Technical Comments

Comment on "Thermal Decomposition Kinetics of Polybutadiene Binders"

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IN a recent Note,[1] Ninan and Krishnan report results of measurements of decomposition kinetics from thermogravimetric experiments at different heating rates, in the range 1-100°C/min. From the opening sentence of their Note, one may be tempted to believe that their results have something to do with combustion of solid propellants: "... thermal decomposition...plays an important role in combustion...".

It is commendable that the authors sought to determine whether TG measurements were sensitive to the vagaries of experimental design; however, their results surely cannot be interpreted as having established relevance to propellant combustion. Specifically, their highest heating rate is about four orders of magnitude lower than occurs near the burning surface in normal propellant combustion. Thus the reported insensitivity of kinetics to heating rate in their experiments cannot be safely extrapolated to combustion conditions (which would include, among other things, much higher temperatures than in the TG tests).

The authors' "statistical" rationalization of their results seems to overlook the obvious. In every tabulation of activation energy vs heating rate presented, the lowest activation energy was at the highest heating rate (five binders, three data reduction schemes). Further, this "high-rate" activation energy was in each case more than 8% below the average of the six values measured at lower heating rates. For the five binders tested, the activation energy at the highest heating rate *averaged* 15.8% below the values at other heating rates. Somehow the authors managed to dismiss this remarkably consistent trend as being within the normal variation of results for TG experiments. In reality, the probability of such a result in the absence of a causative effect is nil.

In summary, the results reported, if free of systematic error of measurement or interpretation, indicate that the *activation energy is sensitive to heating rate,* contrary to the authors' third conclusion. On the other hand, the tests cannot possibly be used to infer activation energy in a propellant burning surface without some rationale that addresses the enormous difference in heating rates (and hence temperatures) involved.

Received April 8, 1982.
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Reference

[1] Ninan, K.N., and Krishnan, K., "Thermal Decomposition Kinetics of Polybutadiene Binders," *Journal of Spacecraft and Rockets,* Vol. 19, Jan.-Feb. 1982, pp. 92-94.

Errata

Analysis of Combustion in Recirculating Flow for Rocket Exhaust in Supersonic Streams

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[J. Spacecraft, **19**, 557-563 (1982)]

DETAILS of Fig. 7 of this article were obscured in reproduction. The figure should appear as shown at right:

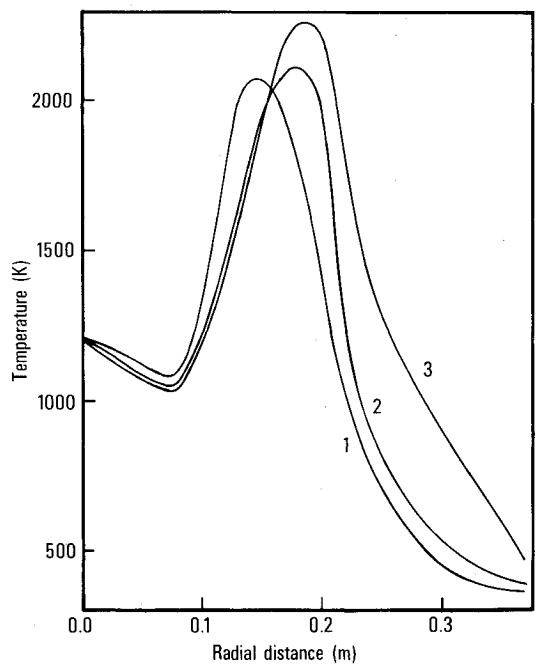

Fig. 7 Radial profiles of temperature at an axial station 0.1 m downstream of the nozzle exit plane [conditions are as in Table 2, except for the freestream axial velocities which are: 1) 300 ms^{-1}, 2) 500 ms^{-1}, 3) 1000 ms^{-1}.]

Received March 23, 1983.