SUMMARY

The discussion by Gates et al of wear test methodology presents an introduction to the complexities permeating the ceramic wear test problem. The authors provide a general structure for wear tests, for which they subsequently provide useful details. They highlight the factors to be considered in the selection of the test method, one of the major elements of the test structure. A discussion of the special considerations for ceramics alerts the reader to wear test factors related to the inherent properties of ceramics. The relative magnitudes of contact stress in metals and ceramics, for example, is examined and the significance of the difference observed is emphasized. The authors also demonstrate the importance to friction and wear results of surface preparation prior to testing.

The paper by Fiderer describes in detail the design and construction of a high temperature, controlled atmosphere test apparatus. The system was developed to test the sliding friction and wear characteristics of unlubricated or solid lubricated ceramics at temperatures as high as 870°C. The test configuration is a block on ring geometry using moving coil actuators to provide the applied force through pivot arms. The force application system provides steady or cyclic forces at frequencies up to 500 Hz. Heating of the test environment is provided by quartz lamp heaters, and environmental control is achieved by gas flow through the system containment. The features of this specific design illustrate the requirements of high temperature wear test systems.

The use of a generic wear test arrangement, the pin-on-disk test, for the study of a specific wear application is described by Tennenhouse. The wear service investigated was that of a cutting tool in turning and boring operations. By careful selection of the test conditions to match the speeds, pressures, and environments of the actual practice it was found that good correlations could be made between the pin-on-disc test results and service performance. Details of the tool material wear process are presented in this demonstration of the specific use of a generalized test.

Wedeven and coworkers discuss the use of several levels of test devices in evaluating ceramics for use as rolling elements in bearings. The varied test levels explore differing aspects of the tribosystem, ranging from a static arrangement which examines the materials in contact in the environment of interest to an operating tribosystem in the intended application. The authors discuss in detail the use of several intermediate levels of testing for rolling elements, including a high temperature traction test rig, and discuss typical results obtained from the latter system. The concept of hierarchical tests is one which could be considered in more general tribological test situations.

The contribution by Wei et al further demonstrates the use of multi-level tests, in this instance by combining the pin-on-disk bench test with tests performed in a single-cylinder engine. The materials tested, ion beam modified ceramics, are candidates for service as piston rings and cylinder walls of internal combustion engines. Bench test results allow the selection of the optimal material pairs for the engine tests, as well as providing an indicator of the magnitude of friction and wear to be expected. The authors describe the tests and discuss early results on ion implanted surfaces which suggest the use of particular implant species as the progenitors of lubricious oxides for the sliding interfaces.

The preceding comments on the papers contained in this book focus on their individual treatments of wear testing of ceramics. Some comments are also appropriate in terms of wear testing, in general. This current book is the fourth in a series regarding the wear testing of materials. STP

615 treated metals; STP 701, plastics; STP 769, coatings. Individually and collectively the papers of this current STP imply the same theme as the papers in the prior publications—the principal point of which is that the wear test used must simulate the intended application. In addition they also point out the care and discipline that is associated with performing a good wear test. Collectively they also attest to the fact that while wear and wear testing are complex, effective wear testing can be done and correlated to service.

In the four STP's fifteen or so different wear tests are discussed. This multiplicity is driven by the need to simulate and the fact that the nature of the different classes of materials make them more or less suitable for particular types of service. For example, polymers are not particularly suitable for high temperature applications, while ceramics are. As a result test apparatus for ceramics frequently have to provide the elevated temperature capability to simulate the applications. Ones for polymers would not. While this is the case the basic elements in developing a wear test and tester are the same. In this respect the paper by Gates et al presents a good overview of the elements that is applicable to all wear testing, not just wear testing of ceramics. It is suggested that the reader review all four STP's for a complete understanding of the subject of wear testing.

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