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**FIRST-CLASS RESOURCE-SAVING AND COMPETITIVE BUILDING
MATERIALS AND PRODUCTS**

Borangalikyzy D., Imanov A.Zh., Kuzhantayeva D.T., Abdugaparov D.Zh.

L.N. Gumilev Eurasian National University, Nur-Sultan, Kazakhstan

Annotation

The introduction of modern high-quality, environmentally friendly materials, products and structures in the field of construction will significantly reduce the consumption of materials and energy consumption of construction facilities and significantly increase the productivity of the construction sector. One of the modern directions of construction is the production of first-class, resource-saving building materials, products and structures, as well as the design and construction of buildings that combine the convenience of planning solutions, environmental friendliness and energy efficiency.

Keywords: building materials, products, structures, energy saving, resource saving, durability.

**БІРІНШІ КЛАСТЫ РЕСУРС ҮНЕМДЕУ ЖӘНЕ БӘСЕКЕГЕ ҚАБІЛЕТТІ
ҚҰРЫЛЫС МАТЕРИАЛДАРЫ МЕН БҰЙЫМДАРЫ**

Боранғалиқызы Д., Иманов А.Ж., Кужантаева Д.Т., Абдугапаров Д.Ж.

Л.Н. Гумилев атындағы Еуразия ұлттық университеті, Нұр-Сұлтан, Қазақстан

Аңдатпа

Құрылыс саласында қазіргі заманғы жоғары сапалы, экологиялық таза материалдарды, бұйымдар мен конструкцияларды енгізу құрылыс объектілерінің материалдары мен энергия тұтынуын едәуір азайтуға және құрылыс саласының өнімділігін едәуір арттыруға мүмкіндік береді. Құрылыстың заманауи бағыттарының бірі бірінші класты, ресурс үнемдейтін құрылыс материалдарын, бұйымдары мен конструкцияларын өндіру, сондай-ақ жоспарлау шешімдерінің ыңғайлылығын, экологиялылығы мен энергия тиімділігін үйлестіретін ғимараттарды жобалау және салу болып табылады.

**ПЕРВОКЛАССНЫЕ РЕСУРСОСБЕРЕГАЮЩИЕ И
КОНКУРЕНТОСПОСОБНЫЕ СТРОИТЕЛЬНЫЕ МАТЕРИАЛЫ И ИЗДЕЛИЯ**

Боранғалиқызы Д., Иманов А.Ж., Кужантаева Д.Т., Абдугапаров Д.Ж.

Евразийский национальный университет им. Л.Н. Гумилева, Нур-Султан, Казахстан

Аннотация

Внедрение современных высококачественных, экологичных материалов, изделий и конструкций в области строительства позволит значительно снизить расход материалов и энергопотребление строительных объектов и значительно повысить производительность строительной сферы. Одним из современных направлений строительства является производство первоклассных, ресурсосберегающих строительных материалов, изделий и конструкций, а так же проектирование и строительство зданий, сочетающих в себе удобство планировочных решений, экологичность и энергоэффективность.

Introduction

The construction materials industry is a priority sector, defining the current state the national economy and its potential development, including the renewal of fixed funds for the construction and repair of objects industry, transport and engineering infrastructure construction required the amount of comfort and quality housing employment in medium and small the settlements, and also size state costs associated with implementation of development programmes.

The activity of the industry directly depends on the level of investment activity – investments in fixed assets, demand for building materials from industrial consumers, the population. Import supplies of products, weak realization of the export potential of the construction materials industry have a significant impact on individual enterprises of the industry.

The production volumes of traditional building materials fully cover domestic demand, with the exception of construction materials that are new to the Kazakh market and (or) characterized by a small volume of consumption or greater attractiveness for consumers in terms of price and quality, that is, more competitive. In general, the capacity for the production of building materials is sufficient to meet demand in the forecast period up to 2030, and in some positions up to 2035 (depending on the scenarios of socio-economic development under consideration).

The construction industry is one of the most dynamically developing areas of industry, consuming a huge amount of resource-intensive materials - metal, cement, aggregates, bricks, concrete, thermal insulation and other materials.

Currently, strict requirements are imposed on modern materials. Materials should be inexpensive, safe, environmentally friendly, have a long service life, resistance to fire, convenience during installation or installation.

There are different points of view on the question of what is primary in construction - material or construction? In accordance with our point of view, the primary is the material, and the structure is a material that has been given a certain configuration with appropriate dimensions, while the shape, dimensions of the structure, its bearing capacity, reliability and economy are determined by the properties of the material from which it is made. What is the material - such is the design. Rocks, wood, metal, reinforced concrete correspond to their own, differing from each other friend, products and designs. At the beginning, a material is purchased or created, all its characteristics are established, and then products, structures, buildings and structures corresponding to this building material are designed. Only such an approach will make it possible to build reliable, energy-efficient and economical construction facilities.

Therefore, one of the main directions of increasing the efficiency of construction is the use of resource-saving materials, products and structures.

Research methods. Analysis, comparison.

Results and discussions.

Various natural raw materials with different degrees of technological readiness are used for the production of building materials, products and structures. The energy intensity of all building materials can be reduced by a qualified selection of raw materials. First of all, it is advisable to use such raw materials, which are more prepared by nature itself for production and require less energy for its processing, raw materials with defects in crystal lattices of minerals; the presence of a mineral-forming medium, liquid, gas; with a higher degree of amorphization of minerals and a higher reactivity.

If we compare the main building materials by energy intensity, then the most energy-intensive building material is steel, for the production of 1 ton of which requires 32290 MJ of thermal energy, and for the production of 1 ton of Portland cement in 8, brick in 12, reinforced concrete in 16, heavy concrete in 23, cellular concrete is 25 times less. At the same time, the mass of 1 m³ of material is also the largest in steel - 7.8...8 t. The average density of heavy reinforced concrete is 2.4...2.5 t/m³, light reinforced concrete - 0.7...2 t/m³, cellular concrete - 0.3 ... 1.2 t/m³, brick - 1.7... 1.8 t/m³. Based on from the above, it can be concluded that cement is the most energy-intensive after metal, and concrete and reinforced concrete are the least energy-intensive and material-intensive. They are also cheaper and more durable than steel. There are raw materials for their production, including waste from various industries, their technology is relatively simple, waste-free, environmentally friendly. It is possible to widely regulate the basic properties of concrete (medium density, strength, durability). Therefore, these materials were the main building materials in the XX century, and they will remain so in the XXI century.;there is no alternative to them. In the XX century in Kazakhstan, more than 5 billion m³ of concrete and reinforced concrete. Almost all responsible load-bearing structures are made of reinforced concrete: long prestressed bridge structures, columns of high-rise buildings, roof beams, crane beams, large-sized shells, pipes for various purposes, sleepers, road and airfield coverings, sewage treatment plants and many others.

However, these materials must undergo profound qualitative changes associated with a significant increase in strength and durability in order to significantly increase the service life of construction objects. Our research shows that the structure of concrete, and in particular heavy, is more heterogeneous, defective, and this determines its strength and durability, since all these characteristics are interrelated. Durability is a generalized concept that includes atmospheric, frost and corrosion resistance, bio, radiation resistance and other similar properties. Concrete it is considered and is durable if its strength remains stable over time under various operating conditions, because strength is an integral value of the energy of internal bonds in a material with a specific structure, ensuring its integrity, identity to itself and the ability to resist destruction from the effects of various factors. In order to significantly increase the value of internal bonds in concrete, and therefore its resistance, it is necessary to significantly increase its uniformity and reduce the defect of the structure. The structure of concrete can be considered homogeneous if all its components have the same chemical, mineralogical compositions and geometric parameters, the same structure, physical and mechanical properties, the uniformity of the composition in each micro-volume is observed, etc.

It is extremely difficult, if at all possible, to create such a uniformity of the concrete structure by simply selecting the initial components. However, it is almost always possible to achieve such uniformity due to a very fine joint grinding of all the components of the molding mass. Since all natural and artificial inorganic materials are formed from the same chemical elements, but in different combinations, the joint fine grinding of various materials will result in a mass consisting of the same primary chemical elements. For example, when fine grinding of dry concrete mix composed of crushed granite, natural sand and Portland cement, it will eventually be mainly consist of the following chemical elements: K, Na, Ca, Ba, Mg, Al, Si, O, Fe and S, because of the chemical composition of the source components of this granite is the main of K, Na, Ca, Mg, Al,O, Si; sand - from Si Oh, K, Na, Ca, Ba, Al, Fe; Portland cement from Ca, O, Si, Al, Fe, Mg, Na, K, S. At the same time, the number of individual chemical elements in the mixture may vary within certain limits. In this In this case, the

chemical, physico-mechanical and geometric characteristics of concrete components are leveled, contact defects are reduced, and the surface energy of the solid phase is used to the maximum extent. In the process of grinding the mixture, its uniformity in composition increases, the shape and state of the particle surface changes, which ultimately increases the integral energy of chemical bonds between elementary particles in a unit volume of the material. The destruction of a material during grinding is the process of breaking mainly chemical bonds between elementary particles of a solid and dividing it into parts.

The rupture of bonds occurs when the distance between elementary particles exceeds a certain critical value, after which the forces of attraction between them cease to act. From a theoretical point of view, it is possible to restore these connections only by bringing elementary particles together at such a distance when attractive forces arise between them again, which is possible only with the application of very high pressures. However, in real conditions, in places where chemical bonds break on the surface of the solid phase, a huge number of elementary particles with a large uncompensated charge. As a result, water vapor, dusty and other particles are attracted to the freshly formed surface in a relatively short time, and the surface energy of the solid phase decreases rapidly. If the dry joint grinding of the components of the concrete mixture, including the binder, is carried out, then there is a high probability that the particles of the binder will be attracted to the freshly formed surface of the filler particles and cover their surface with the thinnest layer. Consequently, with fine joint grinding of dry concrete mix due to surface forces, there will be uniform distribution of the binder over the filler surface is carried out. However, the layer of binder on the surface of the filler particles will be very thin, and in order to subsequently connect all the particles of the solid phase into a single dense monolith at very low In / C , it will be necessary to create significant pressures. The finely ground mass will have an increased water demand, which is extremely undesirable for well-known reasons. To reduce the water demand of such a mixture, it is necessary to introduce super plasticizers and concrete modifiers into it, it is desirable to use intensive methods when grinding mixing and compaction of particularly rigid mixtures with low V / C or similar methods of compaction of dry mixtures followed by their impregnation with water without or under pressure.

The energy potential of composite binders with a clinker component content of up to 70% with a compressive strength of at least 80 MPa has been realized, consisting in the use of a binder modifier and fillers of various genesis in the polymodal distribution of particles of composite binders.

Due to the use of mechanochemical activation of the feedstock, it is possible to produce nano structured building materials with improved characteristics.

The technology should create conditions for maximum convergence of solid phase particles during compaction and hardening concrete, which will contribute to the emergence of a greater number of stronger bonds between the components of the mixture. The concrete obtained in this way in our studies reached a strength of 150 MPa or more. Practice shows that an increase in the strength of both heavy and light concrete, for example, from 40...50 to 60..80 MPa allows not only to reduce the volume of concrete and the mass of structures by 20...25%, metal consumption by 10...15%, reduce the labor intensity of products, but also significantly increase their durability with all the material and energy benefits. With an increase in the strength of concrete to 100...150 MPa and above can achieve even greater effect. High-strength concretes should be used mainly for the manufacture of lightweight, strong and durable reinforced concrete load-bearing frames and structures of buildings and structures.

Obsolete hollow floors and coatings (heavy, metal- and energy-intensive with unsatisfactory heat and sound insulation) should be replaced by lightweight, metal- and energy-saving layered floors and coatings with the best sound, thermal insulation qualities and technical and economic indicators made of high-strength heavy and light concrete on porous aggregates.

If we compare all types of concrete in terms of material and energy intensity, then cellular concrete, which is the most effective for the manufacture of wall products, turns out to be it is widely used in the construction practice of Kazakhstan, Russia, Belarus, Ukraine, Poland, the Baltic States and other countries with a constant increase in its production volume.

Blocks of autoclaved aerated concrete and non-autoclaved foam concrete are mainly produced. Characteristics of autoclaved cellular concrete: average density 400...700 kg/m³, compressive strength 2...7 МПа, frost resistance F15...F35, thermal conductivity 0.1...0.18 W/mK. Non-autoclaved foam concrete has the worst characteristics. Therefore, the task is to obtain and use less energy-intensive non-autoclave cellular concrete, which is not inferior to autoclave in quality, including in the manufacture of monolithic wall structures.

A very effective and low-energy wall material, undeservedly pushed into the background, is concrete based on gypsum and composite gypsum binder. The following facts testify to its effectiveness from an energy point of view. To cook gypsum, a temperature of 140 is required...170 ° C, for firing cement - 1400...1500 °C. Gypsum concrete hardens quickly and without additional heat costs. Concrete and reinforced concrete on cement harden very slowly. To accelerate the hardening, they are subjected to heat treatment, which takes 2.5...5 GJ/m³ of thermal energy. This material it has a good appearance, environmental cleanliness, relatively low average density (300 ...1500 kg / m³) and thermal conductivity, fireproof, sufficient load-bearing capacity and durability. The material is easily processed and hardens quickly without heat treatment. Gypsum concrete can be successfully used for the manufacture of internal wall panels and blocks, partitions, finishing plates, plasterboard sheets, architectural products, dry mixes and other products used in dry conditions. Concretes based on composite gypsum binders can be used for the production of external walls, partitions, light ceilings, sanitary cabins, vent blocks, floors, gypsum fiber slabs, for the manufacture of monolithic products in building conditions.

The use of concrete on gypsum binders instead of Portland cement makes it possible to abandon heat treatment, which saves 200 kg of conventional fuel per 1 m³ of products, reduces the metal consumption of production by 2...2.5 times, electric energy consumption by 2 times, increases labor productivity by 1.8...2.5 times. It is no coincidence that in the USA the volume of production and use of gypsum concrete is about 35 times more than in Kazakhstan.

One of the most important ways to save fuel and energy resources is to reduce heat losses through the enclosing structures of buildings, through the insulation of heat pipelines and technological equipment. According to various sources, 100... 140 million tons of conventional fuel are consumed annually for heating buildings in Kazakhstan, while up to 30% of thermal energy is lost to the environment. In this regard, in the Republic of Kazakhstan for heating on average, 1 m² of building area consumes 2 times more energy than in Germany, and 3.7 times more than in Sweden and Finland. Solve this The problem should be solved by increasing the production and widespread use of effective thermal insulation materials in construction, the production of which Kazakhstan lags behind, for example, countries such as the United States, Sweden, Japan, etc. 7...9 times. Currently, more than 50%

of thermal insulation products, about 8% of foams, 2% of thermal insulation cellular concrete and 0.2...0.4% of products made of expanded perlite and vermiculite are produced in Kazakhstan on the basis of various fibers. But the volume of production of all thermal insulation products is completely insufficient. Calculations show that 1 m³ thermal insulation saves 1.45 tons of conventional fuel per year. To meet all the needs of construction, it is necessary to produce and apply 45 million m³ of fibrous thermal insulation products and 30 million m³ of the rest per year. Many of the thermal insulation materials produced today have significant and often unacceptable disadvantages. From a thermal engineering point of view, the most effective are and are used in practice three – layer wall panels with foam insulation, but they are more labor-intensive and less fire-resistant. An alternative to them in terms of thermal and other characteristics can be single-layer enclosing structures made of cellular concrete with an average density of 400...500 kg/m³ and a strength of 3...4 MPa, which are less labor-intensive and more durable. It is advisable to build single-layer self-supporting walls of buildings up to 4...5 floors high from small cellular concrete blocks with an average density of 400..500 kg / m³ and a strength of 2...4 MPa, as this will lead to significant savings of expensive and energy-intensive metal. For low-rise construction, it is also possible to use hydrophobized cellular concrete blocks with an average density of 200...300 kg / m³ and a strength of 1...2 MPa, including facing made of bricks and other materials. For low-rise monolithic housing construction, it is proposed to use a non-autoclave aerated concrete with an average density of D300 and a strength of B1. In this case, the walls do not have seams, have the necessary thermal and sound insulation qualities, less labor intensity and energy intensity.

Along with the above very effective thermal insulation materials is expanded perlite and products based on it. Energy-saving light cement mortars of medium density can be made on the basis of perlite sand, the use of which instead of heavy increases the thermal resistance of a wall of cellular concrete blocks with an average density of 500 kg/m³ by 25%. This means that the loss of thermal energy to the environment or fuel consumption for heating will be reduced by 25% of the building. It is also possible to insulate the walls with perlite cement mortar.

The use of bitumen perlite is effective with an average density of 250...450 kg/m³ and a thermal conductivity of 0.07...0.1 W/mK for thermal insulation of heat pipes and roofs.

Expanded polystyrene perlite (perlite foam), obtained by introducing perlite sand into expanded polystyrene, is significantly superior in its qualities (strength, heat resistance and durability) to the foam used in construction and it is more appropriate to use it for thermal insulation of enclosing structures.

Conclusion

The main global trends in the development of the building materials industry in recent years are presented in Table.1. In developed countries, the stage of transition to energy-efficient production methods, which was provoked by the first energy crisis of 1973, is almost completely completed. The next stage is being completed - maximizing the replacement of natural fuel with man-made and household waste. For example, in Germany, the share of secondary fuel in cement production is more than 60%, and Belarus may reach a similar figure in the next few years.

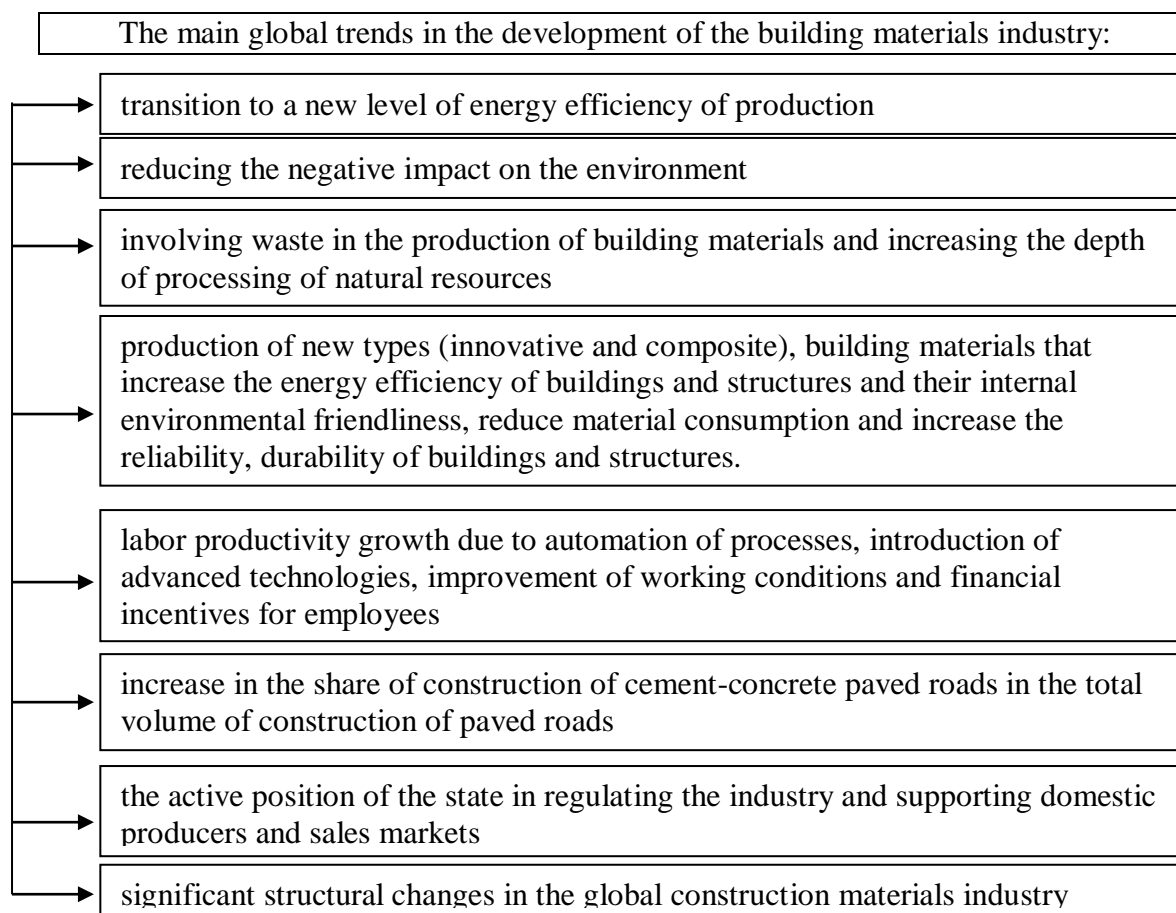
The constant trend of the last decades is the tightening of environmental requirements for production facilities. The roadmaps for the sustainable development of industry until 2050 set the main task of significantly reducing emissions into the environment, reducing the use of natural materials and non-renewable sources of electricity.

The most comprehensive indicator of the development of modern society is the attitude to waste. In many countries of the world, not only belonging to the developed category, the level of waste disposal has long exceeded 50%. Most of them are used in construction and in the production of building materials. In the USA and Germany, for example, for the disposal of ash and slag waste reaches 80%. In the USA, 7 million tons of waste are used annually for the production of concrete alone.

The current level of development of the construction industry assumes the consolidation of the production of building materials one of the key roles in solving environmental problems of civilization.

Application in construction of high-quality, resource-saving materials, products and structures, such as: nanocement and concretes based on it with the expanded use of mineral and chemical additives in the production of cements and concretes; low-clinker composite binders based on the use of metallurgical.

Table 1 The main global trends in the development of the building materials industry



Slags, ash and slag waste from thermal power plants, as well as cement-free binders and systems with low water consumption; composite materials, including ceramic composite materials of a new generation based on modified raw materials; modern polymer materials; concrete with increased strength and high strength for an openwork supporting frame, cellular concrete, gypsum concrete, laminated products in combination with effective thermal insulation materials for enclosing structures; materials with new properties and green

construction technologies will significantly reduce the material and energy consumption of construction projects and significantly increase the efficiency of the construction industry.

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