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ENSURING THE LEVEL OF ENVIRONMENTAL SAFETY OF PROCESSES WHEN PROCESSING ELECTRONIC AND ELECTRICAL WASTE

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Annotation

The article discusses such issues as the recycling of electrical and electronic waste (EEW), modern methods and technologies of disposal with the condition of strict adherence to a number of requirements that ensure the environmental safety of all technological processes. It highlights the sources of education, the composition, the volume of EEW accumulated around the world and the adopted legislative and legal acts, including the first published Directives in developed countries such as the USA, Japan, the European Union, and the countries of the BRICS organization.

Key words: electrical and electronic waste, motherboards, physical and chemical methods, recycling, energy and resource saving, technology, secondary recycling.

Аннотация

В статье рассматриваются такие вопросы, как повторная переработка электрических и электронных отходов (ЭЭО), современные методы и технологии утилизации с условием строгого соблюдения ряда требований, обеспечивающих экологическую безопасность всех технологических процессов. В нём освещены источники образования, состав, объем накопленный по всему миру ЭЭО и принятые законодательные и правовые акты, в том числе впервые изданные Директивы в развитых странах как в США, Японии , Евросоюзе, в странах, входящих в организацию БРИКС.

Аннотация

Мақолада электрик ва электрон чиқиндиларни(ЭЭЧ) қайта ишлаш ва утилизация қилишда замонавий усуллар ва технологияларни экологик хавфсизлик талабларига қатий риоя қилган холда олиб бориш шартлари кўриб чиқилган. Унда ЭЭЧ тўғрисида асосий тушунчалар, уларни хосил бўлиш манбалари, таркиблари, дунё бўйича йиғилиб қолган хажми, ривожланган мамлакатлар АҚШ, Япония, Евроиттифоқ, БРИКС ташкилотига кирган мамлакатлапрда қабул қилинган қонун ва қонуности хужжатлари хамда илк бор чиқарилган Директивалар келтироилган.

Ключевые слова: электрические иэлектронные отходы, переработка, утилизация, современные технологии и методы, требования экологической безопасности, законодательные акты, директивы, энерго и ресурсосбережения, повторное переработка.

Калит сўзлар: электрик ва электрон чиқиндилар, қайта ишлаш, утилизациялаш,замонавий технологиялар ва усуллар, экологик хавфсизлик талаблари,қонун ва қонуности хужжатлар, Директивалар, энергия ва ресурс тежамкорлик, , иккиламчи қайта ишлаш.

Over the past twenty years, the number of electronic and electrical devices has been constantly increasing, which sharply raises the question of the processing of obsolete technology.

A wide range of waste processing technologies is presented on the Uzbek market. However, the growth in the share of recycled waste is constrained by the lack of a separate waste collection system, which is a key condition for deep recycling, as well as insufficient market development and low demand for products made from recycled materials. Many developed countries are almost completely and successfully solving these problems. This is especially true for Japan, USA, Germany, France, the Baltic countries and many others.

The industry for the recycling of waste electrical and electronic equipment, for example, in France, opened in 2005 with the aim of organizing the disposal of this type of waste. Since that time, about 1.8 million tons of waste have been collected.

The total volume of electrical and electronic equipment waste (EEEW) in the world, according to UNEP materials, is about 50 million tons per year.

Based on data from different sources, one can get approximately the following picture for countries (unfortunately, there are no data in comparable versions - studies and assessments were carried out in different years, but there are no general summary data).

According to the Institute of Scrap Recycling Industries (Institute of Scrap Recycling Industries - ISRI), in the United States in 2011, more than 4.4 million tons of electronic scrap was processed only. More than 70% of this weight has turned from waste into secondary raw materials (ferrous and non-ferrous metals, plastic, glass) for manufacturers of materials for new goods.

In the EU countries in 2008 about 7 million tons of EEEW were produced (already taking into account electrical equipment), of which 2.6 million tons, or 37%, were processed). The total income is about 1 billion euros. The number of employees is at least 10 thousand people.

In China, about 2 million tons of refrigerators, computers and other EEEW are disposed of in landfills annually. In India this figure is about 600 thousand tons. Brazil annually produces about 680 thousand tons of EEEW.

All the above circumstances require a special attitude to EEEW, their separation for processing from consumption waste streams.

The problem of limited natural resources, air pollution, water pollution and waste disposal is taking on a global scale. As a result, Europe, Asia and the United States are enacting environmental legislation that is changing the way materials are developed, manufactured, used and recycled in many industries. However, nowhere are these problems felt more acutely than in electronics manufacturing, where development stages and product lifetimes are short, cost is high, and products are developed, manufactured, and marketed around the world. Since electronic and electrical appliances are widely used and the turnover of this market segment is very large, waste is also very high. Several laws already passed in this area aim to reduce waste by creating conditions for recycling and encouraging manufacturers to make more careful choice of materials for production and more careful product development. Japan and the European Union are leading the way in terms of new legislation, although China and the United States are also tightening their requirements for manufacturers of electronic and electrical equipment. The dispersed population of Europe in small cities, the prevalence of incineration methods in waste management infrastructure and political interest in the environmental problem have helped European countries to ensure the effective implementation of new, tougher environmental legislation. Since the market for electrical and electronic devices is global, new legislative norms are reflected not only in national manufacturers - any manufacturer of equipment or components must follow the new requirements. The practical expression of this provision is that environmental legislation is becoming global.

In 1998, Japan passed a law on the recycling of electrical household appliances. This equipment must now be recycled by manufacturers. Now, as a logical result of the introduction of this law, manufacturers are trying to make appliances that will cost less to recycle and are easier to process.

In 2003, the Personal Computers Recycling Law was passed, with the manufacturer taking responsibility for recycling. The user can get rid of the computer, either by handing it over to the manufacturer, or by contacting the mail.

In 2008, Japan took the initiative to create a zero-waste society - New Zero Waste International Action Plan.

1978 The EU Directive 78/319 / EC of March 20, 1978 "On toxic and hazardous waste" came into force.

1989 The Basel Convention on the Control of the Transboundary Movements of Hazardous Wastes and Their Disposal of March 22, 1989 was adopted, which was ratified by Russia (Federal Law of November 25, 1994, No. 49-FZ).

1991 The EU Directive 91/689 / EC of December 12, 1991 "On hazardous waste" came into force. Waste is grouped into three classes - hazardous, non-hazardous, and inert. There is a further tightening of requirements for waste disposal.

Council Directive 91/157 / EEC of March 18, 1991 about batteries and batteries containing certain hazardous substances. It was the first to ban the use of certain types of alkaline batteries containing a certain amount of mercury.

1996 Directive EC No. 96/59 / EC of September 16, 1996 on the elimination of polychlorinated biphenyls and polychlorotophenyls (PCB / PCT) came into force.

1999 The EU Directive 1999/31 / EC of 26 April 1999 “On landfills” came into force, providing for the separate collection of waste, based on the “Polluter pays” principle.

2003 The EU Directive 2002/96 / EC of the European Parliament and of the Council of January 27, 2003 on waste from electrical and electronic equipment (the first WEEE directive) came into force.

Directive 2002/95 / EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the content of certain hazardous substances in electrical and electronic equipment (second WEEE directive).

However, attention to the problem in most countries of the world is explained not only by impressive quantitative indicators. Of particular concern in developed countries is the fact that in the production of electrical and electronic waste (EEEW), often highly hazardous substances are used, which, when released to landfills, lead to serious environmental pollution and damage human health. The second important point is the huge volume of EEEW exports from developed to developing countries. According to some estimates, up to 80% of unprocessed EEEW is exported to Asia. Partly for further use, but mainly for disassembly and subsequent "informal" processing (this is the case in India and China). There is one more reason for the increased attention to EEW: precious and rare earth metals are used in the production of electronic devices. The reserves of rare earth metals are currently very limited, so the use of EEW as a source of state raw materials is relevant, especially given the significant increase in prices for this raw material. [1]

Below we will consider the methods and technologies for processing electronic waste, computer technology, mechanical, physical and chemical methods [2, 3].

Printed circuit boards (PCBs) are one of the components of computers and other equipment below is the percentage of metals and other components in printed circuit boards:

• nickel - 3.25% - in the process of preparation and enrichment with the aim of separating it for sale;
• silver - 2.50% - accordingly, silver refining is profitable;
• copper - 23.04%;
• iron - 12.30% and is high enough for its extraction;
• Gold -0.27%;
• The rest is non-metallic fractions.

PCB waste is distinguished by significant heterogeneity and complexity of composition, although the level of heterogeneity of PCB waste with components is somewhat higher. PP materials are distinguished by a special variety, while the amount of precious metals present in the deposited coatings of various thicknesses, combined with copper, solders, alloys of various compositions, from non-ferrous and ferrous metals, is relatively small.

The uncontrolled generation of e-waste leads to waste of materials and energy, additional economic and environmental costs. There is also a high negative impact of e-waste on the environment, natural resources and the health of citizens. EEE can contain such chemical elements as mercury, lead, cadmium, beryllium, barium, lithium and others. They tend to accumulate, and without losing their toxic effects, they can enter the soil or groundwater, affect the state of the ecosystem, the urban environment, natural resources and human health, i.e. they are environmentally hazardous substances.

It was already noted above that the EEEW contains many components containing such environmental hazardous substances for the environment and humans as heavy metals (in particular, mercury, lead, cadmium and chromium, arsenic), halogenated. (Including chlorofluorocarbons or freons, polychlorinated biphenyls), polyvinylchlorides and bromine-containing flame-retardants, bromide compounds. For example, one waste computer contains 700 types of chemicals, more than half of which are dangerous to humans. And LCD TVs with a diagonal of 26 inches contain 2-4 U-shaped lamps with a mass of 13 g and a mercury content of 62.14 mg / kg, which is 29.6 times more than its permissible content in the soil. As the size of the screen increases, the number of lamps in it increases. LCD TVs with a diagonal of 40 inches already contain 16-20 lamps. With the destruction of such a screen and complete evaporation of mercury, a room with a volume of 50 m3 is contaminated up to 400-500 MPC. If these chemicals are uncontrollably discharged or buried in landfills and landfills, then they will certainly enter the environment. Under the influence of atmospheric precipitation and moisture, they pass into an active chemical state and enter the soil, filtration water and water supply sources. When dismantling and recycling electronic equipment (if it occurs in artisanal conditions, without observing elementary safety rules), a person who comes into contact with these substances receives significant chemical poisoning, which is very dangerous to health also not the best way. In this case, all the same lead, cadmium, mercury are released into the atmosphere. Mercury released into the environment can accumulate in living organisms. If the products contain polyvinyl chloride (PVC), then when it is burned, dioxins and brominated flame retardants are also released into the atmosphere [7].

The most common routes of exposure to hazardous components of e-waste are ingestion, skin contact and inhalation through contaminated soil, water, food and air. Those pollutants that are difficult to degrade over a long half-life are known as persistent organic pollutants (POPs) and are the main hazardous pollutants in e-waste. Some of the most common POPs that are processed are brominated flame retardants, polychlorinated biphenyls, poly-bromobiphenyls, dibrominated diphenyl ethers, polychlorinated or polybrominated dioxins, and dibenzo-furan dioxins. POPs, polychlorinated biphenyls and dioxins as polychlorinated dibenzodioxins. Polycyclic aromatic hydrocarbons are generated due to incomplete combustion of fuels like coal, gas, oil, etc. These hydrocarbons are released into the environment when e-waste is incinerated. Heavy metals such as lead, cadmium, chromium, mercury, copper, manganese, nickel, arsenic, zinc, iron, and aluminum can also pose a threat.

Table 13 provides a summary of the various hazardous impacts caused by exposure to e-waste components with vulnerable populations and their average exposure. It follows from the table that long-term exposure to many toxic substances leads to extremely dangerous consequences. Therefore, proper management of this large amount of e-waste is very important. In this regard, recycling of electronic waste is practiced on a large scale all over the world.

Table 13 The main hazards during prolonged exposure to toxicants from EEE waste

Main toxic components	**Radiation source**	**Exposure environment**	**Primary health hazard**
Polybromodipheny	Flame retardants	Air, water, soil, and food	Thyroid dysfunction
Polychlorinated biphenyls	Capacitors, dielectric fluid lubricants, motors and so on	Food (may cause dust accumulation) and soil	Thyroid dysfunction
Polychlorinated dibenzodioxins, polychlorinated	By-product of gorenje	Air, soil, dust and steam	Thyroid dysfunction
Main toxic components	Radiation source	Impact environment	The main health hazard
Chrome	Anti-corrosion of films, memory disks and so on	Soil, water, air, dust	Reproductive health, DNA damage
Lead	Printed circuit boards, computer monitors, lamps, televisions	Dust, air, water, soil	Reproductive health, increased mental illness, DNA
Nickel	Batteries	Dust, soil, air, food	Lung dysfunction and growth
Copper	Wires, printed circuit boards, and so on	Dust, air, water, soil	Headaches, dizziness, irritation of the eyes, nose,
Mercury	Thermostats, computer monitors, cell phones, circuit boards, sensors, and so on	Food, water, soil	Reproductive health, increased mental illness, DNA
Cadmium	Circuit breakers, connecting components, PCBs, semiconductor chips, batteries, computer monitors, cell	Dust, water, soil, air, food	Reproductive health, DNA damage
Polycyclic aromatic hydrocarbons	Burning of by-products	Air, water, soil, dust	Reproductive health

Below we will consider the methods of disposal of EEE and compliance with environmental safety during their processing.

Pneumatic technologies, which successfully combine the effects of fluidized bed, medium vibration and pneumatic separation, are successfully applied in cases of separation of various particles from electronic waste. It is very important that the feed mixture is uniform in particle size, which guarantees **effective separation**. Ferrous metals are easily separated in the magnetic separator used in the metalworking industry. Almost all non-ferrous metals can be separated in an electrostatic separator due to their high eddy current conductivity. The eddy current separation method was developed in the waste disposal industry when a strong permanent iron-boron-neodymium alloy was introduced. The eddy current rotating belt unit is most widely used for the separation of non-ferrous metals into fractions. In the process of its application, an alternating magnetic field, generated by a rapidly rotating wheel with permanent magnets with alternating poles attached to it, creates eddy currents that generate a magnetic field repulsed from the original magnetic field. The resulting repulsive force and gravitational force separate non-ferrous metals from non-conductive materials.

The hydrometallurgical separation method depends on the selective dissolution of the metals contained in the PP. The efficiency of all hydrometallurgical methods is increased with the use of pre-grinding, but this is done primarily to reduce the bulk of the bulk material and in order to provide a larger metal pickling surface. Using the selective dissolution method, highly efficient copper chloride or ammonium sulfate pickling solutions can be used to dissolve copper; solutions based on nitric acid for dissolving solder and aqua regia for dissolving precious metals. The material is recovered through chemical processing, which includes gasification and pyrolysis. There are various traditional and some modern methods for recovering valuable metallic and non-metallic fractions from printed circuit boards.

Pyrolysis is a chemical processing method widely used for the processing of synthetic polymers, including polymers that are mixed with glass fibers. Pyrolysis of such polymers produces gases, oils and symbols. These products can also be used as chemical raw materials or fuels.
Techniques have been developed that use non-metallic printed circuit board materials in composite boards. Composite boards find applications in many areas including automobiles, furniture, hardware and decorative materials. Phenolic compounds are

used in the manufacture of radios, kitchen utensils and electronic keys. In addition to the above methods, non-metallic waste fractions can also be used for the production of reinforcing fillers of thermoplastic resins of metal composites. Non-metallic fractions have been effectively used as reinforcing fillers in polypropylene, as it provides increased strength and stiffness, with a particle size between 0.178-0.104 mm.

Mechanical cleaning systems are now commercially available to recycle a wide variety of e-waste materials, including component boards and blank boards. One of these systems was developed by Hamos GmbH in Germany and is an automated integrated mechanical processing system that includes the following steps:

- primary crushing of coarse fractions using a grinder with rotating knives for various applications;
- separation of large fractions of ferrous metals using strong magnets located above the vibrating conveyor;
- Powder grinding - in this process, the boards are turned into powder in a ball mill, which uses abrasion-resistant balls;
- screening using self-cleaning sieves;
- electrostatic separation, which actually allows the separation of metal fractions to be completed by recirculation of medium-sized particle fractions;
- further size reduction, which is a secondary pulverization to reduce the size of coarse particles.

The Hamos ERP system can optionally include a density fractionator for the recovery of aluminum and other metals [12].

In conclusion, it can be noted that due to the complexity of the composition, the harmfulness of individual components and the low yield of recycled EEE products, their re-processing and disposal from an economic point of view is not justified, but from an environmental point of view and environmental protection they have an important role. But at the same time, before carrying out the relevant work, it is necessary to pay attention to the strict observance of a number of requirements that ensure the environmental safety of all technological processes. Namely, it is necessary to use personal equipment (protective gloves, goggles, respirators, appropriate headgear and footwear, overalls and, if necessary, a gas mask), corresponding to a certain hazard class of the recycled waste. The room for carrying out these works must comply with sanitary standards (illumination, temperature, humidity, equipment with an aspiration ventilation system). In addition, gas and dust treatment plants, fire-fighting equipment

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must be installed in the room, and automated systems and devices for controlling the technological process of waste processing must be provided.

List of Reference

1. S. B. Gaibnazarov, N. I. Ibragimov. Methodological guide for the discipline solid waste disposal. Tashkent, TSTU, 2019. -136 p.
2. N. I. Ibragimov, L. S. Rakhimova. Disposal of solid household waste. Textbook. "Printing house of the scientific and technical center". Tashkent, 2019. -266 p.
3. Technology for extracting precious metals from electrical waste [Electronic resource]: http://www.waste.ru/modules/section/item.php7itemid = 233 (date4).
4. A. A. Dreyer, A. N. Sachkov, K. S. Nikolsky, Yu. I. Mironov, A.V. Mironov. Solid industrial and household waste, their properties and processing. 2004. p. 57
5. A. I. Murashkin., I. V. Andrujak. The use of waste for the production of rare earth metals. Siberian Federal University. Krasnoyarsk 2017.
6. Lamzina I. V., Goldov A.V., Knyazev Ya. I., Polozova I. A., Zheltobryukhanov V. F., Engineering Bulletin of the Don, No. 2, 2014.
7. Gafiyatova T. P., Lebedeva O. I., Bulletin of the Kazan Technological University, No. 2, 437-440. 2015.
8. Sheina S. G., Babenko L. L., Nedelko S. S., Kobalia N. B., Naukovedenie, No. 4, 1-16. 2012.
9. Parmukhina E. L., Ecological Bulletin of Russia, No. 10, 26-27. 2011.
10. Petrov, V. G. Garbage sorting lines. Prospects of Application, Institute of Applied Mechanics, Ural Branch of the Russian Academy of Sciences, Izhevsk, 2005, 112 p.
11. Slyusar N. N., Borisov D. L., Grigoriev V. N. Bulletin of PNRPU. Urban Studies No. 12, 75-82. 2011.
12. Manual sorting of garbage and waste (MSW) [Electronic resource]. –[2014]. - D5 mode Processing of boards (printed, electronic, maternal) [Electronic resource]: http://netmus.ru/katalog-tipovyh-resheniy/pererabotka elektroniki/ (accessed 17.06.2016).