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Study of the Effect of Mixing Process between Explosive Gas Mixture and Air, on the Stability and the Burning Velocity of the Flame

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In furnaces, combustion is continued by the mixing of fuel and air. Therefore method of introduction and the mixing process of the fuel and air are very important for the design and the use of the combustor. Nevertheless, the fundamental studies on such problems have not been carried out. This paper deals with the problems on flames of explosive gas mixture involved in the upper inflammable region, and air introduced in many ways. To get the relations between the method of introduction and the burning condition and the stability of such flames, very simple two dimensional models of furnace are used. Now, the air pre-mixed with fuel is called primary air, and the air introduced for combustion is called secondary air. As the fuel, propane gas is used.

The results obtained are as follows:

The reaction zone becomes narrower and the stability is decreased with increase of the velocity of secondary air.

From the observation of the blow-off, it is found that to get higher stabilization of flames, the introduction of secondary air inverse to the gas mixture is most effective.

From the results obtained, it is found that the pre-mixing ratio has an important effects upon the stability of the flame. That is, the more the ratio of fuel to the primary air approach to the stoichiometric ratio, the more the flame becomes stable.

Velocity profile of secondary air is measured with the hot-wire anemometer. It is presumed that the blow-off must be correlated with the flow condition of secondary air, especially at very vicinity of the air port, because the flame is confined to it under stable condition. Thus, the experimental equation obtained for blow-off is as follows:

$$g_\beta \cdot \lambda^{1.476} = 300\ l/\text{sec}. \quad \text{(for right-angled flows)}$$

where g_β: velocity gradient of secondary air (l/sec)

λ : the volumetric ratio of fuel to primary air

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