A robust two-dimensional model for the pyrolysis of plastic waste driven by self-sustaining smoldering

Ruming Pan [a], Gérald Debenest [a], Marco A.B. Zanoni [b,c]*

[a] Institut de Mécanique des Fluides de Toulouse (IMFT) - Université de Toulouse, CNRS-INPT-UPS, Toulouse 31400, France

[b] Department of Civil and Environmental Engineering, University of Western Ontario, London, Ontario N6A 5B9, Canada

[c] Construction Research Centre, National Research Council Canada, Ottawa, Ontario, Canada

* Corresponding Author at: Department of Civil and Environmental Engineering, The University of Western Ontario, Claudette Mackay-Lassonde Pavilion, Rm. 1317, London, Ontario, Canada N6A 5B9. E-mail address: mbazelat@uwo.ca (M.A.B. Zanoni).

A.1.Kinetic parameters

Table A.1. Kinetic parameters of char smoldering and PW pyrolysis.

Par.	Value	Unit
A_C	707.9	s^{-1}
E_C	68	$kJ \cdot mol^{-1}$
ΔH_C	-30.82×10^{3}	$kJ \cdot kg^{-1}$
A_{PW}	1.12×10^{22}	s^{-1}
E_{PW}	346.8	$kJ \cdot mol^{-1}$
ΔH_{PW}	323	$kJ \cdot kg^{-1}$
A_{L-}	9.49×10^{-3}	s^{-1}
E_{L-}	0.372	$kJ \cdot mol^{-1}$
ΔH_{L-}	-42	$kJ \cdot kg^{-1}$
A_G	8.10×10^{-1}	s^{-1}
E_G	18.2	$kJ \cdot mol^{-1}$
ΔH_G	-42	$kJ \cdot kg^{-1}$

A.1.Effect of char concentration

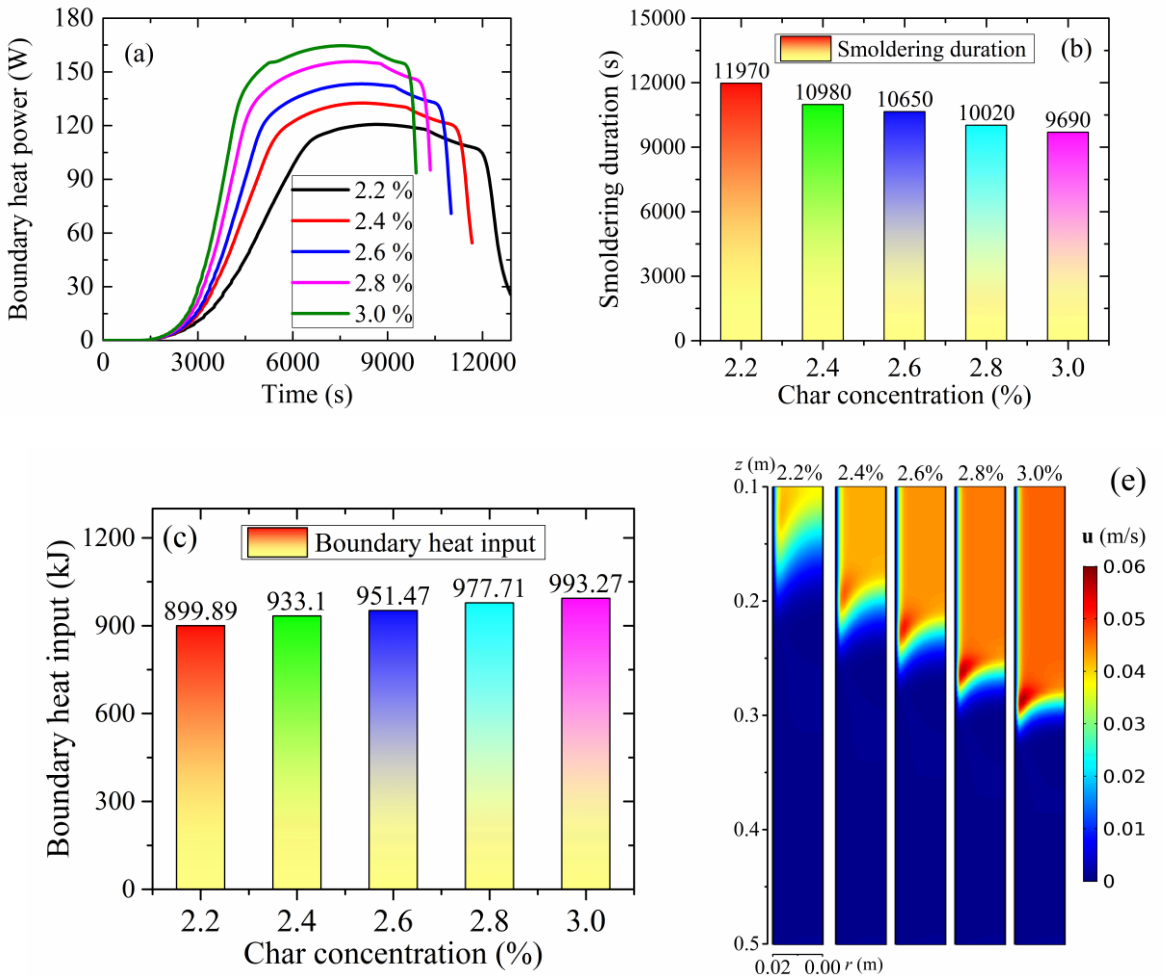


Fig. A.1. Effect of char concentration on (a) the boundary heat power, (b) the smoldering duration, (c) the boundary heat input into the pyrolysis chamber, and (d) the velocity at *t*=7200 s in the pyrolysis chamber.

A.2.Effect of Darcy air velocity

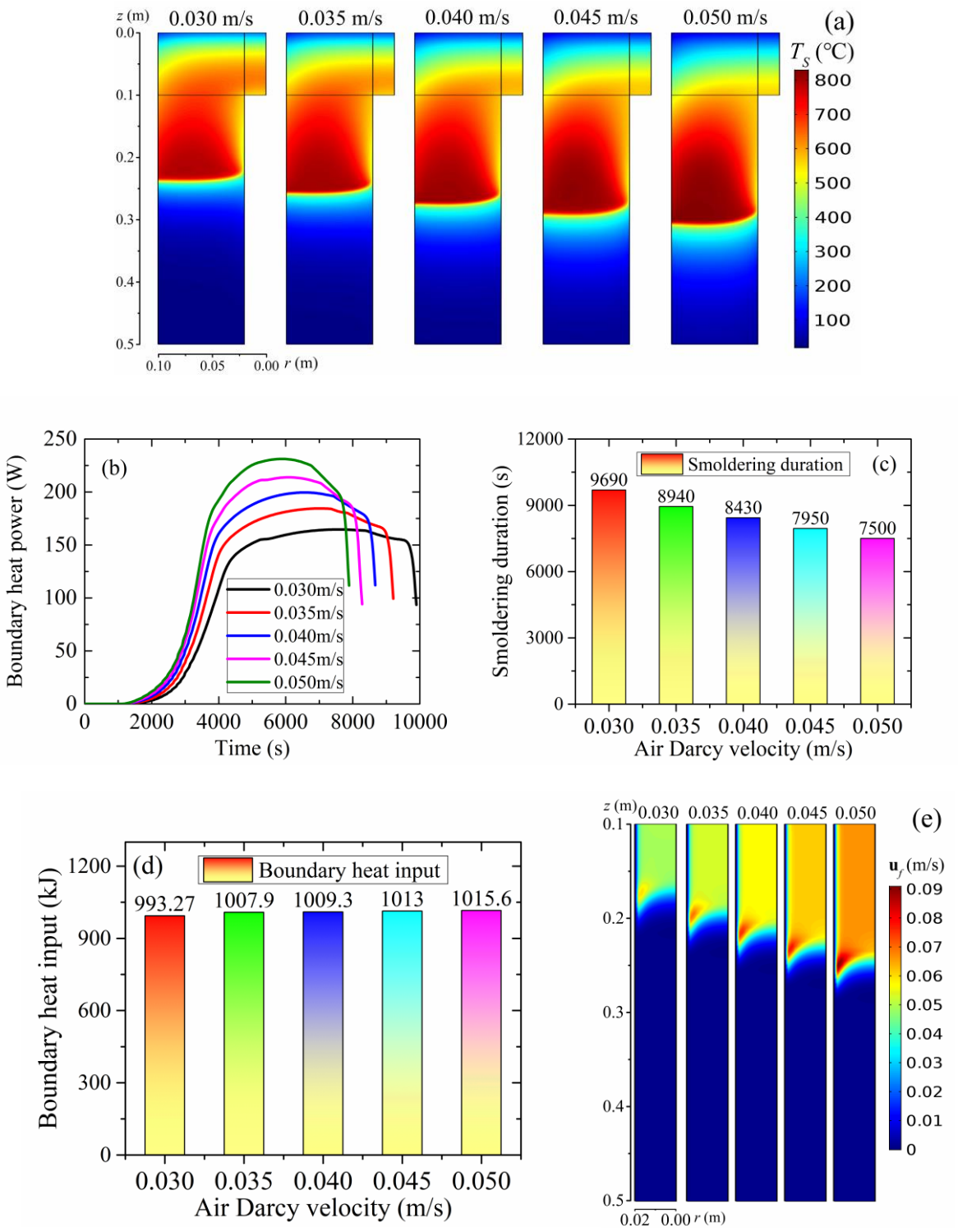


Fig. A.2. Effect of Darcy air velocity on (a) the T_S distribution at t=5400 s in the smoldering chamber, (b) the boundary heat power, (c) the smoldering duration, (d) the boundary heat input into the pyrolysis chamber, and (e) the velocity at t=5400 s in the pyrolysis chamber.

A.3.Effect of PW content

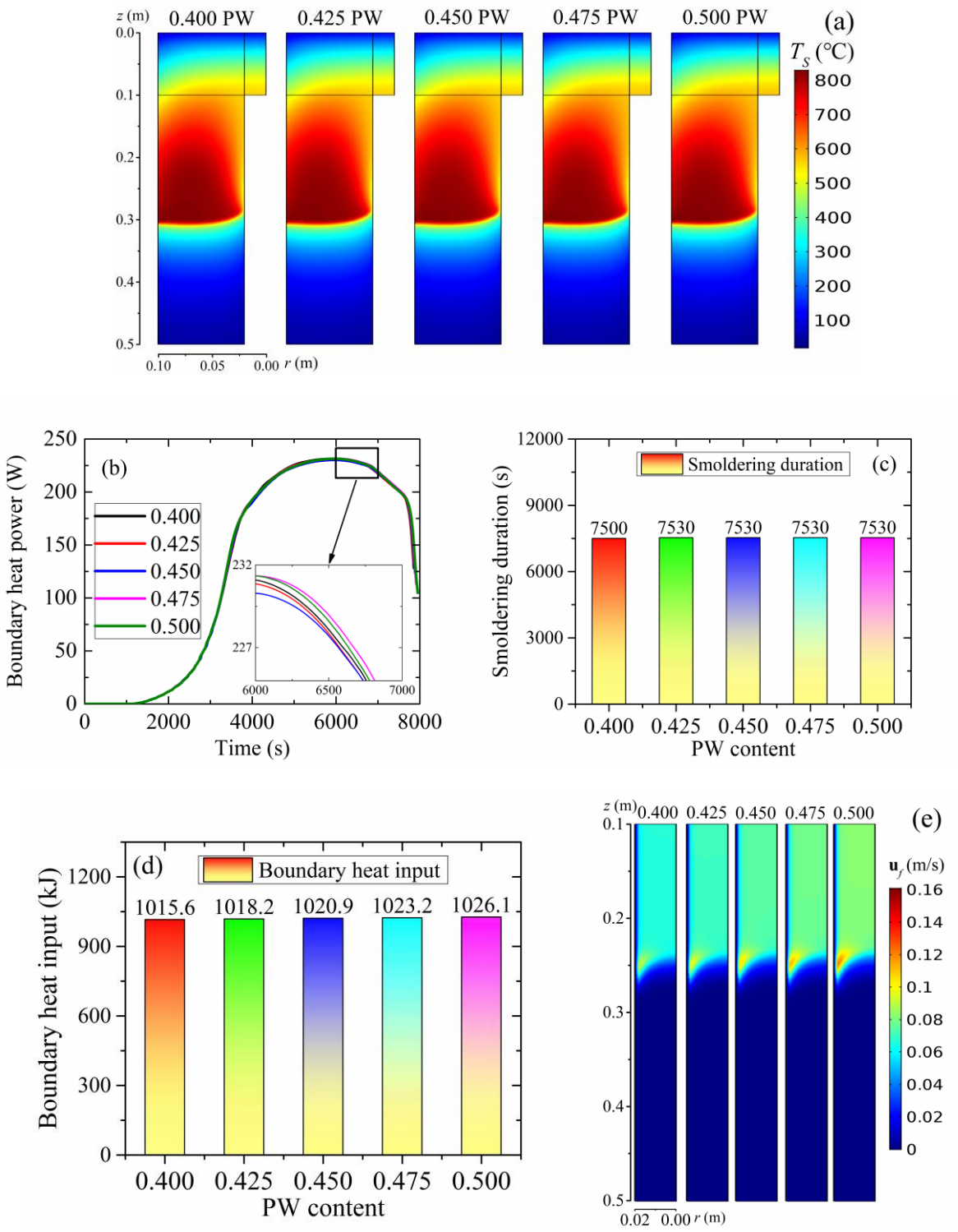
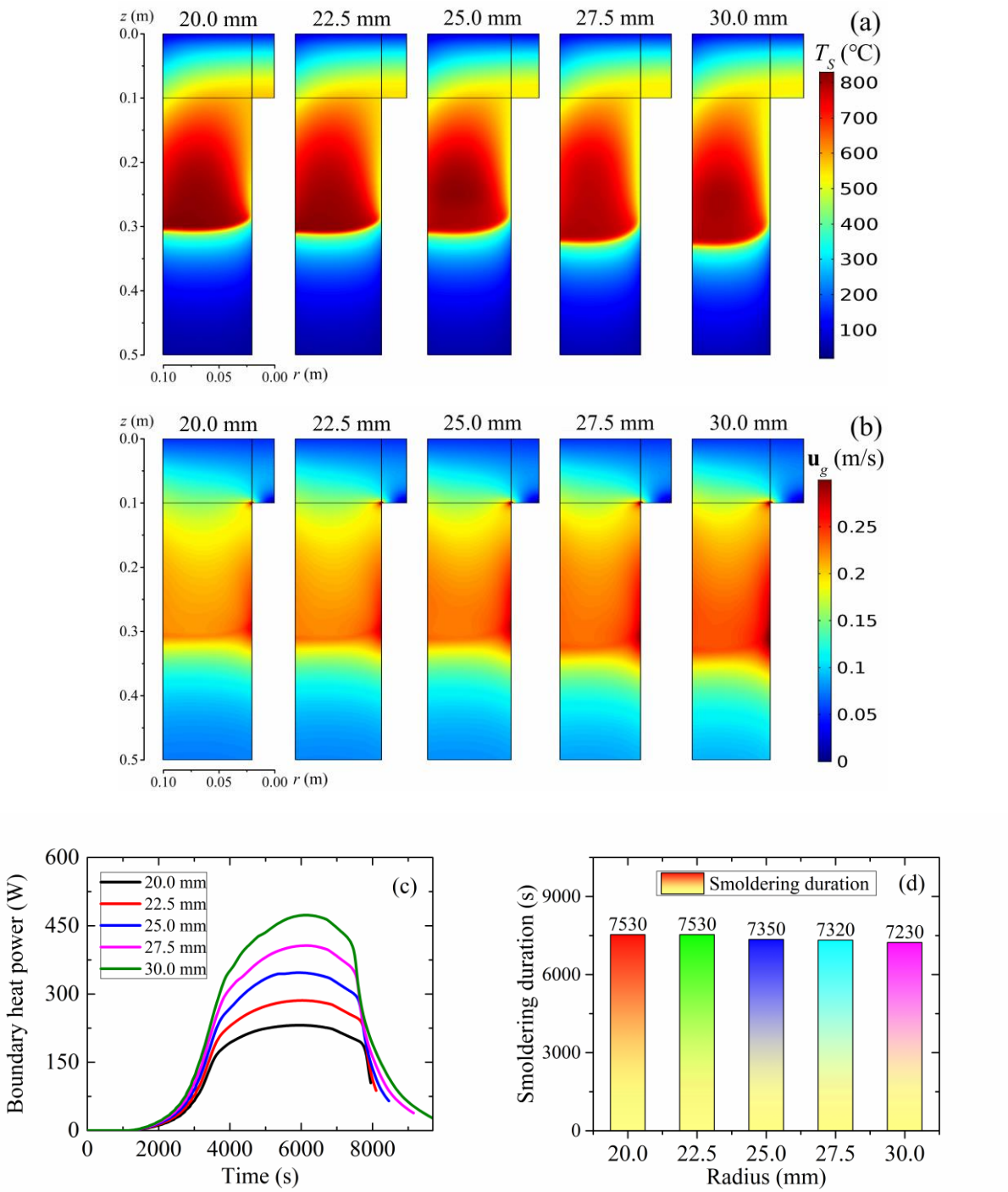


Fig. A.3. Effect of PW content on (a) the T_S distribution at t=5400 s in the smoldering chamber, (b) the boundary heat power, (c) the smoldering duration, (d) the boundary heat input into the pyrolysis chamber, and (e) the velocity at t=5400 s in the pyrolysis chamber.

A.4.Effect of pyrolysis chamber's radius



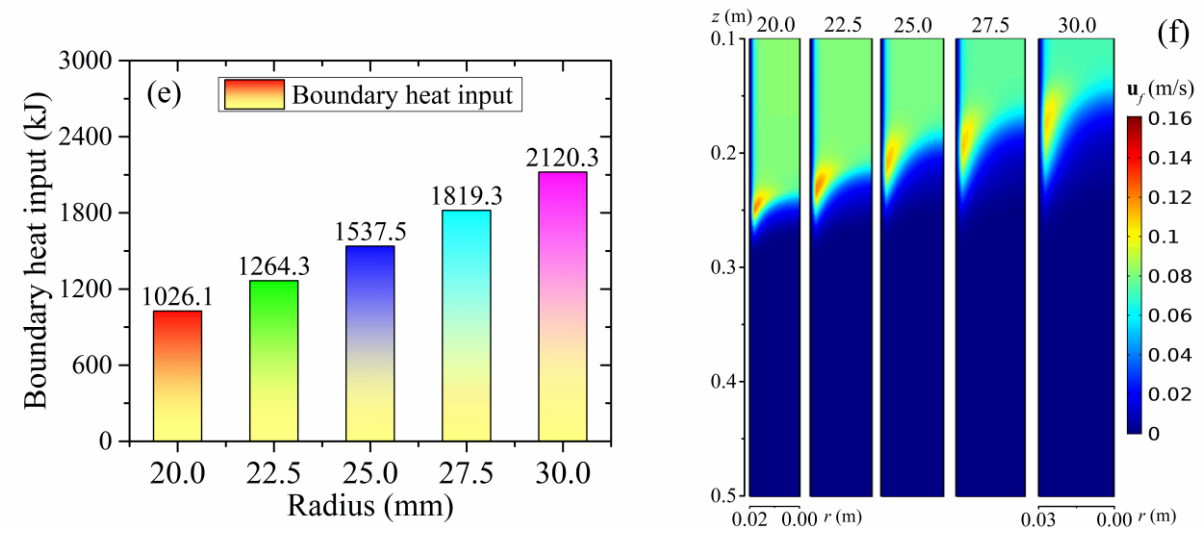


Fig. A.4. Effect of pyrolysis chamber's radius on (a) the T_S distribution at t=5400 s in the smoldering chamber, (b) the $\mathbf{u}_g$ distribution at t=5400 s in the smoldering chamber, (c) the boundary heat power, (d) the smoldering duration, (e) the boundary heat input into the pyrolysis chamber, and (f) the velocity at t=5400 s in the pyrolysis chamber.