Flame Development in Pulverised Biomass.

David J.F. Slatter, Muhammad Azam Saeed, Gordon E. Andrews, Herodotos N. Phylaktou & Bernard M. Gibbs.

Energy Research Institute, University of Leeds.

Leeds, West Yorkshire, UK

Abstracts

Pulverised biomass is a significant source of carbon neutral renewable electricity and hence plays an important role in carbon reduction strategies. Pulverised biomass is burned either co-fired with coal or increasingly in the UK as 100% pulverised biomass, due to fiscal incentives to do so. The particle size fed to the burners is relatively coarse with a low proportion <75µm and most being in the 75 - 1000 µm size range. There is little information on the flame propagation in clouds of coarsely pulverised biomass or on the explosion risk for fine or coarse biomass particles and this work presents some results relevant to both areas, using the Hartmann dust explosion tube with high speed photography. The equipment was fitted with a vertical line of three thermocouples (top 3 red lines) to detect the flame arrival and determine the mean flame speed as a measure of the mixture reactivity. A second reactivity parameter was the initial rate of pressure rise prior to the vent bursting at the end of the tube. Lycopodium, and oak were investigated. Lycopodium powder is a pollen biomass that is ultra-fine. Oak sawdust was investigated for a fine ≤63µm fraction and for coarser fractions. The lycopodium flame propagation is shown in Fig. 1. Similar results were obtained for oak milled to <63µm.

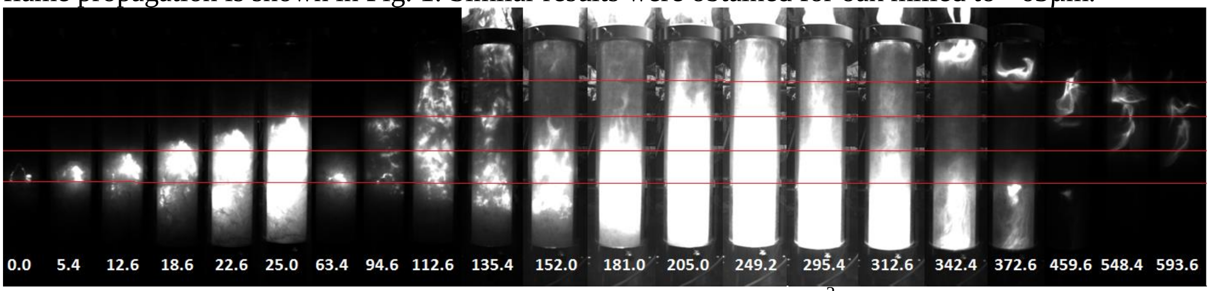

Figure 1 Example of Lycopodium powder flame propagation (375g/m^3, Ø= 3.07).

In rich mixtures 3 stages of flame propagation were observed. The flame speeds before the vent burst for the two materials were 3.5 m/s for lycopodium and 3.0 m/s for oak ≤63µm. Once the vent burst the flame exited the top of the Hartmann tube and then air entered the tube as the products of the first flame propagation cooled down causing a partial vacuum that drew air into the tube. As the initial mixture was rich there was fuel left in the tube that caused a second flame in the tube. This flame was slightly faster than the first flame at 3.8 m/s. For coarser oak dusts the flame development was more fragmented and propagated more slowly, but there was still a clear explosion risk.

Correspondence to: pm06djfs@leeds.ac.uk