type given by equation (2) with $\tau' = \text{const.}$ to evaluate the correction factors, one obtains the calculated results, as shown in Fig. 1, for $a = 2 \times 10^{-10}$ and $3 \times 10^{-4}\ \text{K}^{-1}$, respectively. Examination of this figure shows that the variation of C_p or τ' with temperature is indeed an important source of systematic error.

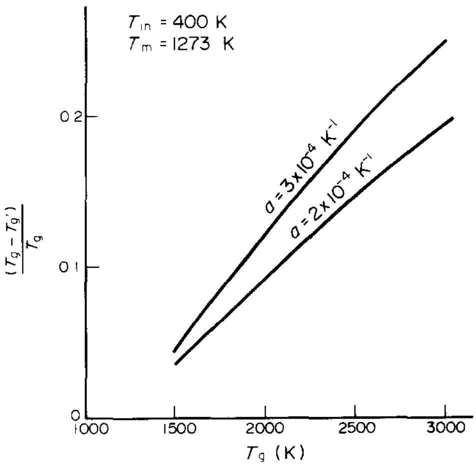

FIG. 1. The systematic error due to $\tau' = \tau_0'[1 + a(T - 273)]$. T_g and T_g' are actual and predicted gas temperatures, and T_{in} and T_m are initial and maximum thermocouple temperatures, respectively.

In addition, the effect of the conduction loss of the dynamic thermocouple may be somewhat overemphasized in ref. [1]. As $Fo = 0$, i.e. no conduction loss exists, Fig. 6 of ref [1] shows that the value of the correction factor is always equal to 1.0. However, equation (6) and the calculated results in Fig. 1 are obtained under the assumption that no conduction loss exists, and the correction factor is not 1.0. Numerical tests [5, 6] show that for a butt-welded dynamic thermocouple, the error due to conduction loss from the thermocouple junction to a porcelain tube can be negligible, provided the part of the dynamic thermocouple exposed to the hot gas-stream is long enough. In spite of the zero conduction error, errors due to radiation or non-constant τ' are still probably appreciable. In addition, experimental and theoretical studies [5, 6] show that for the case where the diameter of the thermocouple junction is considerably different from that of the wires, heat conduction between the wires and the junction would affect appreciably the temperature response curves due to the presence of the difference in their thermal inertia coefficients τ'. This fact may be the reason why many authors [2–4] did not find a great systematic error due to non-constant τ' or radiation in their measurements. Unfortunately, ref. [1] did not give any information about the junction size and the wire diameter of the dynamic thermocouple used in their experiments; and this fact precludes any further comment to be made on their experimental results.

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Reply to 'Comment on "Measurement of high gas-stream temperature using dynamic thermocouples"'

(1) As modelled in our paper the time constant τ of the dynamic thermocouple is given by

$$\tau = \frac{\rho A C_p}{\alpha P(1+R)}.$$

In general all the terms are functions of temperature. The authors of the letter have pointed out that C_p is a function of temperature. So is R and to a marked extent variation of α with temperature which is more complex and pronounced in chemically reactive flames. We do agree, in principle, with the author of the letter that variation of C_p with temperature should be included. Since α also increases with temperature, the overall rise in τ with temperature is less compared to what authors have assumed. In view of this, the error plotted by the authors is an over-estimate of what actually happens. However, due to non-availability of precise data on temperature dependency of various parameters, it is difficult to estimate the error due to temperature dependency of the τ.

(2) In view of this in the analysis both τ and F_0 have been treated as constants assuming that individual variations are smoothed out and mean values of the properties are taken for thermal diffusivity.

(3) The thermocouples used in the experiment were 0.6 mm diameter wires butt-welded to form the junction and smoothed to form a cylindrical surface. The conduction losses considered are the loss of heat through the wires shielded into the porcelain tube and not to the porcelain tube themselves. We have modelled and experimented with beaded junctions where the junction diameters are larger than wires. Even though this will reduce the conduction effects, the wires burn out often in high temperature gas streams before the junction reaches appreciable temperature.

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