Porous media, formed by spherical packed beds, are presented as continuum media with equivalent hydrodynamic characteristics for the purpose of hydrodynamic and thermal calculation. Equivalent characteristics are presented by solid phase thermophysical properties, packed bed porosity and liquid phase thermophysical properties. Theoretical and experimental approaches can be used to define those parameters. The results of numerical modelling of flow and heat exchange in regular spherical packing are presented. Thermal and hydraulic characteristics with account for real thermophysical properties (including chemical reactions of dissociation and recombination on the packed bed surface) are determined. The data can be used while calculating flow and heat exchange in spherical particles porous media. The results are obtained based on elementary cell separation. Flow in elementary cell is simulated, then results are averaged and transition to continuum media properties is performed. Hydrodynamic flow pattern in porous media is obtained, then heating and cooling of spherical beds of regular geometrical packing is calculated. It is determined that in turbulent region accounting of real thermophysical properties results in 10% increase of heat transfer coefficient if compared with experimental data. It is shown that hydraulic resistant coefficient is decreased at 15% due to molecular viscosity increasing in high temperature region.