



Fig. 1. Calibration device for an extensometer. (a) Exploded view of calibration device. (b) Device attached to extensometer. 1. Calibration device, 2. Extensometer, 3. Knife edges of extensometer.

is attached to the jaws of an Instron instrument for testing. Minute deformation of the specimen produces a minute separation of the edges. This movement simultaneously produces movement in the movable core of the transformer and is in turn recorded as the X axis of the X-Y recorder while the stress is recorded on the Y axis. Before studying stress-strain relationships in a polymer, it is necessary to calibrate the extensometer.

A simple compact calibration device for a microformer type extensometer has been developed in these laboratories. The calibration device is constructed from a micrometer caliper. An exploded diagram is shown in Figure 1a and the assembled device attached to the microformer extensometer with one screw is illustrated in Figure 1b. The device is adjusted to zero by moving the knurled nut at the top or by adjusting the over nut. When the device is properly in position, the bottom adjustable nut fits snugly against the movable interior portion of the extensometer. Then the device is ready for the calibration.

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A Remark on the Hydrogen Bond Breaking Action of Urea

It was found that the addition of urea to concentrated solutions of poly-methacrylic acid prevents gel formation and turbidity upon heating.¹ This was explained as being due to an increase of solubility of the polymer as a result of the hydrogen bond breaking action of urea. This explanation cannot be reconciled with the observation that urea decreases the reduced specific viscosity of dilute solutions of poly-methacrylic acid in

the presence of hydrochloric acid.² In order to clarify this it was attempted to measure the viscosity of the dilute polyacid solution in absence of hydrochloric acid. This however could not be done as the time of flow of a solution was found to increase continuously in consecutive runs and no stable state was observed even after 48 hr. (In the absence of urea the times of flow do not change with time over that period.) The increasing times of flow correspond to a more than hundredfold increase in the reduced specific viscosity of the solution.

A likely explanation of this increase of viscosity is the slow hydrolysis of urea in acid medium with subsequent formation of ammonium ions,³ so that the polyacid molecules become increasingly charged and hence unfold. In other words, the addition of urea is in a certain sense equivalent to a slow continuous addition of small quantities of ammonia. In the presence of hydrochloric acid the ammonia is immediately neutralized and cannot charge the polyacid. Hence stable times of flow are obtained in the presence of mineral acid, but not with polymer and urea alone.

The fact that poly-aspartic acid does not dissolve in water, but does dissolve in urea solutions, was also attributed to the hydrogen bond breaking action of the latter.⁴ In order to check on this poly-aspartic acid was dissolved in an equivalent amount of sodium hydroxide. Then excess of hydrochloric acid was added to reduce the pH of the solution to 1 and the intrinsic viscosity was determined both in absence and in presence of urea. The intrinsic viscosity of poly-aspartic acid turned out to be unaffected by urea, indicating that no intramolecular bonds were broken by urea. It is therefore quite likely that the dissolution of polyaspartic acid by urea is also due to hydrolysis of urea and neutralization by the ammonia formed and not due to hydrogen bond breaking.

References

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