



NUMERICAL MODELS OF WOOD PELLET SHRINKING ON PYROLYSIS

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ABSTRACT

The shrinkage of the wood pellet impacts the pyrolysis in several ways. The properties as porosity, permeability, density, mass diffusivity, specific heat capacity, thermal conductivity, the total volume of the particle changes continuously. The density of the char increases during pyrolysis due to the chemical restructuring process. The temperature profile of the particle changes too. Therefore, an explicit understanding of the transport mechanisms and chemical processes of impact in wood pellet shrinking is needed. Researchers analyze the wood pellets shrinking on pyrolysis using a kinetic model coupled with heat transfer model. The numerical models are used to study the impact of shrinkage on particle size, volume, pyrolysis time, product yields and specific heat capacity. These numerical models are validated with experimental results later.

In this paper shrinkage models of wood pellet are discussed. The simplest model is one-dimensional (1D) using constant properties and considering bare minimum processes. The shape of wood pellet is mostly chosen in spherical for 1D model. Three models are formulated for dry wood pellets. Other models for wet pellets are presented too. More complex model is two-dimensional formulated in cylindrical coordinates and used to predict the progress of conversion in a cylindrical wood particle undergoing pyrolysis. Some models are used for single wood particle reactor with low heating-rate. Several researchers suggested model for pyrolysis in packed bed, others formulated for pyrolysis in a fluidized bed. Shrinking effect is included in these models. The most complex model are in 3D, considering all the conceivable processes like heat-up, heat generation, internal heat convection, gas and liquid diffusion, shrinkage, primary fragmentation, drying, condensation, secondary reactions.

All mentioned models shows the influence of anisotropy on the product yield and conversion time. Differences between numerical models are presented in this work.

Keywords: shrinkage, wood pellet, pyrolysis, numerical model