TIIAME
NATIONAL RESEARCH UNIVERSITY

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BioEcUz

ENERGY GENERATION FROM FOOD WASTE IN UZBEKISTAN

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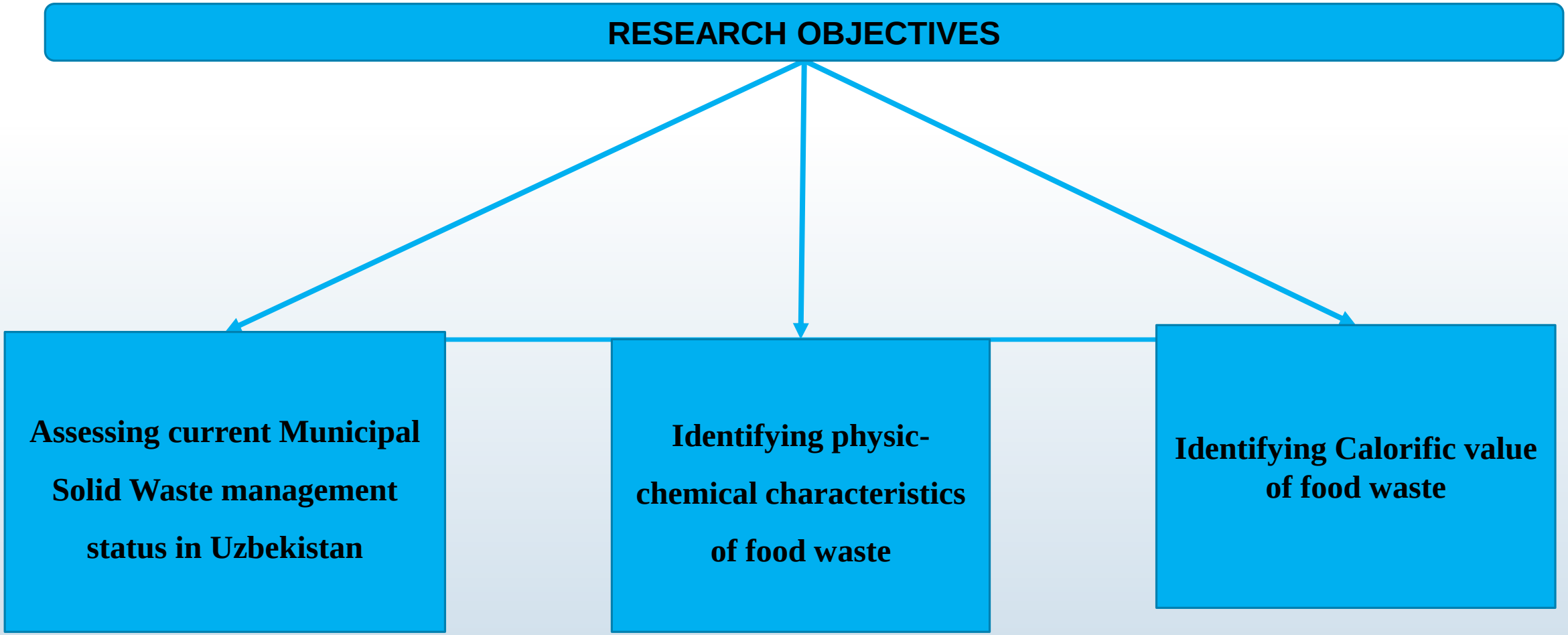
ENERGY GENERATION FROM FOOD WASTE IN UZBEKISTAN



Significance of research work

Justification of the topic:

1. Problems caused by food waste
2. Opportunities available in food waste
3. Research on this field in Uzbekistan

(In order to justify the relevance of the topic, problems and possibilities were studied as organic waste. Because, food waste is often mixed with other household waste)

NEGATIVE EFFECTS		POTENTIAL OPPORTUNITIES	
Problems	**Effect on:**	**Potential**	**How?**
To the environment:		**Energy opportunities:**	
Water pollution	Liquid waste mixture (leachate) poisons surrounding/groundwater when it reaches it	Possibilities of obtaining solid, liquid and gaseous fuels	Through AD, Pyrolysis and Gasification technologies
Air pollution	through CH_4 and CO_2 gases (accounting for 90% of total gases released from MSW)	Biochar	Through torrefaction technology
Soil contamination			
To human health:		**Mineral fertilizer:**	
microbial diseases		After decomposition/digestion processes, remaining substance can be used as a bio-fertilizer and supplementary fertilizer	
infectious and chronic diseases	chronic respiratory diseases, lung cancer, intestinal diseases,		
Toxic gases			
Biological pathogens	stomach and intestinal diseases		
Depression and other mental health issues	psychological stress		

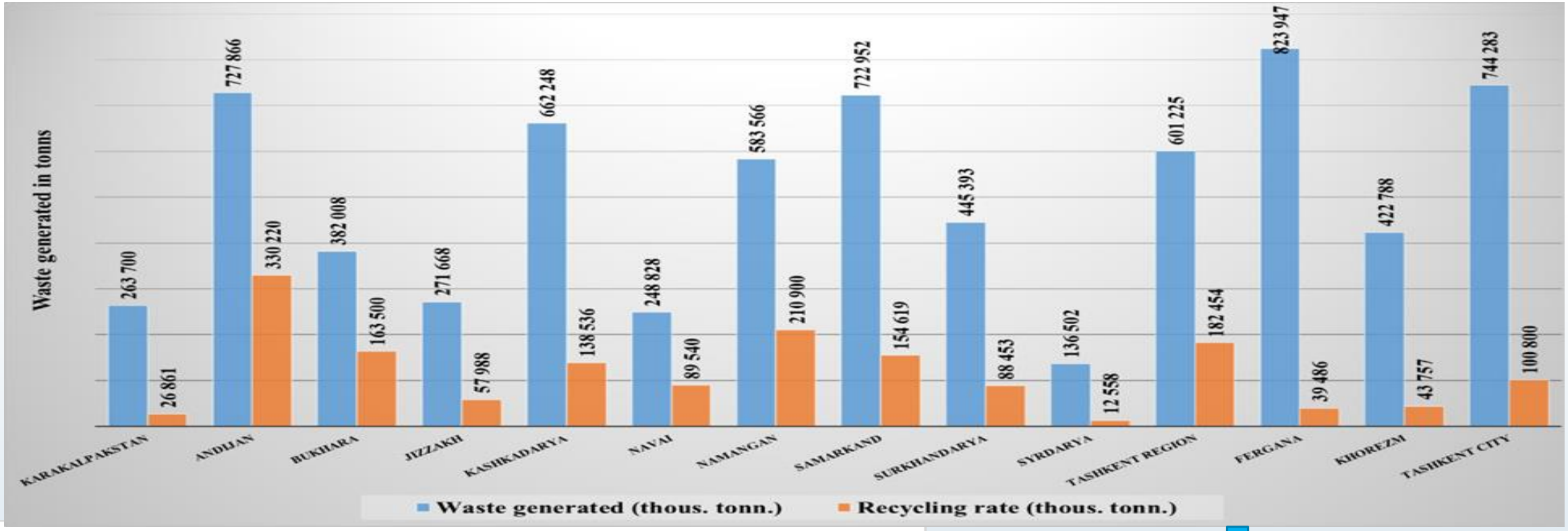
SUMMARY OF THE RESEARCH TOPIC JUSTIFICATION:

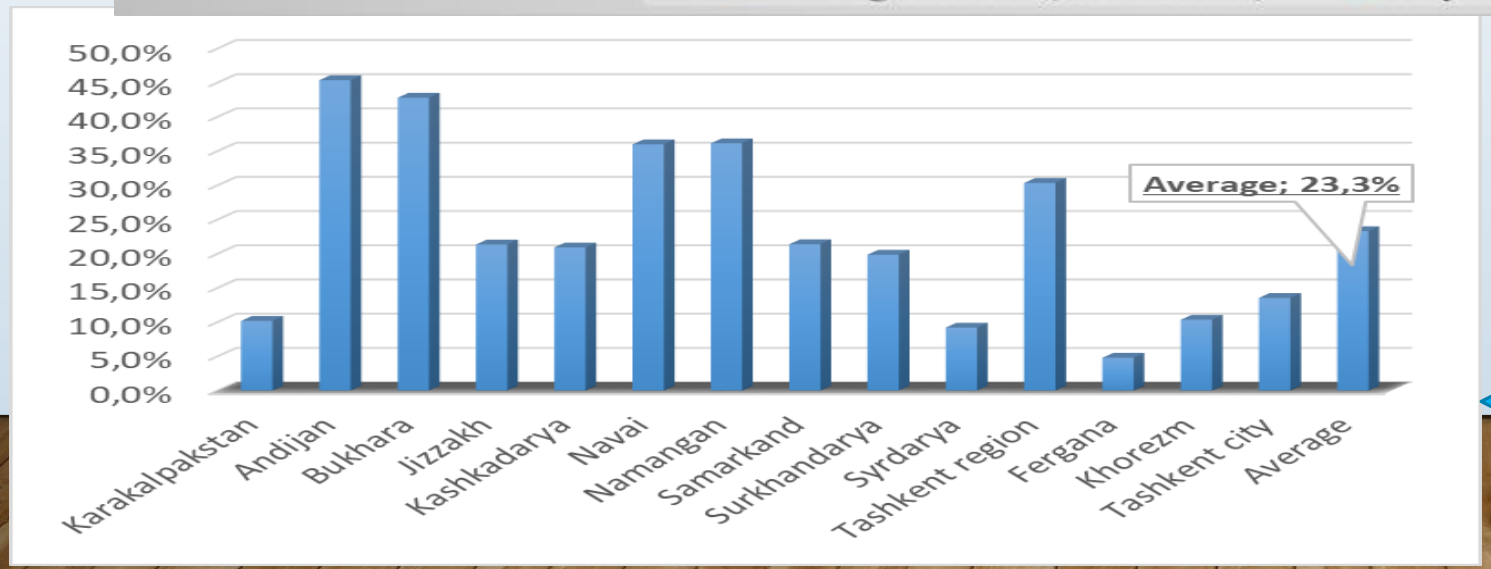
- THE NEED TO ELIMINATE THE NEGATIVE EFFECTS OF WASTE ON THE ENVIRONMENT
- LACK OF KNOWLEDGE IN UZBEKISTAN ABOUT THE USE OF WASTE FOR ENERGY PURPOSES
- INSUFFICIENT WASTE RECYCLING RATES

ANALYSIS AND TESTS ARE DONE UNDER THIS RESEARCH WORK:

1. •Analyzing the current MSW management system
2. •Conducting Social survey
3. •Identifying the Morphological composition of MSW
4. •Proximate analysis of MSW samples
5. •Ultimate analysis of MSW samples
6. •A calorific value analysis of MSW samples

MSW Recycling data in Uzbekistan in 2021





Manba: www.uznature.uz

Methods **Used methods on each analysis, tests**

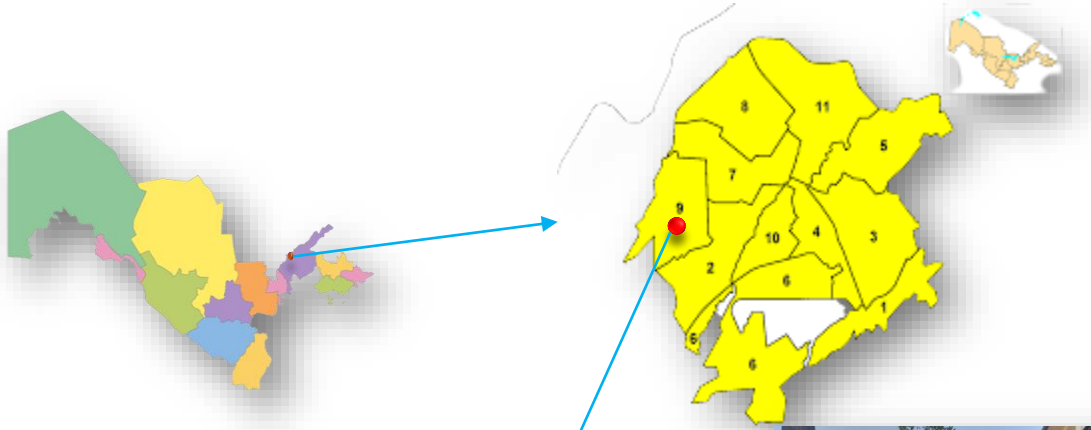
	Methods	Purpose	Calculation equations	Standard
1. Current MSW management analysis in Uzbekistan				
1.1.	Internet search, phone calls, face to face interviews	For collecting necessary data	-	-
2. Social Survey				
2..	An approach used by Sarbassov et al. 2019	In order to study the behavioral attitudes of residents in the research object	-	-
3. Morphological composition study of MSW				
3.1.	Waste sampling	It ensures the reliability of the process and results when studying the physc-chemical characteristics and morphology of waste.	-	ASTM D 5231
4. Proximate analysis				
4.1.	Moisture content	Determination of the moisture content of the sample	%Moisture content= $\frac{Wet\ mass.-Dry\ mass.}{Wet\ mass} \times 100\%$	ASTM-E871
4.2.	Volatile matter content	Determination of the amount of volatile particles (gases) released from the substance as a result of sample combustion	%Volatile matter. = $\frac{Mass\ loss \times 100}{Sample\ mass} - \{\%Mositure\ content\}$	PN-EN 15148–3:2010.900
4.3.	Fixed carbon content	Determination of the amount of carbon that remains after the separation of volatile substances in the sample	%Fixed carbon= $100 - (\%M.C + \%Ash.C + \%V.M.C)$	PN-EN 14775:2010
4.4.	Ash content	Determination of the amount of powdery residue that remains when a substance is thermally decomposed (fully burned)	$\%Ash\ content = \frac{Sample\ mass \times 100}{sample\ mass}$	PN-EN 14775:2010
5. Ultimate analysis				
5.1	Ultimate analysis	Determination of the amount of Carbon (C), Hydrogen (H), Nitrogen (N), Oxygen (O) and Sulfur (S) in the sample	Elemental Analysis is determined by laboratory equipment	ASTM D3176
6. Calorific value estimation				
6.1.	Calorific value of MSW (experimentally)	Determining accurate/real heating value of a biomass sample	-	
6.2.	Calorific value of MSW (theoretically)	Determining theoretical heat value of a biomass sample	$* Heat\ energy\left(\frac{Kj}{kg}\right) = 337C + 1428\left(H - \frac{O}{8}\right) + 9S$	PN-EN 14918:2010

Dulong's formula - calculation of the amount of thermal energy of solid household waste

The object of research and the building where the questionnaire was conducted and Social Survey procedure

Conduct a social survey

1	Study the articles on the survey, determine the expected results of the survey
2	Prepare a questionnaire
3	Define the object of the survey
4	Conduct a survey
5	Recording, processing and analysis of results
6	Prepare a report on the work done



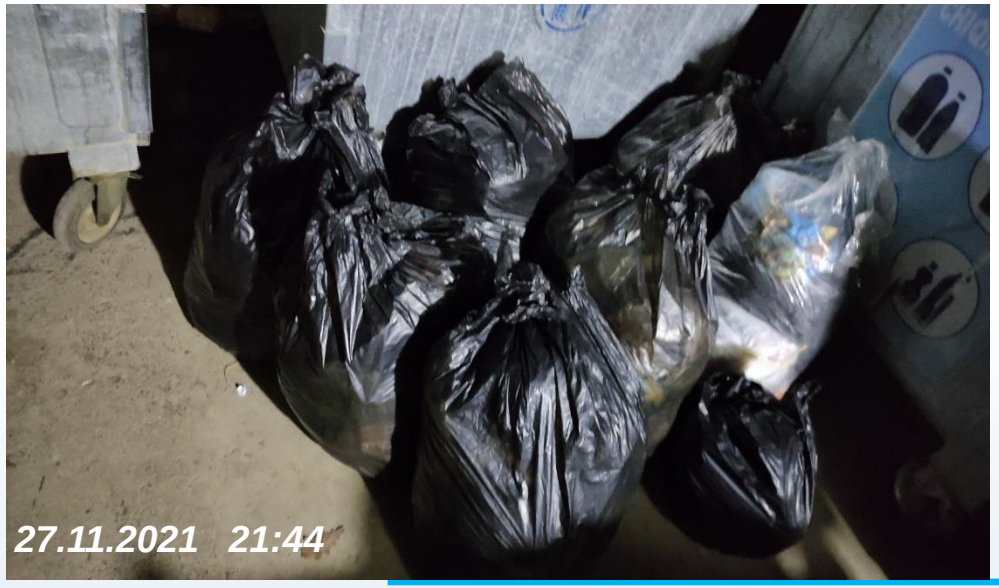
Administrative division of the city of Tashkent::

1. *Bektemir*
2. ***Chilanzar***
3. *Yashinabad*
4. *Mirabad*
5. *Mirzo Ulugbek*
6. *Sergeli*
7. *Shaykhontokhur*
8. *Almazar*
9. *Uchtepa*
10. *Yakkasaray*
11. *Yunusabad*

Residential building conducted social survey

A brief description of study object:
Population: 20448 (approx.)
Area: 0,64 km2
Residential bulidings: 69 pcs.
Schools, kindergardens: 7 pcs.
Supermarkets: 2 pcs.

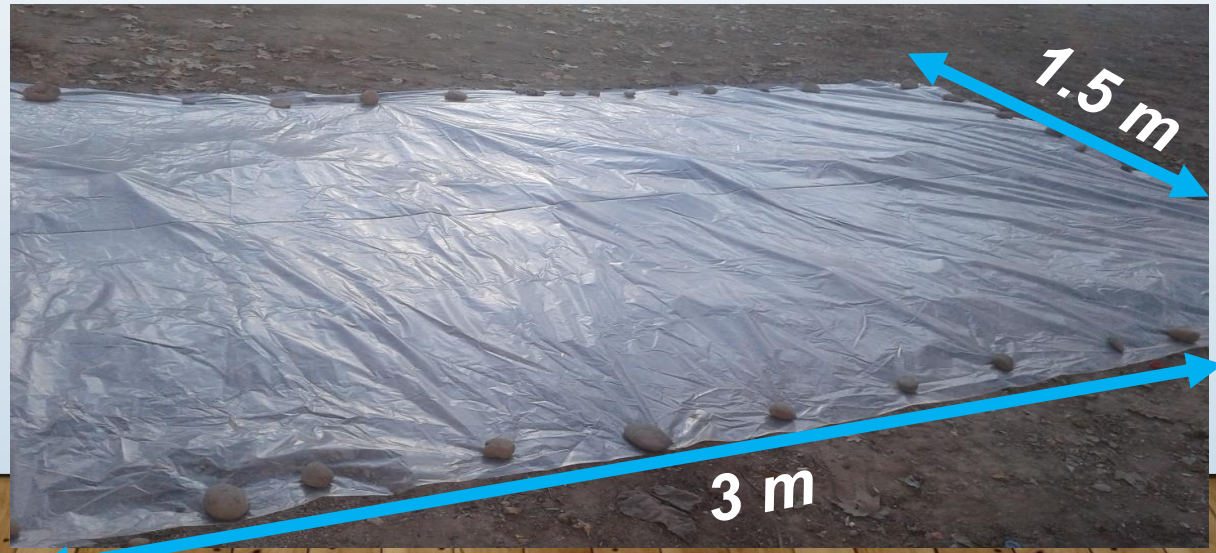
Preparing for the study of the composition of waste



82.1 kg of waste was prepared for morphology study

Preparations were made to study the composition of household waste

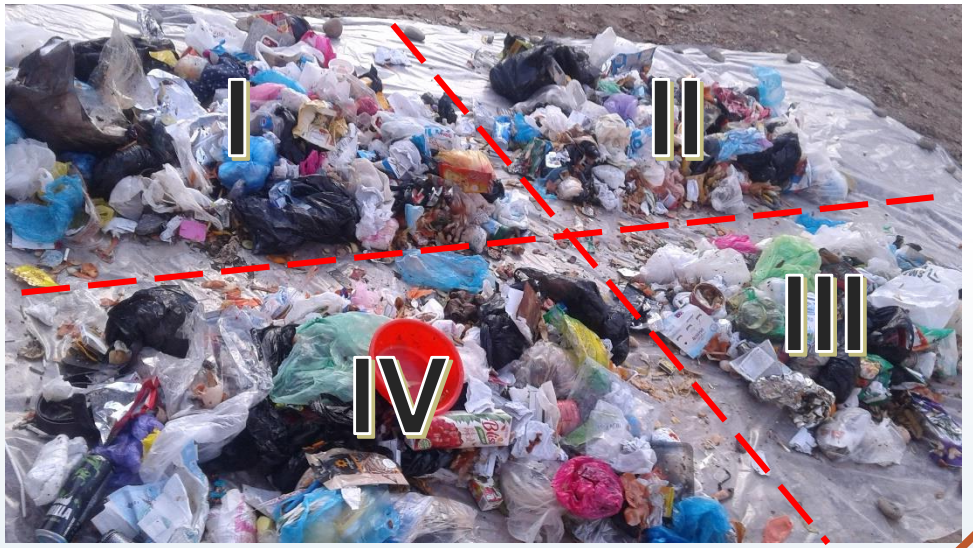
A flat place was chosen for the experiment. In order to make the experiment clean and orderly, a 1.5x3 m2 surface was covered with plasterboard. In order to avoid various external influences, stones were collected around the film.



Methods

Footages from the process

Using the "Quartering" method, waste was divided into 4 equal parts



Cross-contradictory fragments were removed and the remaining fragments were collected in separate packets for analysis

The surface of the film was cleaned for further processing

The "Quartering" method ensures thorough mixing of the waste when the composition of the waste is studied. The composition of well-mixed waste is more evident.

Methods

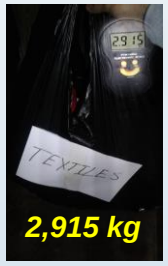
Footage from the process

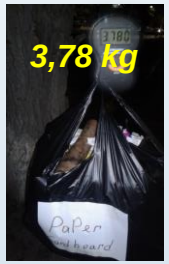
The waste that was found to be heavy was re-released After the 3rd mixing, the waste sorting process began

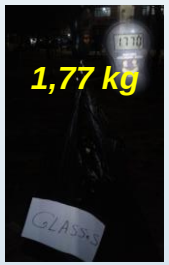
In this case, the following main types of household waste were sorted:

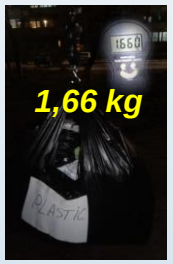
- *Paper*
- *Plastic*
- *Food waste*
- *Textile*
- *Metal*
- *Glass*
- *Others*

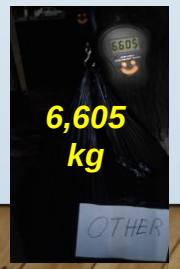
Footage from the process
Final weighting

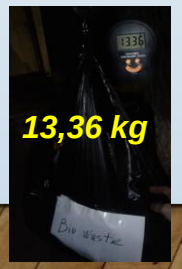


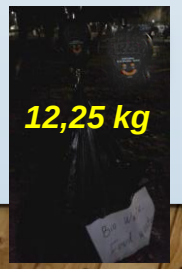


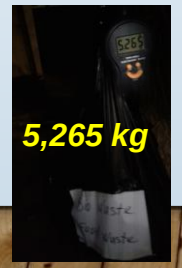








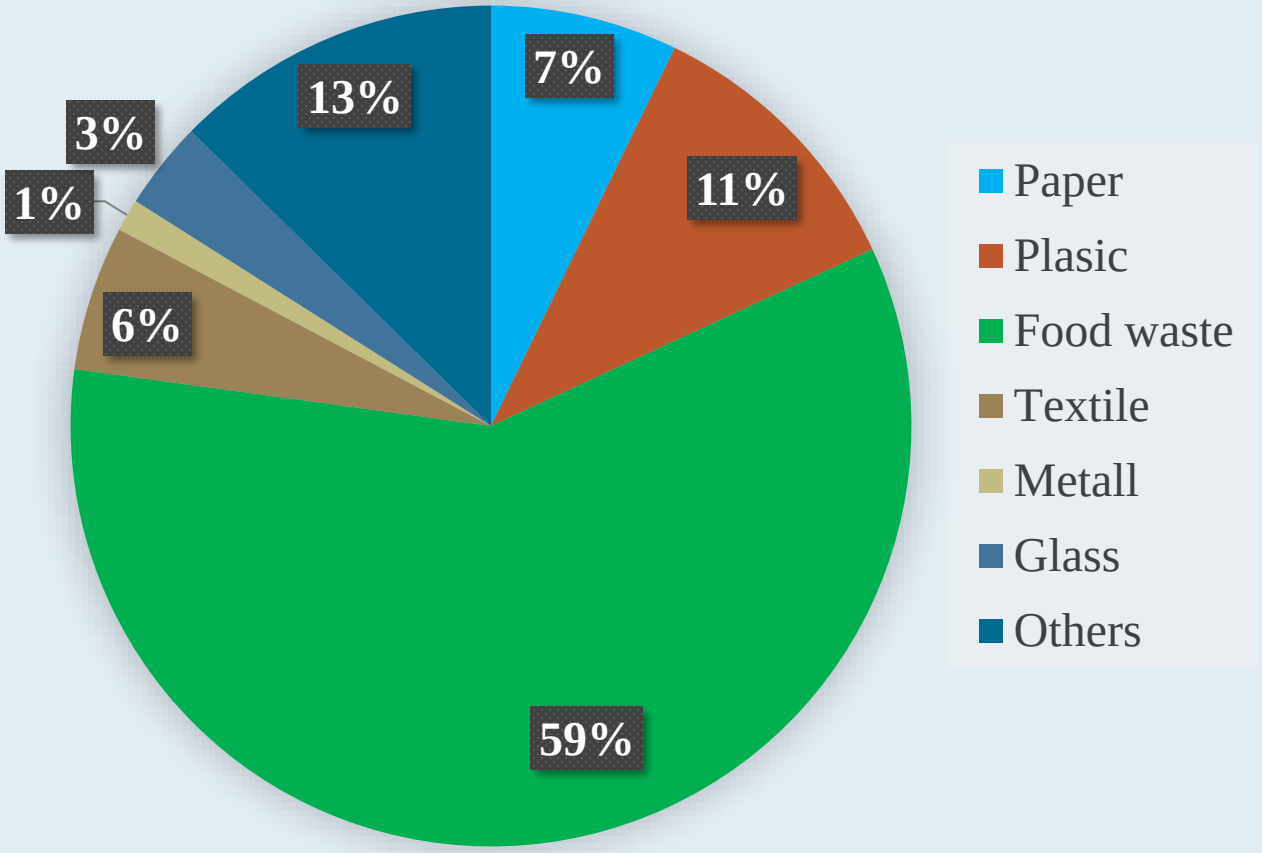


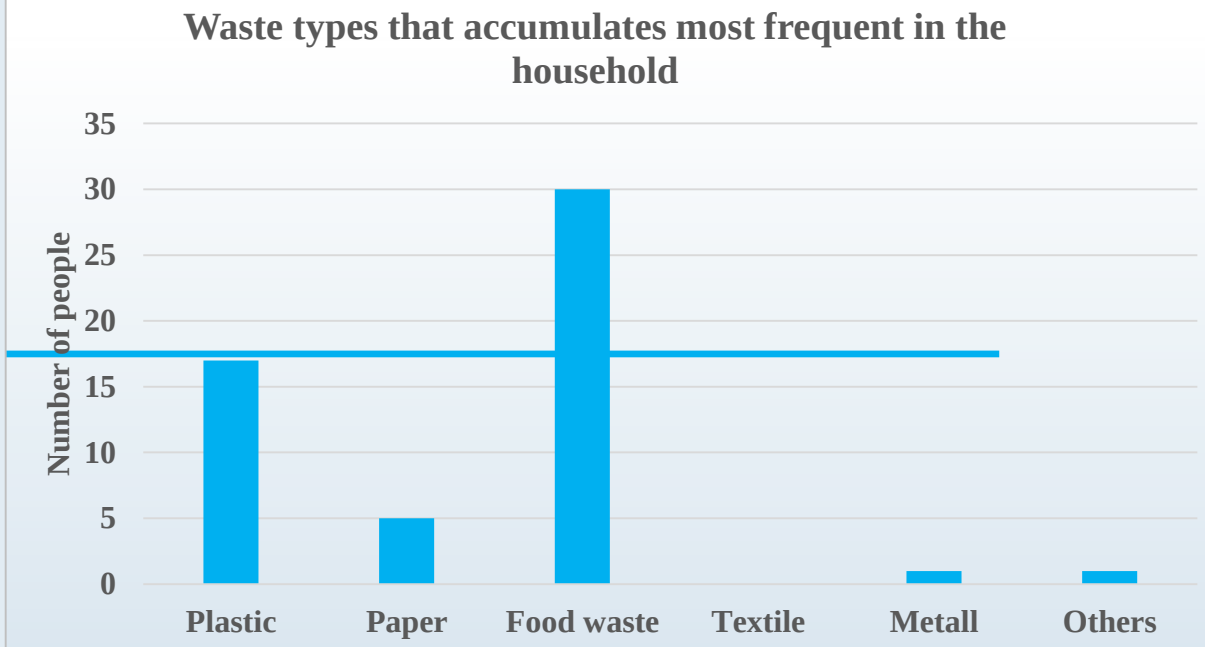


TOTAL MASS: 52

Sorting was done based on the international standard ASTM D 5231

The results of the survey conducted at the facility





Proximate and Ultimate analysis results

Proximate analysis results

Analysis/type	Textile	Mixed waste	Plastic	Food waste
Moisture %	3.51	35.96	0.94	41.24
Volatile matter%	82.26	46.62	95.5	36.84
Fixed carbon%	7.22	10.29	1.59	16.61
Ash content%	7.01	7.13	1.97	5.31
Used lab equipment:	Eltra TGA Thermostep analyzer			

Ultimate analysis results

Elements/type	Textile	Mixed waste	Plastic	Food waste
C %	45.2355	28.9875	79.5422	25.8168
H %	8.3417	15.6201	13.5442	16.0271
S %	0.0528	0.1703	0.0383	0.1950
N %	0.0439	1.6871	0.0477	2.0231
*O %	46.3261	53.535	6.8276	55.938
Used lab equipment:	CHS-580 analyzer by Eltra			

* Constant oxygen amounts are calculated by difference
Note: The results presented are the average values of the results obtained from 3 repetitions of the experiments

Proximal and Final analyzes were determined in cooperation with the international laboratory "Energy and Fuels" of the Academy of Mining and Metallurgy named after Stanislav Stashits in Cracow, Poland.

Results of the energy value determination experiment

Results of energy value (high heat value) analysis

	Textile	Mixed waste	Plastic	Food waste
Gross energy content, (Mj / kg)	18,63	24,39	47,17	23,87
Laboratory Equipment:	Leco AC calorimeter			

Theoretical calculation results of energy value (high heat value)

Parameters	Textile	Mixed waste	Plastic	Food waste
C %	45,2355	28,9875	79,5422	25,8168
H %	8,3417	15,6201	13,5442	16,0271
S %	0,0528	0,1703	0,0383	0,195
N %	0,0439	1,6871	0,0477	2,0231
*O %	46,3261	53,535	6,8276	55,938
Theoretical Energy content, (kJ / kg)	18,8875	22,5198	44,928,4	21,6037

The theoretical heat value was calculated using the Dulong formula:

$$Higher\ heating\ value\left(\frac{Kj}{kg}\right) = 337C + 1428\left(H - \frac{O}{8}\right) + 9S$$

CONCLUSIONS

PROXIMATE ANALYSIS RESULTS:

- Food waste samples taken from the study object have 41.24% moisture, 36.84% Volatile matter, 16.61% Fixed carbon and 5.31% ash. Based on the past works, Volatile matter and Fixed carbon contents are essential indicators of fuel properties of a material, which in our work this was 53.45%.

ULTIMATE ANALYSIS RESULTS

- Food waste samples taken from the study object have 25.8% Carbon, 16% Hydrogen, 0.19% Sulphur, 2.03% Nitrogen and 55.9% Oxygen.
- Calorific value estimation results: According to laboratory analysis, food waste has 23.87 Kj/kg heating energy. When theoretical calculation method by using Dulong’s formula used, this value constituted 21.6 Kj/kg.

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WASTE TO

ENERGY.

Thank you for your attention!