

The project “Development and Validation of a Numerical Model Based on Lattice Boltzmann Method (LBM) for Predicting Transport Properties of Thermochemical Composite Materials” investigates how heat and moisture move through advanced porous materials that undergo chemical reactions. These materials, with sponge-like internal structures, play a key role in energy technologies such as thermal energy storage.

A computational model based on the Lattice Boltzmann Method (LBM) is being developed to simulate the movement of heat and moisture inside these complex structures, including interactions driven by chemical processes. Initial testing of the model will involve simple examples, with gradual extension to more complex and realistic cases. The model will also calculate important physical properties, such as thermal conductivity, mass diffusivity, and permeability.

To verify the accuracy of the model, experimental validation will be conducted using specially prepared material samples—starting with calcium chloride combined with expanded clay. These samples will be examined using high-resolution imaging tools such as scanning electron microscopy (SEM) and micro-computed tomography (micro-CT). Thermal conductivity will be measured using methods like laser flash analysis (LFA) and differential scanning calorimetry (DSC), with other properties included when possible. The results will support calibration of the model and assessment of its reliability.

The final stage of the project involves exploring how the internal structure of the materials affects their performance. By simulating different pore sizes and chemical compositions, the analysis will identify which features most influence efficiency and guide the design of improved materials for future applications.

By combining digital modeling, real-world testing, and material design, this research aims to enhance the understanding and development of high-performance materials for thermal energy storage.