The second life of plastic
How to increase the proportion of plastic recycling in Kazakhstan?

Kamila Zhaksylyk, student, Nazarbayev Intellectual School, Batys-2, 26B, Aktobe, Kazakhstan;

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Authenticity Declaration

I declare that the work in this research project is my own and is authentic. All resources and sources are acknowledged and cited, where sources and resources of other people have been used.

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Abstract: *Plastics are becoming an increasingly preferred material in the design and development of various types of consumer products due to their plasticity, lightness, and recyclability as is often perceived. Furthermore, there are some problems in countries, such as the lack of public awareness and infrastructure for collecting and sorting plastic products, resulting in the pollution of oceans and lands. In order to reveal the main reasons and measures to tackle the issue, mixed-method of data collection has been used, as it includes quantitative and qualitative data and disclose multiple perspectives. This paper considers the development of the plastic processing industries in Kazakhstan, challenges and several solutions of the problem, as supporting organizations engaged in plastic collection and recycling, and implementing eco-projects, to broaden the mindset surrounding plastics recycling to improve their sustainability.*

Пластмассалар икемділігі, жеңілдігі және көбісінің ойынша қайта өңделетін қабиетінің бар екендігіне байланысты тұтынушылық өнімдердің әр түрлі түрлерін жасауда жиі қолданысқа түсіп отыр. Сонымен қатар, елдерде мұхиттар мен құрлықтардың ластануына әкелетін пластикалық өнімдерді жинау және сұрыптауы жайлы халықтың хабардарлығы мен инфрақұрылымының болмауы секілді мәселелер орын алуда. Мәселенің негізгі себептері мен шешу шараларын анықтау үшін мәліметтер жинаудың аралас әдісі қолданылды, өйткені ол сандық және сапалық деректерді қамтиды және бірнеше көзқарастарды ашады. Бұл жұмыста пластикті қайта өңдеу тұрақтылығын арттыру мақсатында Қазақстандағы пластмассаны өңдеу өнеркәсібінің дамуы, қиындықтар мен мәселені шешудің кейбір жолдары, мысалы, пластмассаларды жинауға және өңдеуге қатысатын ұйымдарға қолдау көрсету, сондай-ақ пластмассаны өңдеу көкжиегін кеңейту бойынша экологиялық жобаларды іске асыру мәселелері қарастырылған.

Пластмассы становятся все более предпочтительным материалом при проектировании и разработке различных типов потребительских товаров из-за их пластичности, легкости и возможности вторичной переработки, как это часто считается. Кроме того, в странах есть некоторые проблемы, такие как отсутствие общественной осведомленности и инфраструктуры для сбора и сортировки пластмассовых изделий, что приводит к загрязнению океанов и земель. Для выявления основных причин и мер по решению проблемы использовался смешанный метод сбора данных, поскольку он включает количественные и качественные данные и раскрывает множество точек зрения. В данной работе рассматривается развитие отрасли переработки пластмасс в Казахстане, сложности и некоторые решения проблемы, такие как поддержка организаций, занимающихся сбором и переработкой пластика, а также реализация экологических проектов, для расширения кругозора в отношении переработки пластмасс с целью повышения их устойчивости.

Key Words: *plastics recycling; problem of plastic waste; single-use packaging; environmental education; collection.*

Introduction

The process of reduction scrap or waste plastic and converting the material into beneficial products is called plastic recycling. The problem of recycling plastic waste has escalated to the level of a modern environmental disaster associated with excessive consumption of polymer materials.

Around 300 million tons of plastic waste are produced annually in the world. To date, only less than 10 percent of the plastic waste ever generated has been recycled, and only 14 percent is collected for recycling (United Nations Environment, 2019). There are complicated causes such, as not all plastic can be recycled, as well as a lack of public awareness that leads to the pollution of plastic collections. Hence, processing costs can be increased.

The problem of plastic waste as a source of anthropogenic pollution of the natural environment has become extremely urgent today. Research by Hopewell et al. (2009) claims that about 4 percent of the non-renewable resources, that is world's oil and gas production is used as raw material for plastics, and another 3-4 percent is spent on providing energy for their production. Furthermore, most of the plastic is spent to make single-use packaging or other short-lived products that are subsequently discarded approximately within a year of their production. Thus, majority of the plastic accumulate as waste in landfills and in natural habitats around the world, so the current use of plastics is considered as unsustainable.

According to the Ministry of Ecology, Geology and Natural Resources of Kazakhstan, 4.5-5 million tons of municipal solid waste are generated annually in the country. Moreover, in 2019, the share of recycled and disposed solid waste was 14.9 percent, and only 20 percent of this volume is plastic waste. Also on the territory of the country, there are only 138 plastic waste collection points and 23 plastic processing plants (Bilyalova, 2020). Therefore, increasing the collection of plastic waste and the share of their recycling should become the country's goal to improve the environmental situation.

The purposes of the research paper are to study the basic and effective methods of plastic recycling, considering the main reasons of the problem and find out how to increase the share of processing of plastic, taking into account the development of the plastic processing industry in Kazakhstan.
The following questions provide the project with a clear focus:

1. How common the problem of plastic waste in Kazakhstan?
2. What are the main causes of the problem of plastic waste?
3. How developed are plastic processing industries in Kazakhstan?
4. What methods of plastic recycling can be used to improve the efficiency of this process?

The outcomes of the research project will distinguish main reasons of the problem of plastic waste, consider effective methods of plastic recycling and ways of increasing the proportion of plastic processing in Kazakhstan.

The main reason for choosing the topic of plastic recycling was its relevance. Personally, in my daily life, I come across different ways of dealing with plastic waste. For example, in our school, water coolers that used plastic cups were replaced with drinking fountains, which reduced the use of plastic. Besides, in many courtyards of our city there are containers for collecting various plastic products such as bottles and caps. Therefore, the study of this topic, namely the methods of sorting and processing, as well as statistical data on the problem, seemed interesting, useful and essential.

Context

The problem of plastic waste

One of the main global environmental issues is the problem of environmental pollution by various plastics and plastic bags. The use of plastic in our life has long taken leading positions. Its lightness, strength, low cost has earned popularity. Plastic has replaced glass, metal, wood and other materials that are inconvenient to transport and use. Roughly half of all plastic is used for single use, like

packaging, agricultural film, and disposable consumer products, from 20 to 25 percent for long-term infrastructure, for instance conduit, cable sheaths and structural materials, and the remainder for durable consumer use with intermediate lifespan such as electronic products, furniture, cars, etc. (Hopewell, Dvorak & Kosior, 2009). According to Drzyzga and Prieto (2018), global plastic production has skyrocketed over the past half century. In 2016, 335 million tons per year were produced, of which 60 million tons were generated in Europe alone. They also noted that the plastic production is expected to double in the next 20 years. On such a scale, nature is not capable of recycling human waste. Therefore, plastic pollution poisons soil, water and fauna.

Plastic packaging

Research by Hopewell et al. (2009) supports that the main source of plastic waste is packaging. It is theoretically possible to recycle most thermoplastics in a closed loop, but plastic packaging often uses a variety of different polymers and other materials, like metals, paper, pigments, inks and adhesives, which complicates the task. In addition, most of the packaging waste does not decompose or has a long decomposition time. Moreover, Carey (2017) claimed that in all around 14% of plastic packaging is assembled for recycling, and most of it is recycled into cheaper plastic that used to make trash bags or plastic benches. However, in Europe, it has been found that approximately half of all plastic packaging can be recycled "eco-efficiently" (Glaser, 2017). Nevertheless, even if these plastics are reused, at some point they necessarily turn into waste, causing serious damage to the environment.

Environmental pollution

Plastic is a material that a person synthesized artificially from oil products. There are a huge number of types of plastic in the world, and none of them decomposes naturally. Most of the approximate 300 million tons of plastic that the world emits each year ends up in incinerators, landfills, or the oceans (Carey, 2017). Drzyzga and Prieto (2018) revealed that 1.5–4% of the world's plastic production, that is, about 5–13 million tons, ends up in the ocean every year. The plastic in ocean water breaks down into millions of tiny particles, which is a serious threat to marine life. Animals feed on them and plastic is incorporated into the animal's food chain. Indigestion occurs with constant consumption of plastic. Therefore, the animal dies of hunger and stomach clogged with garbage or suffocation. Furthermore, Incineration replaces the landfill of plastic waste, but in the process, the atmosphere becomes polluted as plastic releases hazardous substances (Hopewell et al., 2009). Hence, plastic pollution negatively affects the earth's surface, atmosphere and oceans. Efforts are being made in various regions to reduce plastic pollution, including reducing the consumption of single-use plastics and encouraging recycling.

Plastics recycling

The most significant way to solve the problem of plastic waste is to receive and recycle it into new products. This option is actively used in many countries around the world. Hopewell et al. (2009) also noted that plastics recycling contains four classes: "primary (mechanical reprocessing into a product with equivalent properties), secondary (mechanical reprocessing into products requiring lower properties), tertiary (recovery of chemical constituents) and quaternary (recovery of energy)" (p. 2118). Besides, Drzyzga and Prieto (2018) found that presently the most prevalent method used to recycle plastic waste is mechanical recycling, which includes collection, sorting, washing and grinding. In addition, this study explains chemical recycling, which involves the conversion of plastic polymers into monomers that may then be remade into chemicals, fuels, or virgin plastic. Research by Miller et al. (2014) also agrees that separating larger, cleaner pieces of material for recycling is a common choice, but as well it adds another way, namely energy recovery. This study concludes that recycling waste to energy practices can be executed, if the energy recovery is the only version. However, plastics processing continues to face serious political, economic and cultural challenges.

Challenges of recycling

Recycling plastics in the automotive industry is a complex task. Drzyzga and Prieto (2018) explained the reasons in their study; post-consumer waste is often a mixed polymer waste with many organic and inorganic impurities, which is a huge issue for recycling. The main problem is that different types of polymers decompose in an uncontrolled manner under certain conditions of oxidation, heating,

radiation, hydrolysis and mechanical shear. Another task is the difference in melting points and processing temperatures of different polymers when processing mixed plastic waste. This is very similar to what Hopewell et al. (2009) found, that is the use of various polymers causes challenges. Miller et al. (2014) also added that lack of a market for secondary raw materials and infrastructure, as well as economic and knowledge gap negatively affect the recycling of plastics. Thus, even if plastic recycling is the most common method, it has certain disadvantages that are difficult to remedy.

Methods

In order to collect and analyse both quantitative (closed-ended) and qualitative (open-ended) data within a single investigation, mixed methods have been applied. The main goal of this methodology is that such integration allows for a more complete use of data than separate collection and analysis of quantitative and qualitative data (Wisdom & Creswell, 2013). Mixed methods approach seeks to understand multiple perspectives on a single problem, and can be ideal for evaluating complex interventions. Mixed methods are useful for understanding the contradictions between quantitative and qualitative results, that is, to fully disclose the topic. However, mixed methods studies are challenging to realize, because they are laborious and require a lot of resources and time.

In the research project, the survey has been used to collect information on public attitudes towards the problem of plastic waste and included 12 questions. Surveys are perfect for evaluating broad range of data, like perceptions, approaches, beliefs, opinions, or knowledge within a clear, determined group of individuals. In addition, online surveys allow collecting data from a large number of respondents in less time. Nevertheless, the options for answering the questionnaire can lead to unclear data, as respondents may interpret certain options differently. Moreover, closed-ended questionnaires may have a lower level of confidence than other types of methods, because respondents may not be motivated to provide accurate and honest answers. In order to solve this problem, all possible answers with various points of view have been considered; also, “Other” option was included for all questions. In the questionnaire, there were several types of questions such as dichotomous, multiple choice, rating scales, ratio data and open-ended questions. These types were applied to fully view the topic and get reliable information about the issue. The survey has been conducted among students, teachers and residents of different regions of Kazakhstan with various age categories to assess the problem from different perspectives. Hence, it was sent from different platforms as Outlook, WhatsApp and Instagram. At least 200 responses was expected to be considered, however only 120 people have completed the survey.

The interview has been included in the project work in order to identify key points of the problem of plastic waste and recycling. Jamshed (2014) noted that interviews allow respondents to voice their opinions at their own pace and manner, with minimal impact on the responses of other respondents. So, through the interview, which is considered as more personal data collection method, the clear perspective and opinion can be obtained. Furthermore, interviews can provide more credible and original responses, because the questions can be made more flexible and adaptive by referring to the interviewee's answers. However, preparing for an interview, conducting interviews and interpreting answers is time consuming, which makes the interview method laborious. It can also be difficult to find a qualified specialist who is familiar with the issue and has the necessary communication skills to conduct an interview. To address this limitation, numerous organizations and companies were contacted through Instagram and their official websites on the Internet, which led to the desired results. The interviews has consisted of eight or nine open-ended questions, depending on the interviewee, to fully reveal the problem. Interviews has been taken from six people who have direct connection to the topic being studied. They were a secretary of the United Nations Educational, Scientific and Cultural Organization club in Nazarbayev Intellectual School, a chemistry teacher, an employee of the company “Kazakhstan Waste Recycling”, the head of the company “Taza Qala”, an environmental specialist of the network of enterprises “PlastNet”

and an environmental project manager of the organization “Recycle BIRGE”. The interviews were recorded with the approval of the interviewees.

Results

The survey included 120 people over 10 years old (33 men, 84 women and 3 who preferred not to answer) (Appendix 2.1). The survey results showed that the majority of respondents (52.5%) use plastic products in their everyday life very often, almost a quarter (23.3%) chose the answer “Always” (Appendix 2.2).

First of all, it is essential to be aware of the causes of the problem of plastic waste. The results showed that the wide range of use of single-use plastic packaging (53.3%) has the greatest impact, and the second is the indifference of the population to the problem (50%). In addition, people who know more about the problem added their own options, such as “government and business are not investing in solving the problem”, “no alternatives in the same price range”, etc. (Figure 1).

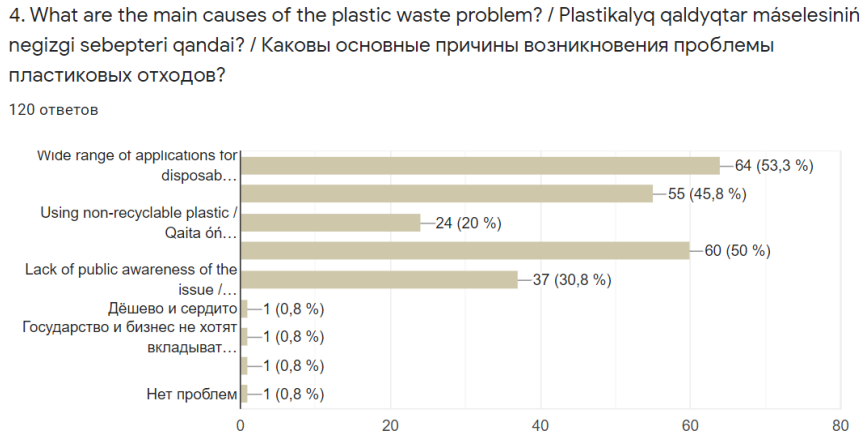

Figure 1. Main causes of the plastic waste problem.

The urgency of the problem can be seen in the question of the frequency of witnessing of places contaminated with plastic waste. Approximately half (46.7%) of respondents see such areas very often, another 32.5% noted the answer "Always". Surprisingly, there was no person who has never seen a place polluted with plastic waste (Figure 2). Thus, currently, the problem of plastic waste is relevant in Kazakhstan, which was confirmed by 83.3% of respondents (Appendix 2.3).

Figure 2. The frequency of witnessing of places contaminated with plastic waste.

The next question concerned the sorting of household waste by materials before disposal. The numbers of people who chose the options “No” and “Sometimes” were nearly the same - 48 and 46, respectively. Besides, some people added their own reasons and variations, such as “I want to sort, but there are no facilities in my city for this”, “I sort if the bins are separated”, etc. (Figure 3). Hence, sorting of household waste is not very common among residents. In addition, opinions about plastic

collection efficiency in Kazakhstan were various. However, the option 5 out of 10 was the largest index (19.2%) (Appendix 2.6).

Figure 3. Sorting the household waste by material.

The majority of respondents (68.3%) claimed that plastic recycling is the most effective way to deal with plastic waste. 55.8% have noted the option "Using alternative, recycled or biodegradable materials", while the answers "Raising public awareness of the problem" (41.7%) and "Prohibit certain types of single-use plastics" (40%) were chosen by roughly the same numbers of respondents (Figure 4).

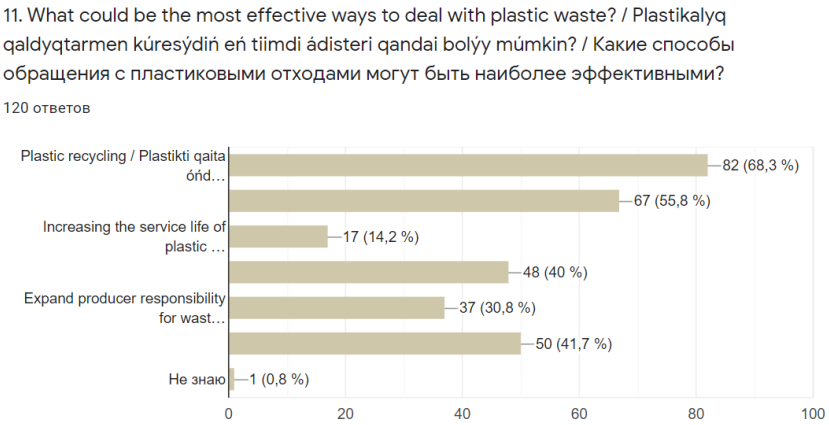

Figure 4. Solutions to the problem of plastic waste.

Interviews were taken with six people directly related to the topic under study. The respondents answered eight or nine open-ended questions, depending on their field of activity, to fully disclose the problem.

All interviewees have agreed that plastic pollution is a enormous problem not only in Kazakhstan, but all over the world. According to an environmental project manager of the organization “Recycle BIRGE”, “in waste sorting complex, which are located in many cities of Kazakhstan, only 10% of the total mass of household waste is extracted, which is transferred to waste processing”. As a result of the study through interviews, it was revealed that in Kazakhstan, the main reason of the issue is a wide range of use of single-use plastic and environmentally uneducated population of the country. Furthermore, a secretary of the United Nations Educational, Scientific and Cultural Organization club in Nazarbayev Intellectual School said that Kazakhstan is one of the countries that does not spend a lot on solving the problem of plastic waste. The next participant, a chemistry teacher, claimed that the companies engaged in the processing of plastic waste in Kazakhstan are limited to the recycling only in their region. Besides, the head of the company “Taza Qala”, has mentioned that almost all projects related to this industry in Kazakhstan are instantly closed, without having time to bring benefits. Nevertheless, at the moment, various programs and laws on sorting and processing of secondary raw materials are being introduced. Additionally, the employee of the company

“Kazakhstan Waste Recycling”, revealed that now there are more and more green initiatives and people who take up the collection of raw materials, despite the complexity of the process. The next interviewee was an environmental specialist of the network of enterprises “PlastNet”, who also noted that a number of non-governmental organizations create various social projects with the support of the donors of these projects to promote domestic companies engaged in the collection and processing of plastic waste.

However, all of them have mentioned that in European countries, the situation is completely different due to the developed infrastructure and responsibility of residents. Considering the major causes, they have suggested some solutions of the issue, such as increasing environmental education (informing) the population of Kazakhstan, creating an infrastructure for separate waste collection, production of new items from recycled materials, etc.

Discussion

Taking into account all the data provided by primary and secondary sources, as well as the results of survey and interviews, it can be clearly seen that the problem of plastic waste has become one of the serious issues that has a considerable influence on the country's ecology.

With regards to how widespread the problem of plastic waste is in Kazakhstan, the data collection statistics showed that the current problem is relevant at the present time, since most of the products have a plastic shell and people do not re-consume plastic. This leads to the fact that non-biodegradable plastic products are becoming waste and accumulating in large quantities in oceans, coastal areas and soils. All of this negatively affects wildlife, habitats and the health of wild animals and people.

As for the main causes of the problem of plastic waste, the results of the study identified that the wide range of use of single-use plastic and environmentally uneducated population of the country, particularly the indifference of the residents to the problem, have the greatest impact. Hence, attitudes of the population towards the issue and their lifestyle, which includes constant plastic application, should be altered. If there are high awareness, responsibility and social activity of residents, it will be easier and faster to address the issue and prevent eco-harming consequences.

Regarding the development of the plastics processing industry in Kazakhstan, this area does not work as efficiently as the European one. However, in environmental projects, there is a trend towards an increase in the number of processing companies. Thus, most plastic waste recycling companies gain extensive knowledge, skills and experience to carry out this activity. Further progress of an industry that uses eco-friendly plastic processing methods can provide a solution to the problem of plastic waste without harming the environment.

With reference to what methods of plastic recycling can be used to improve the efficiency of this process, the manufacture of other plastic products is actively used in many countries of the world, including Kazakhstan. Thereby, the most effectual technique to tackling the problem of plastic waste is to sort and recycle it into new products. Manufacturing consumer goods from recycled plastic helps not only preserve the environment, but also turn it into a socially responsible and profitable business.

With regards to how to increase the proportion of plastic recycling in Kazakhstan, the research has determined that main problems are the attitude of the population towards the problem and the approach of the government. Therefore, government should take some strict measures, as a restriction or prohibition on the use and sale of non-recyclable plastic, and provide support to companies engaged in waste collection and processing, by helping to create infrastructure and comfortable conditions for all citizens. Moreover, it is essential to increase eco-education of the residents and awareness of the problem of plastic waste, implementing eco-projects. These measures can make an enormous contribution to addressing the problem of plastic waste.

Conclusion

Despite the strengths of the research, there were some limitations. For instance, the interview did not involve a person working in a processing plant to find out exactly about their processing technology. Besides, in further project work, there should be fewer interview questions, which related to each other, but not have similar meaning, since some of the answers to subsequent questions were included in the previous responses.

I hope that my research can influence society in terms of collecting and sorting plastic products, since the problem of plastic waste, which is of concern to people, must be addressed by a consistent and collaborative effort.

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References:

Bilyalova, A. (2020, August 28). *Vtoraya zhizn' plastika v Kazakhstane – kak povysit' dolyu yego pererabotki* [The second life of plastic in Kazakhstan - how to increase the share of its recycling]. BaigeNews. Retrieved December 02, 2020 from https://baigenews.kz/news/vtoraya_zhizn_plastika_v_kazakhstane_-_kak_povysit_dolyu_ego_pererabotki/

Carey, J. (2017, January 24). On the brink of a recycling revolution? *Proceedings of the National Academy of Sciences, 114*(4), 612–616. Retrieved from https://doi.org/10.1073/pnas.1620655114

Drzyzga, O., & Prieto, A. (2018, November 8). Plastic waste management, a matter for the 'community'. *Microbial Biotechnology, 12*, 66–68. Retrieved from https://doi.org/10.1111/1751-7915.13328

Glaser, J. A. (2017, April). New plastic recycling technology. *Clean Technologies and Environmental Policy, 19*(3), 627–636. Retrieved from https://doi.org/10.1007/s10098-016-1324-7

Hopewell, J., Dvorak, R., & Kosior, E. (2009, July 27). Plastics recycling: challenges and opportunities. *The Royal Society, 364*(1526), 2115–2126. Retrieved from https://doi.org/10.1098/rstb.2008.0311

Jamshed, S. (2014). Qualitative research method-interviewing and observation. *Journal of basic and clinical pharmacy, 5*(4), 87–88. Retrieved from https://doi.org/10.4103/0976-0105.141942

Miller, L., Soulliere, K., Sawyer-Beaulieu, S., Tseng, S., & Tam, E. (2014, August 15). Challenges and Alternatives to Plastics Recycling in the Automotive Sector. *Materials, 7*(8), 5883–5902. Retrieved from https://doi.org/10.3390/ma7085883

United Nations Environment. (2019, January 02). *Plastic recycling: an underperforming sector ripe for a remake.* Retrieved December 02, 2020 from https://www.unenvironment.org/news-and-stories/story/plastic-recycling-underperforming-sector-ripe-remake

Wisdom, J., & Creswell, J.W. (2013, February). Mixed Methods: Integrating Quantitative and Qualitative Data Collection and Analysis While Studying Patient-Centered Medical Home Models. *Agency for Healthcare Research and Quality, 13*(28), 1-5. Retrieved from https://pcmh.ahrq.gov/page/mixed-methods-integrating-quantitative-and-qualitative-data-collection-and-analysis-while

Appendixes:

Appendix 1. Survey questions:

1. Gender:

   Male / female / other
2. Age category:

   10-17 / 18-35 / 36-55 / 55+
3. How often do you use plastic products in your daily life?

   Always / Very Often / Sometimes / Rarely / Never
4. What are the main causes of the plastic waste problem?
   - *Wide range of applications for disposable plastic packaging*
   - *Low rate of plastic recycling*
   - *Using non-recyclable plastic*
   - *Indifference of the population to the problem*
   - *Lack of public awareness of the issue*
   - *Other*
5. Do you think the problem of plastic waste is urgent in Kazakhstan?

   Yes / Probably yes / No / Find it difficult to answer / Other
6. How often do you see places contaminated with plastic products?

   Always / Very Often / Sometimes / Rarely / Never
7. What are the main consequences of plastic entering the environment?
   - *Contamination of soil, groundwater and oceans*
   - *Release of chemicals into the environment*
   - *The release of methane that contributes significantly to global warming*
   - *Plastics entering the animal food chain*
   - *Negative impact on human health*
   - *Blocking waterways with plastic bags and exacerbating natural disasters*
   - *Other*
8. What do you think, should it be considered an administrative offense to throw garbage in the wrong place or past containers?

   Yes / Probably yes / No / Find it difficult to answer / Other
9. Do you sort your household waste by material before discarding it?

   Yes / Sometimes / No / Find it difficult to answer / Other
10. How effective is the collection of plastic in Kazakhstan, in your opinion?

    Not effective – Medium – Very Effective
    0 / 1 / 2 / 3 / 4 / 5 / 6 / 7 / 8 / 9 / 10
11. What could be the most effective ways to deal with plastic waste?
    - *Plastic recycling*
    - *Using alternative, recycled or biodegradable materials*
    - *Increasing the service life of plastic products*
    - *Prohibit certain types of single-use plastics*
    - *Expand producer responsibility for waste*
    - *Raising public awareness of the problem*
    - *Other*
12. What can you suggest to increase the share of plastic recycling in Kazakhstan?

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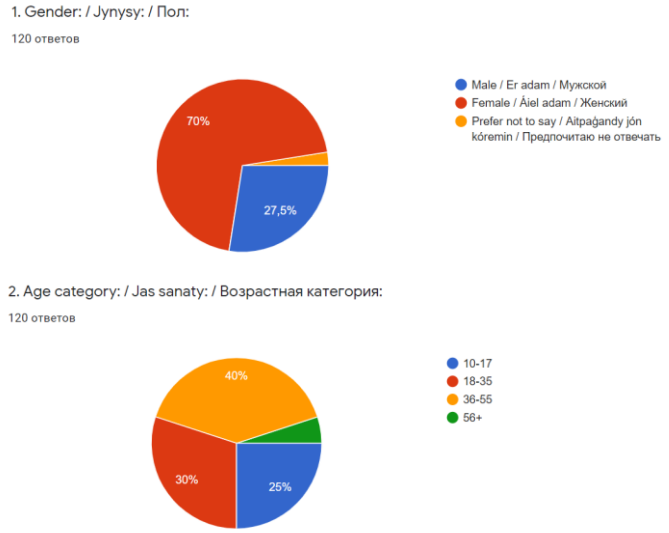
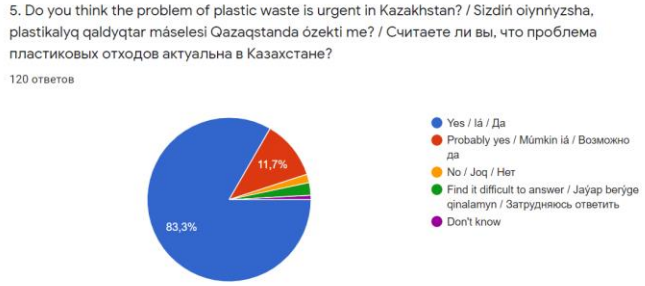
Appendix 2. Survey results:

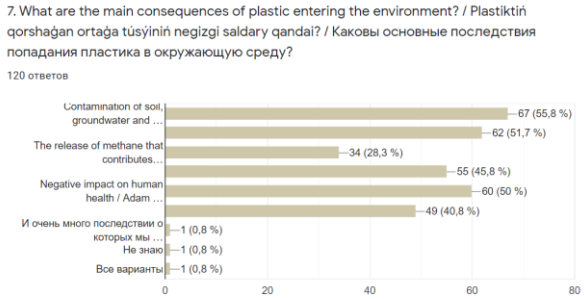


Appendix 2.1. Gender and age category of respondents.

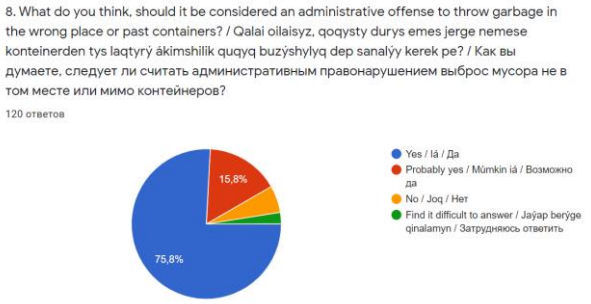
Appendix 2.2. The frequency of use of plastic products in daily life.



Appendix 2.3. Relevance of the problem of plastic waste in Kazakhstan.



Appendix 2.4. The main consequences of plastic entering the environment.



Appendix 2.5. Opinions about an administrative offense for throwing garbage in the wrong place or past containers.

Appendix 2.6. Plastic collection efficiency in Kazakhstan.

Appendix 2.7. Proposals to increase the share of plastic recycling in Kazakhstan.

Appendix 3. Interview questions:

1. What do you think about the problem of plastic waste in Kazakhstan?
2. What leads to the formation of plastic waste in our country?
3. What measures are being taken to deal with plastic waste in different regions of the country?
4. How are things going on the introduction of separate collection of household waste?
5. How effective are companies dealing with the recycling of plastic waste in Kazakhstan?
6. Can you tell us more about your activities? What technologies are you using?
7. Can you compare the situation of plastic recycling in Kazakhstan with European countries?
8. How to increase the proportion of plastic recycling in Kazakhstan?
9. How to raise the level of environmental education of the population?
10. What projects are being carried out on this issue in the United Nations Educational, Scientific and Cultural Organization club in Aktobe?