FIRE SPREAD AS A MOVING BOUNDARY

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1. INTRODUCTION

Attempts to model fire spread go back at least as far as Fons [1]. Most of the models (see Weber [2] for a review) consider only the heat transfer and hence can be classified as Stefan-type models of fire spread. However, following the "combustion theory" approach (e.g. Williams [3]) one can formulate a fire spread model which considers chemical kinetic effects as well as heat transfer.

The two types of fire spread models will be compared using examples and by refering to experimental observations. Including chemical kinetics offers several advantages; in particular the potential to predict extinction phenomena. However, it is difficult to justify favouring one type of model over the other because of the many parameters in each type of model which can only be roughly estimated. Combined experimental and theoretical work is required to test either type of model.

2. STEFAN FORMULATION

Cekirge [4], Fujii *et al* [5] and Pagni [6] have all proposed a formulation of fire spreading which is mathematically similar to an ablation problem (e.g. Crank [7]). The simplest version of this is

$$\rho c u_t = k u_{xx}, \quad s(t) < x < \infty, \; t > 0 \tag{1}$$

$$u(x \to \infty, t) = u_a \tag{2}$$

$$u(x = s(t), t) = u_i \tag{4}$$

$$\rho L \frac{ds}{dt} = k \frac{\partial u}{\partial x}\bigg|_{x=s(t)} + Q \tag{4}$$

The heat input at the boundary between burnt and unburnt matter, Q, drives the fire