In December 2002 the European Parliament adopted a Directive 2002/91/EC "On the Energy Performance of Buildings" [1] which states that the major part of the residential and tertiary sector buildings accounts for more than 40% of the final energy consumption in the Community and is expanding. So, the goals was and is to bound the increasing of the energy consumption and hence also its carbon dioxide emissions. Subsequently, the necessary measures were adopted in the member states of European Community. For example, in 2005, in Slovakia the law No. 555/2005 was adopted regarding to the "Energy Performance of Buildings".

From this practical viewpoint, a search for new knowledge in the area of heat transfer through porous materials should be collected and developed although in the past much knowledge has been gained as well.

In this report we included investigations that were performed by co-authors from the Joint Institute for Nuclear Research and the University of Prešov in Prešov, Slovakia, during the period from 1st November 2009 to 1st November 2011.

In the paper [2] the main goals of the concept of the energy performance of buildings and the energy building certification as a means for energy saving are given. The models of heat and moisture transfer are given which runs, for example, that the energy loss in the moist material are higher than in the dry one which may affect an incorrect energy classification of a building.

A numerical research of the suggested phenomenological model of heat and moisture transfer in a porous material is performed in [3]. The model is described by a system of equations of four unknown functions – the water concentration \( w_l \), water vapor concentration \( w_v \), temperature \( T \) and source \( I \) as functions of the space variable \( x \) and time variable \( t \). Different cases of initial and boundary conditions are considered that correspond drying of a wet sample or wetting of a dry sample. Calculation results show that during the drying process of a wet sample the temperature of the sample decreases under an initial, room temperature and during the wetting process of a dry sample.

An energy building certification as a means for energy saving is described in [4]. The models of heat and moisture transfer are presented. The models run that the energy classification of a building may be affected by the incorrect identification of energy loss in the moist material because this energy loss is higher than in the dry material. Dry material properties are usually and incorrectly used in engineering calculations during the building energy classification.

The spa buildings are largely loaded by moisture because they operate with equipment that produce a high content of moisture. In these objects the moisture causes formation of molds and a higher energy loss as well. In the article [5] a numerical method for calculation of moisture quantity in the building materials is suggested. The method is based on the recently developed mathematical model of heat and moisture transfer in a porous space. The moisture quantity (water and water vapor) is determined as a sum of values of corresponding integrals.

A model for description of the heat and moisture transfer in a porous material is proposed in [6]. The density of saturated vapor and the transfer coefficients of liquid and vapor moisteres depend on the temperature. At the same time, the conductivity coefficient of the porous material depends on moisture. On the basis of the proposed model, a numerical simulation of the heat and moisture transfer for a drying process has been performed.

An exact solution of a linear system of moisture transfer with phase transition is found in [7]. The system consists of three equations. The first equation is a diffusion equation for liquid moisture concentration \( w_l \); the second one is a diffusion equation for saturated vapor concentration \( w_v \). Both equations are tied with the rate \( I \) of change of moisture concentration that arises in the pores due to the evaporation or condensation. The third equation is algebraic and describes two complementary parts of the pores volume: the part where the liquid moisture is present and the part where saturated vapor is present. The system is solved by means of the variables separation method. The same problem with different boundary conditions is solved in [8].

References


