MICROGRAVITY SCIENCES AND PROCESSES SYMPOSIUM (A2)
Fluid and Materials Sciences (2)

Author: Prof. Nickolay N. Smirnov
Lomonosov Moscow State University, Russian Federation, ebifsun1@mech.math.msu.su

Ms. Veronika Tyurenkova
Scientific research Institute for System Studies, Russian Academy of Sciences (RAS), Russian Federation, turenkova.v.v@rambler.ru
Ms. Maria Smirnova
Lomonosov Moscow State University, Russian Federation, wonrims@inbox.ru

LAMINAR DIFFUSION FLAME PROPAGATION OVER THERMALLY DESTRUCTING MATERIAL

Abstract

N.N. Smirnov, V.V.Tyurenkova, M.N.Smirnova

Scientific Research Institute for System Analysis of Russian Academy of Sciences, Moscow 117218, Russia b M.V.Lomonosov Moscow State University, Leninskie Gory, 1,Moscow 119992, Russia c Saint Petersburg State Polytechnical University, 29 Politechnicheskaya Str., St.Petersburg 195251, Russia

The problem of condensed material surface burning in a flow of oxidant in weightlessness is regarded theoretically. The influence of buoyancy on flames is so intrinsic to our experience that it is difficult to predict how fires will behave in low gravity. Typical hydrocarbon flame temperatures cause a seven-fold reduction in the density which drives the familiar buoyant flow. Fire is a catastrophic hazard for spaceflight and the spread and growth of a fire, combined with its interactions with the vehicle cannot be expected to scale linearly. In fact, every occupied structure on Earth has been the subject of full scale fire testing whereas such testing has never occurred in space owing to the complexity, cost, risk and absence of a safe location. Thus, there is a gap in knowledge of fire behavior in spacecraft. In the present paper theoretical solution for the problem of surface fire spread is provided. Temperature and velocity profiles above condensed material are determined theoretically within the frame of boundary layer approximation under the assumption of fuel gasification and gas phase chemical reacting in a diffusion flame. Counter flow flame spread velocity is developed based on the concept of thermally thin fuel layer.