where $\Delta \ell$ is the very rapidly applied sample extension (held constant for the test duration) and W(t) is the measured sample force. The results of five stress relaxation tests at several hydrostatic pressures are shown in Figure 2.

Referring to Figure 2, it will be noted that the apparent relaxation modulus change with pressure is smaller than the analogous results from Figure 1, i.e., the reciprocal of the compliance. The general trends in the creep and relaxation tests are the same, i.e., the hydrostatic pressure does increase the general stiffness and viscosity of the material. It might be hypothesized that part of the difference in the two tests results from the method of loading. In the creep tests, of course, a constant load is suddenly applied while in relaxation tests a sudden displacement was applied to the sample. This later displacement was applied in a very small fraction of a second and, consequently, at these pressures the sample could have behaved like a "glass." If this were the case, instantaneously, very high stresses could have resulted and as a consequence some structural damage and morphological changes could have occurred. Unfortunately, the recorder used to measure the stress had a response time of greater than one second and so was incapable of monitoring such response.

In conclusion, the mean stress does drastically effect the rheology of the polyethylene. As far as the original purpose of the study goes, pressure does indeed enhance the "strength" of polyethylene for use as a high-pressure seal. Subsequent experience with polyethylene seals (both of unsupported and wedge type) substantiated this effect. In fact, sealing at low pressures proved to be more of a problem than excessive seal flow at pressures to 10 kbar.

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References

(1) S. V. Radcliffe and E. Baer, paper to be presented at the Winter Meeting of the Society of Rheology, 1971.

(2) J. A. Sauers and K. D. Pal, paper to be presented at the Winter Meeting of the Society of Rheology, 1971.

(3) G. Biglione, E. Baer, and S. Radcliffe, "Fracture–1969," P. L. Pratt, Ed., Chapman & Hall, London, 1969, p. 503.

(4) L. A. Davis and C. A. Pampillo, "Deformation of polyethylene at High Pressure," Bull. Amer. Phys. Soc., 16, 429 (1971).

(5) C. A. Pampillo and L. A. Davis, "On the volume change before yielding and pressure dependence of the yield stress," Bull. Amer. Phys. Soc., 16, 429 (1971).

(6) P. W. Bridgman, "Studies in Large Plastic Flow and Fracture," McGraw-Hill, New York, 1952.

(7) A. Mendelson, "Plasticity Theory and Applications," Macmillan, New York, 1968.