

# THE FEASIBILITY STUDY FOR THE ORGANIZATION OF POWER FLEXIBLE CABLES PRODUCTION

Received – Priljeno: 2023-06-12  
Accepted – Prihvaćeno: 2024-01-30  
Preliminary Note – Prethodno priopćenje

The article examines the issues of creating a power flexible cable production in the country (Republic of Kazakhstan). The research objective of the study is to assess the technical and economic feasibility for organization of such production. Production program, investment estimation (cost sheet) and model of financial and economic payback for this project were calculated in course of the article's research. The research confirms the effectiveness of the creation for cable production in Kazakhstan, also this project can be recommended for implementation.

*Keywords:* cable production, power flexible cable, technology, investments, financial modeling.

## INTRODUCTION

The cable industry belongs to the basic industries of economy. World experience confirms a direct link between the level of industrial production of the country and the amount of cable and conductor products consumption. These products have a wide range of applications in the mining and metallurgical industry, energy, mechanical engineering.

Recently, the growth of cable products consumption is predicted in the conditions of digitalization of Kazakhstan's industry [1]. At the same time, there are no plants in Kazakhstan for the production of power flexible cable (in rubber insulation and rubber sheath). More than 85 % from the volume of cable and conductor products used in the country is imported [2].

According to statistics data, about 1 million km of various electronic and electrical conductors and cables can be produced in Kazakhstan annually [3]. The country has all necessary raw material bases for the organization of such production.

Despite the existing production of electronic and electrical conductors and cables, 56 thousand tons of cable (worth is over 260 million dollars) are imported to Kazakhstan annually [4]. Thus, the volume of net imports of cable and conductor products in 2022 is amounted to about 40 thousand tons (worth is about 190 million dollars) [5]. The main importers are Russia, Uzbekistan, Ukraine, Germany, Italy, China, Turkey, etc. Russia was the leader in import supplies for this period (more than 64 %) [6].

## PRODUCT RANGE FOR THE PROJECT

The project provides for the production organization of cable and wire products (in rubber insulation and shell) to meet the needs of the Kazakh industry and for export. Technological equipment (what is intended for use) will allow to produce a wide range of cable and conductor products:

- 1 Rubber-insulated and sheathed flexible general-purpose cables, designed for connecting various mobile mechanisms at alternating voltages (up to 660 V, with a frequency of 50 Hz):
  - flexible cable – has copper cores, with rubber insulation in a rubber shell;
  - flexible cable with oil-resistant rubber shell, extinguished in case of fire - has copper cores, with rubber insulation in a rubber oil-resistant shell, that does not spread combustion;
  - flexible cable with winding of the conductive core, what is produced from polyethylene terephthalate film - has copper cores, with rubber insulation in a rubber shell and increased flexibility;
  - high flexibility cable with non-combustible shell made of oil-resistant rubber - has copper cores, with rubber insulation in a rubber oil-resistant shell, that does not spread combustion, it also has increased flexibility;
  - flexible cable, with a polyethylene terephthalate film winding the conductive core, with a core of polyester threads in a rubber sheath - has copper cores, with rubber insulation in a rubber sheath, also has increased flexibility, with a profiled rubber core;
  - flexible cable, with a winding of a conductive core with a polyethylene terephthalate film,

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with a core of polyester threads in a rubber shell, in a rubber oil-resistant shell that does not spread combustion - has copper cores, with rubber insulation in a rubber oil-resistant shell, that does not spread combustion, increased flexibility, with a profiled rubber core;

- flexible cable, with a winding of a conductive core with a polyethylene terephthalate film, with a rubber filling - has rubber insulation in a rubber shell, has copper cores with increased flexibility and rubber filling between them;
- connecting wire with rubber insulation and sheath – flexible wire with twisted cores, with rubber insulation in a rubber sheath;
- connecting wire with conductive conductors made of soft copper wires (in tropical version - tinned copper wires) in rubber insulation, rubber thickened shell – flexible wire with twisted cores, has rubber insulation in a thickened rubber shell. This type of cables is designed to work in various atmospheric conditions at a long-term permissible core temperature (no more than 65 °C).

2. Cable production for mining and processing industries - flexible shielded cables; flexible shielded shaft cables; particularly flexible cables, shielded, shaft, with rubber insulation and sheath, etc.

Regulatory and technical documentation for the planned products includes: Technical specification 16.K71.098-90, Technical specification 16.K73.05-93, Technical specification 16.K73.012-95, Technical specification 16.K73.02-88, Technical specification 16.K73.03-97, GOST (USSR Standard-Setting Authority) 433-73, GOST 16442-80, Technical specification 16.K56.022-98, Technical specification 16.K73.062-2002, Technical specification 16.K56.029-2001, GOST 24334-80, GOST 24334-80, Technical specification 16.K73.05-93, Technical specification 16.K73.02-88, Technical specification 16.K73.064-2002.

## TECHNOLOGICAL AND TECHNICAL SOLUTIONS FOR THE PROJECT

The production of flexible power cable and conductor products (in rubber insulation and rubber sheath) is a complex, multi-stage and high-tech process.

Organization of cable and conductor products manufacturing is based on the application of traditional technology used by all cable and conductor enterprises. At the same time, the projected enterprise has opportunity to expand the range and assortment of products.

Planned equipment for cable production:

1. Coarse copper drawing line, with annealing prefix device.
2. Medium drawing line with annealing device, multi-wire.
3. Double twist bunching machine for 630 / 800 mm coil.

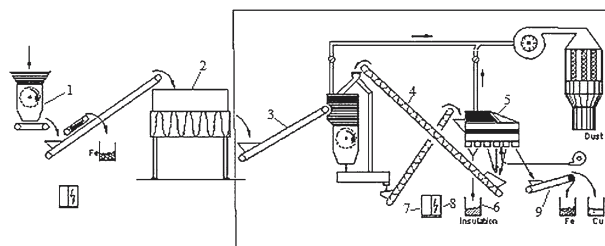
4. Double twist bunching machine for 1 250 / 1 600 mm drums.
5. Torsional machine, bugle type for 1 250 / 1 600 mm drums.
6. Continuous vulcanization insulating line.
7. Continuous vulcanization line for coating.
8. Rubber mixing rollers, rubber-preparatory equipment.
9. Rewinding machine 1 000.
10. Rewinding machine 2 000.
11. Testing station, laboratory equipment.
12. Auxiliary equipment (coiling, etc.).

It is proposed to equip the enterprise with the most modern high-quality equipment, produced by leading European manufacturers of cable products: by Maillefer Extrusion (production of Finland) and Frigeco (production of Italy) companies.

## WASTE DISPOSAL SOLUTIONS

There are two main types of waste - copper and rubber waste, which can be formed in the process of a power flexible cable producing (with insulation and a rubber sheath). In quantitative terms, wastes amount to average indicators: about 3 % for copper (42,9 tons per year) and about 5 % for rubber (75,2 tons per year) in conditions of 100 % utilization capacity.

Within the framework of this project, it is planned to use the technology for complete disposal and recycling of cable production waste. The schematic diagram of the technological line for processing cable production waste or for cable that is out of whack (Figure 1).



**Figure 1** Scheme of the technological line for cable production waste recycling. Where are: 1 - chopper, 2 - pre-shredder, 3 - unloading belt conveyor, 4 - belt conveyor, 5 - over-tape magnet, 6 - bin for intermediate storage, 7 - control panel, 8 - monoblock, 9 - terminal belt conveyor

Specification for the technological line for processing cable production waste:

- 1 VZ 75M chopper. Mounted on a frame. The dimensions of the loading hopper are 2 000 x 1 750. A massive 770 mm long rotor with three rows of knives (5 pieces in a row). Cutting case with one holder, which has 6 fixed knives (they are stationary).
- 2 Pre-shredder for cable.
- 3 Unloading belt conveyor BC 400 x 2 000.
- 4 Belt conveyor BC 500 x 4 500 / 30.

- 5 UMS 1 000 over-tape magnet with built-in permanent magnet.
- 6 A bin for intermediate ISB storage. The volume is 1,8 cubic meters. Rotating unloading device with chain drive and 1,5 kW gear motor. A lid with hatch and level sensor. The screw conveyor SC has a chain drive through a variable speed gear motor VARIMOT with a capacity of 1,5 kW.
- 7 Control panel according to IEC standard.
- 8 Monoblock SR Mini-Module.
- 9 Terminal belt conveyor with magnetic separator BCM 300 × 1 800.

Optimal processing (in terms of productivity, wear and purity of the final product) can be achieved by the correct combination of the following production operations: sorting, crushing, granulation, separation and crystallization of the obtained metals.

Average productivity of the production line is 700 kg per hour.

## THE ASSESSMENT OF ECONOMIC EFFICIENCY OF THE PROJECT

It is necessary to attract investments in the amount of 22,1 million US dollars for the successful implementation of the project. They will have capital character and will be used to provide the enterprise by working capital, including 14,3 million US dollars for the purchase of equipment, 5,3 million US dollars for construction and installation works and 2,5 million US dollars for working capital.

The project requires a land plot with a total area of 4 hectares and the involvement of 174 employees.

The annual project's volume of production will be in amount of 3 215,6 km of power flexible cable (worth 7,2 million US dollars).

Net income for the project will be formed from the second year in the amount of 0,6 million US dollars and will increase to amount of 1,9 million US dollars to the end of the five-year period.

Net discounted income (NPV) for the billing period will amount to 9,7 million US dollars. The discounted

internal rate of return (IRR) is 9,17 %. The discounted return on investment (ROI) is 1,11. The discounted pay-back period of the project (DPBP) is 9,1 years.

## CONCLUSION

In general, the project (proposed for consideration) involves the use of modern waste-free technology for production of cable products in demand for domestic market for the country. The results of technical and economic assessments confirm the effectiveness of the project and its possibility for further implementation.

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**Note:** The responsible for English language is Dana Rahimbekova, Kazakhstan.