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## THERMAL INSULATION MATERIALS AND FEATURES OF THEIR APPLICATION

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**Abstract.** Energy efficiency and soundproofed are important areas of comfort and energy savings for the consumer. In this regard, the building materials market today offer a wide range of types and brands of insulating materials.

Their diversity might lead consumers astray. Each manufacturer specific material information in its advertising to the merits of their material, without the other features of its application, which in some cases simply inadmissible to apply in some cases.

This article describes the basic principles of comparison materials, which the user can choose the most suitable option for him, based on priority technical and economic characteristics. Examined two groups of insulating materials.

As a result of market analysis developed the technique presented in the form of tables and optimizing the choice of a product on a broad criterion of performance.

**Key words:** insulating materials; comparative characteristics; thermal insulation of buildings; thermal conductivity.

# ТЕПЛОИЗОЛЯЦИОННЫЕ МАТЕРИАЛЫ И ОСОБЕННОСТИ ИХ ПРИМЕНЕНИЯ

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**Аннотация.** Повышение энергоэффективности и звукоизоляции являются важными направлениями комфорта и энергосэкономии для потребителя. В связи с этим на рынке строительных материалов сегодня представлен огромный ассортимент типов и марок теплоизоляционных материалов.

Их разнообразие может завести потребителя в заблуждение. Каждый производитель конкретного материала в своей рекламной информации описывает достоинства своего материала, без учета других особенностей его применения, которые в отдельных случаях просто недопустимым применение в некоторых случаях.

В данной статье описаны основные принципы сравнения материалов, по которым потребитель может выбрать наиболее подходящий для него вариант, исходя из приоритетных технических и экономических характеристик. Рассмотрены две группы теплоизоляционных материалов.

В результате проведенного анализа рынка разработана методика, представленная в виде таблицы и оптимизирующая выбор того или иного продукта по широкому критерию характеристик.

**Ключевые слова:** изоляционные материалы; сравнительные характеристики; теплоизоляция зданий; теплопроводность.

## *1. Introduction*

Energy efficiency and soundproofed are important areas of comfort and energy savings for the tenant. Adopted in 2009, the law [1] stimulates dynamic growth, both imported and domestic thermal insulation materials in the construction market.

In the result of the research [2], it became clear that the construction of energy efficient home first to be concerned about preventing heat loss through the building envelope [3].

Insulation materials, whose main characteristic is the thermal conductivity [4], are a major role in ensuring optimal indoor climate conditions. Effectiveness of any type of material related to the following factors:

- ✓ Energy consumption of producing a material having regulatory properties [5];
- ✓ Operational stability of the material in specific operating conditions; energy intensity of construction works (installation material in construction) [6];
- ✓ Reducing the cost of space heating [7].

In choosing the material for insulation must also be taken into account temperature and humidity conditions, load and deformation impact on the design, operating conditions and other requirements in accordance with paragraph 4.2 SNIP 23-02-2003 [8]. These requirements can be breathability, fire safety, sound absorption, etc. It is also important that the material retains its resistance during the lifetime.

The insulation material changes its geometric characteristics over time, which leads to a deterioration in its insulating properties [9]. Therefore preferred layered structure of the material which prevents or reduces the penetration of moisture into the material reduces air filtration rate through a layer of insulation, reduces the risk of erosion of the material [8]. And it is often necessary to use materials having high strength characteristics while retaining high performance thermal insulation [10].

Each fence creates resistance transition heat. To achieve a high resistance walling should be done very thick, however, it is not economically

feasible, so reducing the cost of heating the building happens when you use the most beneficial to the energy and economic point of view, the choice of insulating material [11].

## *2. The object*

Issues related to the comparison of thermal insulation materials [12], which insulating materials are most suitable to reach the energy efficiency level and the principle of choice [13], the use of international standards OHSAS [14] have a description in previously published papers .

Increased requirements [15] for thermal protection of buildings [16], according to SNIP 23-02-2003 [8].

Adapt existing materials to modern requirements like mineral wool, expanded polystyrene (EPS) [17], and a summary of the creation of new insulating materials.

Shortness of selecting a suitable type of insulation material , as well as a comparative analysis of the main types of material on the characteristics of the interests of consumers do not have descriptions of previously submitted papers.

## *3. Review of materials*

Analysis of publications on this topic allows us to represent the conclusion of choosing the optimum material for user [18]. The aim of this paper is to provide a simple and understandable for a wide range of consumers the optimal method of comparing the different characteristics of insulating materials [19]. Main tasks in the study are to analyze the thermal insulation materials [20] and structuring the comparison of their characteristics [21].

Consider the main group of thermal insulation materials, their basic properties and characteristics that distinguish them from the other materials [22].

Mineral wool – a fibrous material having a structure made of a wool and a rock melt with the addition of an organic binder component.

- Thermal conductivity – 0,038-0,045 W / (m • K);
- Density (hardness) – 35-160 kg/m<sup>3</sup>;
- Flammability (fire safety) – NF;
- High chemical resistance;
- Good water vapor permeability;
- Good sound insulation.

Polystyrene foam – hard stuff, mostly with cellular structure, obtained by sintering polystyrene beads or one of its copolymers.

- Thermal conductivity – 0.03-0.04 W / (m • K);
- Density (hardness) – 15-40 kg/m<sup>3</sup>;
- Flammability (fire safety) – F4;
- Hygroscopic;
- Low compressive strength.

To solve the problem of comparing types of insulation are invited to combine the main indicators in the table [1], defining it the most common group of materials and compare options. Consumers will be able to simultaneously estimate all the main characteristics of the different groups of materials, to arrange the parameters required for comparison in a prioritized sequence (see Table 1). And to assess the value of construction work (see annex). Then, after selecting the type of material to clarify its specific characteristics in the group.

Table 1

### Comparison of characteristics

Type of material	Features of application	Thermal conductivity, 045 W / (m • K)	Density, kg / m <sup>3</sup>	Fire resistance	Cost, m <sup>3</sup> /rub	Main characteristics
Mineral wool		0,038-0,045	35-160	NF	1500-3000	Compression strength
Polystyrene foam		0.03-0.04	15-40	F4	500-1200	Material cost

The following table [1] greatly facilitates the selection of the most suitable material for the most important criterion for the consumer. Using it, you can objectively weigh the advantages and disadvantages of each of them, it is almost impossible to do, personally addressing the specific numerous manufacturers. After which you can make an estimate table [2-3], which allow to obtain the most accurate cost of installing insulation.

Table 2

**Local cost estimates mineral wool**

№	Base	Name	Units	Num.	Unit cost, rub.				Total cost, rub.
					Altogether	Including			Altogether
						Basic wage	Operation of machines	Mechanic Salary	
1	2	3	4	5	6	7	8	9	10
<b>Section 1. New Section</b>									
1	FUP26-01-039-01	Insulation of roofs and ceilings of the fiber and dry granular materials <i>HP</i> (393,16 rub): 100% from Wage fund (393,16 rub) <i>SP</i> (275,21 rub): 70% from Wage fund (393,16 rub)	1 m3 of insulation	4	1715,66	98,29	50,24		6862,64
2	FUP15-01-062-01	External facing wall surfaces in the horizontal design on the metal frame (with the device) metalsiding steam insulating layer of a film YUTAFOL <i>HP</i> (553,29 rub): 105% from Wage fund (526,94 rub) <i>SP</i> (289,82 rub): 55% from Wage fund (526,94 rub)	100m2 surface facing	0,4	35141,1	1313,4	121,74	3,92	14056,44
Total direct costs for section prices in 2013.									20919,08
Overheads									946,45
Estimated profit									565,03

<b>Results for Section 1 New Section:</b>	
Thermal insulation work	7531,01
Finishing work	14899,55
Total	22430,56
Including:	
Materials	19750,68
Machines and mechanisms	249,66
FUP	920,10
Overheads	946,45
Estimated profit	565,03
<b>Results for Section 1 New Section</b>	<b>22430,56</b>
<b>Estimated total:</b>	
Total direct costs for section prices in 2013.	20919,08
Overheads	946,45
Estimated profit	565,03
<b>Estimated total:</b>	
Thermal insulation work	7531,01
Finishing work	14899,55
Total	22430,56
Including:	
Materials	19750,68
Machines and mechanisms	249,66
FUP	920,10
Overheads	946,45
Estimated profit	565,03
Value-added tax 18%	4037,50
<b>Estimated total:</b>	<b>26468,06</b>

Table 3

## Local cost estimates polystyrene foam

№	a s e	Name	Units	Num.	Unit cost, rub.				Total cost, rub.
					Altogether	Including			Altogether
						Basic wage	Operation of machines	Mechanic Salary	
1	2	3	4	5	6	7	8	9	10
<b>Section 1. New Section</b>									
1	<b>FUP26-01-041-05</b>	Insulation products made from dry foam roofs and ceilings <i>HP (356,08 rub): 100% from FUP (356,08 rub)</i> <i>SP (249,26 rub): 70% from FUP (356,08 rub)</i>	1 m3 of insulation	4	1129,68	89,02	26,37		4518,72
3	<b>FUP15-02-037-01</b>	Device frame with plastering: walls $239,37 = 1\ 851,69 - 0,36 \times 4\ 455,20 - 0,0013 \times 6\ 500,00$ <i>HP (97,36 rub): 105% from FUP (92,72 rub)</i> <i>SP (51 rub): 55% from FUP (92,72 rub)</i>	100 m2 plastered surface	0,4	239,37	229,6	9,8	2,22	95,75
4	<b>FBPM-101-1677</b>	Net non-woven glass cross 4PSS-T-T-300	m2	40	15,89				635,6
2	<b>FUP15-02-019-03</b>	Continuous alignment surfaces (single-layer plaster) of dry mortar thickness up to 10 mm wall <i>HP (208,59 rub): 105% from FUP (198,66 rub)</i> <i>SP (109,26 rub): 55% from FUP (198,66 rub)</i>	100 m2 plastered surface	0,4	2930,92	476,9	27,51	19,78	1172,37



5	FUP15-04-014-03	Painting of facades with forest on the prepared surface: PVA <i>HP (26,54 rub): 105% from FUP (25,28 rub)</i> <i>SP (13,9 rub): 55% from FUP (25,28 rub)</i>	100 m2 of painted surface	0,4	654,62	62,68	4,04	0,53	261,85
6	FUP08-07-001-02	permutation and demolition outdoor forest inventory up to 16 m: tubular for other finishing works <i>HP (183,78 rub): 122% from FUP (150,64 rub)</i> <i>SP (120,51 rub): 80% from FUP (150,64 rub)</i>	100 m2 vertical projection for outdoor	0,4	724,34	375,8	5,28	0,74	289,74
Total direct costs for section prices in 2013.									6974,03
Overheads									872,35
Estimated profit									543,93
<b>Results for Section 1 New Section:</b>									
Thermal insulation work									5124,06
Finishing work									2672,22
Construction of brick and block									594,03
Total									8390,31
Including:									
Materials									6035,83
Machines and mechanisms									124,13
FUP									823,38
Overheads									872,35
Estimated profit									543,93
<b>Results for Section 1 New Section</b>									<b>8390,31</b>
<b>Estimated total:</b>									
Total direct costs for section prices in 2013.									6974,03
Overheads									872,35
Estimated profit									543,93
<b>Estimated total:</b>									
Thermal insulation work									5124,06
Finishing work									2672,22
Construction of brick and block									594,03
Total									8390,31
Including:									
Materials									6035,83
Machines and mechanisms									124,13
FUP									823,38
Overheads									872,35
Estimated profit									543,93
Value-added tax 18 %									1510,26
<b>Estimated total:</b>									<b>9900,57</b>

## 6. Conclusion

1. In result thermal insulation materials, has made methodic, that gives an easy choice of product, with uses of its characteristics.
2. Allows to represent the conclusion of choosing the optimum material for user.
3. That methodic can be easily uses everyone user.

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