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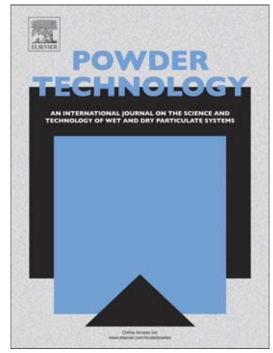

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Effects of Particle Size Distributions on PMMA Dust Flame Propagation Behaviors

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Abstract: Experiments of polymethyl methacrylate (PMMA) dust clouds with same Sauter diameters were conducted to reveal the effects of particles size distributions on PMMA dust flame propagation behaviors. High-speed photography was used to capture the flame propagation behaviors and microstructures. The results showed that the combustion behaviors of PMMA dust clouds with different mass fractions of 100 nm, 5 μm and 30 μm PMMA dust particles were complicated. The macroscopical developments of the flames were determined by the major mass proportion dust particles. The flame front became smoother and the average pulsating flame propagation velocity was faster with more proportion of smaller PMMA dust particles. The flame temperatures were detected by a fine thermocouple comprising 25μm-diameter Pt-Pt/Rh13% wires. It was found that the faster the flame propagated, the higher maximum flame temperature was. The maximum temperatures of mixture B and E dust clouds could maintain longer time due to the larger mass fractions of smaller particles. The thermal conversion processes of mixture A- E dust clouds were dominated by the external heat transfer sources, including radiation from burned region and heat convection between particles and gases. And pyrolysis/devolatilization controlled the overall mixture B- E dust clouds combustion processes. Flames of mixtures were coupled with the premixed gas flame of the smaller particles, the diffusion flame of the agglomerates accompanying local premixed flame around split agglomerates, and the diffusion flame accompanying local premixed flame in high pyrolyzates concentration areas of larger particles. The combustion mechanism was determined by the dominant mass fraction dust

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