

NEW EFFECTIVE TECHNOLOGIES OF PRODUCTION OF BUILDING MATERIALS AND ARTICLES

¹Ya. Zubrilina, T. Lupashku¹, E. Shamis¹

¹Technical University of Moldova

²Institute of Chemistry of the Academy of Sciences of Moldova

COMMON VIEWS

The present proposition includes not only one but several new technologies: building articles on basis of gypsum-cement-puzzolane binder (GCPB); semifinished products from extra-fine basalt fiber (EFBF), first of all basalt wool; quasi-composite building articles from GCPB and EFBF.

It is known that compositions of gypsum bindings and Portland cement are instable. Within the limits of 1-3 months after building mortar making strength decreases and the result of it is destruction.

This result from three-sulphate forming of calcium hidro-sulfo-aluminate on base of calcium sulfate and highly basic calcium aluminates, which contain Portland cement. Hence ettringite forms in composition, which is called "cement bacillus".

A.V. Volzhenskij offered a composition on base of gypsum, Portland cement and active mineral (puzzolane) admixture comprising silica in active state.

Pozzolanic admixture permits to decrease strength of the calcium hydroxide and under existing conditions highly basic calcium aluminates cannot exist. So in opinion of researchers forming:

- mono- sulfate form
 $3\text{CaO}\cdot\text{Al}_2\text{O}_3\cdot\text{CaSO}_4\cdot 12\text{H}_2\text{O}$;
- hidro-granates $3\text{CaO}\cdot\text{Al}_2\text{O}_3\cdot n\text{SiO}_2$ (6-2n)
 H_2O ;
- hydro- aluminum-silicon
 $3\text{CaO}\cdot\text{Al}_2\text{O}_3\cdot\text{CaSiO}_3\cdot 12\text{H}_2\text{O}$;
- gypsum $\text{CaSO}_4\cdot 2\text{H}_2\text{O}$ and theirs solid solutions.

Many years' experience in application of GCPB in building trade had confirmed deductions of researches. In recent years was produced improved form of quick-hardening binding on gypsum – composite gypsum binding (CGB), which also can be used in offered technologies.

Nomenclature of articles: elements of indoor and outdoor walls, dividers – slot-comice blocks and plates, elements of reinforced concrete monolithic overlaps – insert-blocks and plates for

floor beds. All these elements are made from cellular GCPB having compression durability of 5,0 – 6,0 MPa, the density 800 – 1000 kg/m³ with basalt-fiber inserts with density of 45 kg/m³. From the above-enumerated elements it is possible to fully complete the whole constructive surface body of the building – incombustible, enough durable to resist the seismic, wind and other major exposures. The buildings from the above-enumerated elements are supposed to be erected in combination with metal and reinforced concrete monolithic constructions. The wall from the proposed elements by thickness of 300 mm assures the same heat shielding, as the wall from brick with thickness up to 2450 mm.

By the result of the researches it was possible to receive from GCPB inclusively under production conditions, close-meshed rapid-setting for articles for heightened durability but without preliminary preparation of foam or input in forming mixture of gas-forming compounds.

Innovative technical solutions of the equipment and taking, that completely provide manufacturing of materials and articles with a preset predicted and higher performance were developed and tested in industrial practice. With density 1000kg/m³ the actual compression strength made 17,2 MPa, bending strength – 4,7 MPa. Knauf offered by the company possesses the characteristic 4,5 MPa & 2,2 MPa.

Primary equipment includes kneading-and-mixing machine of continuous operation that effectuates cavitation-flush mixing of GCPB or another mineral binding material and water. Activation of mixture (build up of durability characteristics) is taking place during process of its preparation. This is reached due to the special regimes of production process allow in defined order to obtain materials of the programmed density and durability. Kneading-and-mixing machines moves above the forms of the articles, in which it discharges the newly prepared mixture. Gypsum articles are taken out from form in 15-20 minutes after the forms were supplied with mixture, due to natural rapid hardening without any thermal

processing or other artificial exposure. Further the articles are vectored to the chamber where excessive moisture evacuation is effectuated.

Major facts, defining significance of new building technologies complex, are as follows:

- ubiquitous abundance of the initial raw material; natural origin of host materials with a high scale time-approved durability; optimum characteristics of the articles – fire resistance, heat-shielding, acoustical absorption, water-, biological-, cold-, weather resistance etc.; promptitude of development of production and construction of objects, inclusively in areas exposed to extreme effects (natural disasters, military operations, man-caused catastrophes, terrorist acts);
- versatility of articles for construction for buildings and structures of different purpose and of any constructive schemes; possibility of usage in buildings of the diverse architecture; simplicity and briefness of the new technologies of production of building articles; compact, parterre placement of the equipment of technological lines; high performance of usage building items in buildings and structures constructed in any climatic zones of the planet.

POTENTIAL USAGE OF TECHNOLOGIES

Offered building technologies and products are characterized as ecologically clear, energetically efficient, stable in extreme situations, economically efficient. They can be recommended for usage in construction of buildings of any constructive schemes and floor quantity practically in all climatic zones.

The complex of offered technologies is approved in trial manufacture in 90-'s in Russia (Moscow) within the framework of the Federal program "*Energoberejenie Rossi*", the Moscow city program of the Ministry of science and technologies in Russia.

As region of initial industrial realization of new building technologies the Republic Moldova is supposed. Here there is a necessary base, free capacities, relatively inexpensive and insufficiently loaded working and technological personnel, highly skilled scientists and the engineers participating in elaboration of offered technologies. The marketing researches have shown that in Moldova there is a steady demand for the offered building products, determined by their technical and economic advantages in comparison with analogues.

In Moldova offers have got the approval of the state authorities in the form of the Assignment

of the president of Moldova # 05/5–100A from August, 8, 2001, Decision of the Government # 421 from April, 5, 2002, branch building programs.

The elaborated investment project including the marketing-plan and the business-plan, has confirmed expediency of the organization of such a manufacture in Moldova. The potential opportunity of realization of the presented technologies and their production in neighboring countries is also determined in this project.

Technologies can be of interest in regions with a cold climate (for example, the north Russia, the Scandinavian countries, Canada, Alaska). They represent special interest for regions with excess seismic activity.

In our opinion, offers can be recommended for the building market of USA, in particular, for construction of buildings of a little floor quantity. Here special value is got with opportunities of creation of enough strong structures, capable to resist to influence of fire, radiation, seismic loading, but to provide a minimum of costs in construction. Moreover, the important factor in support of offers is energy efficiency not only in production, but also during the operation of building.

ADDITIONAL INFORMATION

Elaboration of a complex of offered technologies was carried out 40 years in Moldova, Russia and Ukraine.

At the first stage of researches (60-70-s') the technology of thin-walled volumetric blocks on GCPB was created, and for the first time in the world building practice in 1961 in Kishinau trial manufacture of volumetric blocks of sanitary-engineering units and engineering communications was organized. Then the technology was widely realized in USSR, now in Moscow two factories of a building industry make these products, providing needs of city construction.

At the second stage (70-s- the beginning of 90-s') the general technology of modular construction with usage of rapid-setting materials on GCPB and aerostatic flying devices (dirigible balloons) was elaborated for transportation and installation of large volumetric blocks. Models of such volumetric blocks were made and tested in 1972 in Kiev with our participation, and the model of the specialized dirigible balloon was constructed and tested in 1991 in Ulyanovsk.

At the third stage (90-s and in present time) the elaborations were conducted in Moldova and Russia and in 1997-99 in Moscow trial manufacture

of effective building production offered technologies was organized.

Exhibits of the offered technologies were submitted and have got an approval on a number of the international exhibition:

- on the third International exhibition-congress “*High Technologies. Innovations. Investments*”. In Sank-Petersburg in 1998.

- on the International Exhibition “Dorogy-98” in Moscow in 1998

- on the exhibition “*Rosstrojexpo*” in Moscow in 1999

- on CEI Summit Economic Forum in Budapest (Hungary) in 2000

- on the International Exhibition “*Moldconstruct’2001*” and “*Moldconstruct’2006*”.

At the present time elaborators carry out the preparation of a batch production of building products on the offered high technology technologies in Kishinau. Simultaneously technologies continue to be improved.

ECONOMIC PARAMETERS

Costs of creation and start – up of the unified process module UTM-1 with the annual capacity 20,0 thousand m³ of building articles and 8,0 thousand m³ of basal wool make up 1230,75 thousand \$USD.

According to the business-plan data the annual receipts from sales of production at prices of Moldavian building market make up 2944,0 thousand \$USD.

Total cost of this production represents 2240,0 thousand \$USD.

Annual profit will make up 704,0 thousand \$USD.

References

1. *Voljenskij A.V., Stambulko V.I. Ferronskaja A.V. Gipso-cementno-puccolanovy'e i betonny'e izdeliya.* – Moskva: Gosstrojizdat, 1971.

2. *Eger S.M., Ishkov Yu.G., Shamis E.E. Dirizhabli dlya severny'h rajonov//Promyshlennyj transport.* – M.: 1988, p.2.

3. *Kostikov V.I., Smirnov L.N., Shamis E.E. Programma “Bazalt”: tehnologii i izdeliya dlya stroitel'stva.* – M.: 1999, p. 5-6.

4. *Kostikov V.I., Shamis E.E. i dr. Gipsobazal'tovyje stroitel'nye izdeliya i tehnologii/ Stroitel'nye materialy, oborudovaniya, tehnologii XXI veka.* – M.: 1999. – p.3-4.

5. *Shamis E.E. Ob'yomno-blochnoe domostroenie s primeneniem by'stroverdeyushhih materialov.* – Kishinyov:Kartya Moldoveneaske', 1971.

6. *Shamis E.E., Smirnov L.N. I dr. Tehnologii gipsobazal'tovy'h stroitel'ny'h izdeliy//Bazal'tovoloknisty'e materialy': Sbornik statej.* – M.:Informkonversiya, 2001.

7. *Shamis E.E., Moorichev V.B. Using Lighter Than Air Vehicles (Dirigibles) in Housing Construction. Proceeding of the Interagency Workshop on LTA Vehicles. FTL Report R75-2, Massachusetts Institute of Technology, Cambridge, Massachusetts, 1975.*