Description of the project for the general public

Building materials are exposed to various atmospheric conditions, which may support moisture condensation and accumulation. Excess moisture is inadvisable, due to degradation of mechanical and thermal properties as well as hazard of the growth of microorganisms. Experimental and theoretical research has been conducted over the years to understand better, not only microstructure of the materials, but also mechanisms of moisture transport. As a result of scientists' effort, simplified heat and moisture transport models were formulated. High complexity of physical phenomena, wide range of analysed scale, multiphase and multicomponent issue led to many simplifications. The structure of typical building material, saturated by water, is presented at figure 1. Also, heat and mass transfer phenomena were marked for clarification of the described process.

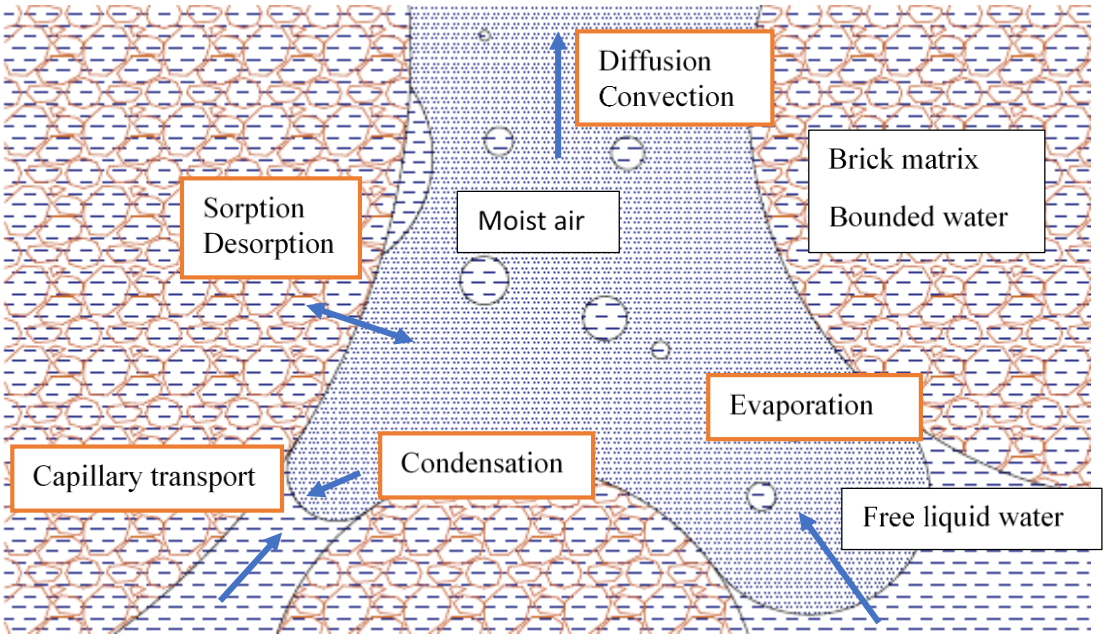

Figure 1. Scheme of moist building material with mass transfer phenomena

The complexity of the analysed issue is rising in building material with biocomponents. Literature remarked that traditional heat and moisture model are inaccurate for novel bio-based materials. Most of the models, presented in literature, are based on two fundamental assumptions. The first one is equilibrium between water and vapour, in other words the evaporation or condensation inside the pores has an infinite speed. This assumption allows to speed up the implementation and computation time and omit the problem of the modelling of moisture phase change phenomena. Moreover, research concluded in the literature indicated an inappropriate usage of equilibrium model in bio-based building materials. The second assumption is a neglected impact of air transport inside the pores. In the project new numerical model will develop, which will take under consideration finite rate of evaporation, as well as, air transport inside the material. Other transport mechanisms, i.e. liquid water capillary transport, vapour diffusion and convection, heat conduction and convection, also will be taken under consideration. The experimental stand will be built for model validation (assessment of model accuracy). Measurements will be carried out for conventional and bio-based building materials. The final part of the project will be an analysis of the evaporation and condensation models. Various phases change kinetics, e.g. linear, parabolic, will be tested and analysed in case of new bio-based materials. The investigation of the kinetics of phase change will relate to experimental measurements on the stand and study of material's microstructure, i.e. pore size and concentration of biocomponents. The results obtained in the project allows to apply heat, air and moisture transport model to wide range of materials and testing conditions. The model may help architects in designing process and producers to improve the hygro-thermal properties of the material, especially bio-based materials.