FIRE SUPPRESSION BY BICARBONATE POWDERS: THE INFLUENCE OF PARTICLE SIZE

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The objective of this project is to investigate the properties of powders and droplets which lead to effective fire suppression. The effect particle size has on the fire extinction effectiveness of sodium bicarbonate and potassium bicarbonate powders has been recently examined.

Five different sieved powder samples for each compound were investigated: <38, 38-45, 45-53, 53-63, and 63-75 microns. Experiments were carried out in propane/air counterflow diffusion flames performed in an opposed flow burner. The burner consisted of two tubes: powder was delivered to the flame in the air flow through the top tube, propane was in the lower tube. Several powder delivery designs were investigated. The system which worked best for delivering the powder sizes studied consisted of a variable orifice for gross adjustment of the delivery rate and a variable frequency vibration unit to accomplish fine adjustment and to maintain powder flow. Light scattering (90°), using a chopped HeNe laser beam and a lock-in amplifier, was used to monitor the amount of powder exiting the air tube and entering the flame. Calibration of the relationship between the scattering signal and the quantity of the powder being delivered to the flame was determined by collecting and weighing the powder as it exited the air tube in the absence of the flame. Particle size and velocity distributions were measured at various locations in the air stream and flame using Phase Doppler Particle Anemometry (PDPA). The PDPA derived mean diameter determined for the powder samples roughly corresponded to the nominal sieving screen sizes. The large particle samples contained a fair number of smaller particles (< 38 microns) which resulted in slightly lower mean PDPA diameters than the nominal sieving label. Suppression effectiveness was found to be inversely related to particle size for the powder samples studied; samples containing the smallest particles were the most effective on a weight basis. Potassium bicarbonate powder was twice as effective as sodium bicarbonate for each particle sample size.