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Алєксєєва Л. В.

**L. Alyeksyeyeva**, Director of perlite division,
State Enterprise «Ukrainian Research and Design Institute of Building Materials and Products «RDIBMP»,
Konstantinovska, 68, Kyiv, 04080, Ukraine,
✉ rdibmp@users.ldc.net ☎ 38-095-011-44-67

**Алєксєєва Л. В.**, зав. сектором перліту,
ДП «Науково-дослідний і проектно-конструкторський інститут будівельних матеріалів і виробів» (НДІБМВ),
вул.Костянтинівська,68, м.Київ, 04080, Україна.
✉ rdibmp@users.ldc.net ☎ 38-095-011-44-67

# WAYS OF DEVELOPMENT IN UKRAINE OF THERMAL INSULATION BASED ON EXPANDED PERLITE

## ШЛЯХИ РОЗВИТКУ В УКРАЇНІ ТЕПЛОІЗОЛЯЦІЙНИХ МАТЕРІАЛІВ НА ОСНОВІ СПУЧЕНОГО ПЕРЛІТУ

## ПУТИ РАЗВИТИЯ В УКРАИНЕ ТЕПЛОИЗОЛЯЦИОННЫХ МАТЕРИАЛОВ НА ОСНОВЕ ВСПУЧЕННОГО ПЕРЛИТА

**Annotation.** The article presents the technologies for the production of heat-insulating materials and products developed by the State Enterprise "NIISMI" using expanded perlite sand with improved performance characteristics, produced from domestic perlite raw materials of the Fogosh deposit in the Transcarpathian region of Ukraine according to the improved two-stage technology of the SE "RDIBMP".
**Keywords.** The field of perlite raw materials of Ukraine, heat-insulating materials, expanded perlite sand, two-stage technology of the SE "RDIBMP", improved operational characteristics.
**Анотація.** У статті наведені розроблені ДП «НДІБМВ» технології виробництва теплоізоляційних матеріалів і виробів з використанням спученого перлітового піску з поліпшеними експлуатаційними характеристиками, виробленого з вітчизняної перлітового сировини родовища Фогош Закарпатської області України за вдосконаленою двох-стадійною технологіэю ДП «НДІБМВ».
**Ключові слова.** Родовище перлітового сировини України, теплоізоляційні матеріали, спучений перлітовий пісок, двох-стадийная технологія ДП «НДІБМВ», поліпшені експлуатаційні характеристики.
**Аннотация.** В статье приведены разработанные ГП «НИИСМИ» технологии производства теплоизоляционных материалов и изделий с использованием вспученного перлитового песка с улучшенными эксплуатационными характеристиками, произведенного из отечественного перлитового сырья месторождения Фогош Закарпатской области Украины по усовершенствованной двух-стадийной технологии ГП «НИИСМИ».
**Ключевые слова.** Месторождение перлитового сырья Украины, теплоизоляционные материалы, вспученный перлитовый песок, двух-стадийная технология ГП «НИИСМИ», улучшенные эксплуатационные характеристики.

Ukraine has large reserves of perlite rock. The field of perlite raw materials in Ukraine is located in the Beregovo district of the Transcarpathian region, with reserves of approximately 100 million m3. Perlite deposits have been exploited by the Beregovsky open pit for more than 30 years; since 1992, industrial development of the Fogosh deposit (13.4 million m3) has been carried out. Deliveries of perlite raw materials are carried out in accordance with the requirements of State standard – GOST 25226-96 (DSTU B.V.2-7-62-97) "Crushed stone and perlite sand for the production of expanded perlite" (developed by SE "RDIBMP").

The expanded perlite produced by the heat treatment of volcanic aluminosilicate perlite rock is a highly efficient heat and sound insulating porous material. It has high sorption properties, fire retardant, chemically inert, bio-resistant. The application temperature of expanded perlite is from –200 °C to + 900 °C. The thermal conductivity is 0.04-0.09 W / m.K when the bulk density is 75-250 kg / $m^3$. It is produced in the form of sand, powder, crushed stone in accordance with the requirements of State standards developed by RDIBMP – GOST 10832 "Sand and crushed perlite expanded", GOST 30566-98 (DSTU 3665-97) "Filter petrlite powder".

Currently, when the problem of energy saving is acute and regulatory requirements for thermal resistance (2,8-3,3 m2 °C / W) of external walls of heated buildings are toughened, the use of heat-insulating perlite materials in construction is of great importance.

The production and use of expanded perlite has been developing for more than 50 years in many countries of the world on all continents. The global production level per year reaches up to 20 million $m^3$ of perlite materials. The volume of production in the USA – the largest producer and consumer of expanded perlite is up to 7 million $m^3$ per year.

Foreign experience in the use of expanded perlite as heat-insulating materials and products includes the following main areas: backfill insulation; perlite wall products; perlite foundations under floors; perlite insulation of the roof; perlite insulation of chimneys, pools; pipeline insulation; insulation of high temperature equipment; perlite plasters; isolation of cryogenic equipment; dry mixes for various purposes for construction, metallurgy, etc. In the USA, up to 70% of expanded perlite is used for thermal insulation in the form of a charge material and various thermal insulation products.

In Ukraine and in other CIS countries, the production and use of expanded perlite has been developing for more than 50 years, as well as throughout the world. Previously, the use of perlite was distributed as follows: 22% – aggregate for light concrete, 20% – for the manufacture of hard-molded products, 13% – for the production of bitumen perlite, the rest – as insulating fillings and for specific purposes: in agricultural technology, cryogenic engineering and, mainly , for filtroperlite.

Currently in Ukraine, the situation of consumption of expanded perlite in the domestic market is changing significantly, both in the construction industry and in other industries, and is distributed as follows: construction (for dry building mixtures – 15%; for perlitobeton – 25%; for thermal insulation products – 10%); agroperlite -15%; metallurgy – 20%; filtroperlite – 15%.

To cover the shortage and high cost of fuel, it is inevitable that the production of heat-insulating perlite materials for various purposes be expanded.

The main way to improve the work of perlite enterprises and stabilize their economic condition is the use of universal regulated technologies capable of producing the products required for the market.

In this regard, it is necessary to note the advantages of using expanded perlite sand obtained from Ukrainian raw materials using the advanced 2-stage technology of the SE "RDIBMP". The peculiarity of the new technology is the possibility of obtaining granular expanded perlite sand with predominantly closed porosity. Compared to the expanded perlite produced by the single-stage technology from other perlite deposits (Greece, Armenia,

Table 1.

| Deposits of perlite (bulk density of samples of expanded perlite) | Fraction, mm | Bulk density, kg/m³ | Thermal conduc-tivity. Wt\|mK | Coefficient of compacting | Water absorption | | Compression strength in cylinder, MPa |
|---|---|---|---|---|---|---|---|
| | | | | | %, by mass | %,. by volume | |
| 2 | 3 | 4 | 5 | 6 | 8 | 9 | 10 |
| Fogosh, Ukraine (γ=127 кг/м³) | 2,5-5,0 | 158,8 | 0,046 | 1,093- | 150 | 23,8 | 0,36 |
| | 1,25-2,5 | 114,8 | 0,044 | 1,118 | 330 | 37,9 | 0,21 |
| | 0,63-1,25 | 104,0 | 0,048 | 1,153 | 425 | 44,2 | 0,15 |
| Fogosh, Ukraine (γ=89 kg/m³) | 2,5-5,0 | 71,2 | 0,042 | 1,135 | 240 | 171 | 0,175 |
| | 1,25-2,5 | 77,6 | 0,040 | 1,137 | 425 | 33,0 | 0,15 |
| | 0,63-1,25 | 83,0 | 0,043 | 1,175 | 490 | 40,7 | 0,12 |
| Fogosh, Ukraine (γ=72 kg/m³) | 1,25-2,5 | 67,2 | 0,038 | 1,145 | 450 | 30,2 | 0,13 |
| | 0,63-1,25 | 71,2 | 0,042 | 1,21 | 530 | 37,7 | 0,11 |
| Greece, Island Melos (γ=82 kg/m³) | 2,5-5,0 | 90,0 | 0,040 | 1,16 | 250 | 22,5 | 0,13 |
| | 1,25-2,5 | 75,0 | 0,040 | 1,17 | 455 | 34,1 | 0,10 |
| | 0,63-1,25 | 65,0 | 0,039 | 1,27 | 580 | 37,7 | 0,08 |
| Bilecic, Turkey (γ=85 kg/m³) | 2,5-5,0 | 93,2 | 0,040 | 1,13 | 250 | 23,3 | 0,125 |
| | 1,25-2,5 | 86,0 | 0,041 | 1,15 | 450 | 38,7 | 0,11 |
| | 0,63-1,25 | 72,2 | 0,042 | 1,22 | 610 | 44,0 | 0,095 |
| Aragatz, Armenia (γ=83kg/m³) | 2,5-5,0 | 99,7 | 0,040 | 1,13 | 230 | 22,9 | 0,16 |
| | 1,25-2,5 | 87,2 | 0,040 | 1,15 | 455 | 39,7 | 0,11 |
| | 0,63-1,25 | 59,2 | 0,039 | 1,21 | 690 | 40,8 | 0,07 |
| Paravan (Georgia) (γ=47 kg/m³) | 1,25-2,5 | 38,7 | 0,031 | 1,23 | 1051,7 | 40,7 | 0,036 |
| | 0,63-1,25 | 46,2 | 0,038 | 1,22 | 1061,6 | 49,0 | 0,032 |

Turkey, Georgia) this expanded perlite sand is characterized by improved indicators: reduced water absorption, coefficient of compacting and increased strength, and with a uniform particle size distribution of the desired fraction.

Characteristics of expanded perlite sand made from perlite raw materials of different deposits are presented in the table 1.

Production of expanded perlite of improved quality makes it possible to expand its use especially in construction / 2 /. The main purpose of perlite in the construction industry is the use in the construction of residential, public and industrial buildings, for insulation of external walls, roofs, ceilings, floors.

On the basis of Ukrainian perlite raw materials, SE "RDIBMP" has developed and introduced into the industry efficient technologies for producing various materials and products:

-the production technology of small pieces of perlite-concrete products using the method of vibropressing (density 500-700 kg / m3, compressive strength 1.0–3.5 MPa, thermal conductivity 0.11-0.14 W / mK). Purpose – for enclosing structures of residential, civil and industrial buildings;

-production technology of thermal insulation structural material – perlitobentonitovyh products in the form of slabs and bricks (density 250-400 kg / m3, compressive strength 0.3-0.8 MPa, thermal conductivity 0.07-0.010 W / m.K):

-effective dry plaster mixtures based on expanded perlite sand – gypsum-perlite (bulk density 400-900 kg / m3, thermal conductivity 0.08-0.20 W / m K) and cement-perlite (bulk density 700-900 kg / m3, thermal conductivity 0.18-0.20 W / m.K);

- technology for producing expanded perlite powders, which are intended for use in the production of alkyd linoleum and as a lightweight additive for cement cements.

-the technology for producing expanded perlite sand on a mobile unit (technology is patented) for filling in cryogenic equipment and for the production of dry mixes.

In addition, in construction, from among the sought-after and insulating perlite materials and products produced in Ukraine, it is recommended to use:

-perlite fillings in wall structures from hollow small-piece products with a density of 75-100 kg / m3;

-gypsum-perlite and cement-perlite plastering and masonry mortars, heated floors, warm adhesives, self-leveling self-leveling floors, putties, etc. in the form of dry building mixtures with a density of 500-800 kg / m3;

-unbaked thermal insulation products with a density of 250-400 kg / m3 for insulation of industrial and household equipment, pipelines, roofs, ceilings and other structures in industrial and civil construction;

-pre-pressed perlite insulation with a density of 150-200 kg / m3 in various shells for insulation of coatings, floors, for laminated walls.

Analysis of foreign and domestic experience in the use of expanded perlite in construction shows that, in addition to the traditional uses of this material, new areas are intensively developing:

-warm masonry solutions that can be used in laying of small-piece heat-efficient blocks of cellular concrete or perlitobeton to improve the thermal engineering uniformity of the building envelope and to prevent the appearance of" cold bridges";

-light sanitizing mortars based on expanded perlite. They fill cavities in walls, blocks, bricks, and grout crevices are made;

-perlite fillings are used to insulate walls from wooden and frame constructions, as well as in constructions of warm inclined roofs, ceilings, floors. Such insulating layers are incombustible, therefore, they increase the fire resistance of buildings;

-with the help of expanded perlite perform heat and sound insulation of floors;

-for the installation of insulated monolithic floors, hydrophobic expanded perlite sand with a particle size of up to 6 mm and a bulk density of about 100 kg / m3 is used.

Thus, the development of the production of expanded perlite in Ukraine can be implemented through the widespread development of high-quality perlite materials and products developed on the basis of domestic raw materials that meet the requirements of various consumers.

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