EXHIBIT 1

Mechanical Properties of Solid Polymers

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fail catastrophically. Yet another type of polymer (a rubber) extends homogeneously to rupture. A salient point to recognize is that polymers in general show all these types of behaviour depending on the exact conditions of test (Figure 1.1). This is quite irrespective of their chemical nature and physical structure. Thus explanations of yield behaviour which involve, for example, cleavage of crystallites or lamellar slip or amorphous mobility are only relevant to specific cases. As in the case of linear viscoelastic behaviour or rubber elasticity what we must first seek is an understanding of the relevant phenomenological features, decide on suitable measurable quantities and then provide a molecular interpretation of the subsequent constitutive relations.

11.1 DISCUSSION OF LOAD–ELONGATION CURVE

The most dramatic manifestation of yield is seen in tensile tests when a neck or deformation band occurs, as in Figure 11.1 (see Plate VIA). In these cases the plastic deformation is concentrated either entirely or primarily in a small region of the specimen. The precise nature of the plastic deformation depends both on the geometry of the specimen and on the nature of the applied stresses. This will be discussed more fully later.

The characteristic necking and cold-drawing behaviour is as follows. On the initial elongation of the specimen, homogeneous deformation occurs and the conventional load-extension curve shows a steady increase in load with increasing elongation (AB in Figure 11.2). At the point B the specimen thins to a smaller cross-section at some point, i.e. a neck is formed. Further elongation brings a fall in load. Continuing extension

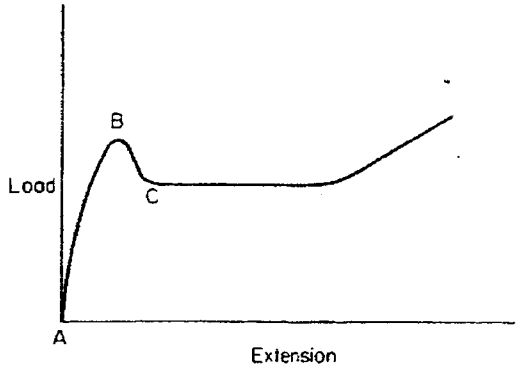

Figure 11.2. Typical load–extension curve for a cold-drawing polymer.