

## Peculiarities of Composition Materials for Architectonical Geonics

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**Abstract:** This study considers the problems of architectonical geonics new scientific field which covers the processes that occur in non-organic world. Optimization of “human material environment” system is most significantly expressed in such sphere of human activity as architecture and its establishment and development requires application of effective building materials. In order to implement this, human intellectual abilities and painstaking work are required as well as distinction of design efforts and their practical implementation. Architectonical geonics is a kind of mode of thinking, aimed at creation of unconventional technologies and rational usage of potential resources given us by nature. As an example, the researchers demonstrate scientific research results, dedicated to creation of highly efficient close-grained fibrous concretes on the base of energy-conserving raw materials, various types of components, concrete treatment systems, specifics of the usage of modern compositional materials for practical implementation of architectonical geonics’ positions.

**Key words:** Architectonical geonics, effective building materials, energy-conserving technologies, technogenic raw materials, evolution of non-organic world, energetic activity, free internal energy, structural defects, fibrous concrete

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### INTRODUCTION

Architecture as a civil engineering has a great influence on creation of psychological climate, positive emotions and creative mood. It seems that one of the most perspective trends is presented by the new scientific field architectonical geonics which implies creation of architectural ensembles that consider results of the impacts of geological and cosmochemical processes, caused to organic world. Architectonical geonics allows create architectural ensembles, hardscape elements, new colour palettes using the “expertise” of non-organic world. An important element here is architectural medium which provides creative attitude (Lesovik, 2013a, b; Stanislavovich *et al.*, 2013).

Geonics is a frame of reference to the processes that occur in non-organic world and their usage for increasing effectiveness of manufacture of building materials and optimization of “human material environment” system (Lesovik, 2012, 2014; Lesovik *et al.*, 2013). Another area of optimization system is architecture. Architectural expressivity is measured by criteria of beauty and aesthetics which beneficially influence people’s consciousness. As V. Gropius mentioned, “architecture can not come to its end it’s just constantly changing”. For obtaining architectonic expression, various architectural

methods are used such as: compositional shape proportion, hardscape elements decorative elements, etc. Any building must satisfy the following maintenance engineering key requirements: functional and technical reasonability, architectural expressiveness and cost effectiveness.

The essence of architecture is endowed with the unity of beauty and benefit. That’s why architectural form of the building is the solidity of perfect constructive solutions with artistic expression which is provided by tectonics. Tectonics of bounding-volume surfaces (walls, overlaps) is intended to artistically express the work of the construction and its material.

Development of science and technology gave rise to many building materials such as concrete and reinforced concrete, synthetic materials, oversize glass, aluminum effective insulants, etc. New materials as well as old ones that were used in a new way became the development basis for new constructive systems of frameworks, walls and shells. New architectural forms appeared resulting from introduction of large-span areas, suspension structural and other systems. Curiously enough, modern architecture is characterized by absence of any limitations or stylistic frames. Art of building has never been so free in self-expression and fantasy. Modern architects are actively looking for new texture

lines and visualization. They are served by modern effective technologies, high-quality materials and inspired by the spirit of the times (Ikonnikov and Hait, 2004).

Architectonical geonics is known to be influencing on the image of modern cities. One of the actual trends of practical realization of architectonical geonics' provisions is a specific character of production and application of modern composition materials. Establishment of materials science, evolution of mining industry as well as specific character of geologic structure of the territory of the Russian Federation prompt for search of new types of raw materials which would be more prepared by geologic, technogenic and cosmochemical processes for production of this or that building material (Lesovik, 2006).

### THE MAIN PART

Production of building materials differs from other industrial sectors by its conservatism is raw material usage. Yet, over a number of centuries the main earth materials used for production of break-stones, autoclaved materials, Portland cement clinker, ceramic materials have been granite, basalt, sand limestone and clay. This led to high power consumption of building materials' manufacture and rising scale of transportation expenditures.

Establishment of constructive materials science, development of mining industry as well as specific character of the geology of the Russian Federation prompt for search of new types of raw materials which would be more prepared by geologic, technogenic and cosmochemical processes for production of this or that building material. This explains sharply risen number of publication, dedicated to study of possibilities of usage of natural conglomerates in building industry, rock forming minerals of which are thermodynamically active opal, zeolites, mixed lattice minerals, metamorphogenic quartz and raw materials, represented mainly by glass phase (Lesovik, 2006; Frolova *et al.*, 2011; Lesovik *et al.*, 2009).

It is topical to investigate these solids in micronized state Low Water Demand Matters (LWDM), Fine Ground Cement (FGC), ceramic concretes multi-component concretes, silica-lime cementitious matters, etc. In this case, one can make better use of energetic of minerals' crystalline grid or potential of material's amorphous condition. Thus in order to synthesize disperse systems of the future building materials science, we need to reconsider raw materials base from the new viewpoint.

Topicality of usage of technogenic raw materials rises as well. By now in Russia in heaps and tailing dumps there have been accumulated >60 billion of tones of

technogenic materials that are geochemical anomalies and it is clear that they damage the environment. Calculations show that building industry may use 25-27% of annual yield of overburden and enclosing rocks as well as enrichment rejects of mineral resources. This is also essential, since expenses on waste storage have almost reached the level of expenses on costs for mining itself.

Development of science and civilization in general, increase of depth of mine development, introduction of new apparatuses and technologies in constructive materials science, the range of geological and waste materials that may serve as a raw material base for construction industry of the next millennium. There are hundreds of varieties of such raw materials.

It appears that in connection with the above matter as well as with establishment of constructive material science as an independent science, there is a need in development of theoretical provisions of energy output lowering while producing construction materials with consideration of raw materials' origin (Lesovik, 2006, 2012). The latter will lead to increased effectiveness of artificial building conglomerate technologies which are the objects of architectonical geonics.

Methodological base for resolving these issues is a unity of raw materials' genesis and technogenesis as a unified aggregate of geochemical affect on various elements of geological environment. Objective reality of this is orientation of geochemical and technochemical reactions that lead to decrease of components' free internal energy at the formation of natural and artificial conglomerates.

Architectonical geonics' activity leads to formation of specific systems that are fixed in space as objects of civil, industrial and agricultural engineering. Technogenesis is characterized by abnormal accumulation of Si, O, Ca atoms and other products of human activities in some areas of geological environment.

Thus, building materials should be considered as a specific stage of non-organic world's evolution and the criterion at raw material selection for their production would be the common features of transformation at genesis and technogenesis as well as energetic condition of geological material or industrial wastes connected with it.

Geological materials go through several stages of their evolution while getting into new thermodynamic conditions: disintegration of monolithic structure, texture and structure of the solid destruction of crystalline grids of rock-forming minerals the synthesis of new compounds formation of structure, texture and the solids in general. Depending on the states of evolutionary transformation,

solids have different energetic activity and to various degrees are prepared for production of these or those building materials, technology of which is similar to evolutionary transformation of subsurface rocks.

It appears that energetic criterion that allows ranging raw materials for production of building materials, may be represented by free internal energy of rock forming minerals and solid in general. This integration characteristic is defined by the result of particles' movement and interaction (clusters, molecules, atoms, ions, etc.), defectiveness of crystal grid rock-forming minerals, like: presence of inclusions of mineral-forming medium as liquid; the level of minerals' crystallinity, structure and texture of solids, post-genetic changes and other parameters that favour energy cost reduction at the production of building materials.

Investigation and theoretical generalization of available information about influence of subsurface rocks' genesis on their abovementioned characteristics allowed to define the correlation between of rocks' free internal energy and their origin (Lesovik, 2006). This dependency was proved by key provisions of architectonical geonics.

Practical implementation of the provisions of architectonical geonics found its expression in scientific researches, held on the base of Building material sciences Department of Belgorod State University of Technology named after V.G. Shukhov. The results of these investigations were development of various special cementitious matters with the usage of various components and concrete treatment systems. In particular in Rakitchenko (2011) research efficiency improvement of fine-grained fibrous concrete was reached by means of using compositional cementitious matters and optimization of matrix structure.

Compositional cementitious matter was obtained by means of joint grinding of Portland cement clinker and quartzitic sand rock of greenschist degree of metamorphism. At this there can be observed intensification of system's hydration at the account of more developed and defective structure of silica-containing component, micro-dispersed additive and super plastificator which leads to synthesis of more homogeneous matrix structure with minimal amount of pores and micro fractures. On the base of developed cementitious matter, technogenic sands of Kursk Magnetic Anomaly (KMA), super plastificator and steel fiber there has been received high-quality fiber reinforced fine grained concrete which is recommended to be used in repair works and building of monolith and composed monolith constructions. According to investigations' results, optimization of micro and macro structure of the composite lead to gain in strength and elasticity modulus more than twofold, in comparison with standard cement

concrete. Besides, inclusion of quartzitic sand rock and microdispersed additive (obtained by means of joint grinding of portland cement clinker) into composition of cementitious matter, allowed to obtain economy on cementitious matter.

As per the results of other investigations, there have been suggested effectiveness-increasing principles of building composites with application of raw sources of the Middle East. The effect is assumed to be gained by means of optimization of structure of fine-grained concrete on nano-, micro- and macro-levels at the account of including Jordan volcanic tuff, super plastificator and fiber into composition of cementitious matter which leads to creation of high-density packaging which in its turn provides optimization of microstructure of cement rock and fiber contact zone and as a consequence, it significantly increases mechanical strength and elasticity modulus of the product (Shakarna, 2013).

Based in developed compositional cementitious matters with the usage of technogenic sands of KMA deposits and volcanic tuff of the Middle East, there has been obtained wide nomenclature of fiber concretes for creation of modern architectural ensembles.

## **SUMMARY**

New scientific area has been offered-architectonical geonics which reflects creative world outlook, considering results and influences of geological and indirect chemical processes on human living environment. There have been developed theoretical provisions of energy output reduction at manufacture of building materials, considering application of free internal energy of subsurface rocks which is defined by the result of particles' movement and interaction (clusters, molecules, atoms, ions, etc.) defectiveness of crystal grid rock-forming minerals, like: presence of inclusions of mineral-forming medium as liquid; the level of minerals' crystallinity, structure and texture of solids.

We have suggested some principles of intensification of production technologies of fine-grained fiber concretes by means of using quartz-containing solids of greenschist degree of metamorphism which due to their specific genesis have high reactivity.

There have been developed new compositional cementitious matters (created with application of energetically active raw materials quartzitic sand rock and volcanic tuffs from the Middle East) on the base of which there have been received high-effective fine-grained fiber concretes for the aims of contemporary building and architecture.

In the light of provisions of architectonical geonics, we have suggested systematic approach to the problem of "human material environment" system's optimization.

## CONCLUSION

Results of geological processes' investigations contributed a lot into development of civilization. Tens of thousands of deposits were opened; genesis processes of strategically significant raw materials were investigated. Particular provisions, formulated within the framework of new research area-architectonical geonics-regarding usage of natural laws for advancement of building materials construction technologies were earlier used at the development of unique crystals' growing, in metallurgy, chemical industry, construction industry, etc.

Architectonical geonics implies to use systematic approach to solution of the problem within the framework of unified transformation of non-organic world and optimization of system "human materia environment". The authors of this article have presented particular examples of this scientific area have shown possible ways of reducing energy outputs of building materials' production by means of using specific types of non-conventional raw materials which is energetically enriched at the account of geological processes.

Researchers hope that architectonical geonics will provoke interest in variously directing specialists and scientists. Today architectonical geonics has only started its way; however, if humankind optimizes the system "human material environment", it is going to reach great results.

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