As the need for both sustainable energy production and waste minimization increases, the gasification of biomass becomes an increasingly important process. What would otherwise be considered waste can now be used as fuel, and the benefits of volume reduction through gasification are seen in the increased lifespan of landfills. Fluidized-bed gasification is a particularly robust technology, and allows for the conversion of most types of waste biomass.

Within a fluidized-bed gasifier, thermal medium (sand) is heated to operating temperature (around 1350°F) and begins to fluidize due to the rapid expansion of air entering the bottom of the reactor. This fluidization allows for excellent heat transfer and contact between gases and solids, and prevents localized “hot spots” within the gasifier, thereby reducing the occurrence of ash agglomeration within the gasifier. Solids enter the middle of the gasifier and are rapidly dried and devolatilized, and the products of this step are subsequently oxidized and then reduced in the remainder of the gasifier. A syngas composed mainly of N2, H2O, CO2, CO, CH4 and H2 exits the top of the gasifier.

A computer model was developed to predict the syngas composition and flow rate, as well as ash composition and mass flow rate from a fluidized-bed gasifier. A review of the literature was performed to determine the most appropriate modeling approach. A chemical kinetic model was chosen, and developed in MATLAB using the Newton-Raphson method to solve sets of 18 simultaneous equations. These equations account for mass and energy balances throughout the gasifier. The chemical kinetic rate expressions for these reactions were sourced from the literature, and some values modified to better fit the predicted gas composition to literature data.