The effect of pH and ionic strength on polyelectrolytes and hydrogels

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Practical:

Abstract

The experiment involves two related exercises. One of these demonstrates the effect of ionic strength and pH on the swelling of cross-linked polyacrylate beads. The other involves measuring the relative viscosity of a polyacrylate solution at neutral and acid pH using a U-ube viscometer. Both exercises illustrate that polyelectrolytes are very sensitive to the nature of the surrounding electrolyte. The relevance of this to everyday products such as superabsorbent polymers, viscosity modifiers and biomedical polymers can be emphasised. The experiment can be extended to include an estimation of the molar mass of the polyacrylate sample. It is used as a laboratory exercise on a polymer chemistry module but would also be suitable for a physical chemistry laboratory.

Intended academic level

Undergraduate 2

Duration

Three hours or could be extended to 2 x 2 hours

Outcomes

1. Understanding of difference between linear and cross-linked polymers and their behaviour in solvents

2. Understanding of dilute solution viscosity measurements and how viscosity is related to polymer properties (including determination of molar mass of polymer)

3. Understanding of concept of screening of ionic charge by added electrolyte.

4. Knowledge of role of polyelectrolytes in food and healthcare materials and why their role is related to the properties illustrated in the experiment.

Materials

Cross-linked poly(acrylic acid) sodium salt Poly(methacrylic acid) sodium salt solution (both above available from Aldrich)U-tube viscometers

Test tubes

Costs

£42 for the polymers (1 kg of each). Viscometers approx £100 each.

Further comments

Although U-tube viscometers are used in our laboratories, there areless sophisticated alternatives if the cost is prohibitive.

Reading

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