Financial project for construction of a plant for the production of granules, panels and plates of foam glass and small and large composite elements

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Abstract: *A financial project has been prepared for the construction of a plant equipped with a technological line for the production of foam glass products. It is planned to build a warehouse for raw materials, a sector for preparation of materials, various production workshops for the manufacturing of foamed granules and pieces, a continuous tape or block of foam glass, various composite materials (thermal insulation and color decorative panels, various small and large composite elements, etc.), repair section and two warehouses for finished products. Approximate calculations have been made for the necessary raw materials, technical equipment, electricity, personnel and other costs for the realization and operation of the plant.*

Keywords: *FOAM GLASS, FINANCIAL PROJECT, EQUIPMENT FOR THE PRODUCTION OF FOAM GLASS, COMPOSITE MATERIAL*

1. Introduction

The modern intensive development of materials science, accompanied with the conduct of multidisciplinary fundamental [1-5] and applied research [6-12], allows the elaboration of innovative functional products with diverse uses in various fields [6-10].

A number of author teams study the amorphous structure [1-5,13,14], properties and possibilities for application of various vitreous materials [6-8,15]. Specific environmental and technological interest is the successful recycling of existing quantities of waste silicate glass (of various origins) and the production of cost-effective products such as foam glass and others.

Foam glass materials are non-combustible, durable, characterized by appropriate thermal insulation and mechanical properties, chemical resistance, high thermal stability [6-8] and retain their functional qualities under the influence of various weather conditions [8] and cyclical climate change [6,8,16,17]. According to its complex operational indicators foam glass products are significantly superior to some thermal insulation products for construction [8], which have gained wide popularity in recent decades.

The presented development for the construction of a factory equipped with a technological line for the production of foam silicate materials is based on the research experience gained in the implementation of several research projects, the elaborated current inventions [18,19] and the numerous additional laboratory tests performed [6-8].

This publication discusses some economic indicators needed to prepare a realistic business plan for the construction of a plant (Fig.1) for the production of various foam glass products: sound and heat insulation boards (for walls, ceilings, floors, equipment, etc.), colored decorative panels for cladding buildings, bulk granules of FG, small and large structural elements (with П– and semi-O-shape), applicable in construction, shipbuilding, industry, energy, etc. The fabrication of various composite materials with reinforcement is envisaged, providing higher mechanical stability and allowing partial bearing function of the final products. The total investment value for the construction of the plant of 2 million euros has been determined, on the basis of which calculations have been made for the prepared business plan.

2. Some financial parameters

2.1. Determining the needs of the product for a period of 10-15 years - marketing analysis

After consultations with specialists, independent research was made, approaching reality. The investigation plan includes the following parts:

The aim of the research

The aim of the marketing research is to prove the need for the product "foam glass" (FG) and the opportunity to establish itself on the market, both in Bulgaria and abroad. The need for the product is proved by its technical indicators, and the imposition of the market depends on the needs, company policy, advertising, economic opportunities of consumers and more.

Methodology for selection of clients - through quotas

In construction

Bulgaria ranks last in Europe in the production of thermal insulation materials for construction. In our country, there is a recent practice, as in other countries, to insulate residential, industrial and social buildings, in order to reduce heat loss and save energy.

The significance of the problem for the thermal protection of external, enclosing structures and the building as a whole requires special design of the thermal insulation, which is a separate part in the design of the building.

The effort is aimed at determining the possible volume of orders from construction companies. The average volume of housing construction taken from the statistical directory for the last three years is 38,000 new dwellings per year, 26,000 for cities and 12,000 for villages. Given the stagnation of the economy, we hope that this volume will be maintained and gradually increase in the period of reaching the maximum production of the new plant. These are an average of 400 residential buildings with 40 - 80 homes built on 1000 sq.m built-up area of 5 to 8 residential floors and 100 sq.m per dwelling. For the thermal insulation of 1 such building an average of 3000 sq.m of insulation boards with a thickness of 50 mm are needed for the external walls, first and last slab. When insulating elevator cages, shafts, corridors, ceilings, etc. unheated premises the volume of consumption increases to 4500 sq.m, which is equal to 225 cubic meters. If this material is also used for sound insulation of each floor slab, the required volume is 400 cubic meters of thermal insulation for a residential building in the city. In the villages, an average of 25 cubic meters of thermal insulation is needed for a single-family house with 100 sq.m of built-up living area. The total required consumption for housing construction is estimated at about 210,000 cubic meters of thermal insulation per year.

It is assumed that half of this volume will not be realized due to conservatism and economic reasons. We distribute the other half among the existing manufacturers of insulation and construction materials (Table 1) - expanded polystyrene (EPS), extruded polystyrene (XPS), wood fiber insulation boards, mineral wool, gypsum fiber boards, aerated concrete blocks of the company "Ytong", foam concrete, expanded clay concrete, perlite concrete, perlite slabs, loose perlite, insulating screeds (perlite, vermiculite, expanded clay) etc. Although the performance characteristics of foam glass are superior to most of the listed insulation materials in the present study we determine equal quotas for various alternative of FG products 7.5% of 210,000 approximately 16,000 cubic meters of FG per year.

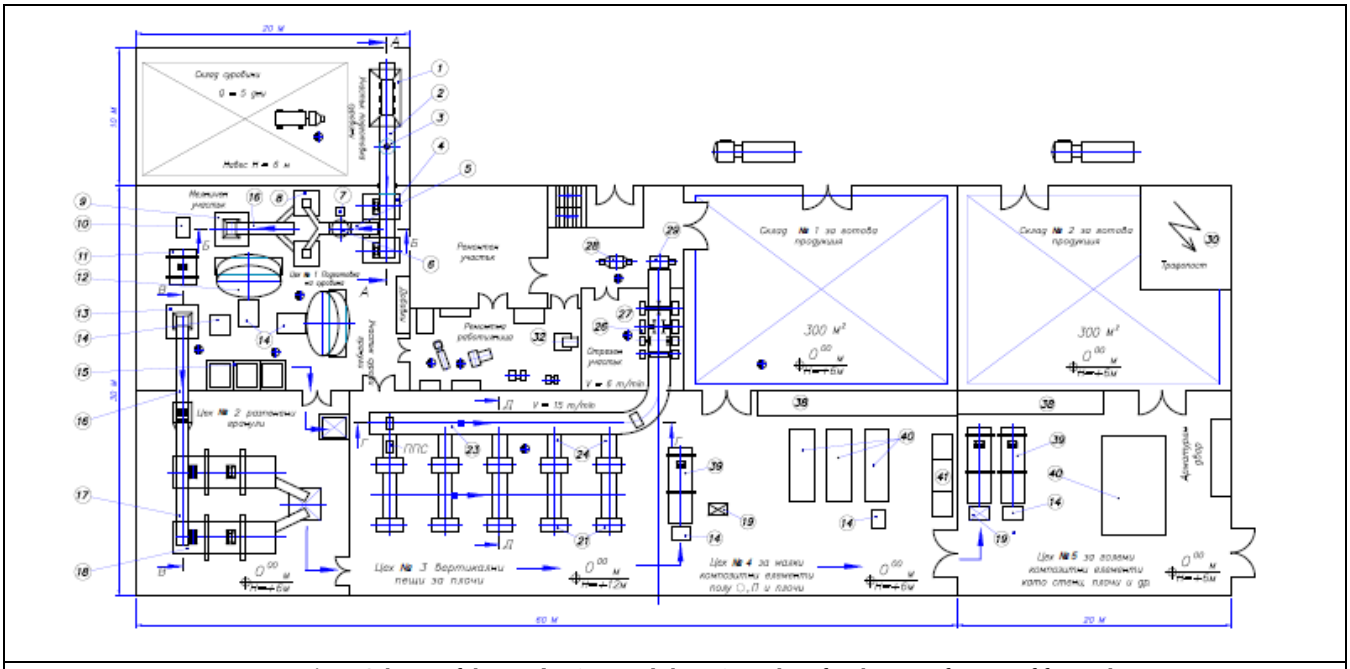

Fig.1. *Scheme of the production workshops in a plant for the manufacture of foam glass.*

For public construction such as hospitals, clinics, kindergartens, etc. public buildings (also from the statistical directory) the volume of construction is approximately 30,000 sq.m built-up area, equal to approximately 30 residential buildings, as described above, ie. 12000 sq.m of insulation material or 1000 cubic meters of annual consumption of FG for public construction.

The volume of industrial construction is also insignificant compared to that for housing construction. It is accepted as 20% of it, ie 1500 cubic meters. Total for construction 18500 cubic meters.

In shipbuilding

A classic option for the use of foam glass as an insulating material is the sphere of shipbuilding. In the experimental - industrial production of FG in 1971, almost the entire amount of foam glass produced was used at the equipment of vessels. Due to the closure of our shipyards is planned. annual consumption of approximately 1,000 cubic meters.

In energy

In the energy sector, foam glass products with a specific shape are used, mainly halves of pipes for insulating pipelines of different diameters.

Table 1. *Competitive materials.*

No	Competitive materials	Market shares, %
1	Brick masonry (without thermal insulation)	50
2	Aerated concrete, foam concrete, perlite concrete, expanded clay concrete,	15
3	Effective thermal insulation materials	
3.1.	Perlite slabs	7.5
3.2	Insulating screeds (perlite, vermiculite, expanded clay, etc.)	5
3.3	Expanded polystyrene (EPS), extruded polystyrene (XPS)	7.5
3.4	Mineral wool	2.5
3.5	Wood fiber insulation boards	2.5
3.6	Foam glass	7.5
3.7	Others	2.5

At the same time the plates from FG are used for rectangular ducts of pipelines, for lining of chambers and rooms with specific functions, insulation of facilities and others. The annual consumption of FG in the energy sector is estimated at 2000 cubic meters.

Table 2 shows the volumes of annual consumption (in the minimum version) in the various branches of industry.

Table. 2. *Areas of application.*

No	Areas of application	Volume, cubic meters
1	Construction	
1.1	Residential construction	16,000
1.2	Public construction	1,000
1.3	Industrial construction	1,500
2.	Shipbuilding	1,000
3.	Energy	2,000
4.	Export abroad	5,000
	Total	26,500

The total required volume is 26,500 cubic meters FG

A suitable product for export abroad is the so-called "sandwich" type panels made of wooden or composite exterior panels and an insulating layer of FG, applicable in the construction of thermal insulation systems of small family houses. When participating in exhibitions, an increased interest was registered (by many construction companies) in this type of panels.

A capacity of 8,000 cubic meters is envisaged for the first stage and a doubling of production for the second stage to 16,000 cubic meters per year. It is insufficient to meet the full needs of the FG. After the implementation of the project, appropriate management decisions can be made to change the volume of production, but at the beginning of the activity it is advisable to work in a market with greater opportunities for implementation. It is assumed that in the next 10-15 years the FG plant will operate at full capacity.

Production program

The initial production program was determined through the marketing analysis, as a basis for calculating the productivity of the technological line.

The production program envisages planning the capacity of the technological line with the necessary reserve for scrap (in small volume), taking into account the necessary scheduled repairs of facilities and all other prerequisites for regular, complete and trouble-free operation of the plant for production of FG. Table 3 presents the production program for a 10-year research period, comparable to the real life of the technological line and the real cycle of production development. In the first year it is planned to

design the plant and carry out a number of preparatory activities. The construction of the building and installation of the necessary equipment is carried out for a period of half a year.

Table 3. *Production program.*

Years	Production
1*	8,000
2	16,000
3	16,000
4	16,000
5	16,000
6	16,000
7	16,000
8	16,000
9	16,000
10	16,000

2.2. Analysis of the consumption of raw materials and auxiliary materials - waste glass, foamers (foaming agents), modifiers, colorants, etc. Material and heat balance of production.

Main raw material - waste silicate glass

The required amount of basic raw material (with 20% stock) for the production of PS with a specific weight of 130 to 180 kg/cubic meter has been determined. The mode of operation of the main equipment of the technological line - the vertical shaft furnace 5 pcs and the rotary kilns 2 pcs is continuous. Annual production estimates have been made for a period of 330 working days. An additional 35 days are provided for scheduled repairs. The daily, monthly and annual consumption of raw material with 20% reserve at a minimum density of 130 kg / m3 and a maximum of 180 kg / m^3 was determined (Table 4). Calculations as cost norms are made for the maximum density.

Table 4. *Consumption of raw materials*

Productivity cubic meters		Consumption of raw materials - glass shards in kg		
		Daily	Monthly for 27.5 working days.	Annual for 330 working days
8,000	min	4,920	135,300	1,623,600
8,000	max	5,250	144,375	1,732,500
16,000	min	9,840	288,750	3,247,200
16,000	max	10,500	288,750	3,465,000

Consumption of foamers (foaming agents), colorants and modifiers

Soot up to 3% (pure, imported) is used as a foaming agent in the production of FG, coloring the obtained product in black. At the same time in the role of foamer it is possible to use glycerin (coloring the obtained material in black), calcium carbonate (coloring the obtained material in white) and others. At preparing the compositions sodium silicate 3%, various colorants (if necessary 2, 4 and 6%), suitable modifiers (TiO_2, etc.) etc. are introduced. In the implementation of the present project it is envisaged the application as foaming agents mainly of glycerin in the production of black foam glass (for the preparation of thermal insulation products) and of $CaCO_3$ together with pigments for the manufacturing of colored foam glass for the obtaining of decorative panels for cladding of buildings.

Table 5. *An expert assessment for a price of 1 cubic meter for materials.*

8,000 m^3/year	MIN	3.0648 EUR/M^3
	MAX	7.9248 EUR/M^3
16,000 m^3/year	MIN	3.0648 EUR/M^3
	MAX	7.9248 EUR/M^3

Production packaging

The packaging of the produced FG plates is carried out on pallets with dimensions 800x1200x150 mm. The stacking of the FG plates on the pallets is done by the palletizing machine at the end of the technological line, if necessary they are wrapped in polyethylene foil (according to the customer's requirements), tied with a strap and stored. The height of the finished pallet is 2 meters. For other types of products, it is also possible to apply the presented packaging procedure.

2.3. Electricity consumption by consolidated indicators

The electricity consumed (table 7) is divided into two groups: electricity used for preparatory and final operations and basic electricity for heating, foaming and stabilization of the resulting foam glass. The first group is carried out by the various equipment described in the title list of the technological line, and the second group is carried out by the heaters of the two furnaces numbers 18 and 21 of the title list. With a productivity of 8,000 cubic meters per year for the first stage and 330 working days per year, the daily productivity is 24 cubic meters of boards and granules, and with 16,000 cubic meters for the second stage, respectively 48 cubic meters. In the table. 6 shows the power consumed by all consumers on the production line, with the same numbering from the title list. Some facilities do not have electricity consumption. The price of the ENERGY consumed is 0.15 EUR / kWh for a three-tariff electricity meter (average value of 0.22: 0.14 and 0.09 BGN per kWh for 2020). If necessary, it is possible to use gas as a heat carrier.

Table 6. *Total power used.*

Power	3a 8 000 m^3/year	3a 16 000 m^3/year
1. Total installed power of machines for preparatory - final processing	243 kW	310 kW
2. Total installed power for heating and foaming	470 kW	940 kW
3. Total daily power used without heating the material for preparatory - final processing	641 kWh/ day	1,119 kWh/ day
4. Total annual power used without heating the material for preparatory - final processing	211,530 kWh/year	369,270 kWh/year
5. Total power used for preparatory - final processing for 1 m3	26.4 kWh/m^3	23.4 kWh/m^3
6. Total daily power used to heat and foam the material for 12 hours (with on and off to maintain the temperature) - max	5,640 kWh/day	11,280 kWh/day
6a. Total daily power used to heat and foam the material for 8 hours (with on and off to maintain the temperature- min	3,760 kWh/day	7,520 kWh/day
7. Total annual power used to heat and foam the material - max	1,861,200 kWh/year	3,722,400 kWh/year
7a. Total annual power used to heat and foam the material -min	1,240,800 kWh/year	2,481,600 kWh/year
8. Total power used for heating and foaming the material for 1 m^3	232.65	232.65
9. Total power used for preparatory and final processing and for heating and foaming of the material for 1 m^3	26.4 + 232.65 = 262 kWh/m^3	23.4 + 232.65 = 259 .kWh/m^3
10. Total annual power used for preparatory and final processing and for heating and foaming the material - max	2,096,000 kWh/year	4,144,000 kWh/year
10a. Total annual power used for preparatory and final processing and for heating and foaming the material - min	1,452,330 kWh/year	2,850,870 kWh/year
11. Total value for 1 cubic meter in Euro - max	39.3	38.85
11a. Total value for 1 cubic meter in Euro - min	27.23	26.73

The annual consumption is calculated for a period of 330 working days, with some facilities operating in one, some in 2 shifts, and furnaces in a continuous cycle of work (3 shifts). Consumption of other types of energy (for heat, cooling, water, steam, fuel, etc.) is not except for household needs - 1 EUR/m^3.

Table 7. *Total power consumption.*

№	Installation	Number	Installed power	Productivity 8,000 m^3		Productivity 16,000 m^3	
			kW	Time for work	Power consumption	Time for work	Power consumption
				h	kW	h	kW
1.	Supply hopper	1	-				
2.	Conveyor	1	1x2.2=2.2	3	6.6	6	13.2
3.	Shower for washing glass waste	1	-				
4.	Crusher - vibrating	2	1x2.8=2.8 2x2.8=5.6	5	14	5	28
5.	Conveyor	1	1x2.2=2.2	3	6.6	6	13.2
6.	Electromagnetic separator	1	1x10 =10	3	30	6	60
7.	Non-glass waste hopper	3	-				
8.	Waste glass mill	2	1x3.6=3.6 2x3.6=7.2	12	43.2	12	86.4
9.	Sieve vibrating flat closed	1	1x4=4	5	20	10	40
10.	Cart for additions with scales	1	-				
11.	Homogenizer	1	1x2.2=2.2	6	13.2	12	26.4
12.	Granulator	2	1x2.2=2.2 2x2.2=4.4	6	13.2	12	26.4
13.	Hopper for feeding raw granules	1	-				
14.	Trolley with trays for drying ready-made raw granules	6	-				
15.	Dryer for raw granules	1	1x6=6	8	48	16	96
16.	Scraper conveyor for raw granules	2	1x2.2=2.2 1x2.2=2.2	3 3	6.6 6.6	6 6	13.2 13.2
17.	Conveyor belt for carrying	1	1x1.1=1.1	3	3.3	6	6.6
18.	Rotary furnace for foaming raw granules	2	1x10=10 2x10=20	8	80	8	160
18a	For heating the material - for 24 hours works 8 (12) hours	2	1x120=120 2x120=240	8 (12)	960 (1,440)	8 (12)	1,920 (2,880)
19.	Hopper for feeding foamed granules	4	-				
20.	Packaging machine for foamed granules in bags of 25 kg.	1	1x10=10	2	20	4	40
21.	Vertical shaft installation (without automation)	5 10	5x2.5=12.5 10x2.5=25	1	12.5	1	25
21a	For heating the material - for 24 hours works 8 (12) hours		5x70=350 10x70=700	8 (12)	2,800 (4,200)	8 (12)	5,600 (8,400)
22.	Container feeding installation with the batch	10	-				
23.	Rolgang main	1	1x6=6 1x6=6	16	96	16	96
24.	Rolgang under the furnaces	5	5x2.2=11 10x2.2=22	0.34	3.74	0.68	7.48
25.	Aspiration system around each vertical furnace	1	5x1.1=5.5 10x1.1=11	24	132	24	264
26.	Cut section with machines	1	4x3=12	1.84	11.06	3.68	22.12
27.	Aspiration system around each machine in the cutting area	1	1x10=10	2	20	4	40
28.	Internal transport	-	-				
29.	Packing machine for plates FG		1x10=10	2	20	4	40
30.	Crane	1	1x8 = 8	4	32	4	32
31.	Quality assessment laboratory	1	1x3=3	0.5	1.5	0.5	1.5
32.	Repair workshop	1	40 80	1	40	1	80
33.	Living quarters	-	-				
34.	Control and computer regulations system	1	1.5	24	36	24	36
35.	Substation - facilities	1	-				
36.	Telephone connections - system - Director's office	1	1	24	24	24	24
37.	Freight elevator	1	1x5=5	1	5	2	10
38.	Stillages for drying and hardening	2	-				
39.	Composite mixture homogenizer	3	1x2.2=2.2	6	13.2	12	26.4
40.	Stretch table for products	4	3x1.5=4.5 1x3.5=3.5	3	24	6	48
41.	Matrices for products	8	-				

2.4. Labor costs and other expenses

Industrial-production staff and salary fund. Distribution of industrial-production staff by categories of shifts and productions.

List of required number of employees:

One superior of shift, automation and control engineer, higher education, male or female, works 3 shifts, 3 people.

Two equipment maintenance technicians - 1 mechanic and 1 electrician, secondary special education, men, working in 1 shift, 2 people.

Two technicians for work of all furnaces and equipment, technicians of silicate materials, secondary special education, men, work in 3 shifts, 6 people.

Three workers (for preparatory and final processing of the materials) and 1 forklift driver , work in 2 shifts, 8 people,

One technician controller, secondary special education "Silicate technology" , man or woman, works 2 shifts, 2 people.

A total of 21 service personnel are needed for one industrial unit operating with 5 shaft furnaces and 1 rotary furnaces for granules for the first stage of commissioning of the plant. An additional 14 people are needed for the second stage of capacity implementation as follows:

Two equipment maintenance technicians - 1 mechanic and 1 electrician, secondary special education, men, working in 1 shift, 2 people.

Two technicians for work of 5 shaft furnaces and 1 rotary furnace for granules, technicians, secondary special education "Silicate technology", men, working in 3 shifts, 6 people.

Two the workers for preparatory and final processing of the materials, 1 employee (secondary special education "Silicate technology") and 1 forklift driver (secondary special education), men or women, work in 2 shifts, 4 people.

One technician controller, technicians, secondary special education "Silicate technology", man or woman, works 2 shifts 2 people.

A total of 35 staff are needed for the plant at full capacity.

Annual salary fund and accruals for social security and retraining and unemployment fund (calculation base)

The calculations of staff costs is provided the inclusion of additional remuneration for classes, night allowances and others, such as 40% of the normal inherent costs of materials for this type of industry and 20% harmful, including 35% for social security and 7% retraining and unemployment fund. A total of 21 service (Industrial-production) personnel are needed for the first stage of the commissioning facilities of the plant, with a total value of monthly salaries (from EUR 184,080 per year) or 23.01 EUR/cubic meter.

In the second stage from commissioning of the facilities for the engaged additional 14 employees, the same remuneration is provided as for the already working staff.

A total of 35 employees (industrial-production staff) are needed for the plant at full capacity, with a total annual salary of 306,800 EUR and a corresponding 19.18 EUR/cubic meter.

On this value for 1 cubic meter are included 35% for social security and 7% retraining and unemployment fund or a total of 42%. Then are included a total of 23.01 EUR /cubic meter for salaries in the first stage and 19.18 EUR/cubic meter for the second stage.

Depreciation deductions

Depreciation deductions are different for different capital investments:

For land and infrastructure - no deductions are provided

For a building - with 20 years term of deductions

The formulas by which we determine the depreciation and the residual value are:

A=P/T, where P is the value of the depreciable capital, and T is the depreciation time.

For 1 cubic meter we receive respectively for the first stage 2.8125 EUR / cubic meter and for the second stage 1.40625 EUR / cubic meter.

For the technological line - we use a formula with nonlinear dependence of residual value calculation.

$P_{res.}=P(1-\kappa)^T$ and $A=P-P_{res.}$

$\kappa = 0,2$ and T=5 years for this type of industry

For 1 cubic meter we add up the total depreciation for the ten years for the first and second stage, respectively, ie we receive 7.81 EUR / cubic meter for depreciation deductions for the first stage and for the second stage 6.23 EUR / cubic meter, which is average value for annual depreciation deductions. Real values are variables that will be reflected in the corresponding annual real costs.

For the second stage of operation of the technological line depreciation deductions are separated after the third year from the beginning of operation of the plant for FG.

2.5. Determining the full cost of produce and of the production and sales price

The values obtained are presented in Table 8. The thus formed factory price in two variants with minimum and maximum costs for the two stages of production shows the limits of the real factory price, which will probably be with average values within the obtained interval, ie. for the first stage for the manufacture of black foam glass **121.38** and for the production of colored foam glass 187,69 EUR / cubic meter, and for the second stage respectively **113.64** and 179.50 EUR / cubic meter.

Full cost of production, production cost by cost elements and analysis of basic costs

The table with the estimated cost shows that the elements for the formation of the full cost are from item 1 to item 6, respectively raw materials, energy costs, labor costs, other costs, depreciation deductions, additional costs, some of which are given as exact values, while others are defined as a percentage of the costs incurred so far, taken from the statistics for the respective type of production. The production price also includes the minimum planned profitability - 12% of the costs incurred for the full cost of production.

The following analysis of the main costs was performed:

-the costs of raw materials and other materials are constant;

-energy costs are also constant, unless the price of electricity increases above 0.15 EUR / kWh, which depends on government policy;

-labor costs are variable, on the one hand until the optimal composition of jobs is established, on the other hand, in order to have a lasting interest on the part of the staff, a progressive increase in wages is envisaged (for example by 5% per year, separately from inflation), which can be guaranteed from the profit, after repayment of loans used or in parallel with them;

-other costs, including transport of raw materials, maintenance and repair, which we define as 10% (of the costs incurred so far) and additional costs for wastage are variable in the direction of reduction, which is the responsibility of the plant management;

- depreciation deductions allocated to a separate fund are constantly decreasing for each subsequent one-year period. The full cost includes the average value for the first stage and the average value for the second stage of the production. The decision to use these funds is the responsibility of management;

- additional costs, including funds for advertising of manufactured products and funds for remuneration of administrative and managerial staff. These funds are necessary for the successful organization of production and realization of the final production. The main criteria in determining them is on the one hand that the funds provided do not significantly burden the cost of production, and on the other hand to contribute to the professional work and motivation of management. Of the 10% set aside, 2.5% is set allocated for advertising and the remaining 7.5% for the remuneration of the governing body (with a 5% increase in wages per year, apart from inflation).

For the 10-year planning period, the total amount of advertising is EUR 375,600, and the distribution by year is not evenly in order to promote the finished product at the beginning of its production.

Administrative staff is kept to a minimum. Funds are provided for the payment of the authors of the patent, fees for consultants in the planning and construction of the plant, other fees and maintaining minimum reserve.

The projected 12% minimum planned profitability (in a separate fund) determines the size of the minimum planned profit relative to the cost of production, and hence the average profitability relative to production funds, which is 10.6% for the first stage and 38.8% for the second stage from the work of the plant. This will help determine the exact value of the minimum selling price of the product.

Factors influencing full cost, production price and selling price

The factors influencing the full cost, production price and selling price of manufactured products are of two types - external and internal. The external ones are the normative documents, referring to the making of legally justified managerial decisions, and the internal ones leading to accumulation of maximum profit and optimally effective result from the production of this type of production in the created macroeconomic external environment, ie. the maximum possible selling price in order to realize the maximum profit and at the same time the sale of the entire produced quantity of production. A sale price of 130 EUR / cubic meter without VAT and 150 EUR / cubic meter with VAT is offered. Based on the presented values, a Business Plan has been prepared.

Capital investments and production funds

The capital investment is worth EUR 1.44 million for both stages.

Structure of capital investments and main production funds

Capital investments are divided into the following costs:

For land – 55,000 EUR

It is planned to purchase land with dimensions of 90x60 m = 5,400 sq.m, on which to build an industrial unit - a building with dimensions of 80 x 30 m = 2,400 sq.m.

Tab. 8 *Full cost of produce and of the production and sales price.*

No	Type of costs	Сума в EUR/m^3 foam glass at density 150 kg/m^3			
		Productivity			
		8,000 m^3/year		16,000 m^3/year	
		min	max	min	max
1.	Raw materials and other materials				
1.1	Main - waste glass	2.7	7.56	2,7	7,56
1.2	Auxiliary	0.0648	0.0648	0,0648	0,0648
1.2.1a	Foaming agent - soot (for comparison) - black foam glass	0.3	0.3	0,3	0,3
1.2.1b	Foaming agent - glycerin - black foam glass (technological additive - sodium silicate)	**10.6**	**14.6**	**10,6**	**14,6**
1.2.1c	Foaming agent - calcium carbonate - white foam glass	9.5	14.1	9,5	14,1
1.2.1d	Foaming agent - calcium carbonate and additional introduction of colorants - colored foam glass	84.75	89.1	84,75	89,1
1.2.2	Other auxiliary				
	Amount for point 1	3.0648	7.9248	3,0648	7,9248
	Average value	5.49 / **10,6**/ 11.8 / 88.8		5.49 / **14,6**/ 11.8 / 89.8	
2.	Energy costs for electricity 0,15 EUR/ kWh	27.23	39.30	26,73	38,85
	Average value	33.26		32.79	
	Amount for point 1 up to point 2	40.53	61.46	40,03	60,91
3.	Labor expenses				
3.1	Salary	16.21	16.21		
3.2	Accruals of 35% for social security	**5.67**	**5.67**		
3.3	Accruals of 7 % for unemployment and retraining	1.13	1.13		
	Amount for point 3	**23.01**	**23.01**	**19,18**	**19,18**
	Average value	9.95		7.535	
4.	Other expenses				
4.1	Transport of raw materials	0	3.00	0	3,00
	Amount from point 1 up to point 4.1	63.54	87.47	59,21	84,09
4.2	Maintenance and repair 10 % from the amount for point 1 up to point 4.1	6.35	8.75	5,92	8,41
	Amount from point 1 up to point 4.2	69.89	96.32	65,13	92,50
4.3	Losses from wastage 3 % from the amount for point 1 up to point 4.2	2.10	2.89	1,95	2,78
4.4	Packaging costs - pallets	4.6	5.6	4,6	5,6
	Amount for point 4	13.05	20.34	12,47	19,79
	Average value	16.69		16.13	
5.	Depreciation deductions A (calculated according to a special formula)				
5.1	For buildings	2.81	2.81	1,41	1,41
5.2	For technological line	7.81	7.81	6,23	6,23
	Amount for point 5	9.62	9.62	7,64	7,64
	Average value	9.62		7.64	
	Production cost price Amount for point 1 up to point 5.2	48.56 62.7	88.46 106.76	44,07 58,21	76,55 94,85
6.	Additional costs - 10 % from the amount for point 1 up to point 5 (advertising, salaries for administration and management)	8.62	11.44	7,93	10,85
	Average value	10.03		9.39	
	Full cost price – amount from point 1 up to point 6	94.83	125.87	87,25	119,37
7.	Profitability - 12 % from the amount for point 1 up to point 6	9.48	12.59	8,72	11,94
	Average value	11.04		10.33	
	Factory price – amount from point 1 up to point 7	**104.31**	**138.46**	**95,97**	**131,31**
	Average factory price for different types of FG at point 0.15 EUR/kWh	Black FG - soot - 104.38 Black FG – glycerin - (additive - sodium silicate) 121.38 White FG - $CaCO_3$ - 110.69 Colored FG - $CaCO_3$ and colorants - 187.69		95.89 **113.64** 102.50 179.50	

Note: Calculations are shown for the accepted foamer glycerin and sodium silicate. The other values are given for comparison.

For infrastructure EUR 80,000

For construction or building – 450,000 EUR

Building of the industrial unit with dimensions 80x30 m = 2,400 sq.m built-up area

For technological line - machines and equipment:

- first stage – 700,000 EUR.
- second stage – 155,000 EUR.

Working capital

Working capital is the sum of the value of the working funds and the circulation funds

The working funds are made up of the following components:

- raw materials and other materials expenses;
- energy costs;
- labor expenses;
- other costs - transport, maintenance and repair, wastage, packaging, etc.;

- additional costs - advertising, administration costs;

The working funds also includes work in progress and stock of raw materials and other materials in the amount of 15% for 1 year.

The circulation funds are formed by the following components:

-unrealized finished products - as quantity and value we accept finished products less than a unit of transport volume (eg 3/4 of the volume of a truck - TIR);

-costs for finished goods on road (full volume of the truck TIR) – 6,570 EUR.

Total value of working capital - is the sum of the above components increased by 20% for unforeseen additional costs

The minimum and maximum value of working capital shows the limits within which they can move. After analysis we accept 540,000 EUR.

Available main funds that will be used under the project

There are no main funds available at the time of project creation. After the realization of the project management form, opportunities will be sought to raise the planned funds.

Production funds

The production funds needed for the implementation of the project are the value of the technological line, respectively 700,000 EUR for the first stage of implementation and 155,000 EUR for the second stage, ie. a total of 855,000 EUR.

One-time costs

The one-off costs are for the purchase of land, construction of a building and infrastructure with a total value of 585,000 EUR.

The total value of the plant for the production of foam glass products is 2 million euros, increasing over time with changes of the inflation index and other external factors.

These data are included in the developed business plan.

NOTE: In the whole project the value of 1 EUR is equal to 2 BGN, limited by the Currency Board in the Republic of Bulgaria. The calculations are made until June 2021, and inflation is reflected proportionally in the changing economic situation.

3. Conclusions

Some financial parameters applicable in the preparation of a detailed Business plan for construction and operation of a plant for the production of various foam silicate products are presented: plates for sound and thermal insulation, colored decorative panels for building cladding, bulk foam granules, small and large structural composites elements (with different forms) with potential application in construction, industry, energy, shipbuilding, etc.

The preliminary calculations for the necessary funds for raw materials, other material, land, appropriate technical equipment, electricity, labor, advertising and other costs for the project are considered. Based on the presented data, the estimated total investment value (for the construction of the plant) in the amount of 2 million EUR has been determined.

4. References

1. D. A. Keen, R. L. McGreevy, “Structural modelling of glasses using reverse Monte Carlo simulation”, Nature, vol. **344**, 1990, pp. 423–425.

2. S. Simon, D. Eniu, “Spectroscopic characterisation of local structure in Y_2O_3-B_2O_3-Bi_2O_3 glasses doped with gadolinium”, Journal of Materials Science, 42(15), 2007, pp. 5949-5953.

3. L. O. Hedges, R. L. Jack, J. P. Garrahan, David Chandler, “Dynamic Order-Disorder in Atomistic Models of Structural Glass Formers”, Science, vol. **323**, Issue 5919, 2009, pp. 1309-1313.

4. S. Bala Murali Krishna, A. Ramesh Babu, Rajya Sree. Ch, D. Krishna Rao, “Influence of molybdenum ions on the structure of ZnO-As_2O_3-Sb_2O_3 glass system by means of spectroscopic and dielectric studies”, Journal of Non-Crystalline Solids, 356 (35-36), 2010, pp. 1754-1761.

5. I. M. Kalogeras, H. E. Hagg Lobland, “The nature of the glassy state: Structure and glass transitions”, Journal of Materials Education, vol. 34/3-4, 2012, pp. 69-94.

6. M. Veleva, D. Bozskov, K. Toncheva, “Industrial perspectives of the bulgarian metod for foamglass production”, 12-th Conference on Glass and ceramics, Publishing House “Science Invest”, Sofia, 1997, pp. 119-123.

7. K. Toncheva, L. Lakov, “Technologies and constructions for the production of foam glass”, Scientific Conference, October 29-30, 2010, Ruse, Scientific Papers of the University of Ruse, Volume 49, Series 1.2, pp. 25-33.

8. K. Toncheva, “Creation and research of a blowing section of a system for obtaining a continuous strip of foam glass“, PhD thesis for the award of the educational and scientific degree "Doctor", Specialty - “Technologies, machines and systems of foundry production”, Code 02.01.18, Sofia, 2014, p. 168.

9. G. Mutafchieva, “Technological development of lighting fixtures in the field of silicate design”, Collection reports, Design & applied arts - Sofia, NAA, 2018, pp. 138-144.

10. G. Mutafchieva. “Modern trends and development of lighting fixtures in the field of silicate design”, PhD thesis for the award of the educational and scientific degree "Doctor", NAA, Bibliography 87, 2020, p. 215.

11. V. Petkov, M. Aleksandrova, R. Valov, “Partial oxidation of biocompatible titanium alloy Ti6Al4V during deposition of glassy carbon coating”, International Journal “NDT Days”, Vol. III, Issue 4, Year 2020, pp. 225-230.

12. V. Petkov, M. Aleksandrova, V. Blaskov, “Deposition of ZrO_2 thin films obtained by sol-gel method on monolithic composite with layered structure of Nb_30Ti/Al”, International Scientific Journal "MACHINES. TECHNOLOGIES. MATERIALS", Year XVI, Issue 2/2022, pp. 58-61.

13. Y. Dimitriev, A. Bachvarova-Nedelcheva, R. Iordanova, S. Yordanov, “Thermal Stability and Microheterogeneous Structure of Selenite Glasses”, Physics and Chemistry of Glasses: European Journal of Glass Science and Technology Part B 48(3), 2007, pp. 138-141.

14. A. Bachvarova-Nedelcheva, R. Iordanova, K. L. Kostov, V. Ganev, St. Yordanov, Y. Dimitriev, “Synthesis and Structural Characterization of a Glass in the Ag_2O-SeO_2-MoO_3 System”, Journal of Non-Crystalline Solids 481, 2018, pp. 138-147.

15. K. Toncheva, "Organizing the production of foam glass", Newspaper "Arch - Art", Issue 2, 16.01.1996, p. 2.

16. P. Mukhtarov, R. Bojilova, “Influence of solar and geomagnetic activity on the ionosphere over Bulgaria”, Comptes rendus de l’Acad´emie bulgare des Sciences, 70, 9, Publishing House of BAS "Prof. Marin Drinov", 2017, pp. 1289-1296.

17. R. Bojilova, P. Mukhtarov, “Relationship between the critical frequencies of the ionosphere over Bulgaria and geomagnetic activity”, Comptes rendus de l’Acad´emie bulgare des Sciences, 73, 8, Publishing House of BAS "Prof. Marin Drinov", 2020, pp. 1113-1122.

18. I. G. Chorbov, K. A. Toncheva, L. I. Lakov, Y. B. Arsov, “Device for obtaining foam glass”, Patent № 65718 / 24.11.2004, Status - Valid, Place of application Bulgaria.

19. I. G. Chorbov, K. A. Toncheva, L. I. Lakov, Y. B. Arsov, L. N. Dosev, K. M. Lichev, “Device for obtaining foam glass”, Patent №65745 /26.05.2006, Status - Valid, Place of application Bulgaria.