

# Characterization of Candle Flames

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**ABSTRACT:** Common household open flame and radiant ignition sources are the actual or suspected cause for many fires. The purpose of this research is to identify the burning behavior and properties of common candles in order to provide additional tools for use by fire investigators. The properties of paraffin wax are obtained from the literature and from experiments. The candles are burned under controlled laboratory conditions to measure the mass burning rate, candle regression rate, flame height, and heat flux. Using the properties of paraffin wax and characteristics of the candles, numerous simulations are performed with the NIST Fire Dynamics Simulator (FDS) to model the burning rate and heat flux profile of the candle flame. The modeling results are then compared with the flame height and heat flux data obtained experimentally. The model facilitates an enhanced understanding of the structure of candle flames.

**KEY WORDS:** arson, candles, fire model, flames, ignition, paraffin, wax.

## INTRODUCTION

**T**HE USE OF candles in the US has been increasing annually since the early 1990s. According to the National Candle Association (NCA), candles are used in 7 out of 10 homes, and retail candle sales exceed approximately \$2.3 billion annually with a growth rate exceeding 15% [1]. The increased use of candles has resulted in a corresponding increase in the number of candle-related fires. In 1998, the US Consumer Product Safety

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