thanks go to Dr. Donald Schoendorfer for his help throughout the investigation.

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DISCUSSION

F. E. Kennedy, Jr.[1]

I enjoyed reading this paper. It presents the results of a study of polymer wear as influenced by surface temperature, and develops a model which says that severe wear begins when the polymer's surface temperature reaches a limiting value. We have a related study underway in our laboratory and have independently developed a similar model, although for different polymer materials (Kennedy and Tian, 1993). Because of my interest in their model and results, I wish to direct several clarifying questions to the authors.

The authors' model is based on a limiting temperature (Eq. (27)) which includes a temperature-dependent shear strength. It is not clear how Eq. (27) is used, though, since temperature is included on both sides of the equation, albeit implicitly in the shear strength term on the right-hand side. In the discussion surrounding Eq. (28) it appears that a temperature is first determined for a given set of operating conditions and it is used to find whether the limiting load has been exceeded. However, as is stated by the authors, both surface temperature and shear stress are a function of friction coefficient, which may also be a function of temperature, as the authors' experiments show. How can the model be used in predicting wear failure if neither the surface temperature nor the friction coefficient is known a-priori?

The authors' experimental results include several quantities that aren't quite clear. I hope they can clarify the following points in their Closure:

What is the relationship between frictional torque (Figs. 10 and 11) and friction coefficient? How much variation of friction coefficient occurred in the tests?

The measured friction coefficient seemed to be in the range of 0.3 and this is a bit lower than the unlubricated friction coefficients quoted for the PES material. Was any of the cooling water present at the contact interface to cause a reduction of friction? Was any leakage of water noted through the PES/stainless steel contact interface?

The authors state that some tests were conducted at operating conditions close to those predicted to cause severe wear. Our tests have shown that polymer wear rates increase drastically once the limiting surface temperature is reached. Have the authors been able to note such transitions to severe wear, perhaps in tests with a different torque sensor? Will any attempt be made to measure wear rates in future tests so that the transition to severe wear can be well characterized?

[1]Thayer School of Engineering, Dartmouth College, Hanover, NH 03755.

Additional Reference

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Authors' Closure

The authors would like to thank Professor Kennedy for his comments and questions on our work. First of all, friction coefficient must be input into this model. This is due to the fact that prediction of the friction coefficient is unlikely and much more difficult than the other variables for this configuration.

Friction coefficient is related to friction torque by Eq. (9), which is derived from the contact geometry. Due to the very small size and geometry of the components, friction coefficient could not be measured directly as would ordinarily be desirable (as in the pin-on-disk configuration). We looked at friction coefficients that would be appropriate for this polymer/metal contact and then calculated the friction torques, which could then be compared with the experimentally measured values. We estimate the variation in the observed friction coefficient to be approximately 25 percent.

No leakage of water was observed through the contact. However, it was not possible with our test apparatus to verify that water never entered the contact since we were unable to probe the contact region.

Further experiments with a different torque sensor arrangement would be worthwhile, and we are in the process of redesigning the apparatus to give a wider range of information on friction torques. The major design tradeoff occurs between low-end sensor sensitivity and high-end sensor capacity, and our plan is to facilitate the ability to observe more of the high-end (failure) torque regime in future tests.