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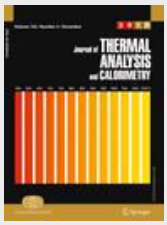

Characterization of the thermal degradation and heat of combustion of *Pinus halepensis* needles treated with ammonium-polyphosphate-based retardants

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摘要

Abstract The thermal degradation behavior of *P. halepensis* needles treated with two ammonium-polyphosphate-based commercial retardants was studied using thermal analysis (DTG) under nitrogen atmosphere. Moreover, for the same experimental material, the heat of combustion of the volatiles was estimated based on the difference between the heat of combustion of the fuel and the heat contribution of the charred residue left after pyrolysis. The heat of combustion of the volatiles was exponentially related to the retardant concentration of the samples. In the range of retardant concentrations from 10 to 20% w/w the mean reduction percentage of the heat of combustion of the volatiles, with respect to untreated samples, was 18%.

Keywords

Bomb calorimeter, Char, Forest fires, Heat of combustion, Long-term retardants, Thermal analysis, Volatiles

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Keywords Bomb calorimeter · Char · Forest fires · Heat of combustion · Long-term retardants · Thermal analysis · Volatiles

List of symbols

APP	Ammonium polyphosphate
DTG	Differential thermogravimetry
DR	DTG peak decomposition rate (10^3 s^{-1})
EHC	Effective heat of combustion (MJ kg^{-1} fuel consumed)
FT1	Fire-Trol 931
FT4	Fire-Trol 934
HC	Heat of combustion (MJ kg^{-1})
HHC	High heat of combustion (MJ kg^{-1})
HY	Heat yield (MJ kg^{-1})
$(\Delta h_c/r_O)$	Heat of combustion released per kg of oxygen consumed (13.1 MJ kg^{-1})
$\Delta h_{dsrp\ H_2O}$	Heat of desorption of bound water in the fuel (MJ kg^{-1})
$\Delta h_{v\ H_2O}$	Latent heat of vaporization of water at 100 °C (MJ kg^{-1})
LHC	Low heat of combustion (MJ kg^{-1})
$\dot{m}_{O_2,\infty}$	Oxygen mass flow at ambient conditions (kg s^{-1})
$\dot{m}_{O_2}$	Instaneous oxygen mass flow (kg s^{-1})
PH	*Pinus halepensis*
$\dot{q}$	Heat rate (kW)
$\dot{Q}_{inc}$	Heat loss due to incomplete combustion (MJ kg^{-1})
$\dot{Q}_{rad}$	Heat loss due to radiation losses (MJ kg^{-1})
R_{550}	Percentage of residual mass at 550 °C to initial mass at 150 °C (% w/w)
PT	DTG peak temperature (°C)
X_c	Char yield (% w/w)
X_H	Percentage of hydrogen (% w/w)
X_r	Retardant concentration (% w/w)
X_w	Moisture content on a dry basis (% w/w)

Subscripts/superscripts

c	Charred residue
f	Fuel
r	Retardant
vol	Volatiles
1, 2, 3	Peak number in DTG graphs

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