**Heat Transfer Problem for Different Densities Layered Gypsum Products in Influences of Fire.**

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**Highlights**

* A mathematical model of heat transfer with specific heat and thermal conductivity coefficients dependence on temperature for a 3-layer environment is offered.
* Modeling of heat transfer process for 3-layer sandwich wall, made of gypsum materials with different densities, in case of fire is done.
* Theoretical model shown good connection with experimental burning results.

**1. Introduction**

The use of gypsum materials in construction is well known. The requirements for lighter materials with good thermal insulation are increasing. This material is foam gypsum, the technology of which makes it possible to obtain a product with a density of less than 200 kgm-3 [1]. Nowadays not only energy efficiency but also demands of better living comfort highly increase sound and fire safety requirements of building components. Lot of construction materials for acoustic and fire safety characteristics are gypsum based which can improved changing properties of the material. Sandwich type gypsum materials with different densities are widely used in construction. The objective of this study is to develop a mathematical model of heat transfer through sandwich type gypsum materials (gypsum board and foam gypsum layer) in fire conditions.

**2. Methods**

The 3-layer sandwich type wall in which the foam gypsum layer is bounded by gypsum boards is considered. It is assumed that the specific heat and thermal conductivity *K* coefficients depends on temperature *T* similarly in [2]. The cubic spline interpolation for and *K(T)* is used. In the case of three layers (N=3) we obtain the system of three PDEs

 (1)

where are thermal diffusion coefficients depending on *T*. For the initial condition for *t=0* are given , where .

Following boundary and continuous conditions are used :

 (2)

where  are the constant mass transfer coefficients, in minutes, .

Conservative averaging method for reduce problem (1)-(2) to an initial problem for system of ODEs [3] is used. The problem (1)-(2) is solved by using MathLab.

**3. Results and discussion**

Experiments were done with a wall of foam gypsum ( ) inside separated by 6.5 mm gypsum boards ( ). The thickness of the foam gypsum layer was 23 and 30 mm. Experimental and theoretical temperature distribution on both sides of wall and inside are shown at fig.1a and fig.2a. ,where the number means the distance to the fire in millimeters. Theoretical temperature distribution in the wall depending on the burning time at one of the edges is shown in the pictures 1b and 2b.

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| **Figure 1a** Temperature distribution in wall with thickness 36 mm. | **Figure 2a** Temperature distribution in wall with thickness 43 mm. |
| **Figure 1b** Theoretical calculated temperature distribution inside wall with thickness 36 mm. | **Figure 2b** Theoretical calculated temperature distribution inside wall with thickness 43 mm. |

**4. Conclusions**

Proposed mathematical model (1)-(2) can be used for more in-depth research of different material layer heat transfer problem. Theoretical model shown good connection with practical experimental burning results.

**References**

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