Thermal decomposition of double-base propellants in a bubbling fluidized bed reactor

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Mathematical modelling of the thermal decomposition of double-base propellants has long been in use for the prediction of burning rates, temperature, and species concentration. However, most of the existing models are unidimensional and have been applied without proper consideration of hydrodynamics in the process. In this work, a multi-dimensional model has been developed from first principles for the combustion of JPN with a composition of 51% nitrocellulose (NC), 43% nitroglycerine (NG), 3% diethyl phthalate (DEP) and 1% ethyl centralite (EC) in a fluidized bed. The governing equations in multiphase flows were closed by the kinetic theory of granular flows and solved by a finite volume computational fluid dynamics (CFD) approach. Global reaction mechanisms for the condensed and gas phases were modelled and introduced into the solver by user defined functions (UDF) to predict operating conditions in the reactor.

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