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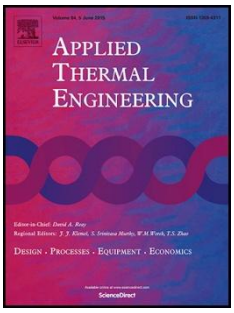

Title: A computational model for a rocket mass heater

Author: Mark Schumack

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A computational model for a rocket mass heater

Mark Schumack
University of Detroit Mercy
Mechanical Engineering Department
4001 W. McNichols
Detroit, MI 48221
schumamr@udmercy.edu

Highlights

- A simple one dimensional transient model of a rocket mass heater is presented.
- Heat transfer and fluid friction through important geometric features are considered.
- Introducing a system damper and increasing duct length can improve efficiency.
- Low chimney height and small barrel clearances can threaten heater performance.

Abstract

A simple one dimensional pseudo-steady computational model of a rocket mass heater is presented. A rocket mass heater is a space heating device that utilizes an insulated "J-tube" to promote complete combustion of burning wood, a steel barrel to act as a heat radiator, and a thermal mass usually shaped into a bench that stores heat from the exhaust before the combustion gases are released to the atmosphere. The gas model is based on fundamental relationships for steady compressible flow through one-dimensional geometry, and is coupled to an unsteady finite difference model for two dimensional heat conduction in the thermal mass, which is modeled as a hollow cylinder. The model accounts for detailed heat transfer effects and fluid frictional losses, and is able to predict efficiency, flow rate, and spatial variations in temperature and pressure as functions of key parameters such as burn rate, thermal mass volume and length, duct routing details, and chimney height. Key results demonstrate how insufficient chimney height and narrow barrel clearances can threaten heater performance, how a system damper and increasing duct length can improve heater efficiency, and that axial temperature variation in the mass is small compared to radial gradients.

Keywords: Rocket mass heater, masonry heater, rocket stove, biomass stove, thermal modeling

1. Introduction

Over the last decade, rocket mass heaters (RMHs) have gained in popularity as space heating alternatives for those interested in sustainable home design, natural building, or off-grid living. These custom built units consist of an insulated burn chamber, tunnel, and heat riser (together called the "J-tube") covered by a steel barrel, followed by a long exhaust duct – sometimes up to 10 m long – embedded in a thermal mass leading to a chimney which exhausts the combustion gases to the outdoors. The adiabatic J-tube is