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| Research Article |

Design Solution On Keramzit Production and Justification On Its Breakeven Points

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Abstract: The article considers the issues of determining the effectiveness of a design solution for organizing the production of keramzit based on low-intumescent loams, barchan sands and oil sludge using plastic processing and molding. By calculations it is proven that the use of substandard natural raw materials and industrial waste makes it possible to reduce the market value of keramzit. The justification for the efficiency of organizing the production of new products was carried out considering the costs of keramzit production and drawing up a break-even format for the design solution in accordance with certain formulas and accepted models for determining the economic efficiency of production options (existing and proposed technology). The economic effect was obtained from the use of new technology with an increasing amount of revenue and profitability, and there was also a reduction in the payback period of capital investments, allowing us to conclude that it is advisable to introduce the developed technology for the production of keramzit.

Keywords: Oil Sludge; Loam; Technology; Keramzit; Revenue; Profitability; Working Format of Breakeven; Efficiency.

INTRODUCTION

The construction of diversified and innovative economy is one of the main directions of the National Development Plan of the Republic of Kazakhstan until 2025. As part of the implementation of this task, the business will actively participate in providing the necessary consultations, as well as take specific actions to increase the productivity and quality of its own goods and services by taking measures to improve operational efficiency, technological updating, and developing the employee competencies" [1].

In connection with the above, this work, devoted to the issues of determining the effectiveness of a design solution for organizing a new business for the production of porous aggregate such as "keramzit" and justifying its break-even, is relevant.

In domestic and foreign literature there is a significant number of developments devoted to the study of resource-saving technology for the production of construction materials, involving the use of substandard natural raw materials in combination with industrial waste and side-products of production. In particular, we can note the developed technology of keramzit based on well-medium- and weakly intumescent clays and loams [2-6], which is a traditional porous lightweight material for the construction industry of Kazakhstan.

Currently, the raw material base of existing keramzit plants in the Republic of

Kazakhstan is focused on the use of highly plastic montmorillonite clays, the reserves of which are very limited. In this regard, there is an urgent need to replace raw material sources at keramzit plants in Kazakhstan. Bringing the main raw materials, that is, clay materials, from other regions leads to an increase in the price of finished products by more than 35%. Therefore, it is possible to eliminate the increase in the cost of production at keramzit plant by involving new types of raw materials in the process that could replace clays close to the production site.

Of the variety of natural and man-caused raw materials in Kazakhstan, the greatest interest for the production of keramzit is represented by weakly intumescent loess-like loams, which are available in almost all regions. The suitability of a particular clay raw material for the production of keramzit is determined by a special study of its properties. The most important requirement for raw materials is swelling during firing. Research in this area is actively carried out in CIS and abroad and is described in the works of the authors [7-13].

The authors' studies [11-16] are devoted to the production of keramzit, where oil-containing waste is used as a burnable additive.

The work [17] presents the results of experiments on the development of optimal compositions of raw material mixtures and technologies for the production of keramzit based on low-intumescent clay rock of Kyzylorda Oblast. In this case, the production of effective keramzit is solved by using it in the form of a fuel-containing and intumescent additive - oil sludge, the organic part of which is combustible and flammable with a calorific value of 2500-3500 kcal/kg, which is equivalent to the calorific value of coal [18,19].

The modernity of the proposed project includes the integrated use of natural loamy raw materials in combination with fuel-containing waste and barchan sand, according to the authors' technology [17].

METHOD

Object of the study is the composition and technology of porous building material such as "keramzit", obtained on the basis of slightly intumescent loams and barchan sand of Kyzylorda field with usage of oil sludge as a burnable and intumescent additive.

The justification of the efficiency of organizing the production of new products was carried out considering the costs of keramzit production and drawing up a break-even format for design solution in accordance with certain formulas and accepted models for determining the economic efficiency of production options (existing and proposed technology) [20,21].

RESULT AND DISCUSSION

The technological scheme for the production of keramzit represents the sequence of production operations using the classical method and has been practically unchanged for several decades.

The main consumers of keramzit products are small and medium-sized businesses focused on industrial and civil construction.

The production of new business - the organization of an enterprise for the production of keramzit is determined to be established in Kyzylorda city. The economic benefits from the proposed technology for the production of keramzit are formed mainly from the use of low-expanding loams, barchan sand of Kyzylorda Oblast, and bottom oil sludge from the reservoirs of AO "PetroKazakhstan Kumkol Resources".

Production costs are determined based on the calculation of the cost of raw materials for the generation of 1 m3 of keramzit. According to the proposed technology, the costs for raw materials are 2.5 thousand tenge. According to the existing option - 2.8 thousand tenge. The costs of raw materials are shown in Table 1.

The most attractive on the economical plane is the use of inexpensive natural raw materials and industrial waste. This is both an ecological and cost-effective method.

Firstly, for the production of keramzit it is proposed to use low-intumescent loams, barchan sands and oil sludge, which significantly expands the raw material base for the production of keramzit and makes it possible to reduce the market value of the products offered.

Secondly, due to the use of oil sludge, the fuel and energy costs are reduced by 30-40%.

Thirdly, simple technology makes it possible to organize the functioning of a mini-plant, which should help providing the construction materials market in Kazakhstan with cheaper products in the form of keramzit.

Thus, the proposed keramzit technology is a resource-saving approach and a relevant direction for the development and widespread implementation of such production.

The cost of production is determined by a cost estimate for the production of keramzit. Operating costs are calculated considering the need for raw materials, other material, energy and labor resources for the annual program, as well as the level of wholesale prices, tariffs, salaries and standards in force in relation to the conditions of Kyzylorda Oblast for similar enterprises. Cost calculation for the production of a unit of product from various raw material mixtures is given in Table 1.

Table 1. Expenses for 1 m3 keramzit, thousand tenge

Name of expenses	On existing version	On suggesting version
1. Raw materials and other materials	2,8	2,5
2. Accessory materials	0,01	0,008
3. Water supply	0,018	0,012
4. Heating- and electrical supply	0,418	0,418
5. Main salary with deductions	0,45	0,45
6. Additional salary	0,048	0,048
7. Expenses on maintenance and operations of equipment	0,278	0,278
8. Shop expenses	0,228	0,228
9. Total plant expenses	0,184	0,184
10. Off-production expenses	0,026	0,026
Total:	4,46	4,152

To assess the technical and economic indicators of keramzit production, calculations were made in relation to a mini-plant with a capacity of 20 thousand m3 of keramzit per year.

The commercial product of the plant when working on the basic technology is keramzit gravel, the bulk density corresponding to grade 500. The introduction of new technology makes it possible to obtain a keramzit of grade 400. The cost of commercial products is determined from the wholesale price for 1 m3 of keramzit gravel for the conditions of Kyzylorda oblast according to price list No. 06-13 -05--1980/4 (Table 2).

Table 2. Determining the cost of commercial product

Name of expenses	On existing version Keramzit of grade 500	On suggesting version Keramzit of grade 400
1. Annual output of product, m^3	20000	20000
2. Wholesale selling price, tenge	7000	6800
3. Cost of annual output of product, thousand tenge	140000	136000

The criteria for the absolute economic efficiency of capital investments in the construction of keramzit gravel plant are revenue, profitability and payback period. Table 3 shows the main technical and economic indicators of keramzit production for the compared options.

Table 3. Main technical and economic indicators of keramzit production for the compared options

Name of expenses	On existing version	On suggesting version
1. Designed capacity of the plant, m^3 per year	20000	20000
2. Annual output of product, million tenge	140	136
3. Prime cost of annual output of product, million tenge	89,2	83,040
4. Specific capital investments, thousand tenge	4,25	4,25
5. Revenue, million tenge	50,8	52,96
6. Product profitability, %	56,95	63,78
7. Production / sales profitability, %	36,3	38,9
7. Payback period, years	1,67	1,60

The economic efficiency of keramzit production is calculated in accordance with the adoption as a base option of keramzit production technology based on low-intumescent loams of Kyzylorda field, then the annual economic effect from the transition to a new raw material base is:

$$E = [(4,46+0,15*4,25) - (4,152+0, I5*4,25)]x\ 20000 = 5,098-4,789= 6180$$
thousand tenge.

Where: 4,46 и 4,152 – prime cost per unit of production for the existing and new options, thousand tenge;

4.25 - specific capital investments in production of products according to the basic and new options, thousand tenge;

Ен - standard coefficient of efficiency of capital investments, equal to C = 0.15;

20000 m3 is the annual production volume of products according to the new proposed option.

Thus, considering the economic efficiency of using the new technology, the increasing amount of revenue and profitability, as well as the reduction in the payback period of capital investments, we can conclude that it is advisable to introduce the developed technology for the production of keramzit.

In order to draw up a financial plan and determine the break-even point of the project, we use the main technical and economic indicators of keramzit production according to the data in Table. 3.

As a rule, considering the practical realities, it is necessary to think through marketing strategies for promoting a new product on the existing market. Even with good marketing, it is not always possible to secure demand for products in the market environment. We need customers to accept the new product. In this regard, when distributing production by periods and distributing costs, it must be considered that in the first months after putting into production, any enterprise will incur losses.

When drawing up a business plan for a new production, it is important to calculate the break-even point of the project. Modern economic literature offers the various modifications of the definition of break-even for an investment project, which were previously used in different situations by the authors of this article.

The break-even point is determined analytically and graphically.

To calculate the break-even point analytically, it is necessary to divide the amount of fixed costs by the difference between the sales price of the product and the amount of variable costs per unit of production:

$$BEP = \frac{F}{(p - v)}$$

Where: F - the amount of fixed costs for the entire project period; P – unit price of product; V - the value of variable costs per unit of production.

According to the keramzit production project, the break-even sales point made: BEP=33216/(6,8-2,5)=7725 m3.

Figure 1 shows the working format of the break-even point of the design solution.

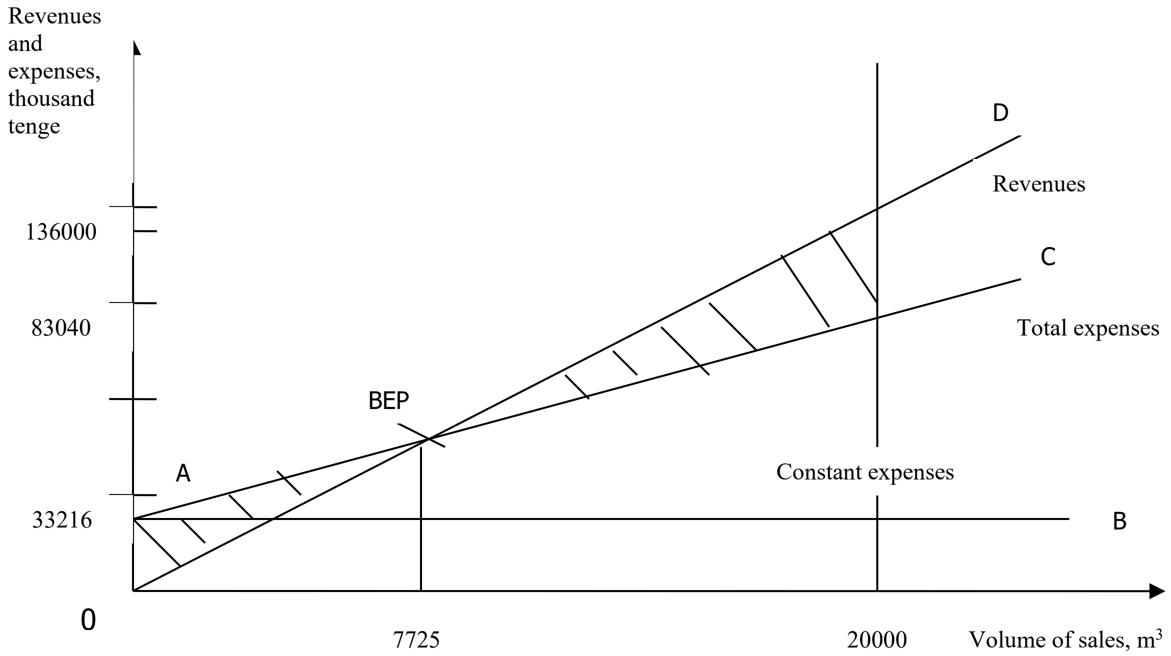

Figure 1. Working format of the break-even point of keramzit production project

The total annual production volume is 20,000 m3 of keramzit. The volume of production at the break-even point, according to the calculation and according to the schedule, was 7725 m3 of keramzit. Each additional increase in production volume above the break-even point will be accompanied by an increase in profit, which is called the profitability zone. And, conversely, as soon as production volume drops below the break-even point, the producer will begin to suffer losses in the loss zone.

The above graph and analytical calculation show that the break-even sales volume, the safety zone, depends on the amount of fixed and variable costs, as well as on the price level for the products. When prices rise, it is necessary to sell less products in order to obtain the necessary amount of revenue to compensate for fixed costs, increasing the profitability threshold and reducing the safety zone. Therefore, every enterprise strives to reduce fixed costs. The optimal plan is the one that allows you to reduce the share constantly. Finding the break-even point has important practical significance. When starting production, it is always necessary to know what sales volume should be achieved in order to recoup the investment. Since the future sales volume and price of a product largely depend on the market, its capacity, the purchasing power of consumers, and the elasticity of demand, the manufacturer must be confident that its costs will pay off and bring profit in the future.

CONCLUSION

Analysis of the results of experimental studies suggests that it is quite possible to produce a keramzit based on loess-like loam, barchan sand, and oil sludge. The economic effect of using the new technology was obtained, with an increasing amount of revenue and profitability, as well as a reduction in the payback period of capital investments, which allows us to conclude that it is advisable to introduce the developed technology for the production of keramzit.

Drawing up a working format for the break-even of a project solution, as a rule, is the most ideal planning for successfully running a business, provided that production volumes remain unchanged. However, in practice, the operating conditions of any enterprise may change, which leads to an increase in the break-even point caused by various factors. Thus, an increase in production volumes will lead to an increase in costs, which will lead to a new increased break-even point. But this should be a temporary phenomenon until the costs aimed at expanding production are recouped. The size of the break-even point is the basis for determining the risks and safety margin of the enterprise to changing situations in the market for the main products produced. The advantages of this method include ease of use, clarity when planning profits, illustration when demonstrating the impact of operational changes on the profitability of enterprise, assistance in determining the rational relationship between fixed and variable costs.

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