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Introduction

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Symposium on Polymers in Space Research: Part III, Solid Propellants

INTRODUCTION

The final session of the Symposium was concerned with the application of polymers as solid-propellant binders. The combined requirements for polymeric materials in this unique application are severe, and a variety of individual characteristics must be optimized to provide an acceptable binder. The extremely high volume fraction of filler necessary for maximum energy release in rubber-based composite propellant places serious restrictions on the original liquid prepolymer. Mixing viscosity levels must be maintained at fairly low levels (<20 Kp), requiring low viscosity-average molecular weights, while the polymer must be capable of chain extension and cross-linking to produce a continuous network throughout the final propellant grain. The mechanical properties of the propellant are ultimately dependent on the nature of the binder, which may represent only 12-16% by weight in the propellant formulation.

Energetic binders such as the nitrocellulose-nitroglycerine combination found in some double-base propellants were not included among the papers in this session.

Chemical compatibility, thermal stability, favorable heat of formation and exhaust products, and often a wide temperature range of rubber-like properties are among the additional characteristics which are sought in the process of selection of binder polymers.

This session consisted of four papers. The first, by H. Marsh, is a general survey of binder requirements for space applications, stressing the need for sterilizable systems. Saturated, difunctional hydrocarbon polymers are included in this discussion, as well as in the second paper, by A. DiMilo, which deals in a more fundamental manner with such binders.

The paper by Zollinger, Throckmorton, Ting, Mitsch, and Elrick presents the details of the synthesis and characterization of a fluorinated polyether which shows promise as a high-density, thermally stable binder.

Finally, a contribution of great significance to binder characterization is given by Muenker and Hudson, who address the problem of functionality measurement in binder prepolymers. The molecular weight range and functionality concentration of these polymers are such that measurement of equivalent weight is quite difficult by the more common methods. In

addition, characterization of the functionality distribution should provide propellant formulators with an additional important variable which may be used in the challenging task of propellant binder optimization.

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