2, 3, 4, 5, 6, 7].

It is worth noting that 80% of this waste is organic, and recycling it can generate large amounts of energy and energy. According to experts, household waste is the cheapest raw material in the world [8]. The experience of developed countries shows that 85% of waste can berecycled. Some countries have a separate waste collection system. As a result, most of the raw materials such as paper, plastic, aluminum is sent for recycling. This process has a huge positive impact on the environment. Waste treatment can save up to 50% of energy and raw materials used to manufacture products [9].

Practice shows that in foreign countries, where a separate system for collecting solid waste has been introduced, the placement of paper, glass, plastic waste in various containers is ofinterest to factories and factories producing products from these materials. While selective food waste makes it possible to produce biogas, non-ferrous metals are used for secondary production [10]. With the rapid development of science and technology, the disposal of industrial waste that is not suitable for human consumption is further exacerbated by the negative human impact on nature. The relationship between man and nature has become more complex, and the impact has reached a level comparable to natural causes. Therefore, protecting the environment through proper management of the ever-growing waste is one of the most pressing issues of our time [11,12].

Solving environmental problems and reducing environmental norms and types by considering different types of waste, recycling and recycling them as secondary raw materials; It is also important to educate residents of rural and neighboring communities on how to handle waste properly [13].

The measures taken will help prevent waste and valuable substances and materials,prevent environmental pollution by industrial and household waste, and also solve the problemof collection and disposal of solid waste. therefore, the most effective ways of utilizing household waste in rural areas, especially in animal husbandry, can be achieved through composting. It is an environmentally friendly, organic fertilizer that increases soil fertility and isa technically and economically viable, affordable and effective way to use it in the field. In addition, it is also possible to obtain natural, environmentally friendly and cheap biogas, which will help solve the problem of natural gas shortages for the population of remote areas of the region [14].

Consumers in the country now have to put solid waste in separate packaging and select plastic, metal (by type), glass products, paper waste, as well as biological waste and other non-recyclable waste. Waste collection points should be equipped with special containers with a color, label and lettering for waste collection, and mercury lamps should be stored separately from other waste. They should be placed in special containers at waste collection points [15].

In the republic, the amount of waste generated per person per day is 0.6 - 0.8 kg, and from the total population 18 - 20 thousand tons.

During 2018, 7.1 million tons of municipal solid waste (MSW) were generated, of which 1.3 million tons (19.1%) were processed by 219 waste treatment organizations, and the remaining 80% were disposed of at the existing 221 solid waste landfills. For comparison, in 2017, 183 enterprises processed 630.0 thousand tons of waste (9% of the total waste) [16].

For reference: The number of paper processing enterprises is 73 units, for the processing of polyethylene and plastic 88 units, for the processing of tires and rubber 12 units, for the processing of textiles 3 units, for the processing of glass 8 units, for the processing of used motor oil 1 unit, 17 units for scrap metal processing, 17 units for other waste processing enterprises [17].

In the regions, according to the morphological composition of waste in 2018, 1.9 million tons of food ((27.53%), 230.2 thousand tons of paper and cardboard (3.22%), 20.7 thousand tons of mercury lamps, medical and wireless devices (0.29%), 330.3 thousand tons of glass (4.62%), 565.6 thousand tons of polymer and polyethylene (7.91%), 98.6 thousand tons of metal (ferrous and non-ferrous metals, 1.38%), 923.2 thousand tons of crops (12.91), 163.7 thousand tons of leather, rubber, bone (2.29%), 101.5 thousand tons of timber (1, 42%), 2.3 million tons of other waste fork (31.83%) [18].

There are currently several ways to recycle polyethylene bag waste. For example, it can be used in road construction together with asphalt as a binder. In addition, airless pyrolysis produces a variety of liquid fuels. However, the recycling of waste plastic bags by these methods does not allow for the complete disposal of tons of waste polyethylene that accumulates in landfills. This situation requires more advanced technology. One way is to feed discarded plastic bags to metallurgical furnaces as fuel [19].

The aim of the study is to target waste polyethylene and improve environmental protection.

MATERIALS AND METHODS. The object of the study is the waste of polyethylene bags with a thickness of less than 40 microns from the landfills [20].

The research process is very simple and consists of two steps:

Step 1: Initially, plastic bags and wood waste are sorted from the landfills, dried in the open air and briquetted for transportation. In the first step of the study, briquetted plastic bags were thoroughly mixed with crushed wood chips. This is because the correct and equal distribution of materials in the production of slag is one of the main criteria for obtaining high- quality raw materials. In this case, the waste of granulated plastic bags and wood chips were mixed in different mass proportions and heat treated. The main purpose of the addition of wood chips is to increase the degree of pores in the combustible product. This is because the more micro-pores there are in combustible and carbonated products, the larger the reaction surfacearea of such fuels exposed to oxygen, and the faster they ignite. Research has shown that the more wood that is added to polyethylene waste, the more pores there are. Figure 1 shows the effect of wood chips on the growth of micro-pores in synthetic fuels.

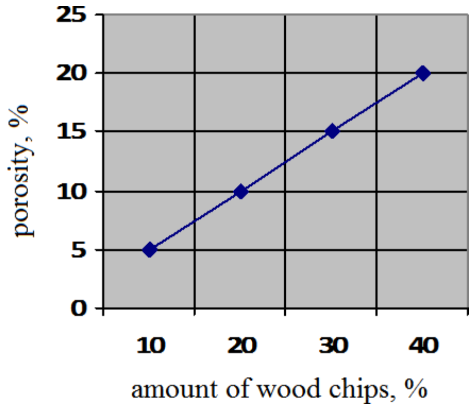

Figure 1. The porosity of a combustible product depends on the amount of wood chips

From the graph shown in Figure 1, it can be seen that an increase in the amount of wood in the raw material will increase its porosity, but the amount of carbon in the combustible product obtained will decrease and the ash output will increase. Therefore, the amount of wood chips to be added should be around 20 – 40 %. Only then will you get a quality combustible product.

The mechanism of formation of pores in the combustible product is explained by the evaporation of water from the wood during heat treatment. At high temperatures (t > 100 ^oC), the water in the cellulose hydrocarbon vaporizes and forms various microscopic (capillary) passages inside the product as it rises. As the reaction system cools rapidly, most of these capillary holes retain their shape and cause the product to porous. A general view of the production of porous combustible products is shown in Figure 2, Figure 2-a shows the process of granulation of polyethylene waste, and Figure 2-b shows the process of obtaining porous artificial combustible products by heat treatment.

a. b.

Figure 2. Waste treatment of polyethylene bags: a - granulation, b - carbonation in a special furnace

Step 2: The selected materials are mixed and placed in a special mold and heat treated in a special furnace until the polyethylene waste is liquefied. Ordinary drying ovens can be used as ovens. The temperature should be 200-300 degrees.

Fuel-fired furnaces in the metallurgical industry include Reverberatory, Vanyukov, Marten, Rotary tube and Anode furnaces (Fig.3). These furnaces will be fitted with appropriate fittings, taking into account the supply of solid fuel. Polyethylene waste bins and air are fed into the kiln through a single burner. Only then should the shape of the burner be chosen so that the resulting polyethylene waste piles loaded from the additional pipe above the burner are directed into the furnace by the pressure of the heated air coming from the main pipe (Figure 4). Such shaped burners are available in metallurgical plants. This will make the project easier to implement. To ensure complete combustion of polyethylene waste, it is necessary to increase the partial pressure of oxygen in the supplied air. It is advisable to carry out the process in the presence of air that retains 23 – 30 % oxygen [21].

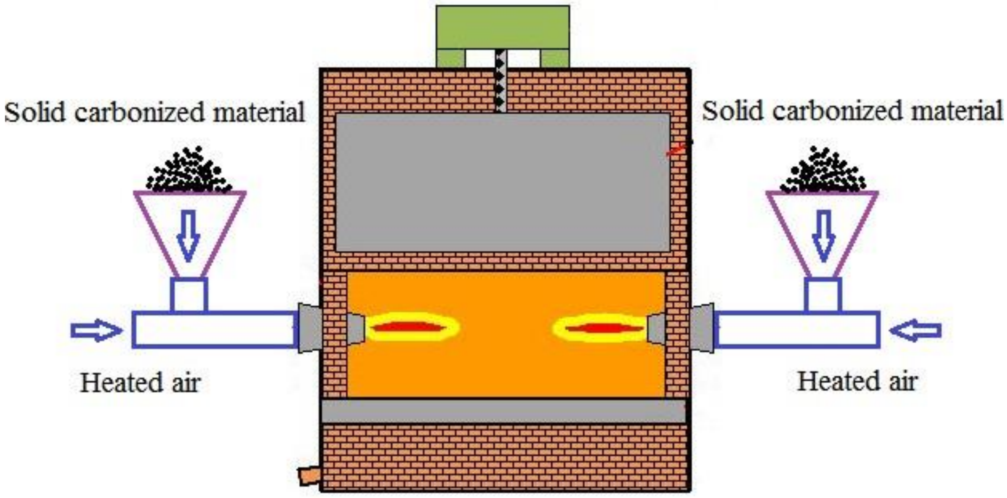

Figure 3. Schematic diagram of the process of feeding polyethylene waste pellets to a metallurgical furnace

RESULTS AND DISCUSSION. As a result of the study, a sample of solid fuel was obtained (Fig.3), which was distinguished by its high flammability compared to natural coal and low emissions. If we see that natural coal emits 70 – 75 % of its own heat, we can see that this new type of solid fuel emits 90 – 95 % of its own heat, and it is also superior in terms of emissions. It was found to be lighter in density than natural coal.

The new type of solid fuel waste can be used as a cleaning agent in the national economy.

With the help of personal laboratory equipment was able to process an average of 1 ton of waste polymer and polyethylene raw materials in 8 hours, as a result of which the following products were obtained:

1) artificial coal 30 %;
2) carbonated coke 70 %.

Artificial coal and carbonated coke obtained as a result of processing provide 20 % of the coke used in the metallurgical plant. At present, waste polymer and polyethylene materials are mainly collected in special landfills in the amount of 565.6 tons.

a. b.

Figure 3. Products obtained by processing waste from plastic bags: a - artificial coal, b - carbonated coke

The chemical composition of the combustible material obtained as a result of thermal processing of polyethylene bag waste is given in Table 1.

Table 1.

Chemical composition of solid combustible material obtained by thermal processing of polyethylene bags and wood materials

Sample №	Components, %			
	C	H	Ash	Combustible part
1	76,45	11,89	11,66	88,34
2	74,67	10,12	15,21	84,79
3	77,14	12,86	10,00	90,00
4	76,77	12,05	11,18	88,82
5	78,19	13,11	8,70	91,30

The values in the table show that 85 – 90 % of the solid combustible material is in the combustible part and differs from other solid fuels in this respect.

In addition to recycling these polymer and polyethylene wastes, we intend to carry out the following works:

1. Development of sanitation infrastructure aimed at ensuring full coverage of the population with services for the collection and removal of solid waste;
2. Creation of an efficient and modern system of solid waste recycling;
3. Ensuring the recycling of at least 60 % of the generated solid waste;
4. Reduce the amount of solid household waste sent to landfills to 60 %;
5. Prevention of solid waste generation - includes slowing growth rates and reducing their hazardous properties;
6. Reuse of raw materials, energy and materials from solid household waste, etc.

Since man-made combustible material is mainly composed of hydrocarbons, it can be compared with other analogues of the same type. For example, natural gas is also a hydrocarbon fuel and is used in many industries. The economic parameters of natural gas and artificial fuels can be seen in Table 2.

The cost-effectiveness of the process can be calculated as follows. It was based on the difference between the cost of natural gas used normally and the price of the combustible part of the waste of the proposed waste plastic bags:

Table 2.

Feasibility study of unusable plastic bags compared to natural gas

№	On natural gas	№	On waste polyethylene waste
1	1 cubic meter of natural gas provides 8000 kcal of heat	1	1 kg of polyethylene gives 7637 kcal / kg of heat when burned
2	The cost of 1 cubic meter of natural gas for legal entities is currently 1,000 sums	2	1 kg of old polyethylene costs 500 sums

Using the technical and economic indicators given in the table above, the expected economic benefits of the study are as follows:

Table 3.

Feasibility study of waste plastic bags with natural gas

№	On natural gas	№	On waste polyethylene waste

1	The heat equivalent of 1 cubic meter of natural gas for polyethylene waste is 8000 kcal / m^3	1	8000: 7637 = 1.04 kg of polyethylene waste is required
2	1 cubic meter = 1000 sums	2	1.04 * 500 = 520 sums
Net profit: 1000 - 520 = 480 sums (per cubic meter of natural gas)			

The life cycle of plastic is significantly exceeding its service life. One way or another, all plastic ends up in landfills, where its attack on nature and movement continues along the food chains to humans. Up to 10% plastic waste ends its journey in the waters of the oceans. Long lasting and often toxic material causes disease and death of many representatives of terrestrial and aquatic fauna. The classical hierarchy of waste management is reduced to only three vectors: utilization, including energy, reuse and recycling. All of them are not optimal, especially for the environment. It should be admitted that in addition to among other things, the way of assessing the life cycle of plastic and the greening of public consciousness in the context of reducing its consumption.

The problem of recycling waste of polymeric materials is gaining relevance not only from the standpoint of environmental protection, it is also associated with the fact that in conditions of a shortage of raw materials, plastic waste becomes a powerful raw material and energy resource. The use of polymer waste allows to significantly save primary raw materials (primarily oil), water and electricity. The choice of schemes for the technological processing of plastic waste is due to their physicochemical, mechanical and technological properties, the time of use and "aging" (change, deterioration of the structure and composition of the polymer component under the influence of operational factors), which significantly differ from the same characteristics primary polymer. The classical hierarchy of waste management, which is the basis for the developed strategies to reduce the amount of waste, is reduced to only three vectors:

- utilization, including energy
(incineration at incinerators), i.e. their correct collection and disposal;
- reuse of the same products;
- processing, or recycling (by mechanical and physicochemical methods).

But none of these methods leads to a real destruction, safe for the natural environment and human health, disposal of plastic waste and waste of their incineration. The actual basic solution to the problem of plastic accumulation is to reduce (to the point of complete elimination) the use of certain types of goods, mainly disposable, and the recycling of others. In Europe back in 2006, the processing of plastics, including mechanical recycling and the production of fuel through waste disposal, exceeded 50%. But the problem is far from being solved, especially on a global scale, and other measures are spreading in this connection. For example, in France, since 2017, there has been a ban on the use of disposable plastic bags in all types of stores, markets and pharmacies. Until 2017, manufacturers of products could still pack goods in polyethylene, but not denser than 50 microns. In Ireland, it is forbidden to give out plastic bags for free, they have high taxes and prices. In Germany, visitors are offered paper bagsand cloth bags instead of polyethylene. In addition to environmental protection, educationalwork is also carried out. In Delhi, where from plastic stray cows are dying, and a ban has been introduced on the production, sale and use of packaging films and plastic bags, except bags for medical waste.

CONCLUSION. The results of the research are as follows:

- Natural gas consumption will be saved, i.e. according to traditional technology, 1 ton of shale would consume about 218 m^3 of natural gas. The proposed method can reduce its consumption by up to 50 %;
- there will be an opportunity to dispose of waste plastic bags in the form of piles at the landfills of metallurgical enterprises and other organizations;

- Waste utilization and targeted disposal will reduce waste areas and improve environmental protection. In addition, fines or fees for the environment will be reduced;

- The technology is cost-effective, i.e. one metallurgical furnace consumes an average of 54,500 m^3 or 54,500,000 sums of natural gas per day to process an average of 250 tons of ore, and the proposed technology uses the same amount. An average of 56,680 kg or 28,440,000sums worth of polyethylene bag waste is used to process the shale. This means that the remaining net profit from the proposed technology is 26,160,000 sums per day, and the annual net profit is $ 925,232.

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GAS COLLECTION SYSTEM EQUIPMENT DURING THE DROP GAS PRODUCTION PERIOD OF GAS CONDENSATE FIELDS

A.R. Li
Transportation Department of O'ZLITINEFTGAZ JSC, Uzbekistan,
100029, TASHKENT, MIRABAD area, street TARAS SHEVCHENKO, 2.
email address: optg@liting.uz

Abstract.*The article discusses the following periods of development of natural gas fields: 1- increasing production, 2- constant production, 3- declining production.*

Methodical approach to solving the problems of a field gas treatment system design during a gas condensate field operation.

Gas or gas condensate fields (GCF) are a complex structure consisting of a large number of elements interacting with each other and with the external environment at different levels, and this interaction is often indefinite. These elements (objects) are usually multifunctional, for example, a collection system, where the connections are of a variable nature, providing a multi- mode nature of functioning.

The listed features are typical for complex or large systems, the design, analysis, research and management of which are possible only on the basis of a systematic approach. There is the principle of "integrity", according to which large systems cannot be studied accurately from a