Kinetic and fuel property effects on forward smoldering

G. Rein Soto-Yarritu; J. L. Ellzey; J.L. Torero; O.A. Ezekoye; S.V. Leach

Abstract-

In this paper, we present the results from a one-dimensional transient model of forward smoldering. Fuel oxidation and pyrolysis reactions as well as a char oxidation reaction are included in the model. The solid energy, solid species, gas energy, oxygen species (bulk gas and surface) and overall mass concentration equations were discretized in space using finite difference techniques and were solved using DVODE, an ordinary differential equation integrator designed for stiff equations. Local thermal and chemical non-equilibrum are allowed in this model and transfer coefficients are derived from a Nusselt number correlation. A base case is chosen to match and represent experimental conditions reported in literature. The effects of the inlet gas velocity, kinetic frequency factors, inlet oxygen concentration and fuel properties such as specific heat, density, conductivity and pore diameter were studied using this model.

Index Terms- Combustion, smoldering, model