**DISCUSSION:**

**I. Jet Flame Physical Description**

**> As the fuel flows along the flame axis, it diffuses radially outward, while the oxidizer diffuses radially inward.**

**> The flame surface can be defined as:**

$$\text{Flame Surface} \equiv \begin{array}{c}\text{Locus of points where} \\ \Phi \text{ equals unity}\end{array}$$

**> The products formed at the flame surface diffuse radially both inward and outward**

**> An *overventilated* flame is where there is more than enough oxidizer in the immediate surroundings to continuously burn the fuel**

**> *Underventilated* flame is the opposite of an *overventilated* flame**

**> Flame length for an overventilated flame is determined at the axial location where:**

$$\Phi(r = 0, x = L_f) = 1$$

**> By ignoring the effects of heat released by reaction, the equation below provides a crude description of flame boundaries when $Y_F = Y_{F,\,stoic}$**

$$Y_{\mathrm{F}} = \frac{3}{8\pi}\frac{Q_{\mathrm{F}}}{\mathcal{D}x}\left[1 + \frac{\xi^2}{4}\right]^{-2}$$

**> When *r* equals zero, the flame length is approximately:**

$$L_f \approx \frac{3}{8\pi}\frac{Q_{\mathrm{F}}}{\mathcal{D}Y_{\mathrm{F,stoic}}}$$



**> Flame length is proportional to volumetric flow rate of fuel**

**> Flame length is inversely proportional to the stoichiometric fuel mass fraction**

**> Since $Q_F = v_e \pi R^2$, various combinations of $v_e$ and R can yield the same flame length**

**> Since the diffusion coefficient *D* is inversely proportional to pressure, the height of the flame is independent of pressure at a given mass flow rate.**

**HISTORICAL THEORETICAL FORMULATIONS:**

**i. Burke and Schumann (1928)**

- **Constant velocity field parallel to flame axis**
- **Reasonable predictions of $L_f$ for round burners**

**ii. Roper (1977)**

- **Relaxed single constant velocity assumption**
- **Provides extremely good predictions**