Determining the molecular weight of a polymer from intrinsic viscosity measurements

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Principle

The viscosity of a liquid is effectively determined by the strength of the intermolecular attractive forces. In the case of solutions, the viscosity of the solvent can alter significantly depending on the type and concentration of the solute. Due to their size, macromolecules have a very considerable impact on the viscosity of the solvent. Viscosity measurements can be used to estimate the mean molecular mass of a macromolecule if something is known about its conformation.

Benefits

- Determination of an important parameter of rheology
- For both demonstration and student experiments

Tasks

1. Use a thermostatted capillary viscometer to measure the viscosities of solutions of polystyrene in toluene over a range of five polymer concentrations.
2. Determine the instrinsic viscosity and from that estimate the molecular weight (relative molecular mass) of the polymer in this solution.

Learning objectives

- Viscosity of liquids
- Ostwald capillary viscometer
- Poiseuilles's equation
- Macromolecules
- Mass average and number average molecular weights
- The Mark-Houwink equation
- Alternative techniques e.g. osmosis
- Sedimentation (ultracentrifuge methods)
- Light scattering

Necessary accessories:

This experiment requires a precision balance

Precision balance, Sartorius ENTRIS® II, 620 g : 1 mg (49311-99)

Scope of delivery

Immersion thermostat Alpha A, 230 V	08493-93	1
Bath for thermostat, makrolon	08487-02	1
External circulation set for thermostat Alpha A	08493-02	1
Retort stand, h = 750 mm	37694-00	1
Right angle boss-head clamp	37697-00	1
Universal clamp	37715-01	1
Ubbelohde viscosimeter, 0.4 mm	03102-03	1
Digital stopwatch, 24 h, 1/100 s and 1 s	24025-00	1
Weighing dishes, square shape, 84 x 84 x 24 mm, 500 pcs.	45019-50	1
Volumetric flask, Borosilicate, 100 ml, IGJ12/21	36550-00	1
Volumetric flask, Borosilicate, 100 ml, IGJ12/21	36548-00	4
Volumetric pipette, 50 ml	36577-00	6
Volumetric pipette, 50 ml	36578-00	1
Volumetric pipette, 50 ml	36579-00	1
Volumetric pipette, 50 ml	36581-00	1
Pipettor	36592-00	1
Pipette dish	36589-00	1
Funnel, glass, top dia. 50 mm	34459-00	1
Water jet pump, plastic	02728-00	1
Rubber hose for vacuum	39286-00	2
Rubber hose	39282-00	4
Hose clip, diam. 8-16 mm, 1 pc.	40996-02	4
Beaker, Boro, high-form	46027-00	4
Graduated cylinder, Borosilicate, 1000 ml	36629-00	1
Glass rod, boro 3.3, l=200mm, d=5mm	40485-03	1
Spoon, special steel	33398-00	1
Pasteur pipettes, 250 pcs	36590-00	1

Rubber caps, 10 pcs	39275-03	1
Wash bottle, plastic, 500 ml	33931-00	1
Styropor P, 250 g	48492-25	1
Toluene 250 ml	30236-25	3
Acetone, chemical pure, 250 ml	30004-25	1
Hydrochloric acid 37 %, 1000 ml	30214-70	1
Nitric acid , 65% 1000 ml	30213-70	1
Water, distilled 5 l	31246-81	1
Tubing connector, ID 6-10mm	47516-01	2

Necessary accessories

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