



Mechanical Properties

Overview:

Knowledge of the mechanical properties of a material provides important information in the selection of suitable applications. A material must have the required properties to function adequately and must be durable enough for the expected product lifetime. In the case of soft contact lenses it has been considered that modulus contributes greatly to the success of a material. However it is also important for a material to have sufficient durability to allow the lens to be handled and cleaned if necessary.

In the case of foldable intraocular lenses including those fabricated from hydrophilic materials, mechanical properties have a significant effect on the design of the lens. It must be soft yet not damaged by the procedure of injecting through the small incision size that has become the standard practice. However the design must also ensure that the lens is located centrally in the eye to provide the best visual outcome.

The mechanical properties are determined by tensile testing of the material through the use of a tensiometer. Samples are held under tension and the force applied to the sample is gradually increased until the sample breaks. The tensile strength is the load at break while the elongation at break is the extension of the sample at the point of breaking. The modulus of elasticity is determined from a graphical plot of stress vs. strain over the elastic region of the curve. Values for a range of other properties can be determined using this form of testing.

Procedure:

Test specimens of the required geometry are produced or cut from samples of the material. The thickness of the sample is measured prior to the start of the testing using a micrometer. It is important to accurately know the cross-sectional area of the sample to enable correct calculation of the material properties. A number of parameters can be varied depending on the type of sample being measured. These include the speed of movement of the extension of the sample, the length of the sample and the distance between the clamping jaws at the start of the test, as well as a range of other parameters that define the precise operation of the testing procedure.

The type of sample being evaluated will dictate the size of the test piece being investigated and this in turn will determine the testing geometries employed. For example, when evaluating actual contact lens samples the specific lens design will result in a sample with a variation in cross-sectional area. The situation is further complicated by the intersections of curves that result in thinner regions as you pass from the centre to the edge of the lens. To overcome these issues changes in the jaw separation can be used so that the thickness of the test sample is relatively constant, which is found typically in the centre of the contact lens.



Each sample is placed in the jaws of the equipment ensuring that the sample is positioned correctly. When measuring hydrophilic materials it is important to ensure that the sample remains hydrated for the duration of the test to ensure representative results are obtained. This process is repeated until the required number of acceptable results is obtained in order to calculate an appropriate average value for each property.