B.

CHEMICAL KINETIC EFFECTS IN HYPERSONIC FLOW

INTRODUCTION

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This chapter contains a survey of the pertinent data to date affecting the chemical aspects of flows at hypersonic speeds. The first paper by S. H. Bauer of Cornell University is a summary of work in the whole field of chemical kinetics, including a discussion of the physical chemists' interest in some of the techniques used in the study of hypersonics or high temperature gasdynamics. It is well to keep in mind, when estimating chemical effects in hypersonic flow fields, the general laws established previously by workers in the field of chemical kinetics, and the editors are grateful to Bauer for outlining these laws.

The next paper, by K. Wray of the Avco-Everett Research Laboratory, concerns the state of knowledge of the specific chemical reactions one may expect to be important at hypersonic speeds in air. Much of these data are scattered widely throughout the literature and some of the quoted rate constants vary widely. Wray, who has been concerned with air chemistry since it became apparent that there would be important hypersonic effects due to the reaction rates, has summarized and evaluated the present status of the rate data, and his paper includes recommendations of what he believes to be the most appropriate rate constants to use in hypersonic studies. He also includes a discussion of the problems still remaining which require further work.

C. Treanor of the Cornell Aeronautical Laboratory has reviewed the status of knowledge of equilibrium radiation from heated air and also summarizes and evaluates the various experimental results. With the advent of higher re-entry speeds for various missions it has become obvious that radiation will play a dominant role. Treanor has included in his work the information necessary to evaluate the role of radiation in any particular hypersonic mission.

At speeds at which radiation has become important there is a

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very close coupling between the details of the approach of the gas to equilibrium and the radiation from this nonequilibrium region. D. Teare of the Avco-Everett Research Laboratory summarizes the present available data and appropriate aspects of the theory. It is apparent that in order to provide a theoretical description of this phenomenon many more actual details of the chemical kinetic aspects of the flow field must be known than are presently available.

In the final paper by R. Vaglio-Laurin and M. H. Bloom of the Polytechnic Institute of Brooklyn procedures are presented for calculating chemical kinetics effects ih hypersonic flow fields. Both inviscid and viscous flows are considered for the case of an axisymmetric hypersonic vehicle at zero incidence. Sample calculation results are given to illustrate the significant effects.

This chapter thus provides the basis for estimating the importance of chemical effects in high speed flows. The editors are indebted to the authors for summarizing and evaluating previous work as well as describing the present day problems.