VERY LARGE METHANE JET DIFFUSION FLAMES

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Abstract

Methane jet diffusion flames with heat release rates approaching 500 MW in both subsonic and supercritical configurations have been studied regarding lift-off height and flame height and absolute flame stability.

Lift-off heights are in line with small scale literature results, i.e., most of the data exhibit an L_f/U_e value between 2.5 and 5 ms. L_f is the lift-off height and for the choked situation U_e is the resulting velocity at the exit diameter D_e after a hypothetical isentropic expansion through a converging-diverging nozzle to atmospheric pressure. Although the ratio of flame height to actual orifice diameter approached 600 in the supercritical regime, the correlated data are suggestive of relatively similar flame heights (H_f) than those obtained at laboratory scale, $(H_f - L_f)/D_e$ approximately equal to 200.

Flames from orifices up to D = 38 mm could be blown off with sufficient gas pressure. For D = 45 mm the flame could not be blown off for stagnation pressures as high as 3400 kPa. Data from tests at 38 mm and smaller diameters allow an accurate extrapolation, for defining a stability envelope, leading to a predicted critical orifice size of 42 mm for absolute flame stability for CH_4. Failure to sustain ignition of gas from a 1 mm diameter aperture in a reservoir at 12,000 kPa is consistent with the shape of the upper portion of the locus of the derived stability curve.