Business plan for managing secondary paper raw material in Murmansk region

M V Svetlova¹, E Yu Aleksandrova¹, A A Trotsenko¹, O V Savateeva¹ and D A Savateev²

¹Murmansk Arctic State University 183038, Murmansk, Kommuny street, 9, Russia
²Murmansk State Technical University 183010, Murmansk, Sportivnaya street, 23, Russia

E-mail: trotcenko2007@yandex.ru

Abstract. The problem of the utilization of solid municipal waste is one of the most acute in the Murmansk region. The paper presents a business plan for creating a small enterprise for the processing of recycled paper raw materials in the Murmansk region based on an analysis of information about modern technologies for processing solid waste. The article gives a brief description of the main project stages, a feasibility study, and environmental rationale. It is assumed that the company will provide the following services: collection, pressing and further processing of secondary raw materials, as well as the production of corrugated packaging.

1. Introduction

The people produce an increasing amount of household waste ranging from packaging material to used televisions and old cars [1-3]. In the conditions of constantly growing demand for raw materials with depletion and exhaustibility of raw materials and natural resources, the secondary use of resources becomes critical to ensure the livelihoods of future generations [4]. Successful practices in the utilization and use of municipal waste, namely the paper waste, can serve as the basis for creating a strategic national waste management plan.

According to data from municipalities in the territory of the Murmansk region, waste is generated annually in the amount of 400 thousand tons per year, which is 396 kg per person. The bulk of household waste from the cities of Murmansk, Severomorsk, and Kola go to the thermal treatment of waste. The amount of waste burned at the incinerator is about 90 thousand tons/year. Other cities and towns of the Murmansk region do not have waste processing facilities, and solid unsorted waste is sent to authorized and unauthorized landfills [4 -7].

The problem of utilization of municipal solid waste (MSW) is one of the most acute in the Murmansk region. The population of the area is mainly urban, and this leads to a higher amount of MSW (over three hundred thousand tons per year for seven hundred and fifty thousand people). Since January 1, 2019, in the Murmansk area, the regional operator JSC “Upravlenie ontkhodami” specializing in the treatment of solid waste started its operation.

The Murmansk region is divided into two technological zones - northern and southern - to organize an effective system for the collection and disposal of municipal solid waste. Following the concession agreement between the government of the Murmansk region and JSC “Upravlenie ontkhodami” the north zone has the following facilities under construction:
• MSW landfill with a capacity of at least 250 thousand tons per year;
• waste sorting plant (WSP), located on the territory of the MSW landfill, with a capacity of at least 180 thousand tons per year;
• waste transfer station (WTS) in the closed administrative-territorial unit of Severomorsk with a capacity of at least 23 thousand tons per year according to the results of the first stage of construction, not less than 35 thousand tons per year according to the results of the second stage;
• waste transfer station (WTS) in the closed administrative-territorial unit of Aleksandrovsk with a capacity of at least 23 thousand tons per year.

In the future, in the city of Zapolyarny, the Pechengsky district, a WTS with a capacity of at least 20 thousand tons per year will be built.

To date, the disposal of unsorted waste at landfills in the region has been the most common method of waste disposal. However, there is always an irretrievable loss of up to 90 percent of useful products that have real demand in the secondary raw materials market. Information on the average composition of solid waste is presented in table 1.

| Waste components   | Composition, % |
|--------------------|----------------|
| Paper, cardboard   | 20-40          |
| Metals             | 2-10           |
| Food waste         | 25-40          |
| Plastic            | 3-8            |
| Textiles           | 4-6            |
| Glass              | 4-10           |

The main component of solid waste, paper, can be divided into three groups: 1) A - high quality; 2) B - medium quality; 3) C - low quality. The key feature of wastepaper is that it is a secondary raw material that previously has gone through a complete cycle or several cycles of processing into paper and cardboard products. The most effective way to process cardboard and paper waste is to use it in the production of sanitary and hygienic products (including paper tissue), cardboard, corrugated board, and green fiber. The range of these products can be expanded. The greatest growth in the use of wastepaper in the future is expected in the production of newsprint, corrugated board components, and sanitary types of paper.

The goal of this project goal is to analyze information on modern technologies for the processing of municipal solid waste and present the business plan of the enterprise for the processing of recycled paper raw materials in the Murmansk region.

2. Materials and research methods

To compile a business plan for the enterprise to produce corrugated packaging and processing of secondary raw materials, we carried out the project cost calculations.

For this purpose, we calculated the performance of the proposed installation for the recycling of wastepaper according to formula 1:

\[ P_i = \frac{P}{(WD \times WH)} \]  

where
\( P_i \) – performance of the installation (t/h),
\( P \) – enterprise performance (t/h),
\( WD \) – number of working days per year,
WH – number of working hours per day.

Then we developed a commercial proposal for the supply of equipment and gave a feasibility study for the project: we calculated the total cost of all the equipment, estimated the productivity of the enterprise, analyzed the morphological and fractional composition of the required solid waste from the residential sector, the estimated composition of commercial waste, average purchase prices for raw materials, and income from recyclable materials.

The calculation of income from recyclables was carried out according to formula 2:

\[ I_r = W \times P_r \]  \hspace{1cm} (2)

where

\( I_r \) – income from the use of recyclables (rubles),
\( W \) – amount of waste required (t/year),
\( P_r \) – average purchase price for a particular brand of recycled materials (rubles).

Calculation of additional costs for tying recycled briquettes with polypropylene tape was carried out as follows:

\[ C_t = \frac{W}{M} \times L \]  \hspace{1cm} (3)

where

\( C_t \) – costs for tying briquettes (rubles),
\( W \) – amount of waste (t/year),
\( M \) – briquette mass (kg),
\( L \) – briquette length (m).

Then we calculated the cost of tying with a polypropylene tape according to formula 4:

\[ C_{pt} = C_{1km} \times L_t \]  \hspace{1cm} (4)

where

\( C_{pt} \) – tape cost (rubles),
\( C_{1km} \) – cost of tape for 1 km (rubles),
\( L_t \) – length of tape required for tying the briquettes (km).

The cost of fuel for 1 unit of special vehicles was calculated based on formula 5:

\[ C_f = C_f \times WH \times WD \times C_{1l} \]  \hspace{1cm} (5)

where

\( C_f \) – fuel cost (rubles),
\( C_f \) – fuel consumption for special vehicles (l/h),
\( WD \) – number of working days per year,
\( WH \) – number of working hours per day,
\( C_{1l} \) – cost of 1 liter of fuel (rubles).

Since the cost of oils is 10% of the cost of fuel, it will be determined as follows:

\[ C_o = C_f / 10 \]  \hspace{1cm} (6)

where

\( C_o \) – cost of oils (rubles),
\( C_f \) – fuel cost (rubles).

The total cost of fuel and lubricants will be:

\[ C_{tfl} = C_f + C_o \]  \hspace{1cm} (7)

where

\( C_{tfl} \) – total costs for fuel and lubricants (rubles),
\( C_f \) – fuel cost (rubles),
Co – cost of oils (rubles),
The cost of annual electricity consumption was calculated according to formula 8.

\[ Ce = \text{Eh} \times \text{WH} \times \text{Pu} \] (8)

where
Ce – total cost of annual electricity consumption (rubles),
Eh – amount of electricity consumed per hour (kW),
WH – number of working hours,
Pu – price per unit of electricity (rubles / kW).

The monthly wage fund will be:

\[ \text{Fav} = \text{AP} - \text{Ded} \] (9)

where
Fav – average annual wage fund (rubles),
AP – annual payroll without deductions (rubles):

\[ \text{AP} = \text{M} \times \sum (\text{HC} \times \text{S}) \] (10)

Ded. – social deductibles (rubles):

\[ \text{Ded.} = \frac{(\text{AP} \times 34.2\%)}{100\%} \times \text{M} \] (11)

HC – number of employees (HC),
S – salaries of employees (rubles),
M – number of months per year.
The cost of low-value and fast-wearing materials will be:

\[ \text{Cw} = \text{M} \times \text{C1u} \] (12)

where
Cw – cost of low-value and fast-wearing materials (rubles),
M – number of months per year,
C1u – cost of materials per month (rubles).

According to the results of the calculations, we can calculate the total cost of processing secondary raw materials:

\[ \text{Cp} = \text{M} + \text{Ce} + \text{Fpt} + \text{Co} \] (13)

where
Cp – the cost of processing raw materials (rubles),
M – material costs (Cpt + Ctfl), rubles,
Ce – energy costs (rubles),
Fpt. – payroll and taxes (rubles),
Co – other expenses (rubles).
The payback of the enterprise from the moment of its launch is determined as follows:

\[ \text{PBe} = \frac{\text{Cest}}{\text{NP}} \] (14)

where
PBe – payback of the enterprise (years),
Cest – cost of establishing an enterprise (rubles),
NP – net profit (rubles)

3. Main stages of the “Ecogofra” project

The purpose of this technical and economical offer is the production, supply, installation, and commissioning of equipment necessary for the enterprise for the processing of secondary raw materials in the territory of Murmansk and the Murmansk region (the productivity of the newly
created enterprise will be up to 2000 tons per year). It is assumed that the company will provide the following services: collection, pressing, and further processing of secondary raw materials, as well as the production of corrugated packaging.

Among a number of advantages, it is possible to distinguish a decrease in the landfill waste flow, and, consequently, the environmental impact, more efficient use of the landfill space (its life-time period is extended by 3-4 times), reduced costs for the removal and disposal of waste, and the return of secondary material resources to the production and consumption industries as well as new workplaces [8].

Project cost: 1134 thousand rubles.

Project financing proposals: attracted investments. The activities of the enterprise are not subject to licensing.

Location, legal address, legal form, and type of ownership of the enterprise. The newly created enterprise will be located in the city of Kola, Murmansk region. Legal form is a limited liability company with a statutory fund with a percentage ratio.

Fixed assets of the enterprise. The list of fixed assets located on the territory of the site and placed on the balance sheet of the enterprise is formed on the basis of 1) existing site and facilities, infrastructure, communications, completion and installation of the necessary production capacities; 2) the acquisition and commissioning of equipment for pressing and processing secondary raw materials, the commissioning of a line for the production of corrugated packaging, required vehicles and working capital.

The position of the company in the recycling sector. The enterprise will carry out its activities in the city of Murmansk in the following mode: 1) acquisition (procurement) of secondary raw materials from enterprises and the population; processing of prepared raw materials (waste paper); 2) pressing in the acquired secondary raw materials; 3) recycling; 4) the manufacture of corrugated packaging. The key suppliers of household waste: markets, exhibitions, trade enterprises (secondary raw materials obtained from trade, and commercial waste).

The main stages of the project: 1. Development of a draft feasibility study, a business plan includes studying the market for the supply of raw materials, sales of the final product and equipment manufacturers to start a production line. 2. Conclusion of agreements with local authorities (joint activities of the company, etc.). 3. Preparation of the production area. 4. Conclusion of a contract for the supply of equipment, purchase, delivery, installation supervision of the equipment, staff training. 5. Installation and commissioning. 6. Establishment of structures for the uninterrupted supply of raw materials, marketing of finished products, and transport services. 7. Establishment of a corrugated packaging production line.

Enterprise products. The final product is 1) sorted secondary raw materials, ready for recycling (waste paper), compressed and packaged in “block briquettes,” in size convenient for their transportation by any freight transport; 2) manufactured and laid out corrugated packaging ready for selling.

The pricing policy for the payment of sorting and processing of industrial and household waste at the enterprise is determined by the established prices for consumed electricity, heat, water, transportation costs, auxiliary materials (packaging wire, staff salaries, etc.), as well as the amount of taxes paid.

Installation development. The development of the installation is carried out in accordance with the specification: 1) productivity of the enterprise: 2.000 tons/year (500 tons of solid waste from the residential sector plus 1.500 tons of solid waste from the commercial sector); 2) number of business days: 365 business days/year; 3) the number of working hours/day is 8 hours, a total of 8 hours/day, total operation of the line for the selection and sorting of secondary raw materials is 8 hours/day. The calculation is carried out according to the formula 1: 1.277 t/h (≈1.3 t/h)

Preliminary commercial proposal for the supply of equipment for the collection and pressing of secondary waste with a capacity of 2000 tons per year (table 2):
Table 2. List of necessary equipment.

| No. | Equipment                                              | Price      |
|-----|--------------------------------------------------------|------------|
| 1.  | Hydraulic Press                                       | 217 000 rubles |
| 2.  | Hydraulic Press                                       | 217 000 rubles |
| 3.  | Vehicle                                               | 230 000 rubles |
| 4.  | Hydraulic all-weather oil VMGZ                        | 120 000 rubles |
| 5.  | Polypropylene tape                                    | 120 000 rubles |
| 6.  | Tool set                                               | 20 000 rubles  |
| 7.  | Machine "Roll Press" of the brand MV-2000 (for the production of corrugated packaging) | 810 000 rubles |
|     | TOTAL                                                 | 1134 thousand rubles |

Technical and economic assessment of the project. Let us calculate the productivity of the plant (table 3-6). To do this, we state that the proposed production line has the potential for processing by 15-20%, the required 2.000 t/year (table 3).

Table 3. Processing potential of the production line.

| Total volume of solid waste | 2 000 t/year |
|----------------------------|--------------|
| MSW volume from the residential sector | 500 t/year |
| MSW volume from the commercial sector | 1 500 t/year |

The percentage of paper waste recommended for technological calculations is at least 22% of all solid waste.

The average purchase price for secondary raw materials at enterprises in Russia and the CIS is from 8,000 to 24,000 rubles/ton with VAT.

Let us calculate the income derived from recyclable materials (take the prices of recyclable materials at the lower limit, formula 2):

1) Paper, cardboard.

Maximum revenue:
R = 4000 thousand tons × 12000 rubles = 48,000,000 rubles

Minimum revenue:
R = 4000 thousand tons × 8000 rubles = 32,000,000 rubles

Revenues from corrugated packaging:
2) Corrugated packaging.

Maximum revenue:
R = 20000 pc. × 820 rubles = 16,400,000 rubles

Minimum revenue:
R = 20000 pc × 600 rubles = 12,000,000 rubles

Costs include the following:
1) Material supply.

The polypropylene tape is used for tying briquettes; the consumption rate per 1 briquette is 750 cm. When tying 2000 thousand tons of recyclables per year, the total demand for polypropylene tape for one year will be the following (formula 3):

C_t = 2000/50 × 1.5 = 60 km,

where 1.5 m – length per briquette, 50 kg – briquette weight
The cost of a polypropylene tape is 2000 rubles per 1 km.

The total cost of polypropylene tape (formula 4):

\[ C_{pt} = 60 \text{ km} \times 2000 \text{ rubles} = 120 \text{ thousand rubles} \]

2) Fuel and lubricants.

The cost of fuel is 50 rubles per 1 liter. The fuel consumption for special vehicles ~ 11 l/h, i.e.: \( C_f = 11 \times 7 \times 313 \times 50 = 1 \, 201 \, 200 \) rubles for a unit of equipment (according to formula 5).

The cost of oils (\( C_o \)) is 10% of the cost of fuel, i.e., 120,120 rubles (formula 6).

Total costs for fuel and lubricants (\( C_{tfl} \)) is 120,120 + 120,120 = 321,320 thousand rubles (formula 7).

3) Electricity consumption. The total electricity consumption is 10 kW (table 4).

Table 4. Calculation of annual electricity consumption.

| TOTAL (kW) | 10 |
|------------|----|
| Hour/year  | 2920 |
| Cost/unit (rubles/kW) | 5.90 |
| Total annual cost | 172,280 rubles |

Based on formula 8, the cost of annual electricity consumption (\( C_e \)) will be 172,280 rubles.

4) Monthly and annual payroll fund. The monthly wage fund is determined based on the average monthly salary of one employee (table 5, formulas 9-11).

Table 5. Payroll fund.

| №  | Job title          | HC | Monthly payroll |
|----|--------------------|----|----------------|
| 1  | Pressers           | 1  | 16,000         |
| 2  | Drivers            | 2  | 18,000         |
| 3  | Unskilled workers  | 1  | 18,000         |
| 4  | General accountant | 1  | 20,000         |
| 5  | General manager    | 1  | 24,000         |
| TOTAL |                 | 6  | 96,000         |

Consequently, the average annual wage fund is \( 12 \times 96,000 = 1,152,000 \) rubles, and annual social deductions (34.2%) amount to 393,984 rubles.

5) Low-value and fast-wearing parts and materials.

Low-value and fast-wearing parts and tools - 16,000 rubles per month. Based on the formula 12, \( C_w = 16,000 \times 12 = 192,000 \) rubles.

6) The cost of processing secondary raw materials (collection, pressing into bales) (table 6, formula 13).

Table 6. Cost pf processing secondary raw materials.

| №  | Item                                | Cost       |
|----|-------------------------------------|------------|
| 1  | Material costs:                     |            |
|  | - Polypropylene tape                | 120,000    |
|  | - Fuel and oil                      | 1325,554   |
| 2  | Outside supply of energy resources  | 286,160    |
| 3  | Payroll and taxes                   | 1,545,984  |
| 4  | Other expenses:                     |            |
|  | low value wearing items and production tools |    |
The payback of the enterprise from the moment of its launch is calculated according to formula 14.

Optimistic forecast:
- 1634 thousand rubles (costs of creating an enterprise), the return on the enterprise is 1.3 years.
- 28 800 rubles (net profit).

Pessimistic forecast:
- 1634 thousand rubles (costs of creating an enterprise), the return on the enterprise is two years.
- 20 420 rubles (net profit)

4. The environmental rationale for the project
The construction of the “Ecogofra” enterprise in the city of Kola will make it possible to locate the production line between Murmansk and the cities of this region, which minimizes the environmental impact and transportation costs. However, reconstruction of the southern treatment facilities is required, which is already an urgent need for greening the production in the Murmansk industrial hub and for preserving the Kola Bay ecosystem. Thus, the implementation of this project is of great environmental and economic importance for the strategic planning of the development of the region [9, 10].

5. Conclusion
The business plan of the enterprise for the processing of secondary raw materials and the production of corrugated packaging is proposed. Presumably, the company is located in Kola. The total cost of the proposed project will be 3,469,698 rubles. The payback of the enterprise from the commissioning according to the optimistic forecast will be 1.3 years, according to the pessimistic forecast - 2 years. Net profit will be in the range from 20 420 to 28 800 rubles annually.

References
[1] Kolychev N A 2011 On the need to develop modern technologies for municipal waste management Ekologicheskii vestnik Rossii 1 38-9
[2] Orletskaya L V 2007 Valuable secondary resources Retsikling otkhodov 6 (12) 2-4
[3] Parmukhina E L 2010 Russian waste paper market Ekologicheskii vestnik Rossii 8 24-5
[4] Report on the state and protection of the environment of the Murmansk region in 2016 2017 180
[5] Rossstat 2016 Regions of Russia. Main characteristics of the constituent entities of the Russian, accessed 10 March 2019, <http://www.gks.ru/doc_2016/region/subject.zip>
[6] Trotsenko A A et al 2010 The impact of demographic and climatic factors on the nonspecific immunity of residents of the Republic of Karelia and the Murmansk region Narodonaselenie 1 113 - 9
[7] Bascomb R et al 1996 Health Effects of Outdoor Air Pollution Am J. Respir Crit. Care Med 153 477-98
[8] Trotsenko A A, Belevsky T V, Kievskaia O G, Alexandrova E Y and Gurevskaya L A 2018 Definition of the effective strategic enterprise management model in context of economic security Revista Espacios 39 (36) 18
[9] Zhuravleva N G, Matishov G G, Ottesen O, Budilova E V Trocenko A A and Larina T M 2013 Biojekologicheskie osnovy zhiznedejatel’nosti organizmov v uslovijah Zapoljar’ja (Apatity: KNC RAN)
[10] Bascomb R, Bromberg P A, Costa D L, Devlin R, Dockery D W, Frampton M W, Lambert W, Samet J M, Speizer F E and Utell M (1996) Health Effects of Outdoor Air Pollution Am J. Respir Crit. Care Med 153 477-98