МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ
НАЦІОНАЛЬНИЙ АВІАЦІЙНИЙ УНІВЕРСИТЕТ
ФАКУЛЬТЕТ ЕКОЛОГІЧНОЇ БЕЗПЕКИ,
ІНЖЕНЕРІЇ ТА ТЕХНОЛОГІЙ
КАФЕДРА ЕКОЛОГІЇ

ДОПУСТИТИ ДО ЗАХИСТУ
Завідувач випускової кафедри
_____ В.Ф. Фролов
«_____» _____ 2020 р.

ДИПЛОМНА РОБОТА

(ПОЯСНЮВАЛЬНА ЗАПИСКА)

ВИПУСКНИКА ОСВІТНЬОГО СТУПЕНЯ МАГІСТРА

ЗА СПЕЦІАЛЬНІСТЮ 101 «ЕКОЛОГІЯ»,
ОСВІТНЬО-ПРОФЕСІЙНОЮ ПРОГРАМОЮ
«ЕКОЛОГІЯ ТА ОХОРОНА НАВКОЛИШНЬОГО СЕРЕДОВИЩА»

Тема: «Розробка обладнання для переробки побутових відходів»

Виконавець: студентка групи ЕК- 202 ма, Тодорович Олена Сергіївна
(студент, група, прізвище, ім'я, по батькові)

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Нормоконтролер: _____ (підпис) Явнюк А.А. (П.І.Б.)

КИЇВ 2020

MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
NATIONAL AVIATION UNIVERSITY
FACULTY OF ENVIRONMENTAL SAFETY, ENGINEERING,
AND TECHNOLOGIES
ECOLOGY DEPARTMENT

APPROVED TO DEFENCE
Head of the Graduate Department
_____ V.F. Frolov
«_____» _____ 2020

MASTER THESIS

(EXPLANATORY NOTE)

SPECIALTY 101 "ECOLOGY",
TRAINING PROFESSIONAL PROGRAM
"ECOLOGY AND ENVIRONMENTAL PROTECTION"

Theme: «**Municipal waste recycling equipment development** »

Done by: student of the ЕК– 202 ма group, Olena S. Todorovych
(student, group, surname, name, patronymic)

Supervisor: Ph. D. in Technological Sc., Associate Professor, Lesia I. Pavliukh
(academic degree, academic rank, surname, name, patronymic)

Consultant of the chapter "Labor Precaution": _____ Olena V. Konovalova
(signature) (S.N.P.)

Standards Inspector: _____ Andrian A. Iavniuk
(signature) (S.N.P.)

KYIV 2020

NATIONAL AVIATION UNIVERSITY

Faculty of Environmental Safety, Engineering and Technologies

DepartmentofEcology

Specialty, training professional program: specialty 101 “Ecology”,Training Professional Program “Ecology and Environmental Protection”

(code, name)

APPROVED
Head of the Department
_____Frolov V.F.
«____» _____ 2020

MASTER THESIS ASSIGNMENT

Olena S. Todorovych

1.Theme: «Municipal waste recycling equipment development» approved by the Rector on on September 06, 2020, № 1937/ст.

2. Duration of work: from 06.10.2020 to 21.12.2020.

3. Output work (project): statistical data of waste production, data from the polls of the population.

4.Content of explanatory note: (list of issues): Analytical review of the literature on the topic of the diploma. Conducting a survey among the population of Ukraine in 2019 and 2020, conducting an experiment on composting waste at home for 5 months, developing a device for processing organic waste with a prototype, developing a device for sorting dry waste, an agreement with a potential plant in Kharkov, proposed social waste management program.

5. The list of mandatory graphic (illustrated materials): 8 tables, 22 figures.

6. Schedule of thesis fulfillment

№ з/п	Task	Term	Advisor's signature
1	Receive themes task, search the literature and legislation	06.09.2020-12.09.2020	
2	Preparing the main part (Chapter I)	13.09.2020-26.09.2020	
3	Preparing the main part (Chapter II)	27.09.2020-13.10.2020	
4	Preparing the main part (Chapter III)	14.10.2020-29.10.2020	
	Preparation of the main part (Chapter IV)	30.10.2020-08.11.2020	
	Consultation on section V (Occupational safety)	05.11.2020	
	Preparation of the main part (Chapter V)	09.11.2020-21.11.2020	
5	Formulating conclusions and recommendations of the thesis	22.11.2020-24.11.2020	
6	Making an explanatory note to the previous presentation of the department, consultation with the norms controller	25.11.2020-30.11.2020	
7	Presentation of the work at the department	01.12.2020	
8	Taking into account the comments and recommendations and training to protect	02.12.2020-20.12.2020	
9	Thesis defense at the department	21.12.2020	

7. Consultant(s) of certain chapter(s):

Chapter	Consultant (academic rank, S.N.P)	Date, signature	
		Given by	Accepted by
Labor Precaution	Olena V. Konovalova, Associate professor Chair of Civil and Industrial Safety		

8. Date of task issue: «06» September 2020

Qualification Paper Advisor: _____ Lesia I. Pavliukh
(advisor's signature) (S.N.P.)

Task is taken to perform: _____ _____
(graduate's signature) (S.N.P.)

НАЦІОНАЛЬНИЙ АВІАЦІЙНИЙ УНІВЕРСИТЕТ

Факультет екологічної безпеки, інженерії та технологій

Кафедра екології

Спеціальність, освітньо-професійна програма: спеціальність 101 «Екологія»,ОПП «Екологія та охорона навколишнього середовища»

(шифр, найменування)

ЗАТВЕРДЖУЮ
Завідувач кафедри
_____Фролов В.Ф.
«____» _____ 2020 р.

ЗАВДАННЯ
на виконання дипломної роботи
Тодорович олени Сергіївни

1. Тема роботи «Розробка обладнання для переробки побутових відходів» затверджена наказом ректора від 06 вересня , 2020, № 1937/ст.

2. Термін виконання роботи: з 06.10.2020 р. по 21.12.2020 р.

3. Вихідні дані роботи: статистичні дані виробництва відходів, дані опитувань населення.

4. Зміст пояснювальної записки: Аналітичний огляд літератури за темою диплому. Проведення опитування серед населення України у 2019 та 2020 роках, проведення експерименту з компостування відходів вдома протягом 5 місяців, розробка пристрою для переробки органічних відходів з прототипом, розробка пристрою для сортування сухих відходів, угода з потенційним заводом у Харкові, запропонована програма управління соціальними відходами.

5. Перелік обов’язкового графічного (ілюстративного) матеріалу: 8 таблиць, 22 рисунки.

6. Календарний план-графік

№ з/п	Завдання	Термін виконання	Підпис керівника
1	Отримання теми завдання, пошук літературних джерел та законодавчої бази	06.09.2020-12.09.2020	
2	Підготовка основної частини (Розділ I)	13.09.2020-26.09.2020	
3	Підготовка основної частини (Розділ II)	27.09.2020-13.10.2020	
4	Підготовка основної частини (Розділ III)	14.10.2020-29.10.2020	
5	Підготовка основної частини (Розділ IV)	30.10.2020-08.11.2020	
6	Консультація щодо розділу V(Охорона праці)	05.11.2020	
7	Підготовка основної частини (Розділ V)	09.11.2020-21.11.2020	
8	Формулювання висновків та рекомендацій дипломної роботи	22.11.2020-24.11.2020	
9	Оформлення пояснювальної записки до попереднього представлення на кафедрі, консультація з нормоконтролером	25.11.2020-30.11.2020	
10	Представлення роботи на кафедрі	01.12.2020	
11	Урахування зауважень, рекомендацій та підготовка до захисту	02.12.2020-20.12.2020	
12	Захист роботи на кафедрі	21.12.2020	

7. Консультація з окремого(мих) розділу(ів):

Розділ	Консультант (посада, П.І.Б.)	Дата, підпис	
		Завдання видав	Завдання прийняв
Охорона праці	Коновалова Олена Вікторівна, доцент Кафедра цивільної та промислової безпеки		

8. Дата видачі завдання: «06» вересня 2020 р.

Керівник дипломної роботи : _____ Павлюх Л.І.
(підпис керівника) (П.І.Б.)

Завдання прийняв до виконання: _____ _____
(підпис випускника) (П.І.Б.)

ABSTRACT

Explanatory note to thesis « Municipal waste recycling equipment development»: 95 pages, 22 figures, 8 tables, 46 references.

Object of research – the process of waste management.

Subject – the process of waste management.

Aim of work – is to improve and develop the municipal waste recycling equipment separately for organic waste (equipment for composting) and for other (equipment for recycling).

Methods of research: analysis, data comparison, statistical data processing, mathematical modeling.

MUNICIPAL WASTE, RECYCLING, SORTING, TECHNOLOGY, COMPOSTING, DEVICE FOR RECYCLING, SDW TREATMENT, GREENWASHING, ECOHABITS, SOLUTION OF WASTE PROBLEM.

CONTENT

INTRODUCTION

Relevance of the work. Nowadays, tons of garbage are produced each year, which can be reused as a valuable resource. Recycling using modern environmentally friendly technologies, including waste disposal, is a very effective way to solve the problem, but it is necessary to change the usual behavior of people, as household waste must be sorted, as the problem of waste is high due to slow decomposition (for example, paper breaks down in 2-10 years, cans - almost 100 years, polyethylene materials - 200 years, plastic - 500 years, and glass for complete decomposition requires 1000 years).

Every European country has special containers for sorting garbage. Typically, waste is divided into several main categories: plastic, paper, glass, organic waste and metal.

By the way, if we all sort household waste, and utilities provide everyone with containers for separate sorting and service them in a timely and high-quality manner, the waste processing industry would be profitable in Ukraine, because sorted waste is much more expensive than unsorted waste, which attracts investment. to this industry. In the end, the average citizen wins because living in a clean country is an elementary "garbage culture."

For comparison, more than 60% of waste is recycled in EU countries. The leader is Sweden, where 99% of all waste in the country is recycled. With the help of secondary raw materials, houses are heated and supplied with electricity. In addition, Sweden imports garbage from other countries.

The situation is similar in Germany, Switzerland, Austria and a number of other countries. They have landfills as such are generally closed, because 97% of waste is recycled. Recycling companies use waste as an energy source. This saves billions of liters of petroleum products. In addition to saving budget funds, such companies create jobs and solve environmental problems.

Aim and tasks of the diploma work

The aim of work is to improve and develop the municipal waste recycling equipment separately for organic waste (equipment for composting) and for other (equipment for recycling).

Tasks of the work:

- To analyze waste management problems and technologies in Ukraine and the world.
- To poll residents of Ukraine and compare results 2020 vs 2019
- To calculate municipal waste generation
- To develop equipments for recycling of waste
- To propose recommendations for waste management program in Ukraine.

Object of research is waste management.

Subject of research is development of waste recycling equipment.

Methods of research – Analysis, data comparison, statistical data processing, mathematical modeling.

Scientific novelty of the obtained results. Equipment for composting (for organic waste) was developed; equipment for recycling (for other waste) was developed; waste management program in Ukraine was proposed.

Practical importance of theobtained results. The results of the survey among the population of Ukraine in 2019 and 2020 can be used as proof of what to look for when solving the problem of garbage, composting experiment shows the productivity of organic waste, development of devices allows to make them and use on a domestic and industrial scale, proposed social program solving the waste problem will be used to spread and raise environmental awareness.

Personal contribution of the graduate: Conducting a survey among the population of Ukraine in 2019 and 2020, conducting an experiment on composting waste at home for 5 months, developing a device for processing organic waste with a prototype, developing a device for sorting dry waste, an agreement with a potential plant in Kharkov, proposed social waste management program.

Approbation of results.

1. Diploma of the first degree laureate at All-Ukrainian competition "Technogenic Safety". -Lviv, Ukraine, 2019.
2. Laureate of the second degree of Elephant Fund Hakaton Ukraine / Shamansky S., Pavliukh L., Syrotina I., Todorovych O. – Kyiv, 2019.
3. Certificate Approval of Scientific Research Results at International scientific conference of young scientists "Ecology, neoecology, protection of the environment and the balanced use of nature", Kharkiv. Ukraine, 2018
4. Diploma of the laureate of the first degreeat All-Ukrainian competition "Youth and progress in rational nature management", Kyiv, Ukraine, 2017

Publications.

1. Analysis of waste dealing in Ukraine and in the world/ Todorovych O.S - V International Scientific and Practical Conference of: "Ecology, neoecology, protection of the environment and the balanced use of nature." - Kharkiv. Ukraine, 2018. – p. 219
2. Identification of plastic types before sorting/Todorovych O.S. – II International Scientific and Practical Internet Conference: “EFFECTIVE FUNCTIONING ENVIRONMENTALLY-STABILIZED TERRITORIES IN CONTEXT OF STRATEGY FOR SUSTAINABLE DEVELOPMENT: AGROECOLOGICAL, SOCIAL AND ECONOMIC ASPECTS.” – Poltava, Ukraine, 2018. – p.222
3. How to choose packaging for food/ Todorovych O.S. – XXIV International Scientific and Practical Internet Conference: “NEWS OF XXI CENTURY SCIENCE.” – Vynnytsia, Ukraine, 2018. – p.77
4. Recommendations for waste sorting in apartments / Todorovych O.S., Syrotina I.O.- IV International Scientific and Practical Conference: "MODERN TECHNOLOGIES OF INDUSTRIAL COMPLEX: BASIC PROCESSING INNOVATIONS." - Kherson, 2018.-p.321.
5. Recommendations for waste sorting in private house / Syrotina I.O., Todorovych O.S. - IV International Scientific and Practical Conference: "MODERN TECHNOLOGIES OF INDUSTRIAL COMPLEX: BASIC PROCESSING INNOVATIONS." - Kherson, Ukraine, 2018.- P.319.

6. Methane from waste as fuel for motor vehicles / Syrotina I.O., Todorovych O.S.,– 21th conference for Lithuanian junior researches «Science – future of Lithuania. Transport Engineering and Management». – Vilnius, Lithuania, 2018.

7. Assessment of waste management treatment ways / Todorovych O.S., Syrotina I.O. - All-Ukrainian Scientific and Practical Conference of Young Scientists and Students "Ecological Safety of the State". – Kyiv, Ukraine, 2018. - P.108

8. Environmental audit in Ukraine / Todorovych O.S., Syrotina I.O. - All-Ukrainian Scientific and Practical Conference of Young Scientists and Students "Ecological Safety of the State". - Kyiv, Ukraine, 2018. - P.110

9. Issues of waste situation in UkraineTodorovych O.S. - International Scientific and Practical Conference "Polit. Challenges of science today", Kyiv, 2018

10. Conceptual approach of waste treatment/Todotovych O.S., Syrotina I.O. - SCIENTIFIC-PRACTICAL CONFERENCE ANOTHER TOUR OF THE ALL-UKRAINIAN COMPETITION STUDENT SCIENTIFIC WORKS OF SPECIALTY 183 "ENVIRONMENT PROTECTION TECHNOLOGIES" – Odesa, Ukraine, 2018 – p.29

11. Reforestation of municipal waste landfill, International scientific and practical conference "Permaculture and organic agroculture", Uzhhorod, Ukraine, 2018 – p.31

CHAPTER 1
ANALYSIS OF WASTE RECYCLING METHODS

1.1. Classification of waste

According to the Law of Ukraine "On Waste" [1], waste management is actions aimed at preventing the generation of waste, their collection, transportation, sorting, storage, treatment, processing, disposal, disposal, disposal and disposal, including control over these operations and supervision of removal sites.

Household waste is waste generated in the process of human life and activity in residential and non-residential buildings (solid, large, repair, liquid, except for waste associated with the production activities of enterprises) and is not used at the place of their accumulation.

According to the Law of Ukraine "On Housing and Communal Services" [2] services for household waste management - services for the removal, processing and disposal of household waste provided in the village in accordance with the rules of landscaping, developed taking into account the scheme of sanitation settlement and approved by the local government.

Sources of household waste generation include facilities where household waste is generated (residential building, enterprise, institution, organization, land plot). Quantitative and qualitative characteristics of household waste are not constant and depend on the sources of their generation. In general, the composition of solid waste includes:

- food waste (vegetables, fruits, gardening waste, etc.);
- paper and cardboard;
- polymers (plastics, plastics);
- glass;
- ferrous metals;
- non-ferrous metals;

- textiles;

- tree;

- hazardous waste (batteries, dry and electrolytic batteries, containers from solvents, paints, mercury lamps, television tubes , etc.);

- bones, skin, rubber;

- residual solid waste after removal of components (small construction debris, stones, street litter, etc.)

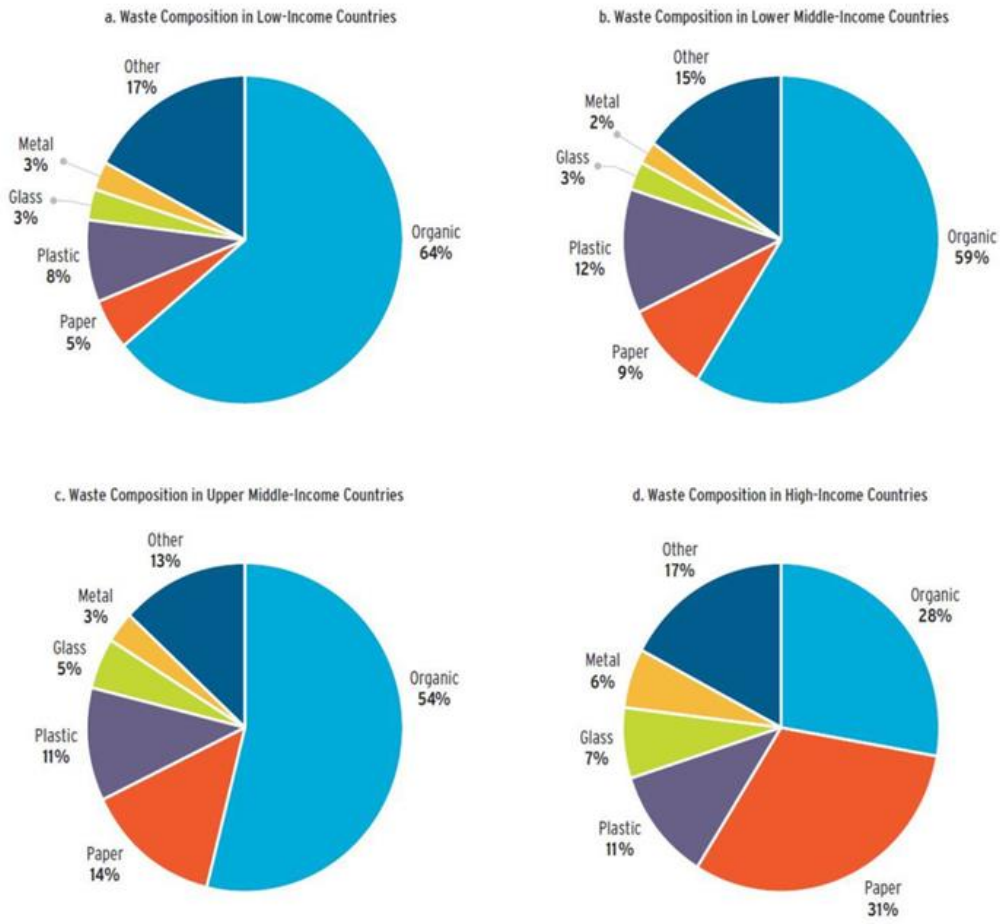

Fig. 1.1. Waste composition per income level [13]

Updated country income classifications for the World Bank's 2020 fiscal year are available here [14]. The World Bank classifies the world's economies into four income groups — high, upper-middle, lower-middle, and low. We base this assignment on Gross National Income (GNI) per capita (current US$) calculated using the Atlas method [15]. The classification is updated each year on July 1st.

The classification of countries is determined by two factors:

1. A country's GNI per capita, which can change with economic growth, inflation, exchange rates, and population. Revisions to national accounts methods and data can also influence GNI per capita.
2. Classification threshold: The thresholds are adjusted for inflation annually using the SDR deflator.

Until last year (Fiscal Year 2019), the income classifications had an analytical purpose and did not influence the World Bank's lending terms. However, since the last fiscal year, the high-income threshold is also a determining factor for lending rates. Surcharges are applied for lending rates of countries which have been categorized as high income for two consecutive years [16].

Updated Thresholds

New thresholds are determined at the start of the World Bank's fiscal year in July and remain fixed for 12 months regardless of subsequent revisions to estimates. The thresholds for income classification have increased from last year due to SDR inflation.

Table 1.1

The new thresholds for classification by income

Threshold	July 2019/$ (new)	July 2018/$ (old)
Low income		
Lower-middle income	1,026 - 3,995	996 - 3,895
Upper-middle income	3,996 - 12,375	3,896 - 12,055
High income	> 12,375	> 12,055

The country and lending groups page provides a complete list of economies classified by income, region, and lending status and links to previous years' classifications. The classification tables include all World Bank members, plus all other economies with populations of more than 30,000. The term country, used interchangeably with economy,

does not imply political independence but refers to any territory for which authorities report separate social or economic statistics [16].

According to the forecasts of the World Bank [3] , in 2025, city dwellers will produce an average of 1.42 kg / person of solid waste per day - compared to the current 0.64 kg.

According to the Law of Ukraine "On Housing and Communal Services" [2] the criterion for the quality of services for the removal of household waste is compliance with the schedule of removal of household waste, compliance with the rules and requirements of legislation on the provision of services for household waste.

The world generates 2.01 billion tonnes of municipal solid waste annually, with at least 33 percent of that—extremely conservatively—not managed in an environmentally safe manner. Worldwide, waste generated per person per day averages 0.74 kilogram but ranges widely, from 0.11 to 4.54 kilograms. Though they only account for 16 percent of the world's population, high-income countries generate about 34 percent, or 683 million tonnes, of the world's waste.

When looking forward, global waste is expected to grow to 3.40 billion tonnes by 2050, more than double population growth over the same period. Overall, there is a positive correlation between waste generation and income level. Daily per capita waste generation in high-income countries is projected to increase by 19 percent by 2050, compared to low- and middle-income countries where it is expected to increase by approximately 40% or more. Waste generation initially decreases at the lowest income levels and then increases at a faster rate for incremental income changes at low income levels than at high income levels. The total quantity of waste generated in low-income countries is expected to increase by more than three times by 2050. The East Asia and Pacific region is generating most of the world's waste, at 23 percent, and the Middle East and North Africa region is producing the least in absolute terms, at 6 percent. However, the fastest growing regions are Sub-Saharan Africa, South Asia, and the Middle East and North Africa, where, by 2050, total waste generation is expected to more than triple, double, and double respectively. In these regions, more than half of waste is currently

openly dumped, and the trajectories of waste growth will have vast implications for the environment, health, and prosperity, thus requiring urgent action.

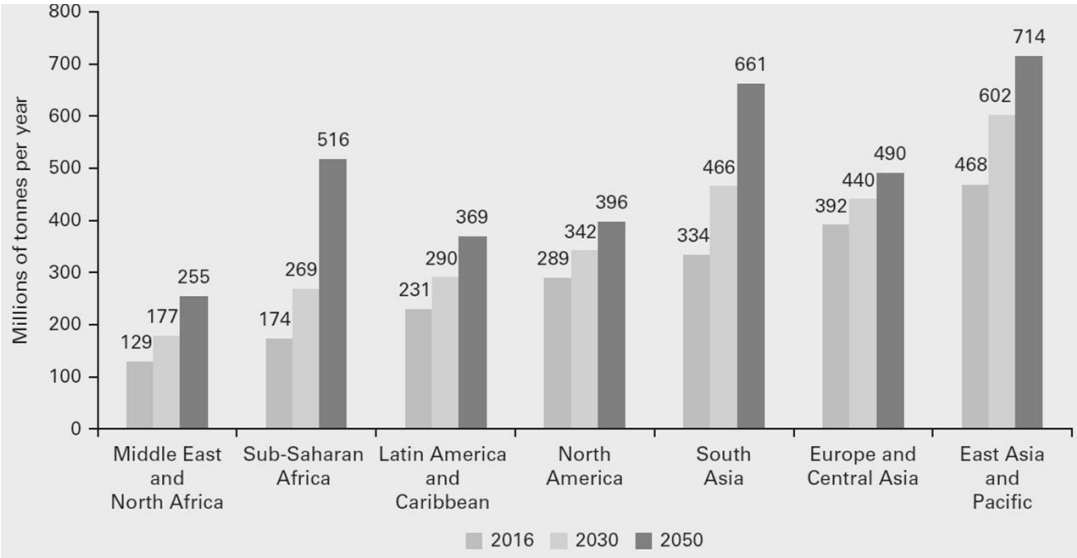

Fig. 1.2. Projected waste generation, by region (millions of tonnes/year)

Waste collection is a critical step in managing waste, yet rates vary largely by income levels, with upper-middle- and high-income countries providing nearly universal waste collection. Low-income countries collect about 48 percent of waste in cities, but this proportion drops drastically to 26 percent outside of urban areas.

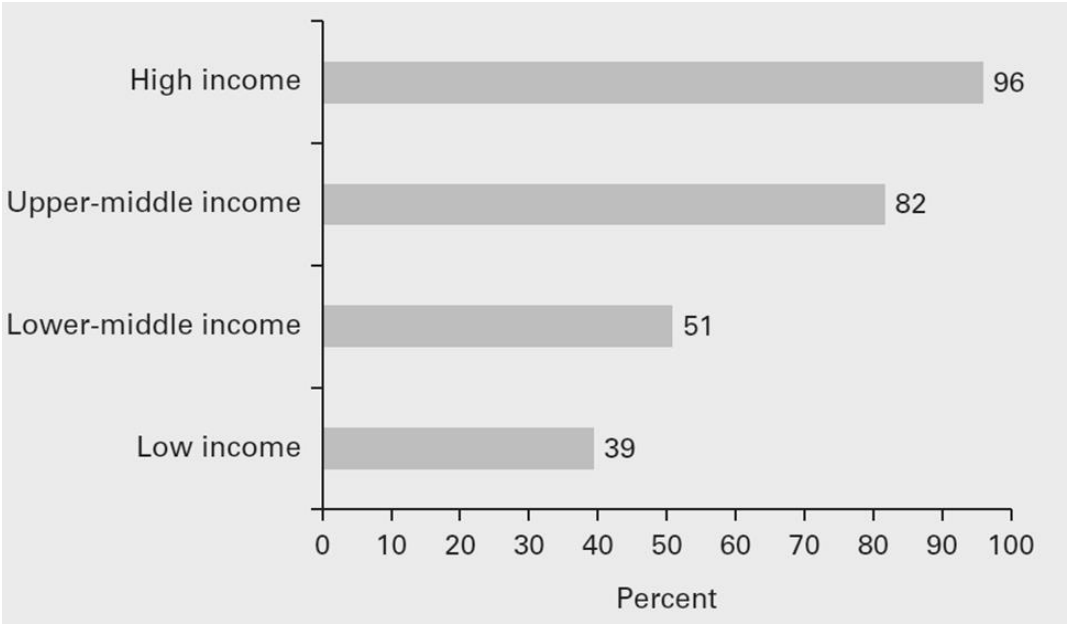

Fig.1.3. Waste collection rates, by income level (percent)

Waste composition differs across income levels, reflecting varied patterns of consumption. High-income countries generate relatively less food and green waste, at 32 percent of total waste, and generate more dry waste that could be recycled, including plastic, paper, cardboard, metal, and glass, which account for 51 percent of waste. Middle- and low-income countries generate 53 percent and 57 percent food and green waste, respectively, with the fraction of organic waste increasing as economic development levels decrease. In low-income countries, materials that could be recycled account for only 20 percent of the waste stream. Across regions, there is not much variety within waste streams beyond those aligned with income. All regions generate about 50 percent or more organic waste, on average, except for Europe and Central Asia and North America, which generate higher portions of dry waste.

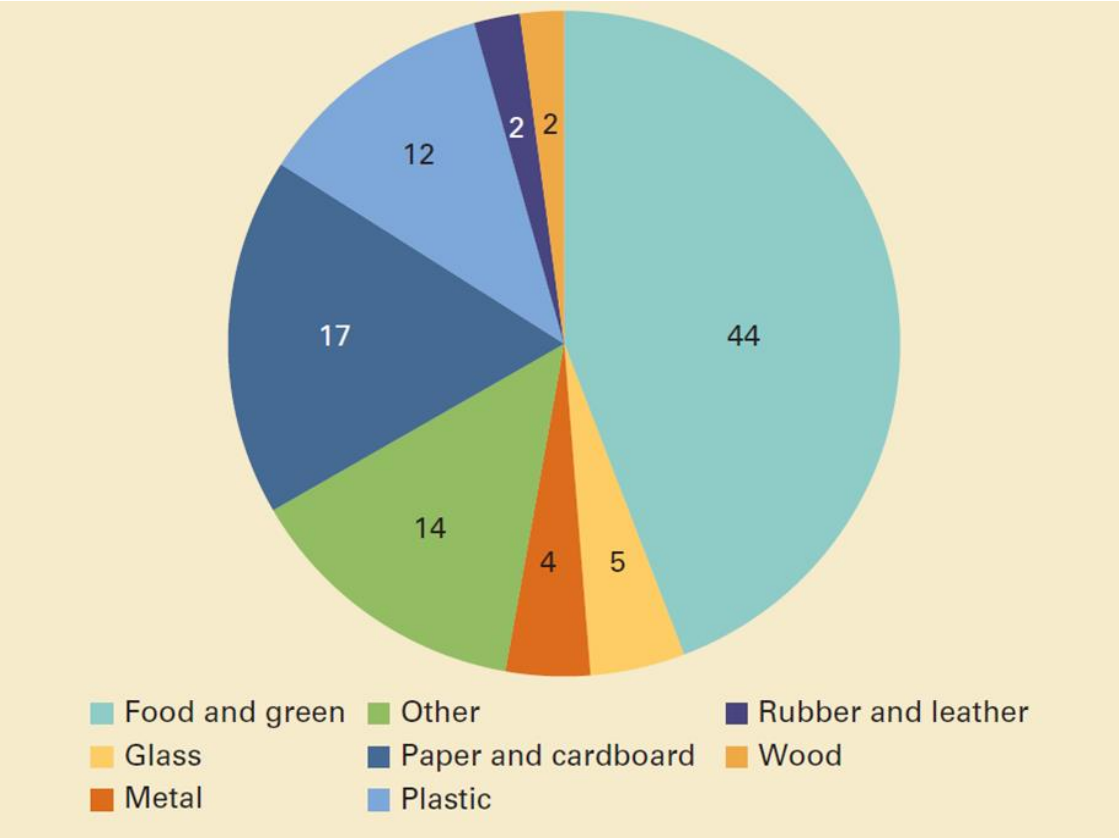

Fig.1.4. Global waste composition (percent)

It is a frequent misconception that technology is the solution to the problem of unmanaged and increasing waste. Technology is not a panacea and is usually only one factor to consider when managing solid waste. Countries that advance from open dumping

and other rudimentary waste management methods are more likely to succeed when they select locally appropriate solutions. Globally, most waste is currently dumped or disposed of in some form of a landfill. Some 37 percent of waste is disposed of in some form of a landfill, 8 percent of which is disposed of in sanitary landfills with landfill gas collection systems. Open dumping accounts for about 31 percent of waste, 19 percent is recovered through recycling and composting, and 11 percent is incinerated for final disposal. Adequate waste disposal or treatment, such as controlled landfills or more stringently operated facilities, is almost exclusively the domain of high- and upper-middle-income countries. Lower-income countries generally rely on open dumping; 93 percent of waste is dumped in low-income countries and only 2 percent in high-income countries. Three regions openly dump more than half of their waste—the Middle East and North Africa, Sub-Saharan Africa, and South Asia. Upper-middle-income countries have the highest percentage of waste in landfills, at 54 percent. This rate decreases in high-income countries to 39 percent, with diversion of 36 percent of waste to recycling and composting and 22 percent to incineration. Incineration is used primarily in high-capacity, high-income, and land-constrained countries.

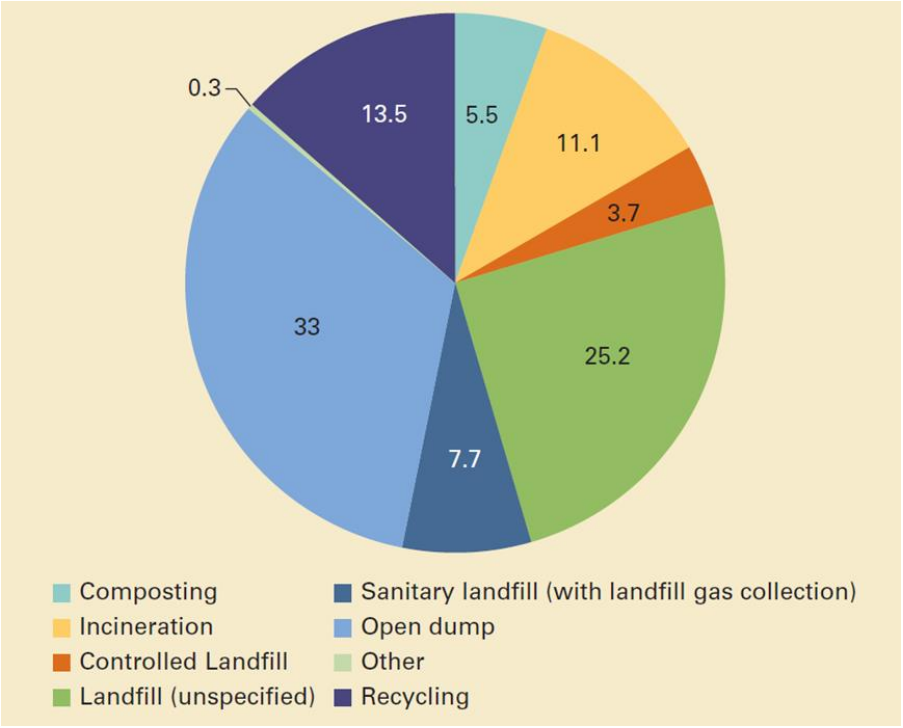

Fig.1.5. Global treatment and disposal of waste (percent)

Based on the volume of waste generated, its composition, and how it is managed, it is estimated that 1.6 billion tonnes of carbon dioxide (CO2) equivalent greenhouse gas emissions were generated from solid waste treatment and disposal in 2016, or 5 percent of global emissions. This is driven primarily by disposing of waste in open dumps and landfills without landfill gas collection systems. Food waste accounts for nearly 50% of emissions. Solid waste–related emissions are anticipated to increase to 2.38 billion tonnes of CO2-equivalent per year by 2050 if no improvements are made in the sector.

In most countries, solid waste management operations are typically a local responsibility, and nearly 70 percent of countries have established institutions with responsibility for policy development and regulatory oversight in the waste sector. About two-thirds of countries have created targeted legislation and regulations for solid waste management, though enforcement varies drastically. Direct central government involvement in waste service provision, other than regulatory oversight or fiscal transfers, is uncommon, with about 70 percent of waste services being overseen directly by local public entities. At least half of services, from primary waste collection through treatment and disposal, are operated by public entities and about one-third involve a public-private partnership. However, successful partnerships with the private sector for financing and operations tend to succeed only under certain conditions with appropriate incentive structures and enforcement mechanisms, and therefore they are not always the ideal solution.

Financing solid waste management systems is a significant challenge, even more so for ongoing operational costs than for capital investments, and operational costs need to be taken into account upfront. In high-income countries, operating costs for integrated waste management, including col-lection, transport, treatment, and disposal, generally exceed $100 per tonne. Lower-income countries spend less on waste operations in absolute terms, with costs of about $35 per tonne and sometimes higher, but these countries experience much more difficulty in recovering costs. Waste management is labor intensive and costs of transportation alone are in the range of $20–$50 per tonne. Cost recovery for waste services differs drastically across income levels. User fees range from an average of $35 per year in low-income countries to $170 per year in high-income countries, with full or

nearly full cost recovery being largely limited to high-income countries. User fee models may be fixed or variable based on the type of user being billed. Typically, local governments cover about 50 percent of investment costs for waste systems, and the remainder comes mainly from national government subsidies and the private sector [17].

1.2. Regulatory framework in Ukraine

Household waste management in Ukraine is carried out in accordance with state norms and standards. These rules are enshrined in the laws of Ukraine "On Housing and Communal Services" [2] , "On Waste" [1] and "On Local Self-Government in Ukraine" [4] . The mechanism for providing business entities with household waste management services in cities, towns and villages, regardless of the form of their ownership, is defined by the Rules for providing household waste management services , approved by the Cabinet of Ministers of Ukraine dated December 10, 2008 № 1070 (as amended) [5], p shutdown th Cabinet of Ministers of Ukraine from 16.11.2011 number 1173 "issue I nada Mr. tion services for the export of waste" [6] , the Resolution of the Cabinet of Ministers of Ukraine of 21.07.2005 number 631 "on the Procedure zavterdzhennya tender for the provision of housing -communal services " [7] . Also the ishennya of Kyyivorady of 14.12.2017 № 697/3704 "On some issues regarding the handling of waste in the city of Kyiv " [8] , p ozporyadzhennya we of the Kyiv City Council (Kyiv City State Administration):

- On establishment I tender committee on the definition of a service provider for the export of waste in the city of Kyiv (Order of the KSCA from 26.07.2016 number 606) [9] ,
- On amendments to the tender committee on the definition of a service of household garbage in s waste in the city of Kyiv (Order of 20.11.2017 number KCSA 1454) [10] ,
- Changes in the composition of the tender committee on the definition of a service provider for the export of waste to tery t Oria in Kyiv (Order of 30.11.2017 number KCSA 1536) [11] ,

- On introduction of the decision jumping with Noah Commission definition of a service provider for the export of waste in the city of Kyiv (Order of the KSCA from 08.12.2017 number 1589) [12]

Features of concluding a contract for the provision of services for household waste management:

Conditions and features of concluding an agreement on the provision of services for the treatment of household waste are defined by the Law of Ukraine "On Housing and Communal Services" [2] .

Until May 1, 2020, the co-owners of an apartment building are obliged to independently choose one of the models of organization of contractual relations for the provision of utilities. In case of non-selection of one of the models of contractual relations, an individual agreement on the provision of household waste management services is concluded between the executor and each co-owner. Owners or tenants, users, including tenants, of sources of household waste generation enter into agreements with the provider of household waste disposal services, pay for household waste management services and provide separate collection of household waste.

The contractor for household waste removal services shall be determined by the local self-government body on a competitive basis in accordance with the procedure established by the Cabinet of Ministers of Ukraine. Associations of co-owners of an apartment building, the manager of an apartment building or another authorized person who enters into a collective agreement on the provision of utilities, in accordance with the rules of landscaping, have the right to choose among statutory contractors for waste disposal.

The provider of household waste disposal services enters into agreements on the provision of household waste management services with consumers. The contractor for household waste disposal is obliged to enter into agreements on the provision of services for processing and disposal of household waste with businesses that provide such services in accordance with the rules of landscaping, developed taking into account the scheme of sanitation of the settlement. Contracts for the provision of municipal waste management services should contain information on concluded agreements between the provider of

municipal waste disposal services and economic entities that provide services for the processing and / or disposal of household waste.

How is a household waste disposal service provider determined?

For state and communal property, the service provider is determined based on the results of a tender conducted in accordance with the Procedure approved by the Cabinet of Ministers of Ukraine dated July 21, 2005 № 631. For privately owned residential buildings, the service provider is determined by the local government, except when homeowners have expressed a desire to determine the service provider themselves.

The procedure for conducting a tender for the provision of services for the removal of household waste approved by the Cabinet of Ministers of Ukraine dated November 16, 2011 № 1173, according to paragraphs 30-31 of which the organizer of the tender within no more than five working days from the date of the tender the decision of the tender commission to determine the winner of the tender in a certain area of the settlement, the boundaries of which were determined by the terms of the tender. An agreement on the provision of services for the removal of household waste in a certain area of the settlement shall be concluded with the winner of the tender within ten calendar days after the decision of the tender commission .

The Law of Ukraine "On Public Procurement" does not apply to a tender to determine the contractor for the removal of household waste. In accordance with paragraph 5 of the fourth part of Article 2, this Law for customers engaged in certain areas of management, does not apply to cases where the subject of procurement are goods, works and services, if prices (tariffs) for them are approved by state collegial bodies, other authorities in accordance with their powers or determined in the manner prescribed by these authorities, including if the determination of such prices is carried out at auctions.

In accordance with paragraph "c" of the first part of Article 18 of the Law of Ukraine "On Waste", the powers of the Cabinet of Ministers of Ukraine include the establishment of tariffs for services for household waste management. The procedure for setting tariffs for household waste management services was approved by the Resolution of the Cabinet of Ministers of Ukraine of July 26, 2006 № 1010.

According to Article 5 of the Law of Ukraine “On Housing and Communal Services”, household waste management services are communal services, which, in turn, belong to housing and communal services.

Article 25 of the Law stipulates that the household waste management service is provided in accordance with the terms of the contract concluded taking into account the features defined by this Law and the requirements of the rules for providing household waste management services approved by the Cabinet of Ministers of Ukraine.

The contract for the provision of services is concluded in accordance with the standard contract, which is given in the annex to the Rules for the provision of services for household waste management, approved by the Cabinet of Ministers of Ukraine dated December 10, 2008 № 1070.

According to Article 35-1 of the Law of Ukraine "On Waste", the executor of services for the removal of household waste is determined by the local government on a competitive basis in the manner prescribed by the Cabinet of Ministers of Ukraine.

Who controls the waste management?

Control in the field of waste management is carried out by the State Ecological Inspectorate of Ukraine - the central executive body that implements state policy on state supervision (control) in the field of environmental protection, rational use, reproduction and protection of natural resources, waste management. At the local level, the field of waste management is controlled by local state administrations, executive bodies of village, settlement, city councils, and public inspectors for the improvement of settlements.

Public control in the field of waste management is carried out by public environmental inspectors in accordance with the law.

1.3. European experience of waste management

1.3.1. Program-targeted approach with clear definition of priorities

In the EU, 61 million tons of solid waste are processed annually into secondary materials [18], which is four times more than the annual volume of solid waste generation

in Ukraine. The level of household waste recycling in Europe it varies greatly depending on the country.

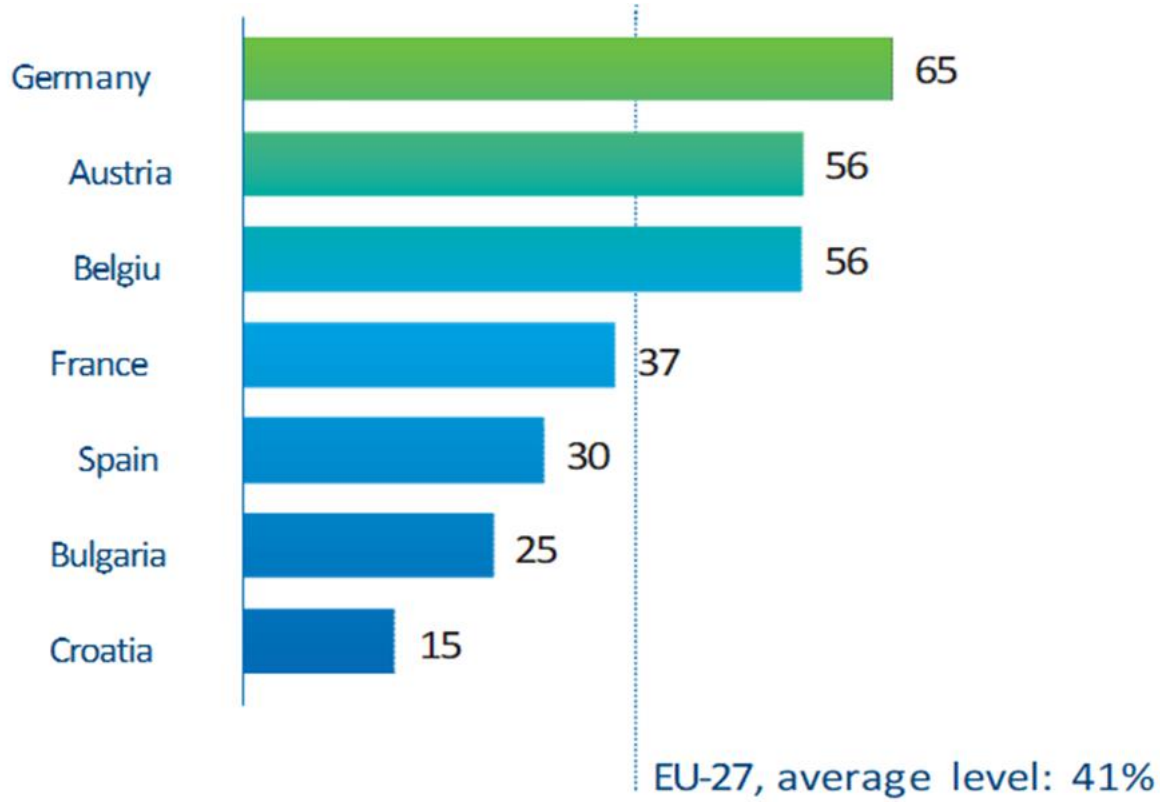

Fig. 1.6. Indicators of solid waste processing in some European countries

It is necessary to create a balanced system of behavior with waste. To achieve this goal, it is necessary to identify long-term strategic priorities that will allow to combine environmental efficiency and rational consumption of material and energy resources.

Unlike industrial waste, which can be significantly reduced through the use of more efficient technologies, it is difficult to prevent waste generation in utilities, and appropriate measures to reduce them may not be very effective, as waste is an integral part of the process of consumption of goods and services (packaging, food waste, used appliances, etc.) by households.

That is why the EU policy in the field of solid waste management is not aimed at preventing the generation of waste, but at building the most environmentally friendly management system with their flows. In Directive № 2008/98 / EC, which is the basic document in the field of behavior on solid waste and was adopted in 2008, the priority objectives of the policy on solid waste management are environmental protection,

minimization of negative impact formation of solid waste and their treatment for the environment and public health.

The Directive sets out the basic principles for the organization of the treatment system with solid waste and requirements for it. The direct structure of the system is set by each country independently.

According to this directive, when choosing methods of solid waste management in the first place should be guided by the principles of environmental safety and economic efficiency. All methods of waste management are presented in the form of so-called "Lansink stairs".

Fig. 1.7. Solid Waste Management Hierarchy [19]

The greatest preference is given to waste prevention. Among recycling methods, waste reuse has the highest priority because of its negative impact to the environment is minimal (as an example, the reuse of glass containers), and the smallest - the disposal of waste in landfills and landfills.

Waste incineration and processing into secondary materials and energy occupy an intermediate position in the hierarchy. It is assumed that in parallel with the development of the treatment system waste will be gradually moved up the "stairs", ie more environmentally friendly methods of waste management will begin to prevail.

As the EU experience shows, the definition of priorities is determined primarily by the choice of society and the guidelines set at the national level. At the same time, in order to establish achievable indicators of projects and programs, it is advisable to take into account regional differences in the volume and structure of waste generation, potential demand for secondary materials and energy, climate and seasonal factors, availability and quality of land resources.

Given the need to increase the level of waste recycling, in EU countries, priority is given to methods that minimize net losses of materials and energy.

At the same time, each country chooses approaches to work to achieve results, types of projects and technologies, taking into account local peculiarities.

A key element in the development of the waste management system in the EU has been the transition from a procedural approach focused on technical and sanitary regulation of individual procedures and stages of waste management, to the program-target, which is to build a hierarchy of targets and develop approaches to their achievement, taking into account local specifics.

Priorities in solid waste management are determined by EU directives, which enshrine the basic principles, requirements and targets of the system. Legislators of individual countries decide on the application of specific approaches and mechanisms to achieve certain goals (in including appropriate incentives). Market operators define procedures and technologies for the provision of services to achieve targets and ensure compliance with EU sanitary and environmental requirements.

The general basic principles of the EU policy in the field of solid waste management can be classified into three main groups:

1) ensuring environmental safety in accordance with standards (requirements) during the life cycle of solid waste;

2) setting priorities in accordance with the above hierarchy of solid waste management methods;

3) full-scale implementation of the "polluter pays" principle in two areas:

- the principle of extended producer responsibility - the producer pays;

- waste disposal entities (households and organizations) pay in full for the most environmentally friendly method of recycling and disposal.

An important aspect at the initial stage of creating a system is compliance with social and environmental standards: full coverage of households with services for collection and transportation of solid waste, responsible disposal of solid waste in landfills, taking into account the established sanitary requirements. Only after the construction of the basic infrastructure it becomes possible to further develop this industry by improving waste management methods. EU countries have followed this path in different ways. Developed countries have progressed evolutionarily, step by step. What to the new member states of the EU (EU-12), they overcame this path on an accelerated trajectory. The key to achieving the set goals and ensuring the effectiveness of regional policy is the issue of waste ownership. Distribution of property rights for waste, which is enshrined in Ukrainian legislation, is stored in the former socialist countries of Europe. In the countries that have shown the greatest success in the field of waste management (for example, in Scandinavia), there is a system in which municipalities are the owners of waste.

If businesses or households dispose of waste, they give up ownership of it, while polluting the environment. At the same time, they have to pay in full for the disposal of such waste. Municipalities independently or together with other municipalities decide on how to handle waste.

Households pay the highest rate for landfilling, while they pay slightly less for waste incineration. In general, households are interested in separate waste collection and recycling.

EU countries are approaching another important stage - the development of national solid waste management plans aimed at preventing the generation of waste to be developed until November 1, 2013.

The next stage after reaching the marginal indicators of financial efficiency and increasing the indicators of waste processing (not less than 50-60% in general and by individual components) is the creation of a comprehensive system of waste-free production and consumption. The principle of "zero waste" is actively promoted in the context of "green" economy, and in the context of corporate ethics in office work.

1.3.2. Evolutionary and accelerated ways to improve the solid waste management system in Europe: key conclusions for Ukraine

The experience of developing solid waste management systems in Belgium and Hungary is indicative.

Belgium is one of the countries with the most developed waste management systems. As of 2009, landfills accounted for less than 4% 38 of solid waste, almost 40% was recycled for secondary materials, 23% went to composting and 34% to incineration.

To date, the share of solid waste destined for incineration has decreased. In addition, it was planned to reduce the amount of waste incinerated from 161 kg per capita in 2005 up to 150 kg in 2010.

Belgium has come a long way in building its existing waste management system. The main stages of building a waste management system in the country can be demonstrated by the example of the evolution of waste recycling in Flanders in the period from 1985 to the present. In the development of the waste management system, there are five stages that reflect the upward movement of the Lansink stairs.

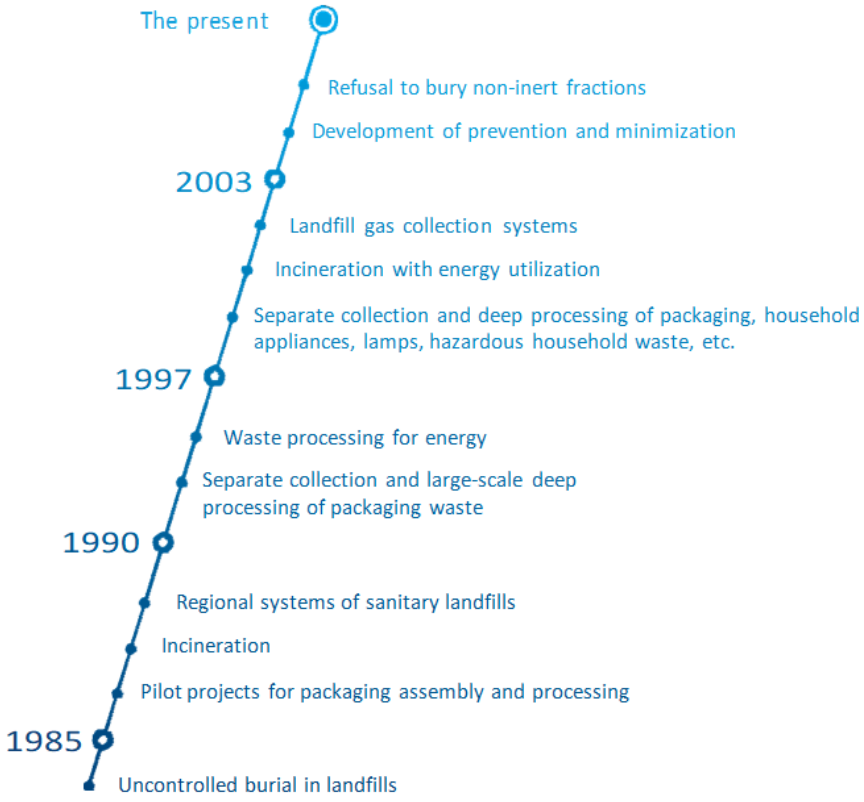

Fig. 1.8. Formation of a solid waste management system in Flanders as an example

It took Flanders 35 years to achieve the advanced level of waste management system development. However, this does not mean that another country will need the same time to reach the appropriate level of development of this industry.

Currently, there are new technologies and methods of solid waste management. As a confirmation, we can cite the example of the accelerated implementation of a modern waste management system according to EU standards in Eastern Europe. Consider the example of Hungary.

In Hungary, active changes in the waste management system began with the country's accession to the EU. The Law on Waste Management, signed in 2000, provided for the harmonization of national legislation with the legislation of the European Union. The law established and revised the rules and requirements, defined the responsibilities of the parties involved in the operation of the system, and outlined the basic principles of waste management, including RWB, and the responsibilities of the parties in the waste management process.

On the basis of this law, the National Action Plan in the field of behavior was subsequently adopted waste for 2003–2008, aimed at introducing new requirements and improving scientific and technical research. A similar document was also approved for the period 2009-2014.

Such The measures led to significant positive changes in the structure of solid waste management: the share of waste disposal decreased from 95 to 80%, while the share of waste recycling increased almost tenfold: from 2-3 to 15% in 2010. Currently, the share of waste recyclable is 21%. According to forecasts, provided that the current trend continues, Hungary will be able to reach a processing rate of 42% by 2020 (while the recommended level is 50%).

To this end, in early 2012, a single body was established in Hungary to coordinate the work of waste collection, transportation and recycling companies, the National Waste Management Agency.

In 2013, a landfill tax of € 10.5 per tonne was introduced, which will be increased to € 42 by 2016. The example of Hungary demonstrates that a country with initial conditions similar to Ukraine is able to build a waste management system in a short time. It should be

noted that a key factor in achieving the result is the effective interaction of private operators with the authorities responsible for waste management. In this context, the experience of Eastern European and Balkan countries is interesting.

The situation in the field of solid waste management in the region as of the mid-1990s was similar to the current state of affairs in Ukraine:

- municipal waste collection and disposal infrastructure was outdated;
- funds from the payment of tariffs, which served as the main source of funding for the industry, did not allow for even basic modernization, not to mention the introduction of modern technologies;
- municipalities could not solve the existing problems on their own: there was a lack of knowledge about the mechanisms of regulation of the industry and the use of new technologies;
- the public showed no interest in receiving higher quality services.

However, the joint efforts of public authorities and private operators have allowed not only to generate demand for modern mechanisms for solid waste management, but also to implement these mechanisms more efficiently than municipal operators could do if they worked independently.

The experience of countries such as Hungary shows that combining recycling with an active program of measures aimed at remediation and reclamation of landfills, as well as upgrading equipment and techniques for waste collection and transportation can reduce the cost of construction of new landfills in 10-12 years.

Similar programs in 2005–2008 were effectively implemented by some Balkan countries (Serbia, Montenegro and Albania). Countries that have reached the highest levels of recycling (Belgium, Germany and the Netherlands) have almost completely abandoned landfilling and are no longer building new landfills.

Thus, in the Baltic States, as well as in the Czech Republic, Slovakia and Hungary, the share of waste to be recycled increased from scratch between 1998 and 2005.

up to 20–25% 39. In addition, burials in uncontrolled landfills were almost completely stopped.

The bulk of waste began to be directed to new facilities built with the involvement of private operators, including such large European companies as Remondis, SITA and ASA The experience of implementing measures and programs that have led to such a transformation can be studied and applied in Ukraine.

1.3.3. Model of the coordinating agent for management of streams of household waste

In international practice, solid waste management is one of the most common is the model of a coordinating agent as a separate structure or non-profit organization with exclusive or partial rights to manage waste generated in a particular area. Coordinating agents enter into agreements and settlements with organizations that provide services and operate the relevant infrastructure, as shown in Fig. 1.9.

Within such a system, the coordinating agent is empowered to manage waste streams, select service providers and set tariffs for consumers. The municipality is only one of the customers of services (for example, for garbage removal from public places, cleaning of territories and provision of other services within the public sector). The application of such a model in Ukraine is currently very relevant.

The model combines the desire of municipal authorities to achieve waste recycling targets and reduce landfills in the most economical way. The financial capacity of local budgets is often limited. The use of the most efficient processing technologies and the scale effect reduce the cost per unit of solid waste processing.

This approach combines a number of characteristics that are important for the implementation of the innovation scenario proposed in Section 2 of this report:

- the only one a vision of the end result (effective system) that can make the market more predictable and transparent for regulators, operators and investors;
- diversity of regional approaches to the choice of technologies, methods of processing / utilization and financing mechanisms (depending on the environmental situation and economic conditions);

• maintaining a unified approach to the control of factors that directly affect the state of the environment (technical and sanitary safety of infrastructure).

Fig. 1.9. The role of the coordinating agent in the waste management system

1.3.4. The model of the coordinating agent in the implementation of the principle of extended responsibility manufacturer

One example of a collective approach to solid waste management is the international Green Dot network, which brings together producers of goods and services, as well as organizations in the field of waste management. Participants' contributions are used to create and maintain appropriate waste recycling infrastructure.

If the participant pays the amount of such contribution, its obligations are considered fulfilled, as the monitoring and reporting system of the national associations of Green Dot is coordinated with the governments of the respective countries. An example of the implementation of such a mechanism is shown in Fig. 1.10.

Fig. 1.10. Organization of solid waste management with the participation of the Green Dot Association

Municipalities are often involved in Green Dot systems. In such cases, the principle of RWB is fully integrated into the regional solid waste management system. In some countries, garbage collection and transportation services are provided exclusively within municipal or regional systems and are financed through the payment of appropriate tariffs.

Although a new competition was announced in 2009, it will be difficult for potential candidates to compete with a government-backed organization.

Thus, applying the experience of Eastern European countries with similar initial conditions, Ukraine can achieve significant results in the development of waste processing and minimization of landfills. Success such measures depend on the introduction of an

effective administrative system. Various variants of the coordinating agent model have been implemented in European countries. They can also be used in Ukraine.

Examples of implementation of the Green Dot system:

In almost all EU countries, as well as in a number of other countries, there are national associations united by a single coordinating organization PRO EUROPE. Green Dot organizations perform the same functions in all countries and are created on a single principle.

Their main task is to implement the principle of extended producer responsibility in the field of packaging waste processing. Because these organizations operate at the national level, they may, for a fee, exempt producers and sellers from their obligations to recycle packaging waste.

These institutions were established to provide recycling services with the highest economic and environmental efficiency. Manufacturers and sellers make contributions to the national organization Green Dot. Packaging materials that have already been paid for are marked with the Green Dot symbol.

Green Dot, in cooperation with private and municipal operators, collects and recycles packaging waste with the Green Dot symbol. In addition, the organization also conducts campaigns aimed at raising public awareness of the importance of reliable waste disposal.

An example of the implementation of the Green Dot system: the experience of Belgium:

Belgium is an example of a country that has made significant progress in the recycling of packaging waste. As of 2009, the corresponding figure in the country reached 93%. Companies supplying packaged products to the Belgian market can enter into an agreement with the national organization of the Green Dot system, called Fost Plus. This organization has almost 5,500 members, covering 92% of the packaging market.

The amount of contributions is calculated taking into account the types and amounts of packaging declared annually by companies. For example, in 2010, the fee for the disposal of 1 ton of glass was 18.4 euros, aluminum - 137.9 euros, and PET bottles - 199.4 euros. Small companies that produce less than 300 kg of packaging materials per year and

seek to place the Green Dot logo on their products, pay a fixed annual fee of 30 euros. In addition to contributions from companies, Fost Plus also receives income from the sale of secondary raw materials.

In order to organize the collection and sorting of packaging waste, Fost Plus enters into agreements with municipalities for five years, which provide for the volume, methods of waste collection, costs and other conditions.

The municipality has the right to perform these functions independently or to delegate their performance to private operators. Waste recycling organizations are selected on the basis of competitive procedures. Fost Plus actively conducts information campaigns and participates in the development of environmentally friendly packaging materials. The organization has about 50 employees.

1.4. Analysis of socio factors on waste generation, sorting and recycling

The constant increase in the amount and diversification of solid human waste produced by humans is one of the most pressing environmental problems facing humankind. The most scientifically and technically advanced countries of the world are already successfully applying modern technologies and measures to reduce the burden of solid waste on the environment and, in general, to remove them as efficiently as possible.

Therefore, the very difficult problem with solid household waste that exists today can be solved using the experience of developed countries that have already achieved significant success in waste management. However, every measure they take before implementation needs to be analyzed in detail and transferred to our realities. And first you need to find out the opinion of people and how aware they are about the problem of waste management. Therefore, the survey was conducted for residents of Ukraine in 2019 [20] and 2020. It is based on the Google Form (Figure 2.7).

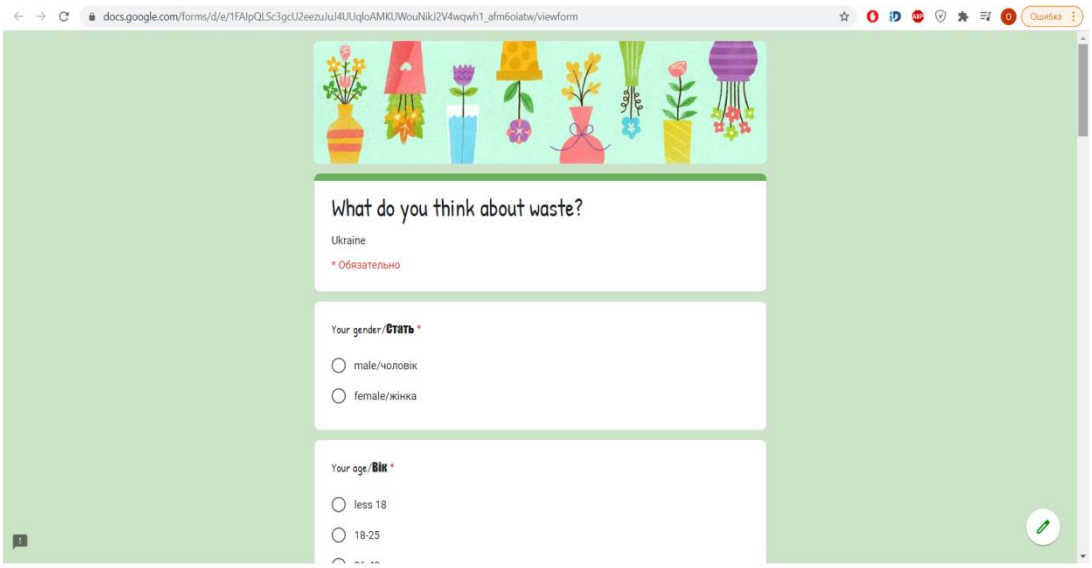

Fig. 1.11. View of poll in Google Form

This form with questions sent to people from Ukraine in 2020. The same form exists for people in 2019. After receiving answers we analyzed them and results you can see in table 2.13. The diagrams presented in annexes A and B.

After analysis we can define different relation of people to waste.

Attitudes toward waste sorting and handling: In 2019, almost all respondents said that it is important to worry about rubbish, but less than half the people are sorting garbage. The reason for this is the lack of a well-established sorting system, the lack of tanks. And therefore almost all rubbish is sent to the landfill.

In 2020 almost the same situation. Environmental awareness increased by 2 percent and amount os people which sort waste increased by 30%. Almost the same statistics about reasons because of people don't sort waste. The reasons for this are the lack of a well-established sorting system, the lack of tanks.

Attitudes toward the fee for the sorting system: In 2019, if you adjust the sorting system, then almost everyone is ready to sort and pay more.

In 2020 if you adjust the sorting system, then everyone is ready to sort and almost all ready to pay more.

Attitudes towards hazardous waste: Almost everyone knows that some waste is hazardous. But not everyone knows what to do with it.

Table 1.2

Questions to residents of Poland and Ukraine

№	Question	Answer	2019 Annex A	2020 Annex B
1	Your attitude to the problem of recycling	• I consider important • I do not care • I do not think it is important	92,6% 7,4% 0%	96% 0% 4%
2	How is garbage disposed of in your locality?	• taken to landfills • burning on incineration plant • sorted and recycled	81,5% 0% 18,5%	76,9% 7,7% 15,4%
3	Do you sort waste?	• yes • no	48,1% 51,9%	76,9% 23,1%
4	Is there enough garbage cans on the street and near your house?	• enough • no	40,7% 59,3%	23,1% 76,9%
5	Did you know that some household waste is hazardous?	• yes • no	96,3% 3,7%	92,3% 7,7%
6	What types of waste could you sort at home?	• paper and cardboard • plastic • metal • glass • organic waste • clothes, shoes • hazardous waste	81,5% 81,5% 48,1% 74,1% 74,1% 63% 33,3%	100% 100% 84,6% 92,3% 65,4% 69,2% 46,2%
7	Do you have recycling points in your area?	• yes • no	51,9% 48,1%	57,7% 42,3%
8	Can you refuse one-time packages?	• yes • no • more yes • more no	44,4% 3,7% 51,9% 0%	57,7% 0% 34,6% 7,7%
9	Are you ready to pay more than you pay for better waste sorting system?	• yes • No	88,9% 11,1%	84,6% 15,4%
10	Are you ready to collect waste separately?(if there is no garbage system)	• yes • no	92,3% 7,7%	100% 0%
11	If you do not use recycling points, what is the reason?	• do not arrange reception hours • no time • not used to using them • no tanks	3,7% 7,4% 22,2% 67,7%	15,4% 0% 15,4% 69,2%

Attitudes towards refusing of one-single items: In 2019 less than half is ready to refuse from one-time packages and 3,7% said that they cannot refuse. But in 2020 situation is quiet better. More than half are willing to refuse one-time packages, and none that can refuse.

1.5. Conclusions to chapter 1

Household waste is waste generated in the process of human life and activity in residential and non-residential buildings (solid, large, repair, liquid, except for waste associated with the production activities of enterprises) and is not used at the place of their accumulation.

Control in the field of waste management is carried out by the State Ecological Inspectorate of Ukraine.

In international practice, solid waste management is one of the most common is the model of a coordinating agent as a separate structure or non-profit organization with exclusive or partial rights to manage waste generated in a particular area.

The constant increase in the amount and diversification of solid human waste produced by humans is one of the most pressing environmental problems facing humankind. After analysis we can define different relation of people to waste.

CHAPTER 2
METHODOLOGICAL PROVISIONS FOR THE ORGANIZATION OF STATE STATISTICAL SURVEILLANCE ON WASTE MANAGEMENT

2.1. Purpose, main characteristics and coverage of state statistical observation

The purpose of this observation is to obtain data on the volume of generation, waste management in Ukraine, regions, settlements and provide this information to the needs of users.

The basic principles of the organization of the state statistical supervision concerning waste management are based on the uniform methodological approaches providing comparable dynamics of data concerning volumes of formation and waste management.

Indicators of national statistical surveillance are developed taking into account European requirements and standards for statistical information on waste, in particular set out in the Council Regulation (EU) of 25 November

2002 № 2150/2002 on waste statistics, relevant methodological documents of Eurostat.

The State Statistical Survey on Waste Management has the following main characteristics:

• Type of state statistical observation:

- by the degree of coverage of units: non-continuous main array;

- by time of data registration: current.

• Organizational form of state statistical observation:

statistical reporting.

• Method of state statistical observation:

documentary accounting.

• Respondent of the state statistical survey:

legal entities, their separate subdivisions, the activity of which is connected with the formation, treatment of wastes of I-IV hazard classes, for which the permission of the authorized bodies has been obtained.

• Unit of state statistical observation:

local unit.

• Bodies carrying out state statistical surveillance:

the central executive body that implements the state policy in the field of statistics, TODS.

• Venue of the state statistical survey:

Autonomous Republic of Crimea, regions, cities of Kyiv and Sevastopol.

• National classifications used in conducting

state statistical observation:

NACE, COATUU, KOPFG, CODE, DKV.

• European statistical classification of waste:

EWC-Stat Rev.3.

The State Statistical Survey covers all possible sources of waste (economic activity and households) and all types of waste (including secondary waste) that are generated and collected in the country (including waste from foreign companies), except for radioactive waste.

Waste generated as a result of economic activity is distributed according to the main type of economic activity of the enterprise (ATS) in accordance with NACE-2010, which is the national analogue of NACE Rev. 2.

The amount of waste generated in households is determined indirectly through a survey of waste collectors or enterprises and organizations involved in waste disposal and disposal.

State statistical observation covers statistical units that:

▪ refer to all possible codes according to KOPFG, KODU;

▪ by main type of economic activity according to NACE-2010 belong to all possible types of economic activity, except for sections T and U;

▪ refer to all possible waste category codes by material, which are harmonized with the European statistical classification of waste categories EWC-Stat Rev.3 (Annex 4 to these Methodological Provisions);

▪ by size of the enterprise belong to the large - "3", "medium" - 2, "small" - 1. Enterprises with less than 10 employees are excluded from the survey (except for those who have received permits for the generation and disposal of hazardous waste or carry out specialized waste management activities).

The size of the enterprise is measured on the basis of the number of employees, in the absence of this indicator - on the basis of the volume of goods and services sold (except for financial intermediaries);

▪ are related to the generation, management of waste (including waste collection for further transfer for disposal or disposal).

2.2. System of indicators of state statistical observation

The main input indicators of the state statistical survey (its program) are:

▪ number and annual capacity of waste incineration plants used for energy purposes;

▪ the number and annual capacity of waste incineration plants used for the thermal treatment of waste to reduce its volume, hazard and produce an inert product that can be disposed of;

▪ number and annual capacity of waste disposal plants;

▪ number and annual capacity of waste disposal plants;

▪ the total number, volume and area of specially designated places and facilities for waste disposal;

▪ quantity, volume and area of specially designated places and objects of household waste disposal;

▪ volume of waste generation;

▪ volume of waste collection (collection);

▪ volume of waste utilization;

▪ volume of waste disposal;

▪ volume of waste incineration;

▪ volume of waste removal for other reasons;

▪ total amount of waste accumulation (disposal);

▪ volume of temporary accumulation (disposal) of waste.

The list of input indicators of waste management (section 2) is provided for each separately identified waste, which meets the following characteristics:

▪ DKV code;

▪ material waste category code according to the list of codes and names of material waste categories;

• code of the group of wastes for the main hazardous component according to the list of groups of wastes for hazardous components, which includes 125 groups of wastes with hazardous properties, including wastes regulated by the Basel and Stockholm Conventions (Annex 5 to these Methodological Provisions);

• code of waste hazard class, which corresponds to the national toxicological classification and is determined in accordance with current regulations: Class I - extremely hazardous, Class II - highly hazardous, Class III - moderately hazardous; IV class - low-risk;

• waste code of used packaging materials and containers in accordance with the list of used packaging materials and containers (Annex 6 to these Methodological Provisions).

2.3. Tools for conducting state statistical observation

The state statistical survey on waste management is carried out on the form № 1-waste (annual) "Waste management" in accordance with the explanations on its filling.

Form № 1-waste consists of three sections.

Section 1 "Waste Management Facilities" consists of two sections. Subsection 1 of Section I "Waste Management Installations" contains information on the actual quantity and production capacity of waste processing (disposal and disposal) facilities. Subsection 2 of Section I "Specially designated waste disposal sites and facilities" contains

information on the actual number, volume and area of waste disposal sites, ie specially designated sites and facilities (landfills, complexes, structures, subsoil areas, etc.).

Section 2 "Waste Management" contains information on the volume of generation, waste management by codes and names of waste according to DKV, waste categories by material, waste groups by main hazardous component, hazard classes of waste, list of used packaging materials and containers.

The "Reference" section provides indicators of the amount of waste for enterprises that have industrial sewage sludge. As the latter can contain very different proportions of water, the volumes of such wastes are reported as liquid wastes (Section 2) and as dry matter.

Sources of information for reporting on the form № 1-waste are the data of primary accounting documents, namely:

1) standard form of primary accounting documentation № 1-VT "Accounting for waste and packaging materials and containers", approved by the order of the Ministry of Nature from 07.07.2008 № 342, registered in the Ministry of Justice on 09.09.2008 for № 824/15515;

2) waste passports;

3) passports of waste disposal facilities, special passports of waste disposal sites;

4) transport invoices;

5) acts of reception and transfer of waste, performance of works with independent objects of removal, utilization of waste.

2.4. The general scheme and the organization of work on formation (actualization) of set of units of the state statistical supervision

The formation of a set of units of state statistical surveillance for waste management is carried out taking into account the requirements of international standards, which allows to ensure the completeness and representativeness of statistical information. At the same time, taking into account the need to ensure comparable dynamics of data on

indicators in Ukraine, as well as at the regional level, the principle of stability of the range of units of state statistical observation is used in its formation.

Table 2.1

The general set of statistical observation units includes objects that have the following identification and classification features

№ п/п	Formation criteria general population	Classifications	A sign of the criteria of formation
1.	Type of statistical unit in accordance with the Regulations on RSO	Directory of types of statistical units	Local unit
2.	Organizational and legal form of management	KOPFG	Regardless of the organizational and legal form of management
3.	Type of economic activity	NACE	Regardless of the type of economic activity, except for sections T and U
4.	Territorial units	KOATUU	According to the administrative-territorial system
5.	Public administration body	CODE	Regardless of the public administration body
6.	The size of the enterprise	Directory signs of the size of enterprises	Regardless of the size of the enterprise, except for small enterprises with up to 10 employees (except for those that have received permits for the generation and disposal of hazardous waste or carry out specialized activities for waste management)
7.	A sign of economic activity	X	Active
8.	Indication of belonging to regional ROUV, RMVV, ROOUV.	X	Current

On the basis of the general population (the basis of the sample) a set of units of state statistical observation (main array) is formed in the form № 1-waste.

Previously, the Department of Agriculture and Environment Statistics of the State Statistics Service of Ukraine and TODS on the basis of information obtained from administrative sources, prepare proposals for inclusion and exclusion from the set of statistical observation units.

Units obtained from administrative data are identified on the basis of RSO data. In addition, the RSO receives information on entities engaged in the collection, disposal, disposal of waste (Chapter 38 of NACE-2010).

At the same time, at the central level, the current population is reviewed in the form of № 1-waste to meet the selection criteria, which provides for the removal from the previous year's population of units that have ceased operations or undergone other demographic changes.

Since the observation covers the majority or the most significant units of the statistical population, which play a decisive role in the characterization of the latter, the dissemination of data in the form № 1-waste to the general population is not carried out.

The approved set of units of state statistical observation is sent electronically to the territorial bodies of state statistics to provide respondents with reporting and statistical tools.

The scheme of formation of the set of units of the state statistical supervision concerning waste management is given in appendix 7.

2.5. The procedure for conducting state statistical observation, dissemination of its results

Form № 1 – waste consists of legal entities, their separate divisions, whose activities are related to the formation, treatment of waste I-IV hazard classes, for which the permission of the authorized bodies of ecology and natural resources.

TODS receive information on the form № 1-waste on paper or electronically within the time specified on the form.

If the location and place of production of the respondent are the territories of different administrative-territorial units, the state statistics bodies receive a report on the place of economic activity (waste generation, waste management operations). In cases where the unit does not keep records of all indicators of the report, the state statistics bodies receive a report based on the data of the legal entity or directly from the legal entity at the place of economic activity of the unit.

The bodies of state statistics accept statistical reporting on the form № 1-waste for each subdivision of the respondent separately, according to the place of their economic activity.

The state statistics bodies accept one consolidated report in the form of № 1-waste for the respondent's subdivisions located within one settlement.

The state statistics bodies accept statistical reporting from the respondents on the form № 1-waste as an electronic report in accordance with the established procedure.

At the district level of processing, primary reports in the form № 1 – waste received from respondents are subject to logical control and entered into the KEOI database, arithmetically controlled, adjusted and prepared for transmission to the regional level.

Primary information (controlled reports) is transmitted electronically from the R (M) of the Armed Forces to the GUS through communication channels.

At the oblast level, the received information is summarized, controlled, analyzed as a whole in the oblast and in other sections provided by the KEOI. If necessary, the reports are additionally worked out with the respondents, adjusted (including information for previous reporting periods). After analysis and revision, the initial reports are submitted to the state level.

The primary information transmitted to the state level through communication channels is controlled, summarized and analyzed in the country as a whole and in other sections provided by the KEOI.

Terms of information transfer at the regional and state level are determined by the technological plan of state statistical observations and the technological schedule of information transfer developed by GURS.

Based on the results of data development on the form № 1-waste on the basis of primary reports of enterprises in terms of districts, regions, state statistics bodies form archives and time series, as well as create databases of primary reports.

The first publication of the results of the state statistical survey is carried out in the form of an express issue "Waste generation and management in the reporting year", which is posted on the official website of the State Statistics Service of Ukraine at: www.ukrstat.gov.ua.

In addition, the main statistical publications on waste are distributed annually on the website of the State Statistics Service of Ukraine (in due time):

- report "Environment of Ukraine";
- statistical collections: "Statistical Yearbook of Ukraine"; "Regions of Ukraine", "Environment of Ukraine";
- statistical bulletin № 2 "Socio-economic development of Ukraine":
- statistical information in tabular form on the volume of generation and treatment of waste of I-IV hazard classes (in terms of waste categories by materials and in general by region);

Indicators of state statistical observation are also placed by state statistics bodies in tables for questionnaires of international statistical organizations (CIS Statistics Committee, Eurostat, UNECE).

Data from state statistics on waste generation and management are also published annually by the Ministry of Ecology and Natural Resources in the National Report on the State of the Environment of Ukraine, used in reports of central executive bodies, provided to international organizations (DG ENV). Environmental Agency (EEA), Joint Research Center (JRC).

If necessary, state statistics bodies provide users with data from state statistical surveys by direct issuance or in accordance with the procedure established by the Law of Ukraine “On Access to Public Information”.

2.6. Conclusions to chapter 2

The purpose of this observation is to obtain data on the volume of generation, waste management in Ukraine, regions, settlements and provide this information to the needs of users.

The formation of a set of units of state statistical surveillance for waste management is carried out taking into account the requirements of international standards, which allows to ensure the completeness and representativeness of statistical information. At the same time, taking into account the need to ensure comparable dynamics of data on indicators.

CHAPTER 3
THE DEVICE FOR ORGANIC WASTE RECYCLING

3.1. Characteristics of the organic fraction of solid waste

No other type of waste contributes to the spread of problems such as organic waste. In total, organic waste accounts for 63% of all waste generated worldwide [10].

Organic waste is a component of waste that is subject to biodegradation and has a biological origin. In developing countries, the amount of organic waste significantly exceeds the amount of organic waste in developed countries, as shown in Figure 3.1. [11].

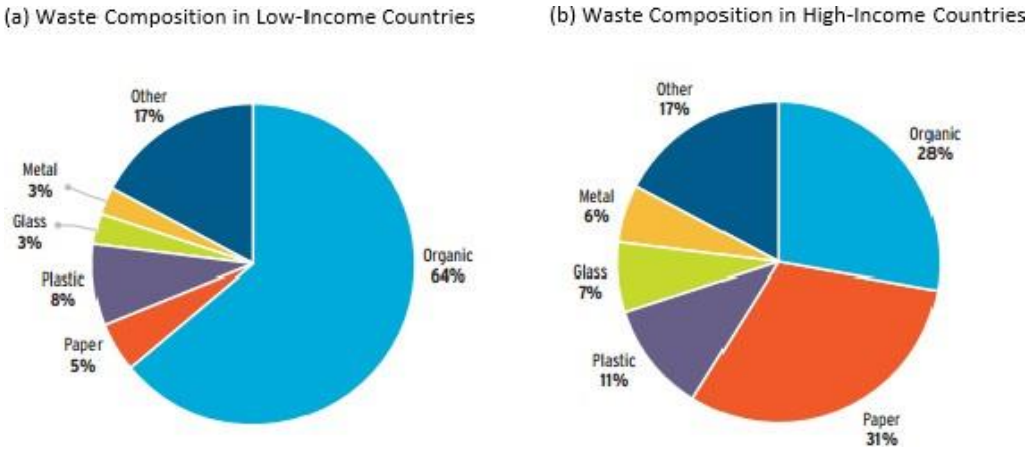

Fig. 3.1. Composition of solid waste in developing and developed countries countries (b) [11]

Decomposition of organic waste in the soil and body of landfills is due to unnatural conditions, because they are anaerobic in nature leads to the fact that organic waste in the soil or under layers of waste can not decompose completely, because aerobic bacteria that can carry out deep oxidation of organic waste unable to survive without access to oxygen in the waste. The study showed that in 5-6 years only less than a third of organic waste decomposes [22]. It usually takes less than a year to decompose organic waste under favorable natural conditions. As a result of the artificial creation of anaerobic conditions, organic waste creates a number of environmental problems.

Almost all types of organic waste can be processed into valuable products using certain technologies.

Given that organic matter is a natural resource, their utilization can occur both in real environmental conditions and using methods that use the principles of conversion of organic matter in natural cycles.

There is no one common classification of organic waste, but it is possible to perform their conditional division into separate types. The main categories include:

• carbohydrate wastes (these include wastes from vegetables and fruits, plants, as well as wastes from the food industry);

• humus (they include products of food processing of small and cattle, birds and other animals);

• wastes containing cellulose (this type of waste includes products of the textile industry, enterprises engaged in grain processing, pulp and paper and logging industries);

• substances obtained in the process of biological purification of the water body.

The amount and composition of solid organic waste depends on the location of the waste source, socio-economic factors, weather and water availability. Therefore, generalized data from the literature cannot be easily applied to a specific case.

Solid organic wastes generated as a result of human activities include household and some industrial categories.

Table 3.1

The comparative composition of municipal solid waste in some developing and developed countries

	Thailand	Egypt	UK	USA
Food waste (organic)	63.6	70	17.6	9
Paper and cardboard paper	8.2	10	36.9	40
Metals	2.1	4	8.9	9.5
Glass	3.5	2	9.1	8
Textile	1.4	2	2.4	2
Plastics and rubber	17.3	1	1.1	7.5
Other (combustible)	3.2	10	21.9	4
Other (non-combustible)	0.7	1	3.1	20
Bulk density kg / l	0.28	-	0.16	0.18

The percentage of food waste (organic matter) is 60-70% for developing countries (Thailand and Egypt). On the other hand, paper and cardboard are mostly produced in large quantities in developed countries.

As the organic fraction of solid household waste is subject to recycling (for example, through composting and anaerobic digestion), the raw material must be collected separately for environmental, energy and economic purposes.

All organic industrial waste used for fertilizers can be divided into three main groups.

Wastes that require composting. This group includes wastes that are hazardous in sanitary-helminthological, entomological and sanitary terms. This group includes kaniga, waste from feathers, down, husks of oilseeds, cranberry and apple cake, grape pomace, wine precipitation.

Wastes that require early application to the soil. These wastes include pulp and pulp, grape meal, bristle waste, woolen items, felt cuttings, woolen waste and woolen dust. Typically, this is a waste with a high ratio of carbon to ammonium nitrogen. When they are introduced into the soil before sowing, there is a temporary biological fixation of available soil nitrogen by microorganisms, which leads to nitrogen starvation of plants and even reduced yields. Therefore, they are used long before sowing.

Waste suitable for fertilizer without restrictions. This group includes pork and beef slag (slaughterhouse waste), raw fish waste, carapace, gluten production waste, horn shavings, silk pupae, silk down, silkworm excrement, tobacco and shag dust, tobacco leaves, nicotine extract after nicotine extraction. , rapeseed, feather cake [23].

3.2. Characteristics of existing methods of processing of organic fraction of msw and choice of technology

General data on possible biotechnological methods of organic waste processing are given in Table 2.1. It does not take into account such specific wastes as wood building materials, plastics and polymer products, which are easier to recycle by physical and physico-chemical methods and reuse to obtain various products.

Materials with the addition of recycled waste are cheaper, their production reduces energy consumption and at the same time reduces the amount of newly generated waste. These wastes can also be processed by biological methods, such as biomodification, biodegradation, production of bioplastics and polymeric materials to be biodegraded and biological devulcanization.

Table 3.2

Biotechnological methods of disposal or recycling organic waste

Organic waste	Method of biological processing
Vegetable waste	Composting, vermicomposting, ensiling, methane fermentation in anaerobic bioreactors, biomodification, protein production of unicellular organisms, biofuel production, delignification, mushroom growing
Wastes rich in dissolved organic matter (carbohydrates, fats, proteins)	Production of food products, feed protein of unicellular organisms, biofuels and other products of microbiological and enzymatic processing, methane fermentation in anaerobic bioreactors.
Solid protein and fat waste, sedimentary yeast	Obtaining food and feed additives, components of biological origin, biologically active substances, various products of microbiological processing, methane fermentation in anaerobic bioreactors, production of organo-mineral fertilizers
Manure and bird droppings, litter	Composting, vermicomposting, methane fermentation in anaerobic bioreactors, production of organo-mineral fertilizers, processing in feed additives
Sludge and activated sludge treatment buildings	Methane fermentation in methane tanks and septic tanks, composting, vermicomposting, taerobic stabilization, holding on silt sites, obtaining organo-mineral fertilizers
OF-MSW	Composting, vermicomposting, burial in sanitary landfills and landfills - bioreactors, methane fermentation in anaerobic bioreactors

As can be seen from the table, microbiological processes are most widely used for the processing of various organic wastes.

The ability of microorganisms and their enzymes to decompose complex organic waste, to transform natural and anthropogenic polymers is the basis for obtaining many useful products of microbiological synthesis and processing of waste. Methods of ecobiotechnology are used for processing carbohydrates, protein and fat-containing liquid wastes, plant biomass, OF-MSW, ERUs, etc.

The definition of composting [26] was presented as biodegradation and stabilization of organic substrates under conditions that allow the development of thermophilic temperatures as a result of biologically produced heat, with the final product sufficiently stable for storage and use without harm to humans and any environmental consequences.

Another definition refers to composting to a controlled aerobic process that is implemented using microbial populations that combine both regimes: mesophilic and thermophilic, which leads to the formation of CO2, water, minerals and stabilized organic matter.

Typically, composting is used for solid and semi-solid organic wastes, such as animal manure, agricultural residues and municipal wastes, in which the total solids content usually exceeds 5%.

Aerobic composting is the decomposition of organic waste in the presence of oxygen (air); the end products of biological metabolism are carbon dioxide (CO2), NH3, water and heat.

Anaerobic composting is the decomposition of organic waste in the absence of oxygen; the end products are: methane (CH4), CO2, NH3 and a large number of other gases and other low molecular weight organic acids. NH3 is further oxidized to nitrate (NO3-) by nitrifying bacteria during maturation.

Aerobic composting is the most effective technology for stabilizing a large amount of organic waste.

Some composting processes, such as those that occur in compost pits, processes that were originally aerobic, become anaerobic in the later stages of composting.

Composting can also be divided into modes of operation, ie to batch and continuous or semi-continuous operation.

In other words, composting is a technology designed to convert organic solid waste into a stable, humus-like product that is mainly used to improve soil composition. As a biochemical process, it is limited by microbial populations and environmental factors. Theoretically, aerobic processes occurring in the body of solid waste in the presence of air can be represented as follows.

In the first stage, by biochemical cleavage (hydrolysis) macromolecular compounds are decomposed into low molecular weight ones. The second stage is characterized by oxidation of glucose. Glucose can be completely oxidized to obtain carbon dioxide and water under aerobic conditions with the release of heat in the amount of 688 kcal / mol of glucose - a component of cellulose.

The whole process can be described as follows. The first stage is characterized by the accelerated development of mesophilic microorganisms, which as a result of their activity emit heat and heat solid waste to a temperature of 25-35 oC. When this temperature is reached, optimal conditions are created for the development of thermophilic microorganisms. Thus processes of vital activity of microorganisms are promoted by:

- the presence of moisture; the optimum of 45-60% is carried out at the expense of additional irrigation;

- the presence of oxygen at all points of the environment; is carried out due to the porosity of solid waste and its mixing in artificial conditions of biodrums;

- with additional air supply in the amount of 0.25 (winter) and 0.8 (summer) m 3 / kg of solid waste per hour;

- reduction of heat loss; is carried out at the expense of thermal insulation;

- increase in specific surface area; is carried out by extracting from solid waste large fractions and grinding.

Under optimal conditions, the first stage can last 1 - 3 days. The second stage is characterized by the accelerated development of thermophilic microorganisms and the release of heat as a result of the decomposition of a wider range of organic substances. At the same time due to the large heat release the temperature in the environment of solid waste rises to 60-75oC. This temperature is detrimental to pathogenic microorganisms.

This feature of the aerobic microbiological process to heat solid waste in a short time is used to disinfect them.

Along with temperature, antibiotics that produce mesophilic and thermophilic microorganisms are an important disinfectant. Antibiotics inhibit the development of pathogenic microorganisms and cause their death. The third stage is characterized by a slow drop in temperature in the environment of solid waste, which indicates the use of decomposing organic compounds. At this stage, thermophilic microorganisms partially die or remain in the form of spores. When the temperature in the MSW drops to 20 - 300 o C mesophilic microorganisms again begin to actively multiply. In this case, they have a more diverse and powerful enzymatic system, through which decompose more stable organic compounds (eg, lignin, etc.). When composting solid waste is not only the decomposition of organic matter, but also its synthesis with the formation of humic compounds that improve the quality of organic fertilizers. The effect of aerobic disinfection in the composting process is clearly demonstrated. Disinfection during composting of solid waste can be carried out both in open field areas and in a waste processing plant in biodrums [27].

The conducted researches allow to state that composting is a dynamic microbiological process which occurs due to the activity of microorganisms of different groups: bacteria, actinomycetes, fungi, yeast, etc. A study of the populations of bacteria, fungi and actinomycetes involved in composting has been conducted by a number of researchers. The dominant form of microorganisms has been found to be mesophiles. Up to 90% of their number belongs to bacilli, various pigment bacteria and oligotrophs [28; 29].

At the beginning of composting, aerobic bacteria predominate, in the following stages, the number of bacteria decreases [30].

The composition of the compost varies widely and mainly reflects the components of the finished compost used organic raw materials: organic matter 25.0-80.0% s .; carbon 8.0-50% s.r.; nitrogen 0.4-3.5% c.r.; phosphorus 0.1 - 1.6% s.r.; potassium 0.4-1.6% s.r.; calcium (in the form of CaO) 0.7-1.5% s.r. [31]

The resulting compost can be used:

- as a fertilizer:
- in agriculture;
- in forestry;
- in green construction;
- for land reclamation;
- as fuel with preliminary briquetting; briquetting should be carried out according to standard technologies, which include pre-drying of compost to a moisture content of 3% to 8% and processing on a press [31].

Composts are used as fertilizer to improve the mineral nutrition of plants, to accelerate the growth of crops and ornamental trees. The disadvantages of composting the organic component of solid waste are the significant period of time required to obtain compost from waste (from several months to a year), labor-intensive and multi-operational process, the availability of production areas for compost stacks and environmental pollution. Composting of organic household waste has not been introduced at the industrial level in the settlements of Ukraine. Composting is done independently by residents on the territory of private houses.

To date, there are 3 main technologies for industrial processing of food and garden waste: line composting, composting in closed reactors, anaerobic processing. The first two need oxygen, the third - no. As the processing technology becomes more complex, costs increase, but so do the capabilities of the technology and the value of the output material.

3.2.1 Wind composting

Field composting is the easiest way to dispose of and recycle solid waste. If at landfills neutralization takes place within 50–100 years, then in field composting this process occurs in 6–18 months, depending on climatic conditions.

Composting is a complex biological process that is accompanied by intense heat release. Easily rotting organic matter decomposes to form mobile forms of humic acids, which are well absorbed by plants. As a result of composting, humus is synthesized, which

is the main component of the soil. The basis of compost is the process of ammonification under the influence of aerobic bacteria. In turn, ammonification is the process of decomposition of organic solids with the release of ammonia. Therefore, when composting solid waste loses up to 20% (by weight) of organic matter.

The decomposition of organic matter, initiated by aerobic microflora, requires a constant flow of oxygen and removal of gaseous oxidation products, including carbon dioxide. Accumulation of carbon dioxide, reducing the oxidative potential, can slow down the process. Therefore, a certain ratio of carbon and nitrogen must be maintained in solid waste (C: N = 25: 30). In the process of composting, the weight loss of organic matter is 20% by weight.

Composting of solid waste is carried out on sites located near landfills. The simplest composting technology is to stack - in parallel rows with a distance between them of 3 m.

The width of the base and height vary depending on climatic conditions. To prevent the hatching of flies, eliminate odors and reduce heat transfer between the stacks and the air, they are covered with a layer of earth or peat 15-20 cm high.

Bookmarks as a result of aerobic composting during the first 15-20 days there is a self-heating of the stack to 60-70 ° C; then for 2–4 months the temperature is kept at the level of 40–45 ° C, and further decreases to 30–35 ° C. After 10 months of "burning" thetemperature is set at 14-18 ° C and maintained until next spring.

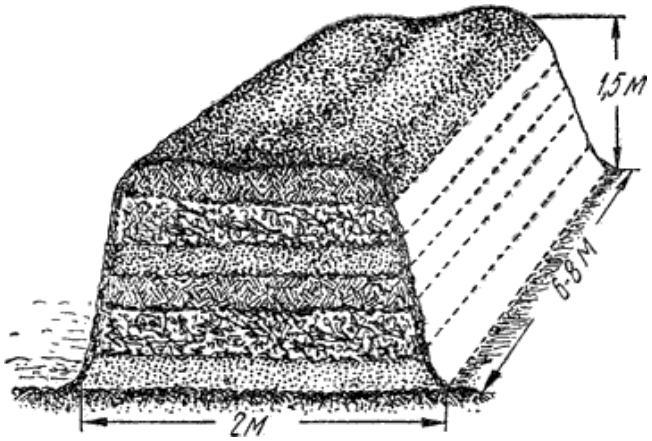

Fig. 3.2 Stacking composting

Duration of composting of solid waste in stacks, which is recommended to take from 12 to 18 months. At regular shoveling and moistening of stacks the term can be

essentially reduced. In the process of composting, the moisture content of waste is intensively reduced. To ensure the activation of the process together with shoveling and forced aeration the material should be moisturized. The received compost is cleared of ballast fractions: glass, stones, metal with use of installation for the mechanized sorting.

To prepare waste for field composting, inorganic impurities must be removed by mechanical or manual sorting. A typical mechanized sorting plant contains a magnetic separator, a vibrating screen and conveyors. Another variant of field composting technology is the preliminary crushing of solid waste before stacking, which is carried out using crushers. In this case, the compost yield increases and the amount of waste decreases.

The more advanced technology of field composting is carried out on special section platforms with a waterproof basis (concrete plates), equipped with the grab crane which is carrying out formation and shoveling of stacks. There is a crushing and sorting department on the sites, equipped with a receiving hopper with a plate feeder, a magnetic separator for scrap metal selection, a system of belt conveyors, a cylinder roar, a compost crusher.

Perforated air ducts connected to the fan are laid in stacks for aeration of MSW. The sites also contain an irrigation and fire extinguishing system. To eliminate large screenings of ballast fractions, the sites may contain incinerators or pyrolysis units of low productivity; in their absence, the ballast is taken to the landfill.

For small towns (up to 200,000 inhabitants) such composting sites are a real alternative to landfills. Composting corresponds to the maximum degree to the natural cycle of substances, providing disposal and utilization of MSW.

Biological disinfection of solid waste during composting is carried out as follows. In the presence of moisture and oxygen in the environment of solid waste aerobic bacteria develop. Initially, a group of mesophilic aerobic bacteria develops that break down some organic compounds. At the same time, energy is released, which heats the solid waste to 20–35 ° C. After the primary heating in the solid waste environment, a group of thermophilic aerobic bacteria begins to actively develop, which are able to break down more stable organic compounds. The energy released heats the solid waste to 60 ° C or more. This temperature is detrimental to pathogenic microorganisms. Thus, the causative

agents of tuberculosis die at a temperature of 55–60 ° C in 5–60 minutes, typhoid fever at the same temperature in 5–30 minutes, dysentery in 60 minutes, and cholera in 60–80 minutes. The result is the disposal of biofuels and compost.

Then there is a slow decrease in temperature with a reduction in the number of thermophiles that go into a spore-like state; mesophilic microorganisms develop again. lowering the temperature indicates that the mobile compounds of organic matter are mainly assimilated. 39 ammonifying microorganisms work in this phase.

At the final stage of the composting process, microorganisms that decompose cellulose develop. For the successful course of the composting process it is necessary to comply with the following conditions: the moisture content of solid waste must be at least 50-60% by weight; food waste content - not less than 25-30% by weight; the ratio of C: N in solid waste - 25:30. Abroad, there is considerable experience in processing solid waste into compost. The positive effect of long-term application of compost from solid waste on soil properties, on accumulation of organic substances and water-resistant structural aggregates, on improvement of other agrochemical and biological properties is proved [7].

During field composting, solid waste delivered to the field site is unloaded into a receiving hopper or leveled site. A bulldozer, a grab crane or special machines form stacks in which aerobic composting processes take place. The height of the stacks depends on the method of aeration of the material and can exceed 2.5 m. Between the stacks leave a distance of 3-6 m for travel.

To prevent the scattering of light fractions of debris, intensive reproduction of flies and the elimination of odors, the surface of the stack is covered with a layer of peat, mature compost or soil about 0.2 m thick.

Duration of solid waste disposal at composting sites from 1 to 6 months. depending on the used equipment, the accepted technology and a season of a bookmark of stacks.

In turn, the category of "row composting" can be divided into subcategories:

1) compost rows, mixed mechanically (to ensure access to oxygen);

• Output product: compost

• Compost production costs (USA, 2010): $ 15- $ 40 / t

• Duration of composting: ≈3 months

• Temperature range: 10-55 ° C, which allows you to get rid of pathogens, larvae and weeds.

The advantages are that the costs are minimal compared to other technologies; in case of unscheduled increase of the received raw materials, numbers can be increased.

The disadvantages are that you can not process large amounts of food waste (nitrogen-rich), you need a large amount of carbon-rich material (eg, leaves, branches); anaerobic areas can be formed in rows due to the complexity of the passage of oxygen, which leads to problems with the smell of the composting base and the release of methane into the atmosphere; problems with the smell of the compost base, if you do not strictly follow all the rules of composting: the ratio of nitrogen and carbon, excess precipitation leads to leaching of valuable substances from the material, contaminates the compost and disrupts the decomposition of the substance.

2) aerated compost rows. Oxygen supply through pipes inside

row);

• Output product: compost

Compost production costs (USA, 2010): $ 25- $ 60 / t

• Duration of composting: ≈3 months

• Temperature range: 10-55 ° C, which allows you to get rid of pathogens, larvae and weeds.

The advantages are that this technology allows to process larger volumes of food waste than the first type of composting;

The disadvantage is that it is more expensive than the first type of line composting.

3) rows with aerated synthetic cover (to maintain the required level of humidity and temperature stabilization).

• Output product: compost

• Composting costs (USA, 2010): $ 55- $ 65 / t

• Duration of composting: ≈ 2-4 months

• Temperature range: 10-55 ° C, which allows you to get rid of pathogens, larvae and weeds.

The advantages are that there are no problems with odor control from the compost base; relatively simple control over the level of humidity.

The disadvantages of this technology are that it is more expensive than the first and second types of row composting, and after the active stage of any of the three types of composting, the curing phase begins, which lasts 3-6 weeks. Next, the material is sieved to remove foreign elements (plastic, glass, etc.).

3.2.2 In-Vessel composting

Aerobic composting in biodrums is characterized by three phases that develop sequentially over time: the phase of temperature rise, the stationary phase of high temperatures and the phase of temperature drop.

The first of them is characterized by enhanced reproduction of mesophilic microorganisms, the optimal temperature of development of which is 25-30 ºC. The source of energy for bacteria are easily decomposed organic compounds contained mainly in food waste (sugar, organic acids, proteins). In the process of their vital activity, thermal energy is released, which contributes to the heating of the mass to temperatures above 50 ºC.

The second phase is characterized by the development of thermophilic bacteria, as a result of which the heat production increases, the processes of solid waste processing into compost are accelerated (temperature increase for every 10 ° C intensifies microbiological processes 2-3 times).

The third phase - a slow drop in temperature - indicates the depletion of easily degradable organic compounds. At this stage, the thermophilic microflora goes into a state of spores, partially extinct, and the mesophilic - begins to reproduce again due to the fact that it has a more diverse and powerful enzymatic system, which decomposes more stable organic compounds (fiber and lignin). When disposing of household waste, not only the decomposition of organic matter occurs, but also its synthesis, ie the formation of humic compounds, facilitates the quality of organic fertilizer. In the cycle of aerobic biothermal composting, the content of organic matter in the material is reduced (by dry weight) by 16-26%. Operational experience has shown that during delivery to the plant of solid waste

with a temperature above +5 ºC their disposal and processing is performed in biodrums for two days. Upon receipt of solid waste with a temperature less than +5 ºC for their disposal and processing requires up to 3 days. A necessary condition for the disposal of solid waste in biodrums is the exposure of the mass for at least 12 hours at temperatures above 50°C.

The microflora required for the biothermal process is present in the required amount in the MSW. Activation of its vital activity is provided by mixing of MSW at rotation of biodrums and aeration of weight. Use two modes of rotation of the biodrums: rotation for 12 hours at a speed of 1.1 rpm, which provides loading and unloading, and subsequent rotation in the other 12 hours at a speed of 0.2-0.3 rpm, which provides mixing of the mass. The disadvantage of the first mode of rotation is the increased energy consumption of the process, which is a consequence of the mismatch of productivity bio drum performance further in the process equipment chain.

To ensure optimal living conditions of aerobic microflora in biodrums it is necessary to supply air at the rate of 0.2-0.6 m3 per 1 kg of solid waste. In the process of aerobic decomposition, carbon dioxide and water are released.

Biothermal aerobic composting may be accompanied by a focal anaerobic process. Anaerobic phenomena may be associated with insufficient aeration of individual areas of biodrums or prolonged storage of solid waste before feeding into biodrums. In the process of anaerobic decomposition, indole, skatole and hydrogen sulfide are released.

Aeration along with intensive mixing and grinding of the material helps to eliminate anaerobic zones. Aeration reduces the moisture content of the material, which is important for further sifting, separation and crushing of compost, which are most effectively carried out on material with a moisture content of not more than 50%.

In winter, in order to reduce heat loss, the minimum amount of air is fed into the biodrums - 0.2-0.3 m3 per 1 kg of processed material, and in autumn - the air supply is increased to 0.3 m3 per 1 kg of material.

In the process of neutralization of the organic fraction of solid waste in biodrums, its density increases due to abrasion of paper, cardboard and food waste. The solid drum receives solid waste with a density of 160-230 kg / m3, and at the unloading end their

density reaches 800 kg / m3 during the 2-day processing cycle. The average density of the mass in the biodrum is 540 kg / m3.

Increasing the duration of the mass in the biodrums leads to a significant increase in density, reaching 1000 kg / m3.

When unloading from the biodrum increases the porosity of the mass, and its density decreases to 500 kg / m3. The technological process of solid waste processing is fully mechanized and controlled from the central control panel. The biothermal process of waste disposal is due to the active growth of thermophilic microorganisms under aerobic conditions. The mass of waste itself is heated to a temperature of 60 Co, at which pathogenic microorganisms, helminth eggs, larvae and pupae of flies die and the mass of waste is neutralized.

Every day, the bio-drum is loaded with a minimum of ½ useful volume of fresh waste and unloaded at the same time. Thus, fresh waste loaded into the drum enters the environment with an active biothermal process, which reduces the cycle of composting to 1 day. The capacity of each bio drum is up to 34 thousand tons.

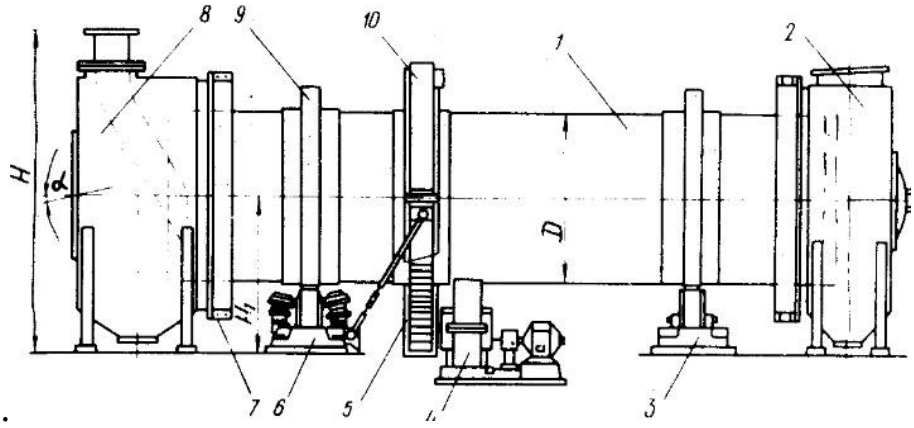

Fig. 3.3 Drum design

The biodrum performs almost two functions: providing the necessary biothermal process in the mass and mechanical mixing of waste.

Biodrums are used in conditions of limited land resources. Aeration (oxygen supply) is carried out by supplying hot air. The compartments are usually 2 m in diameter.

Output product: compost

Compost production costs (USA, 2010): $ 80- $ 110 / t

Duration of composting: 4-10 weeks (1-3 active stage, 3-6 weeks

- stage of maturation)

The advantages of the method are a relatively fast composting process; no large area required; it is possible to process more waste, than at line composting; no problems with odor control; good aeration of the process (the formation of anaerobic sites is not allowed).

To carry out the composting process in this work, the method of composting in a closed reactor (bio drum) was chosen due to the greatest efficiency and absence of significant disadvantages [32], [33].

3.3. Investigation of municipal organic waste production

Since about 50% of organic waste is generated, it is important to have the right approach to it. It is a fact that getting to the landfill, the organic waste does not compost, but decomposes for a long time and releases harmful toxins.

For investigation of organic waste production, it was experiment for collection and composting organic waste for 5 month.

Working condition: 1 flat, 2 people.

Table 3.3

Experiment of waste production

	Period	Amount per period, l	Amount per day, l
	05.06 – 01.07	8 l	0,32 l
	02.07 – 22.07	8 l	0,4 l
	23.07 – 25.08	15 l	0,48 l
	26.08 – 18.09	18, 5 l	0,77 l
	19.09 – 06.10	10,5 l	0,6 l
	07.10 – 23.10	10,5 l	0,65 l
	24.10 – 18.11	10,5 l	0,43 l

Average amount of production of organic waste = 0,27 l per day per 1 person.

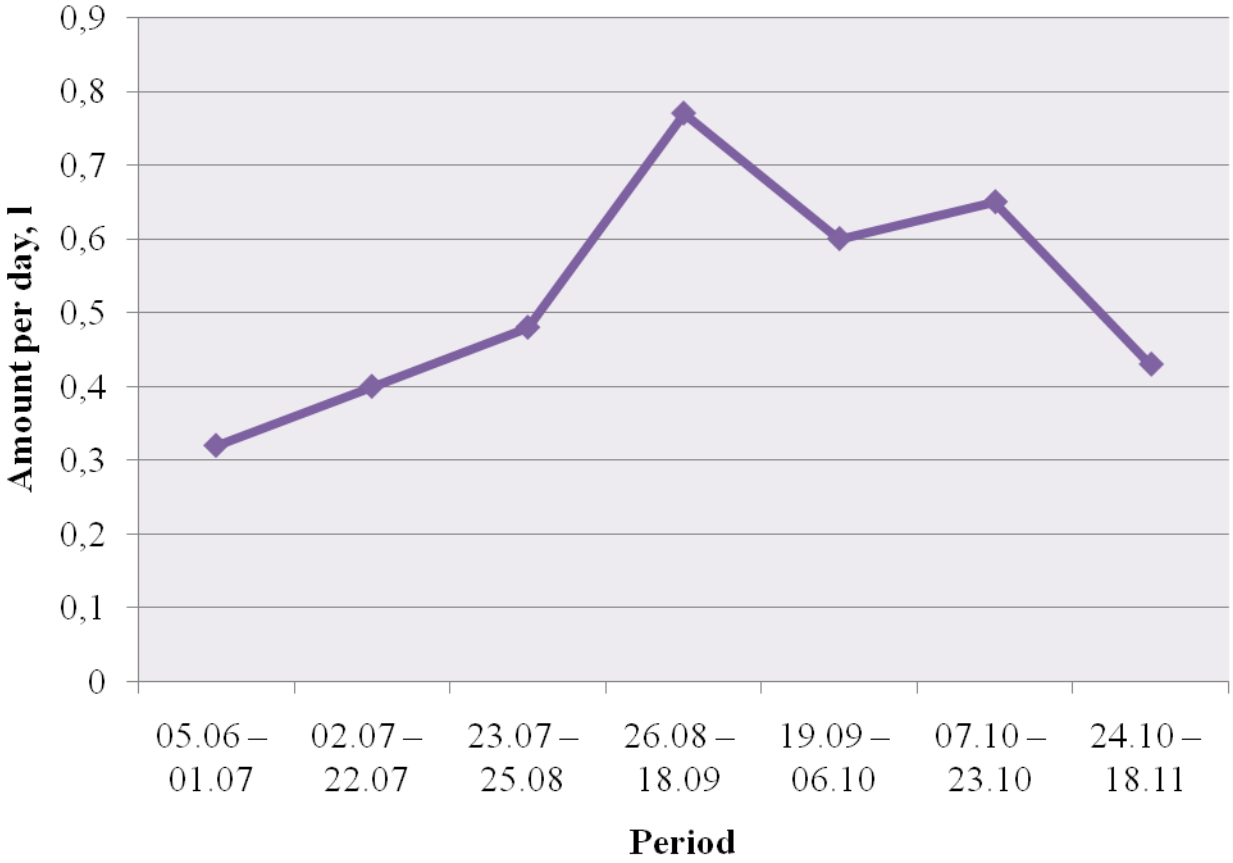

Fig. 3.4. Waste production for 5 month

3.4. Construction of the device for organic waste recycling

For decision of this problem with organic waste, we propose new device.

Components of the device consists:

1. Housing
2. Cover cover
3. Capacity for collecting the finished product (processed fertilizer)
4. Latches-holders of interlevel latches
5. Power supply
6. Engine
7. Blades
8. Cooler valves for drying the cut material
9. Process control buttons

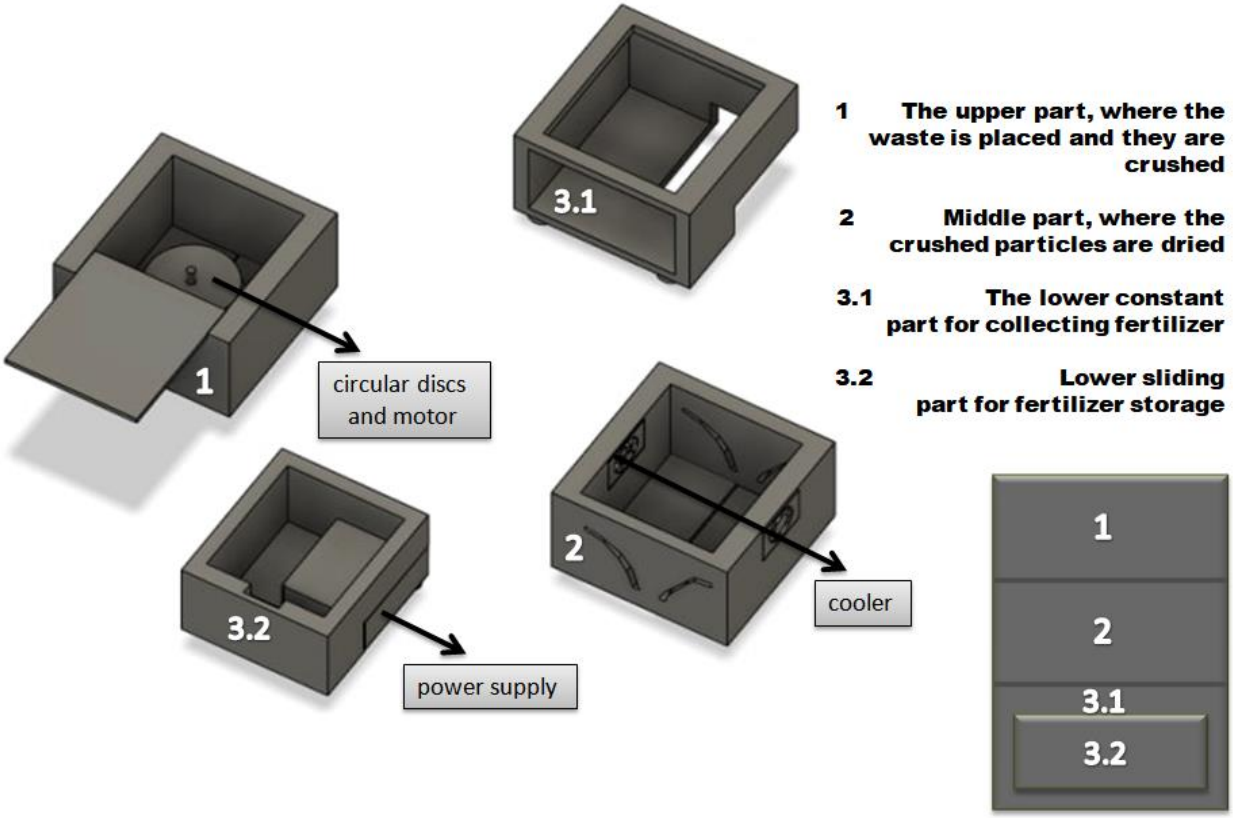

Fig. 3.5. 3D-model of recycler

Working principle:

The device is connected to the 220W network. Open the lid, Place the organic debris inside until the accumulation of the tank №1. After each room, especially before the processing cycle, close the lid. To start work, press the button. After removing the latches-holders between the first and second level. Then press the button. Then begins the process of removing moisture from the resulting material. We also remove the latches-holders between the second and third levels. For the best effect it is necessary to press the key. For run by air on the second level, at the end it is pressed again on the key. Then return the latches between levels two and three to their original position.

Reaching for the third level excavation you will pull out the container for collecting the finished product, where you will find dry fertilizer for your flowerpot and flowers or you can throw it just on the ground and it will not only not harm the environment but also help it return a small percentage of resources spent on production of these products.

3.5. Conclusions of chapter 3

Decomposition of organic waste in the soil and body of landfills is due to unnatural conditions, because they are anaerobic in nature leads to the fact that organic waste in the soil or under layers of waste can not decompose completely, because aerobic bacteria that can carry out deep oxidation of organic waste unable to survive without access to oxygen in the waste.

To date, there are 3 main technologies for industrial processing of food and garden waste: line composting, composting in closed reactors, anaerobic processing. The first two need oxygen, the third - no. As the processing technology becomes more complex, costs increase, but so do the capabilities of the technology and the value of the output material.

Since about 50% of organic waste is generated, it is important to have the right approach to it. It is a fact that getting to the landfill, the organic waste does not compost, but decomposes for a long time and releases harmful toxins.

For investigation of organic waste production, it was experiment for collection and composting organic waste for 5 month. Average amount of production of organic waste = 0,27 l per day per 1 person.

For decision of this problem with organic waste, we propose new device.

CHAPTER 4
DEVELOPMENT OF WASTE RECYCLING TECHNOLOGY

4.1. Ecomat design

We cannot imagine our life without waste. And almost all used materials possible to reuse in different ways. The most important what we should to know about waste that are resources for production new materials.
In our country 97% of waste is landfilled and just 3 is recycled.

For analisys of the population's attitude to waste problems it was opinion poll of residents in Ukraine. Almost all respondents said that it is important to worry about rubbish, but less than half the people are sorting garbage. Of course, sorting is good, but you need to fight not only with the consequences, but also with the causes. In Ukraine, half of people do not know at all that such environmental alternatives to plastic.

The reason for this is the lack of a well-established sorting system, the lack of tanks. And therefore almost all rubbish is sent to the landfill.
What is the solution? – Ecomat! We propose to implement complex system, which must influence at the same time different spheres of life. We should control all together step by step [34].

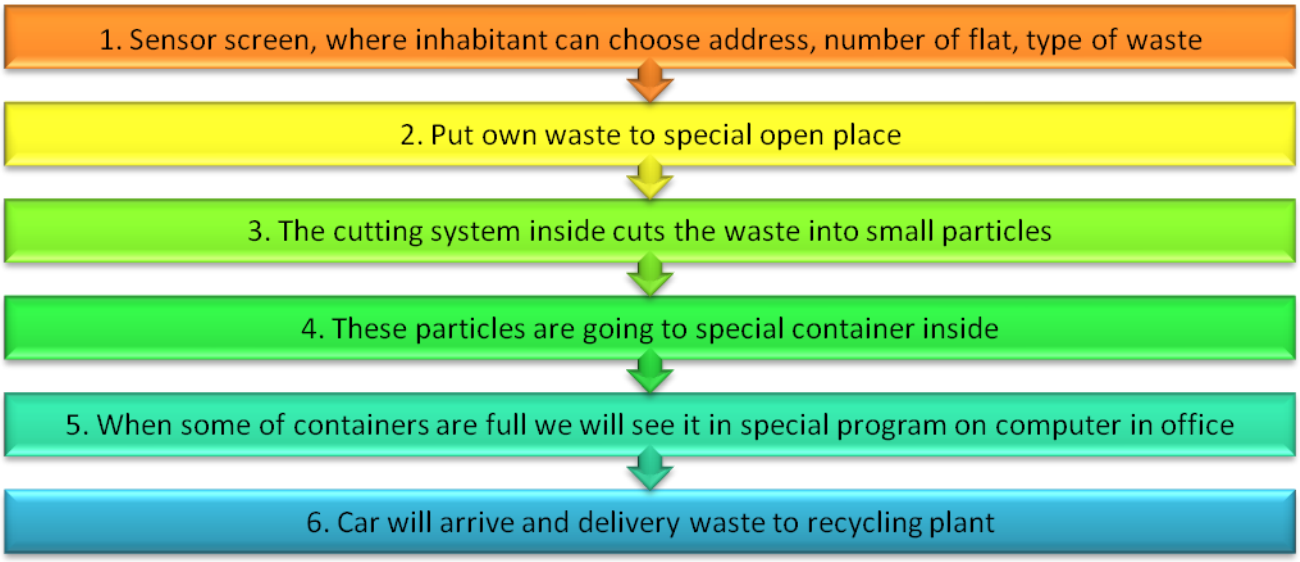

Fig. 4.1. The working procedure

Depend on amount of waste and type people will receive

- Cash or Special eco currency for buying ecological products in ecomat, like bamboo toothbrush.
- To convert waste into communal discount. The residents choose number of flat and depend on type of waste and amount they will receive this discount.

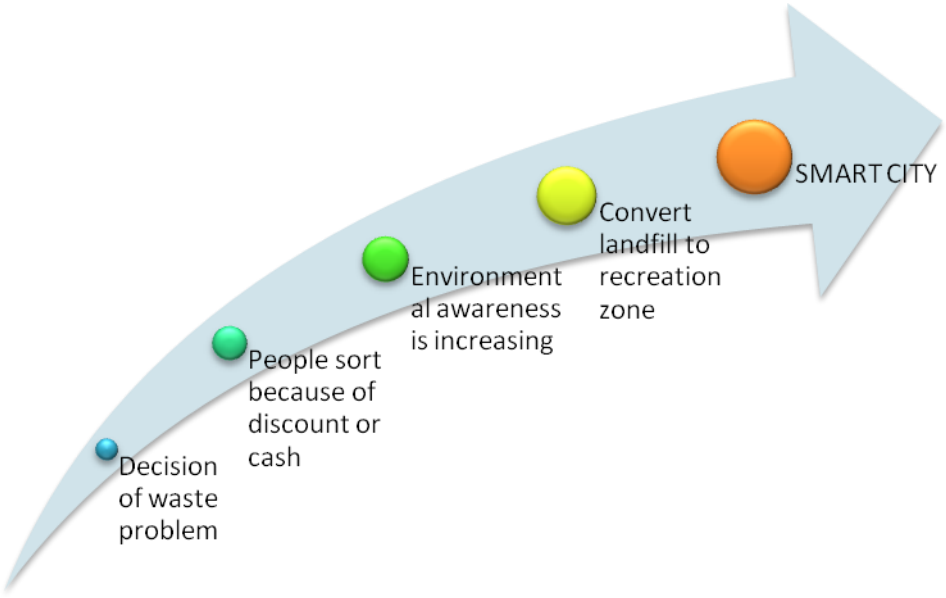

Fig. 4.2. General benefits of ecomat

The technology of integrated waste treatment involves the successive steps that take into account the environmental, economic and social spheres of life.

Fig. 4.3. General view of ecomat

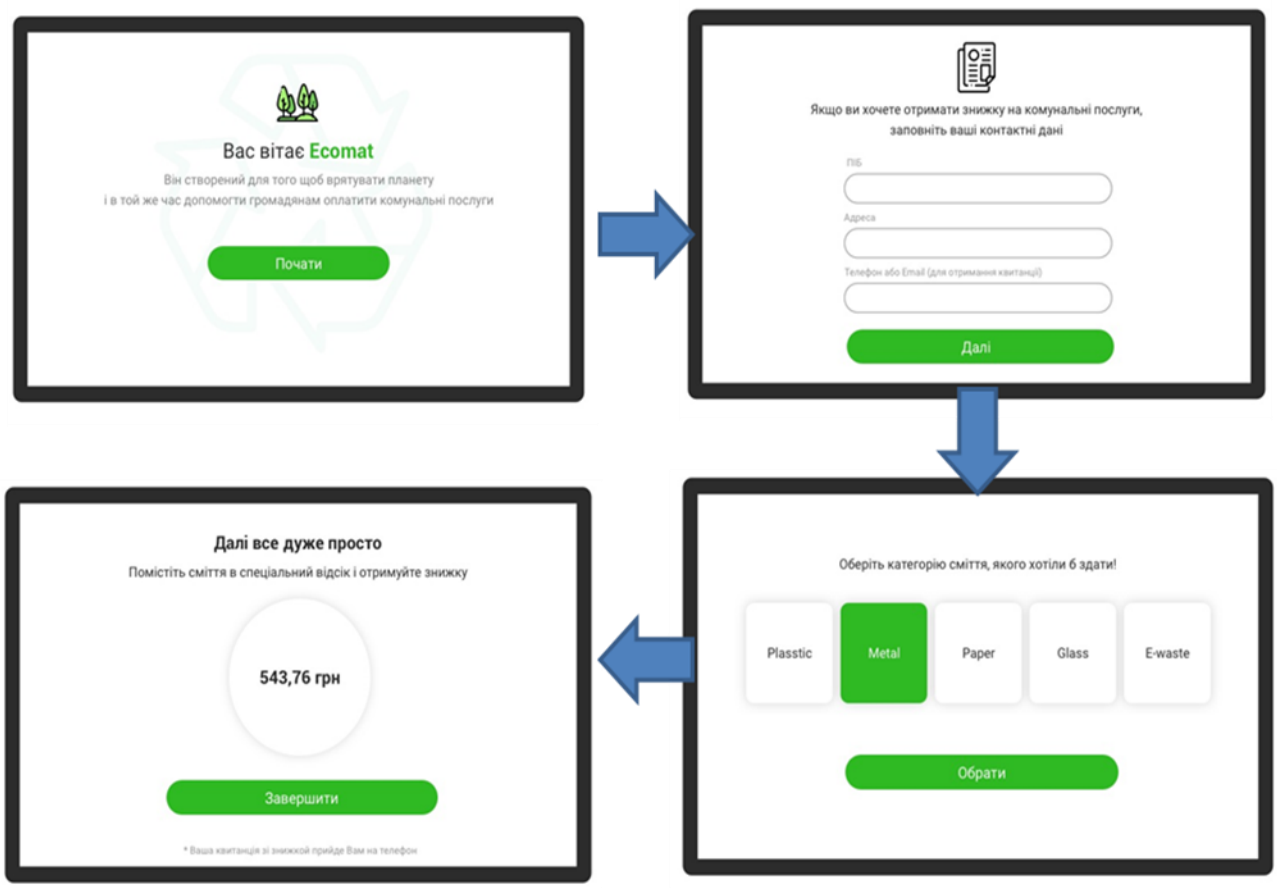

Fig. 4.4. General view of screen

4.2. Marketing analysis, strategy, risk assessment and financial plan

Costs of ecomat:

1. Ecomat - 130 000 UAH.
2. Shredder - 7850UAH (device for grinding plastic)
3. Extruder - 7300UAH (device for making plastic "sausages" of different diameters)
4. Injector - 6260UAH (device for molding plastic into molds)
5. Stove - 5900UAH
6. Tools, forms - 3500UAH

Total: 160 800 UAH

Revenues per 1 machine per month for the sale of 3000 kg of the collected container - 25 000 UAH.

Profit per 1 machine per month - 15 000 UAH.

Payback of 10 machines - 18-24 months.

Ecomats can be installed all over the country and attached to any public institution (homes, schools, hotels, restaurants, etc.)

The plan is to distribute ecomats to all possible places through advertising and goverment support.

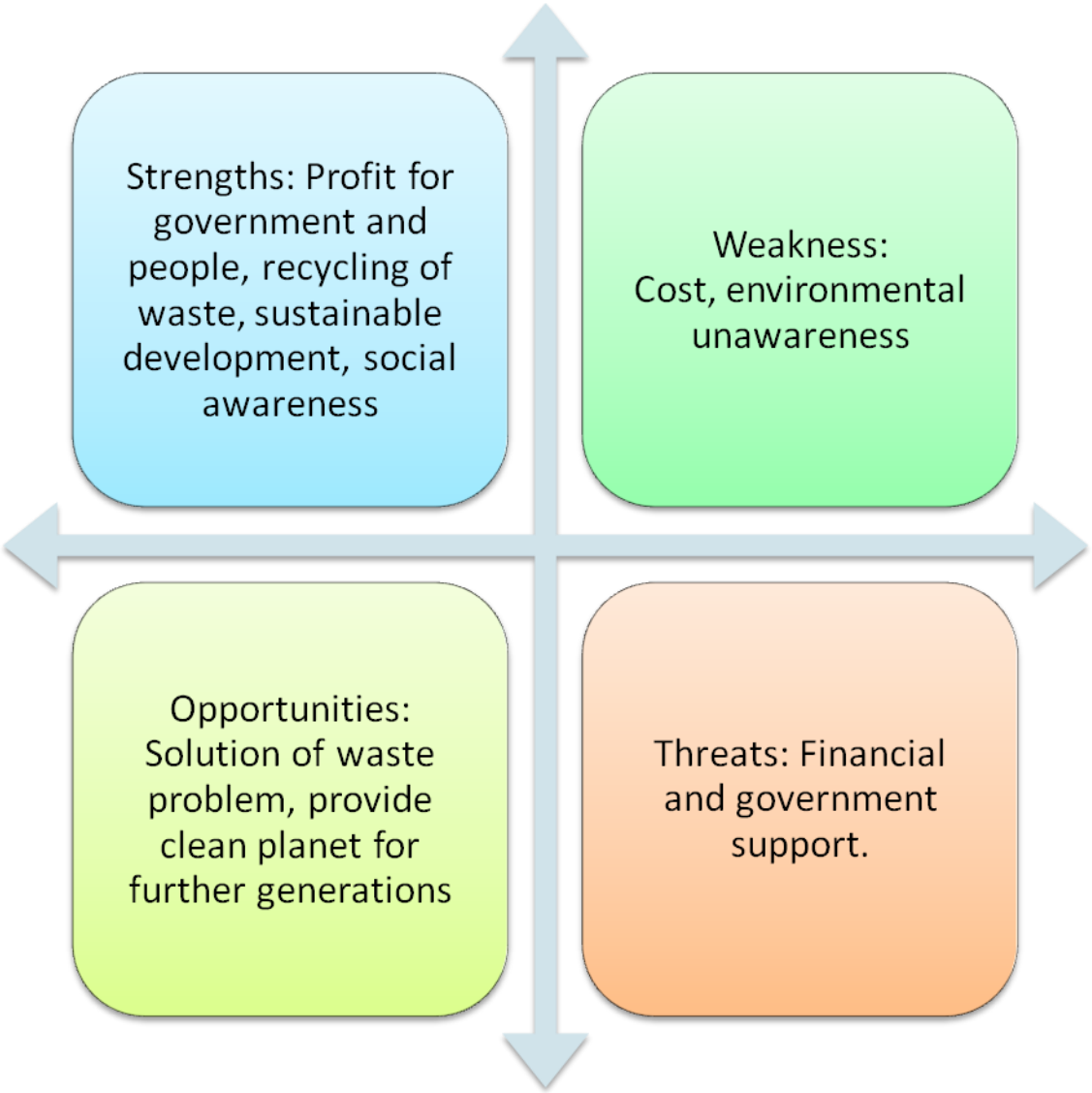

Fig. 4.5. SWOT analysis

Qualitative indicators of impact: One container has a volume of 0.2 meters cubic. For example, in such a container is placed 220 kg of a broken insole or 15 kg of plastic products. When processing this garbage, we will get 374 hryvnias for glass and 105 hryvnias for plastic.

Fig. 4.6. Stages of development

Table 4.1.

Business model Canvas

<table>
<tr>
<td rowspan="2">Key Partners
Recycling enterprises
Plastic produce manufactures
National and Regional governments
Specific investors and producers
Specific financiers (long term contract and responsibility within the partnership)</td>
<td>Key Activities
Solution of waste problem in country
Increasing awareness about environment
Reuse (prolonged use)
Remanufacture(Product redesigning)
Recycle and disposal
Introduction of new sharing schemes
Take-back management and Franchise selling
Convert landfills into recreational zones</td>
<td rowspan="2">Value Proposition
Environmental: Less budget on health, aesthetic value, rational waste management
Economic: Real waste market, auxiliary businesses, job creation. Waste management and energy savings
Social: Improved quality of life</td>
<td>Customer Relationships
Consumer education and individual actions for consumer retention.
Viable business environment for investors—circular feedback about the market player and governmental guaranties
Positive regulations and policies for long term</td>
<td rowspan="2">Customer Segments
Various consumer segments:- manufacturers-entrepreneurs
Citizens
Using sharing platforms where the products and services are shared among customers</td>
</tr>
<tr>
<td>Key Resources
Recyclable material (no waste burning)
New technology
Financial support (market-based and public)</td>
<td>Channels
New circular trading and service platforms
Strategic alliances for circular business
Government owned systems</td>
</tr>
<tr>
<td colspan="3">Cost Structure
Processing plant design and outlay
Technology selection—mechanical and electrical
Channel costs—raw material and vendor selection
Estimated cost is approximately 18000 $</td>
<td colspan="3">Revenue Streams
Cost saving attributable to use of recyclable material flow
Diversification in circular products and materials
Government support such as tax</td>
</tr>
</table>

4.3. Social conribution of solution of waste problem

Taking into account that in the morphological composition of Ukrainian household wastes the share of food waste, which mainly provides high humidity, accounts for the largest part, then there is a need for additional equipment for drying waste. It is difficult to control the release of prohibited toxic wastes or materials such as polyvinyl chloride, which can produce a large amount of hazardous substances during combustion. Atoms of heavy metals, depending on their properties, are concentrated in ash or together with uninflamed organic matter and particles of dust fall into the air. Sulfur, carbon and nitrogen oxides, volatile organic compounds, including dioxins, polyaromatic and other chlorine-containing hydrocarbons, are also received in the air.

Highly toxic waste and ash resulting from combustion, which is up to 30% of the initial mass of waste, should still be buried at landfills. In the process of disposal of solid waste on the VSG, gas emissions are also generated, water is flushed out of gases (with wet cleaning), filtrate (saturated with many hazardous substances contained in solid waste). A multi-stage filter system is used to clean the air. From some gaseous impurities, air can be cleaned quite easily. For example, acid gases can be collected using fabric filters. To reduce the amount of dioxins, you can burn waste at high temperatures (more than 1200 ° C), but it increases the content of other harmful substances, such as nitrogen oxides [35].

Therefore, in order to ensure environmental safety during the operation of the incineration plant, there is a need for very high financial costs and a system of preliminary waste preparation, which is not real for Ukrainian cities at the present stage. Therefore, it is logical to use other methods of handling solid waste. The pyrolysis technology has two main advantages over waste incineration [35]: a significant reduction of air and water pollution; practically complete disposal of potential material and energy resources contained in household waste.

Table 4.2

Impacts of SDW treatment on the environment

Environment	Way of waste management		
	Separate assembly	Use of sorting complexes	Thermal treatment
Air	Minimal possible impact of residual non-sorted waste	Dust emissions	Emissions of CO,CO_2, SO_2, HCl, HF, NOx, heavy metals, aromatic hydrocarbons, dioxins (during the pyrolysis the emissions of the latter two are absent)
Water	Insignificant contamination of materials and substances that remain unassociated and sent to the landfill	Insignificant contamination of materials and substances that remains unassociated and sent to the landfill. Sewage contaminated with hazardous substances, harmful microorganisms (filtrate)	Potential precipitation of pollutant particles in surface water bodies; aldehydes and chlorides in water from flushing gases
Soil	Insignificant contamination of materials and substances that remain unassociated and sent to the landfill	Insignificant contamination of materials and substances that remain unassociated and sent to the landfill	Burglary of ash and slag residues containing heavy metals and other hazardous compounds

From the proposed table, it is evident that the most environmentally acceptable method of treatment of solid waste is their separate collection, followed by utilization of selected secondary raw materials. And the use of waste incineration complexes is the least environmentally friendly treatment of solid waste.

Each of the proposed methods of treatment of solid waste has a different correlation of the necessary mental and physical work, and thus provides different degrees of participation of the waste generator. In addition, each method has different capital and operating costs, requiring different levels of financial commitment of both the population and local authorities.

The choice of the model of treatment of solid waste depends also on the availability and completeness of legislation in this area, as well as on the control of its implementation. The method of stimulating the population to adjust to the chosen model of waste management can also be influenced by the choice of the method. One of the main

tasks in creating an integrated waste management system is to reduce the risk to human health and environmental pollution.

Therefore, when choosing the method of disposal, recycling, utilization and disposing of waste, it is necessary to determine possible negative consequences for the health of the population and the impact on the state of the environment. Priority methods are those that eliminate the negative effects or at least allow them to be minimized.

The results of modern studies on the presence of Bisphenol A (BPA) in plastic products that are intended for contact with food, show that BPA has a negative effect on the thyroid gland and destroys it. BPA is also dangerous to human health at any age, as it affects the brain, nervous, endocrine system and skin [36].

Food plastic labeling is very important because many different types can adversely affect human health. Most manufacturers put a label that corresponds to the material, but if the appropriate label is missing, then this plastic in any case harms the normal state of man.

To choose the optimal material for the manufacture of plastic containers, you should know the basic properties of materials used for the production of disposable containers. Today, the most popular polymers for the manufacture of containers are: Polypropylene (PP), Polystyrene (PS), Polyvinyl chloride (PVC), Polyethylene tetraphthalate (PET).

Polypropylene (PP) is one of the best materials for the manufacture of food containers, which has high structural, good barrier properties and allows sterilization in the package (up to 130 ° C). High barrier properties provide greater safety of the product aroma in polypropylene packaging. Polypropylene containers can be exposed to microwave radiation.

The polypropylene material is resistant to breakage, which makes it the most popular for the production of various fasteners and covers. The only drawback is the low frost resistance, which is compensated by special additives of other polymers, which reduces the limit of use of the material to - 40 ° C.

Typically, polypropylene is used for the production of glasses and jars, medical devices, utensils for hot dishes, food packaging, food containers.

Polypropylene is of 3 types: "high" "medium" and "low" pressure. The fact is that there are several methods of polymerization to obtain polypropylene, but only "high-pressure" polypropylene is officially allowed for food packaging - it is obtained simply by heating and strong compression of propylene. But 2 other methods, although much cheaper, but use dangerous to human health catalysts (nickel, for example). If it is polypropylene obtained with catalysts, when heated in a microwave oven, harmful substances will pass into food much faster than from simple lying down. Among other things, even high-pressure polypropylene can be "contaminated" with non-food paint, for example.

Chemical activity: when interacting with fatty foods, polypropylene is destroyed and releases toxic substances. For example, butter or sunflower oil - in contact with fats, polypropylene is destroyed, and formaldehyde and phenol are released, which are also dangerous to health.

Polystyrene (PS) - is highly manufacturable, the ability under certain conditions to achieve transparency close to the properties of glass. But its thermal instability does not allow packing of hot products in this material. A significant problem is the disposal of polystyrene products, which can hardly be recycled. Most often, polystyrene is used for the production of food trays, cups, food containers, forks and spoons. PS cookware is designed for cold food and drinks.

Chemical activity: in contact with hot or alcohol, a toxic substance is released - styrene. You can not pour hot tea, coffee, alcohol in such dishes. Do not heat food in polystyrene containers.

Polyvinyl chloride (PVC) - has good technological performance. But the limitations in its use are due to the fact that toxic substances can be released from the packaging material. Here the most important are plasticizers, which are added to give PVC more plasticity and flexibility. But even the vinyl chloride monomer itself has pronounced carcinogenic properties. An even greater danger is posed by the by-products of PVC production and disposal, especially dioxins, which are released during combustion.

Polyvinyl chloride is used for the production of caps for PET bottles and 19-liter bottles for coolers, food containers, bottles.

Chemical activity: decomposes to give vinyl chloride. When heated and frozen PVC products begin to emit dioxin.

PVC is the most harmful of all plastics. Poisons released by PVC in different conditions - vinyl chloride, dioxin, bisphenol A, mercury, cadmium.

Polyethylene tetraphthalate (PET) is the most popular plastic for the production of water bottles, disposable food containers for salads, frozen foods. This type of plastic is the most harmless to health. In addition, it is important to be recyclable. Containers have significant resistance to shock loads, however, have low wear resistance.

Chemical activity: PET packaging has low barrier properties. It transmits ultraviolet rays and oxygen to the bottles, which degrades the quality of drinking water. PET packaging is weakly resistant to heat. In order to avoid deformation of the bottle during thermal sterilization, chemicals dangerous to human health are used. Unlike polypropylene, which is able to withstand low temperatures.

Summarizing the information above:

Polycarbonate - can only be used for water, heat transfer

PET - can be for different liquids, can not be heated

PVC - categorically can not be used

Polypropylene - can be used, can be heated to 80 ° C, can not be used for fat and alcohol

Polystyrene - can be used for cold food and beverages, can not be used for hot and alcohol

Recommendations for handling plastic:

1. Use only plastics marked 2 (HDPE) and 5 (PP) for food storage.

2. Do not use other types of plastic for food storage, but give it for recycling. Do not reuse PET bottles and do not heat food in the microwave on the trays with the food in which you bought it (unless the packaging states that they are suitable for this purpose).

3. Do not heat food in a microwave oven in packages containing bisphenol (group 7), do not pour hot liquids into them and do not wash them in the dishwasher.

4. Do not buy mineral water in plastic packaging that is stored in the sun, but it is best to buy drinks (including milk, yogurt, yogurt) in glass containers.

All polymers are harmful in one way or another, even hot. Operating information, everyone decides for himself [36].

Greenwashing is a behaviour or activities that make people believe that a company is doing more to protect the environment than it really is. The environmental movement has warned consumers against greenwashing, saying that when businesses use terms such as "environmentally friendly" and "green" they are often meaningless [37].

In the mid 1960s, the environmental movement gained momentum. This popularity prompted many companies to create a new green image through advertising. Jerry Mander, a former Madison Avenue advertising executive, called this new form of advertising "ecopornography."

In practical use, greenwashing takes various forms, so today a number of its main features have been identified (the so-called "7 sins of greenwashing"):

- hidden compromise (highlighting advantages and hiding disadvantages) - voicing the environmental friendliness of one of the components of the product, but the silence about the dangers and environmental impact of the entire production process (for example, "Nestle" plastic bottle contains 30% less plastic, but its production so itself comes from oil and is not subject to processing, falling into landfills);

- unproven - lack of evidence of environmental positioning of the company or its products (reliable data, relevant certificates), so the consumer is unable to verify the authenticity of the "green" product (for example: tailoring from fabrics made from recycled materials; use of the prefix "eco", but lack of clear explanations why the products are environmentally friendly);

- Uncertainty (general statements) - environmental positioning is due to a very common statement, which is misunderstood by the consumer (the use of vague concepts in advertising texts: "safe for nature", "100% natural", which the buyer takes as evidence that the manufacturer's product really useful and environmentally friendly);

- unnecessary information (irrelevant statements or their inappropriateness) - information about the environmental friendliness of the goods may be true, but completely unnecessary or untimely (statements about the absence of substances that are not contained in the product or prohibited by law);

- less than two evils - the manufacturer focuses on certain characteristics of the product distracting consumers from the general consequences (for example, eco-cars are safer for the environment in use than just cars, but their production also harms nature; cigarettes certified "organic" have no less impact on health than conventional counterparts);

- deception of the consumer (lies, erroneous statements) - to attract the consumer, the manufacturer deliberately misleads him, using the words "eco", "bio", "organic" or invents energy saving categories, non-existent laboratory tests and quality certificates;

- false markings - the manufacturer applies to the product fictitious titles, non-existent markings (seemingly approved by a third party).

How to distinguish a natural product from cheating?

See if he has a real certificate of organic cosmetics: BDIH, NaTrue, ICEA, Ecocert, USDA. If they are, then the product is truly organic and natural.

Learn to read the composition and look for the words there: SLS (Sodium Lauryl Sulfat, Sodium Laureth Sulfat), Dimethicone, Cyclomethicone, Cyclopentoxilase, Methylisothiazolinone ,, paraben, synthetic fragrances, silicones, paraffin and other oil by-products in natural cosmetics are excluded. If you found these (or one of them) ingredients in cosmetics, then this cosmetics is not natural, but pseudo-natural.

So, components "eco", "bio", "organic", "natural", etc. - some manufacturers use them even in product names. Unfortunately, these are often nothing more than empty words, unsupported by anything - this is easy to see by studying the composition of the product. Similarly, signs - a leaf, a tree or a planet on the package - can not describe the quality of the product. Therefore, we should check all information and trust only verified information [37].

Our banal everyday actions affect our lives in one way or another. You can't think that this does not concern me. As for: the weather, the quality of food, diseases, the loss of water in wells, air, etc.

You don't need to leave to live in the forest. But you can start small, which is simple and everyone can:

* Go to the store with your own package / bag

* Drink drinks without straws

* Buy bananas without a bag, glue the sticker directly on the banana * Buy more of what you use constantly (shampoo, cotton pads, cereals, etc.)

* Buy fruits / vegetables at the market

* Take out the glass next to the dustbin and leave

* Boil as much water in a kettle as needed

* The smaller the packaging, the better

Remember that nature does not end with country borders.

4.4. Conclusions of chapter 4

Almost all rubbish is sent to the landfill. What is the solution? – Ecomat! We propose to implement complex system, which must influence at the same time different spheres of life. We should control all together step by step.

The technology of integrated waste treatment involves the successive steps that take into account the environmental, economic and social spheres of life. when choosing the method of disposal, recycling, utilization and disposing of waste, it is necessary to determine possible negative consequences for the health of the population and the impact on the state of the environment. Priority methods are those that eliminate the negative effects or at least allow them to be minimized.

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CHAPTER 5
LABOUR PRECAUTION

5.1. Analysis of harmful and dangerous production factors

Dangerous and harmful production factors can act on the employee during the performance of works related to solving the problems of solid waste disposal [38].

Natural hazardous and harmful production factors:

- external meteorological factors (wind, precipitation, thunderstorm, solar radiation, low or high outside air temperature, ice, deep snow on the ground and snow and ice hanging on trees, buildings or structures, etc.);

- difficult relief, hydrological and soil conditions (steep slopes, screes, landslides, rock falls, villages, landslides, karst funnels, floods, liquid silt, swamps and sunken objects, mountain rivers and drains).

Physical hazards and harmful production factors:

- moving machines and tools; moving parts of production equipment; moving materials, products, parts, blanks and their fragments; structures that collapse;

- increased dust and air pollution of the working area, the presence of harmful substances in the air of the working area;

- increased or decreased air temperature of the working area, heat radiation;

- increased or decreased surface temperature of equipment, materials and workpieces;

- increased noise or vibration in the workplace;

- increased or decreased humidity;

- increased or decreased air mobility;

- increased or decreased ionization of air;

- increased level of ionizing radiation in the work area;

- increased brightness of light;

- increased level of ultraviolet radiation;

- increased level of infrared radiation;

- sharp edges, burrs, roughness on the surfaces of materials, workpieces and parts, tools and equipment;

- slipperiness of wet and frozen surfaces of movement.

Chemical hazardous and harmful production factors:

- toxic;

- irritants;

- sensitizing;

- carcinogenic;

- allergenic.

Biologically dangerous and harmful production factors:

- predatory animals, poisonous reptiles, spiders, mites, other insects, etc .;

- poisonous and irritating plants, their fruits and pollen;

- pathogenic microorganisms (bacteria, viruses, rickettsiae, spirochetes, fungi, protozoa) and products of their activity.

Psychophysiological dangerous and harmful production factors:

- physical overload (static and dynamic);

- neuropsychological overload (mental overload, analyzer overload, monotony of work, emotional overload).

Sources of dangerous and harmful production factors at the landfill are:

- vehicle, lifting equipment;

+ - handicrafts that cause physical and mental overload.

5.2. Measures to reduce the impact of harmful and dangerous production factors

The organization of labor protection at landfills is carried out in accordance with the Law of Ukraine "On labor protection" and provides for the implementation of measures aimed at preserving human life, health and ability to work in the process of work [39].

In the workplace, where the technological process, equipment, raw materials and materials used are potential sources of harmful and dangerous production factors that may adversely affect the health of workers and their descendants, both now and in the future, attestation of workplaces must be carried out in accordance with the Procedure for attestation of workplaces under working conditions, approved by the resolution of the Cabinet of Ministers of Ukraine dated 01.08.92 №442 [40].

Work at the landfill at night is allowed only by order of the management of the landfill.

Men and women over the age of 18 who have passed a medical examination and have no contraindications due to their state of health, have been instructed, trained in occupational safety, first aid for victims of accidents and rules of conduct are allowed to work at the landfill. in case of an accident [41].

The staff of landfills must undergo appropriate training, education (training), testing of knowledge on health and safety in accordance with the Standard Regulations on the procedure for training and testing of knowledge on health and safety, approved by the order of the State Committee of Ukraine for Labor Protection from 26.01. 2005 №15, registered with the Ministry of Justice of Ukraine on 15.02.2005 under №231 / 10511 [42].

Every accident, as well as any violations of labor protection regulations that lead to accidents or accidents, are subject to investigation, identification of the cause and culprits of their occurrence and taking measures to prevent the recurrence of such cases [43].

A team of three workers is allowed to work in the wells on the territory of the landfill and only after the air in the well is checked by a gas analyzer for the presence of oxygen and the absence of harmful and explosive gases.

Employees of the landfill, engaged in work with harmful and dangerous conditions or work related to pollution or adverse weather conditions, the management of the landfill provides special clothing, special footwear and other personal protective equipment in accordance with the Regulations on the provision of special clothing , special footwear and other personal protective equipment, approved by the order of the State Committee of Ukraine for Industrial Safety, Labor Protection and Mining Supervision dated 24.03.2008

№53, registered with the Ministry of Justice of Ukraine on 21.05.2008 under №446 / 15137 [44] .

The management of the landfill is obliged to provide funding and conduct preliminary (during employment) and periodic (during employment) mandatory medical examinations of employees and mandatory vaccinations in accordance with the order of the Ministry of Health of Ukraine 21.05.2007 № 246 "On approval of the Procedure for medical examinations of certain categories of employees", registered with the Ministry of Justice of Ukraine on July 23, 2007 under 46846/14113 [45].

+ To provide first aid in case of injuries and accidents, each operational section of the landfill must have a first aid kit with a supply of medicines and dressings, which must be replenished periodically (depending on the expiration date of medical devices).

5.2.1. Ventilation calculation

The choice of fan depends on the type of ventilation system chosen (general or local) that is organized in the room. The ventilation system is selected based on the characteristics of the working conditions, the type and concentration of pollutants, vapors and gases that are released into the air during work. The type and model of the fan are selected based on its purpose and technical characteristics. At the same time, catalogs are used by manufacturers of equipment for industrial ventilation systems.

The required fan capacity W_{vent} [m3 / h] is determined by the condition in the formula 5.1:

$$W_{vent}^{\Sigma} \geq V_{vent}; W_{vent}^{\Sigma} = W_{vent} \cdot n_{vent}, \quad (5.1)$$

where n_{vent} - number of installed fans.

According to [30, appendix. 40] choose a fan model TsAGI-5 with a capacity of W_{vent} = 2300 m3 / h. Install one fan (n_{vent} = 1). At the same time the condition is fulfilled in the formula 5.2:

$$W_{vent}^{\Sigma} \geq V_{vent} \quad (5.2)$$

5.2.2. Lighting calculation

Industrial lighting, which is properly designed and executed, improves the conditions of visual work, reduces fatigue, increases productivity and quality of work, increases occupational safety and reduces occupational injuries.

Artificial lighting is provided in all industrial and domestic premises, where there is not enough natural light, as well as for lighting in the dark.

The calculation of artificial lighting is performed by the method of light flux utilization η. To determine the coefficient η calculate the index of the room by the formula 5.3:

$$i = \frac{a \cdot b}{h_{sv} \cdot (a + b)} \quad (5.3)$$

where *a*, *b* - respectively the length and width of the room, m

h_{sv}- the height of the lamp above the lighting surface, m. Accepted depending on the height of the room. h_{sv}= 4.8 m in the formula 5.4.

$$i = \frac{12 \cdot 15}{4{,}8 \cdot (12 + 14)} = \frac{168}{124{,}8} = 1{,}44 \quad (5.4)$$

For calculations, the luminous flux coefficient η depending on the index of the room i take 0.4. The total luminous flux F_{zag} (lm) required for room lighting is calculated by the formula 5.5:

$$\text{Fzag} = \frac{E \cdot F_{pr} \cdot K_z \cdot Z_n}{\eta} \quad (5.5)$$

where E is the norm of illumination, lux;

According to [46, appendix. 42] E = 280 (lux); K_z - stock ratio, for gas discharge lamps K_z= 1.5;

Z_n - coefficient of uneven lighting, we take 1.2 in the formula 5.6;

$$Fzag = \frac{280 \cdot 168 \cdot 1{,}5 \cdot 1{,}2}{0{,}40} = 211680\ (лм) \quad (5.6)$$

The number of lamps that will provide the required level of illumination of workplaces is calculated by the formula 5.7:

$$N_{св} = \frac{\Phi_{заг}}{\Phi_{л} \cdot n_{л}} \quad (5.7)$$

where F_l - luminous flux of one llama, lm;

n_l - the number of lamps in one lamp, units

For installation we choose according to [46, appendix. 43] fluorescent lamps LB 80 with a luminous flux F_l = 6170 lm. The number of lamps in one lamp n_l = 2 units in the formula 5.8:

$$N_{св} = \frac{211680}{6170 \cdot 2} = 17{,}15 \approx 18\ (lamps) \quad (5.8)$$

5.3. Occupational Safety Instruction

Even though OSHA has had an impact on worker safety and health, significant hazards and unsafe conditions still exist workplaces.

Occupational safety instruction

General provisions: workers engaged in pressing and packing paper waste must comply with the requirements of the general and given instructions on labor protection. Persons who have undergone introductory training on labor protection and fire safety, initial training on labor protection at the workplace have been trained in safe work methods, testing of knowledge on labor protection, as well as have practical skills are allowed to work independently. In the future, they must be re-instructed in occupational safety once every six months.

When pressing and packing paper waste, the following dangerous and harmful production factors may affect employees:

- moving parts of presses;
- increased dust in the air of the working area;
- increased or decreased air temperature of the working area;
- increased or decreased humidity;
- lack or insufficient amount of natural light;
- increased level of static electricity;

- sharp edges, burrs and roughness of paper waste, bales, wire, equipment, devices, tools, etc .;

- static overloads.

Stack bales with waste must be carefully ("bandaged"), while adhering to the rules of storage, in specially designated areas.

Safety requirements before starting work: put on a cotton suit and tarpaulin gloves, put on leather shoes (boots), hide your hair under a hat. Check for goggles, respirator.
Inspect the workplace and equipment, check its serviceability, the presence and serviceability of barriers, grounding, reliability of safety, on, off devices, order and cleanliness in the workplace, the absence of unnecessary items on the equipment.

Inform the immediate supervisor about the found malfunctions or shortcomings in the work of the equipment (organization of the working city) and do not start the work until their elimination.

Safety requirements during work: when using a vertical press, before starting the machine, check and constantly monitor the reliable operation of the limit switches that stop the moving plate in the extreme upper and lower positions; strength of closing the front and rear doors.

When loading the hopper, make sure that it does not get other materials and foreign objects (pieces of iron, glass, wood, stones, etc.).

Wear gloves and goggles when working to prevent injury to hands and eyes.

Check the serviceability of the safety electrocontact manometer.

When using works with the help of a vertical press it is forbidden:

While moving the plate, correct or add by hand the scraps, waste paper, paper folded in the hopper of the press;

When the press is connected to the mains, clean, repair, adjust and lubricate it.

When packing paper waste without the help of mechanisms:

Stack the waste in specially prepared containers (boxes) as tightly as possible by stacking them layer by layer.

Do not make excessive efforts to tamp the waste.

Do not compact waste with bare hands or feet (by placing the worker in a container).

The height of the container (box) should not exceed 1.6 m. The box ready for transportation should be tied (strengthened) with packing tape, twine, wire, etc.

Paper waste ready for loading or storage should be transported only by mechanization.

Safety requirements after work: disconnect the press from the mains, collect paper dust, clean the workplace. Wipe and lubricate the equipment.

Remove overalls and hide them in a special closet.

Wash hands and face with warm soapy water, lubricate hands with moisturizer.

Report any malfunctions that occurred during the work to the immediate supervisor or foreman.

1.4. Conclusions to chapter 5

Dangerous and harmful production factors can act on the employee during the performance of works related to solving the problems of solid waste disposal

The organization of labor protection at landfills is carried out in accordance with the Law of Ukraine "On labor protection" and provides for the implementation of measures aimed at preserving human life, health and ability to work in the process of work

The choice of fan depends on the type of ventilation system chosen (general or local) that is organized in the room.

Industrial lighting, which is properly designed and executed, improves the conditions of visual work, reduces fatigue, increases productivity and quality of work, increases occupational safety and reduces occupational injuries.

So, in this chapter the negative influence of waste sorting on a person was investigated. The impact of toxic matters on a human was determined. Some measures for negative impact reducing of waste were proposed.

CONCLUSIONS

Every year the situation of waste management becomes more and more popular. The amount of waste is growing, and the tendency to find new ways to solve the garbage problem is increasing.

Household waste is waste generated in the process of human life and activity in residential and non-residential buildings (solid, large, repair, liquid, except for waste associated with the production activities of enterprises) and is not used at the place of their accumulation.

Control in the field of waste management is carried out by the State Ecological Inspectorate of Ukraine.

In international practice, solid waste management is one of the most common is the model of a coordinating agent as a separate structure or non-profit organization with exclusive or partial rights to manage waste generated in a particular area.

Surveys in 2019 and 2020 showed that the environmental awareness of Ukrainians is growing and they are increasingly ready and already sorting garbage.

Since about 50% of organic waste is generated, it is important to have the right approach to it. It is a fact that getting to the landfill, the organic waste does not compost, but decomposes for a long time and releases harmful toxins.

An experiment with home composting in an apartment for 5 months showed a tendency to generate a lot of organic waste, and as we know, getting into the landfill poses the greatest threat, emitting dangerous gases that seep into the soil and groundwater, and cause fires.

The devices presented in the work for composting of organic waste and collection and processing of others offer a new level of waste management in Ukraine.

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