Options for evaluating the project efficiency: technospheric security factor

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Abstract. In the context of a fall in consumer demand due to a decrease in cash incomes of the population, starting in 2013, a decline in business activity in the investment and construction market of Russia has been observed. The recession was noted even in regions that were previously the locomotives of the construction boom. In accordance with this, against the background of general stagnation of the economy, the only way out in this situation should be recognized as a way to improve the quality of products to maintain market share. According to experts, over the past ten years, the quality of traditional construction products manufactured by domestic manufacturers has significantly increased, but there remain problems of aging production technologies, the quality of raw materials, the low level of qualifications of specialists in the construction industry, etc. A varied approach to the choice of production technology for building products and building technology makes it possible to react flexibly to emerging environmental challenges and the deterioration of key indicators of business activity in the construction business in modern conditions of risk and uncertainty at macro and micro levels.

1. Introduction
Aerated concrete has won its place of honor in the investment and construction market due to the perfect combination of structural and thermal insulation characteristics, high technological and operational parameters. Low heat conductivity, low specific gravity, fire resistance, environmental friendliness, reasonable prices [1-4] - these and many other properties allowed it to become a popular building material. However, as marketing research shows, there is a shortage of this universal product in the building materials market. This is due to the lack of large manufacturers in the Tyumen region. This niche in the market is occupied by small and medium-sized businesses, focused more on quantitative indicators than on innovative trends. Failure to use proven technology for the production of this type of concrete is not in favor of innovation leads to serious problems. As a result, during the operation of buildings erected using this building material, problems of loss of structural integrity, cracks, etc. are most often encountered. The causes and solutions to problems are described in the following sources [5-10]. The capacities of existing construction industry enterprises are outdated. According to the following sources [11-13], manufacturers of building materials, including products from aerated concrete, use traditional technologies, while over-pricing products, resulting in financial problems and loss of stability in the market. Thus, based on the above trends in the investment and
construction industry and market analysis, we can conclude that the current economic crisis should be an incentive to review the range of products, study foreign experience in the organization of aerated concrete production. This decision is extremely relevant and it should be the starting point for overcoming the protracted crisis in all spheres of life, since the construction cluster is a locomotive for the entire economy of the region and a criterion for assessing the quality of life of the population.

2. Literature Review

Despite all the positive aspects in the use of cellular concrete in both low-rise and high-rise housing construction, scientists and practitioners emphasize the presence of an unrecoverable problem [5, 7, 8]. In the process of eliminating such an object, a large amount of waste is generated (more than 17 types of waste of 1, 2, 3, 4, 5 hazard classes). Therefore, the question arises of the justification of the environmental safety of the design decisions made, the development of appropriate environmental measures and the assessment of environmental damage during the implementation of the design decision. Aerated concrete has high thermal insulation and strength characteristics, low weight and good machinability. This is one of the types of cellular concrete, which is distinguished by environmental cleanliness, good thermal insulation and sound insulation. The existing experience of using this building material [1,4], confirms its high operational and physico-mechanical characteristics. This building material is made of cement containing calcium oxide CaO, sand containing silicon dioxide SiO2, water, gypsum. As a steam generator, aluminum powder is used. In the manufacture of aerated concrete blocks, strict adherence to its dimensions is required: the permissible error is not more than 1 mm. Directions of use: laying of load-bearing walls, internal walls and partitions, wall filling of frame high-rise buildings. Aerated concrete is the optimal building material for the construction of cottage-type houses in two or three floors. Aerated concrete is also successfully used in the construction of multi-storey buildings with a monolithic frame construction. Cellular foam concrete is made from traditional mineral raw materials: cement, aluminum, quartz sand, lime, water and additives. It began to be actively applied from the beginning of the 90s. During use, it has established itself as a reliable, economical, and convenient construction material for construction and transportation [1,4]. Due to its special properties, a comfortable microclimate is created in the premises of aerated concrete. For thermal protection, a wall of aerated concrete with a density of 500 kg / m3 and a width of 200 mm is equal to a brick wall with a width of 725 mm. The use of aerated concrete blocks during the construction of walls allows the use of special glue instead of cement mortar, which reduces the seam (from 5-7 mm to 1-2 mm), which also reduces the cost of construction, improves the thermal conductivity, as the so-called "cold bridges" disappear. The thermal insulation of wall structures laid on glue is 1.5-1.8 times better than that laid on a solution. Aerated concrete is frost-resistant, easily processed by any cutting tool - this makes its use especially attractive [1,4,14,15]. The main advantages of autoclaved aerated concrete [1,2,4,15]: environmental friendliness (autoclaved aerated concrete is obtained by swelling a solution made from cement, lime, ground quartz sand and water using aluminum powder); thermal insulation (thermal resistance of cellular concrete structures is three times higher than clay brick and eight times higher than heavy concrete. The blocks are laid not on mortar, but on glue, so the thickness of the formed joints is less than 3 mm, which allows avoid the "bridges of cold"); sound insulation (the material has a through porosity and is characterized by a relatively high absorption coefficient (\( \alpha \) over 0.2); strength (one block 300 mm thick and a density of 500 kg / m3 withstands a load of 50 tons. At the same density, autoclaved aerated concrete has a strength of one and a half to two times higher than non-autoclave; regular geometric shape (due to the use of modern cutting devices, minimal (up to 1 mm) deviations of the geometric dimensions of small blocks are achieved. Given that the products are cut from arrays, they can be obtained with any sizes and various shapes); relatively low price of aerated concrete in comparison with other materials. Use of aerated concrete provides lower construction costs.

According to the information [1,15], today in Russia there are 40 enterprises producing construction materials from autoclaved cellular concrete. The total capacity of these enterprises is 2 million m3 per year. Based on 1 thousand people, only 13 m3 per year is produced in the Russian
Federation, and 100-200 m$^3$ in Germany, France, England, Sweden, Poland, the Czech Republic, Slovakia. In Germany, Denmark and the Netherlands, the proportion of cellular concrete in the total volume of concrete and reinforced concrete is more than 40%, in Sweden this share exceeds 60%. Unfortunately, in our country in the total volume of concrete produced, the proportion of cellular concrete is so far less than 5%.

3. Results of approbation

The use of aerated concrete is intensively developing. It is associated with the presence of large manufacturer it this type of material, and small businesses, working on technical specifications (TS). Industrial mschnost her existing plants enough to meet the needs of the south Tyumenskoy area. In the Tyumen region, the production of building materials from autoclaved aerated concrete is represented by a plant located in the city of Yalutorovsk. Capacity of the plant is satisfied yet needs and south of the region, but there is a pent-up demand in the Yamalo-Nenets Administrative District (YaNAD) and the Khanty-Mansi Administrative District (KhMAD). The shortage of aerated concrete is covered by the supply of material from neighboring regions. At present, the main supplier of aerated concrete to the north of the Tyumen region is Reftinsky Association Teplit LLC, which has its largest production capacities (the total capacity of the two plants is 360 thousand m$^3$). However, the products of this association are sold at the highest prices among other manufacturers of aerated concrete blocks in the Ural Federal District. The selling price of the gas block is from 2.6 to 5.2 thousand rubles / m$^3$. At the same time, the remoteness of the plant from consumers of KhMAD causes a rise in the cost of the product due to transportation costs by an average of 25% [19].

In modern conditions of high risks and uncertainty in the consumer market and markets for industrial goods, the closure of borders within districts and regions, the issue of diversification of the production program of northern construction companies becomes relevant. Since the construction industry, according to the authors of the article, is the locomotive of the domestic economy and a stable source of local budget formation, the option of expanding the range of activities of the construction organization should also be the starting point in the introduction of innovative technologies in the production of building materials of own production for self-construction installation work. Universalization in construction manifested itself most vividly in a pandemic and it was this industry that was among the first to receive permission to conduct operations. Given the protracted economic crisis, falling incomes in certain sectors of the economy, remoteness of the main producers of goods on the one hand, as well as falling interest rates on mortgage loans, expanding the range of socially-oriented programs launched to support the construction market, on the other, the authors of the article believe that the end of summer 2020 the market for northern cities will feel an increasing need for building materials. In this connection, in this publication, it was decided to demonstrate to potential investors and participants in the construction industry the effects that they can count on when starting the aerated concrete plant with regard to the territorial features of the cities of the KhMAD. The plant construction project provides for the operation of facilities whose activities are accompanied by the generation of production and consumption wastes, pollutant emissions. The amount of capital investment in the implementation of the project is estimated at 153 million rubles for Surgut. The investment in the project is financed through the leasing line of the regional program for equipment, credit resources for launching the plant and own funds for the construction of the building. The expected effects for KhMAD are the further development of the production of building materials in the KhMAD; the use of modern technology; competitive products; creation of additional jobs.

We are considering two options for assessing the effectiveness of the project: taking into account the environmental component (recycling of waste from the main production line) and excluding the environmental component. We are considering two options for assessing the effectiveness of the project: taking into account the environmental component (recycling of waste from the main production line) and excluding the environmental component.

The first assessment option is without taking into account the environmental component. The tools of the calculations were the works of the following authors [16-18]. Its main characteristics: the
unused reverse sludge generated during cutting and crushing of rejected products is 20%, which leads to an increase in demand for raw materials. Material costs in this case amount to 241,827 thousand rubles / year. Since aluminum paste and gypsum will be delivered by rail, an increase in the consumption of raw materials will lead to an increase in transportation costs in the amount of 2109 thousand rubles in year. Due to the fact that rejects and return sludge will not be reused, waste is generated that must be disposed of and disposed of in designated areas. This type of waste is classified as hazard class 5. The costs of removal and placement will amount to 488.475 rubles / year. The water demand of the enterprise is supposed to be met at the expense of the city water supply. Annual payments will amount to 8732 thousand rubles. The calculated indicators of the economic efficiency of the project for this option - the payback period of the project is 9.2 years, the net present value (NPV) is 192066 thousand rubles.

Let us dwell on the technological and technical and economic indicators of the plant proposed for launch on the basis of the existing construction organization to create a closed system of “materials-work-finished products” in accordance with the principles of the “kanban” method.

In the aerated concrete production workshop, raw sand (no dust emissions) is fed from the hopper to the grinding zone. The material sifted out during dosing and feeding enters the sump and then into the return sludge. The feedstock, including sand sludge, recirculated sludge, cement, ground lime and water, are fed to the mixers using technology (emission of inorganic dust). Waste from the cutting lines is accumulated in a special container called a sump, while the sump pump with a mixer prevents settling and setting of materials. The resulting waste is then re-introduced into production. Sources of emissions of the aerated concrete workshop are exhaust ventilation (deflectors, roof fans) - an organized source. The places where pollutants appear are the posts for the transfer of raw materials and additives to mixers. In the cement and gypsum warehouse, the source of polluting substances in the room will be cement pouring stations in silos, and cement dust and gypsum dust will enter the atmosphere. In the repair shop, the sources of emission of pollutants are internal combustion engines of internal workshop vehicles.

In the boiler room, gas-fired boilers act as sources of polluting substances. In connection with the above, the question arises of the development of technological solutions that ensure environmental protection. Such decisions include measures related mainly to planning, technological and special events: the location of the enterprise in the industrial zone, away from residential buildings; the use of modern technologies that meet the requirements of European standards; the use of ultrapure natural gas combustion technologies in mixing air heaters, gas treatment plants (GTP) in those technological operations related to the emission of pollutants.

### Table 1. Evaluation of environmental damage from air pollution.

| Name of pollutant | The amount of pollutant, t | Name of pollutant | The amount of pollutant, t |
|-------------------|----------------------------|-------------------|----------------------------|
| Methane           | 0.65                       | Iron oxide        | 0.0010                     |
| Benzapirene       | 0.0000095                  | Calcium oxide     | 2                          |
| Odorant           | 0.000015                   | Manganese         | 0.0002                     |
| Petrol            | 0.0125                     | Soda              | 0.0008                     |
| Kerosene          | 0.0615                     | Nitrogen dioxide  | 11,536                     |
| Suspended matter  | 0.004                      | Inorganic dust    | 1,535                      |
| Abrasive dust     | 0.00005                    | Sulphuric acid    | 0.000015                   |
| Rubber dust       | 0.00005                    | Soot              | 0.0315                     |
| Nitric oxide      | 1.874                      | Sulfur dioxide    | 0.0225                     |
| Carbon oxide      | 21.7545                    |                   |                            |

*Protection of surface areas and groundwater from depletion and pollution.* Water supply of the projected facility is provided from the city water supply and artificial surface reservoir of fire-fighting
water supply. Industrial waste water from the autoclaves (condensation) using this repeatedly and partially relieving wastewater in artificial about created reservoir. Wastewater households yaystvenno-household and storm water is provided to the local sewage treatment plant and into the artificial pond.

| Water Direction                  | Costs m3 / day |
|----------------------------------|---------------|
|                                  | ABA | Aerated Concrete Production | Repair shop | Total |
| Household s needs                | 5.23 | 20.31 | 0.925 | 26,465 |
| Water used by technology and     | -   | 288  | -   | 288   |

In order to ensure the rational use of water, the project provides for the full use (return) of condensate formed during the steaming of products. In order to ensure the rational use of water, the project provides for the full use (return) of condensate formed during the steaming of products. To assess the effectiveness of the project, taking into account the environmental component, we kept the technical and economic indicators for the project, but made changes to the technological section, strengthening the position in the field of ecology and environmental protection. Indicators of economic efficiency without taking into account the environmental component. The measures that need to be provided are aimed primarily at reducing the anthropogenic load, eliminating the effects of anthropogenic impact on ecological systems, preventing environmental pollution beyond established standards, and maintaining normal conditions for the life of the population.

Figure 1 shows the change in net cash flow taking into account the environmental component is presented in Figure 1.

![Figure 1. Net cash flow with taking into account the environmental component.](image1)

![Figure 2. Net cash flow excluding the environmental component.](image2)

Assessment of pollutant emissions carried out during the design indicates that the location of the enterprise in the selected area will not lead to a significant impact on the air, to changes in the nature of land use and will not affect the state of surface and groundwater in the proposed construction area.

The information presented on the graphs indicates that cash flow becomes positive three years after the start of the project. The indicators characterizing the economic efficiency of the project: the discounted payback period of the project - 8.5 years, the net present value (NPV) - 353 732 thousand rubles. According to the results of the calculations related to the evaluation of the project's efficiency, we can talk about a fairly high investment attractiveness and economic feasibility of the project. In conclusion, it should be noted that the project under consideration will have a positive impact on the economic and social climate, ensure the creation of additional jobs, and significantly increase the amount of tax revenues to the budget.
4. Conclusion
According to the results of the research can make a conclusion that the organization of the modern high-tech manufacturing in demand of construction material in the region with limited transport and logistics system to ensure it becomes extremely relevant in the world taking place of uncertainty in present-day conditions. Recommendations on the possibility of expanded reproduction of the existing material and technical base of the region and a more reasonable use of its property potential will allow enterprises to reduce costs for the purchase of imported goods from neighboring regions for a limited period, giving preference to their own producer. When implementing an innovative scenario for the development of the region in the conditions of diversification of production programs by its enterprises, the subject of the Russian Federation will be self-sufficient and no pandemics will be able to destabilize the situation in the social and economic environment. What is of particular relevance for the KhMAD with social indicators above the national average, but the existing unresolved problem of obsolete housing stock. According to the source [19,20], the total area of unsuitable for living (dilapidated) and emergency housing stock on January 1, 2019 amounted to 2599.5 thousand square meters. meters (7.7% of the total housing stock), of the total dilapidated and emergency housing stock, the dilapidated amounted to 1982.4 thousand square meters. meters, emergency - 617.1 thousand square meters. meters. The number of dilapidated and dilapidated residential buildings (houses) is 10243 (17.9% of the total housing stock), of which 1693 are emergency. This underlines the relevance of the raised problem in this publication for a specific region.

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