Student's Name

Tutor's Name

Course

Date

Intrinsic Viscosity: Evaluating the Polymerization Pattern in Polyvinyl Alcohol

Specific Aims

In the current experiment, potassium periodate will be used to treat a polyvinyl alcohol of high molecular weight. Potassium periodate typically reacts with 1,2 glycols, but it has no impact on 1,3 glycols (Hershberger 1). Furthermore, the regular repeating polyvinyl alcohol unit, produced by polyvinyl acetate hydrolysis, is comparable to a typical 1,3 glycol. The vinyl acetate also contributes to the production of 1,3 alcohol and 1,3 acetate (Hershberger 1). Therefore, the production of a 1,2 glycol is an atypical head-to-head monomer addition to the expanding chain. Based on this information, the current study hypothesizes that treating polyvinyl alcohol with potassium periodate will reveal the number of atypical head-to-head polymerizations. This premise will be proved by meeting four main objectives:

a. Determining the viscosity using a relevant instrument.
b. Describing viscosity as an intrinsic attribute of a fluid.
c. Finding an unknown molecular weight using a typical curve.
d. Determining the magnitude of the atypical head-to-head polymerization.

Based on the presented objectives, the intrinsic viscosity of polyvinyl alcohols with different molecular weights will be gauged. Consequently, the periodate-treated polymer's weight will be computed from the graph of viscosity against molecular weight. The ratio of the untreated polymer's mean molecular weight to the treated polymer's molecular weight will then be approximated to determine the number of head-to-head polymerizations. Altogether, these results will prove the primary hypothesis by evaluating the polymerization pattern in polyvinyl alcohol.

Materials

All materials for the project can be accessed from the school laboratory, and they include:

- A size 100 Cannon-Fenske Viscometer with a thermometer to sustain a 25 °C reading and a 1000-mL beaker.
- Materials for preparing standard solutions:
    i. Five 150-mL beakers
    ii. One 100-mL volumetric flask
    iii. Polyvinyl standards of varying molecular weights
- A 10% ethanol distilled water solution
- A balance specified for a range of 0.0001 g to 0.001 g
- A spatula
- Potassium periodate
- A hot plate
- Stirring bars with magnetic heat and stir plates
- A 100-mL graduated cylinder
- A stopwatch
- Polyvinyl alcohol
- An ultra-micro pipette tip, a 10-mL syringe, and plastic tubing

Procedure

Detailed Experimental Design

Preparing the 1% Polyvinyl Alcohol Solutions

1. 1.000 g of each sample was weighed and placed in 150-mL beakers. 40 mL of hot distilled water was then added to each sample. Consequently, the solutions were heated and stirred to dissolve.
2. The polyvinyl alcohol sample was poured into the 100-mL volumetric flask after the dissolution was complete. 50 mL of the 10% ethanol/distilled water solution was then added, and the solution was diluted to the mark using water. After that, the volumetric flask was repeatedly inverted to mix the solution, which was then transferred into a labeled bottle.
3. The 1% polyvinyl alcohol laundry bag solution was prepared and labeled by repeating steps one and two.
4. 0.0625 g of potassium periodate was weighed and placed in a separate beaker. 25 mL of the prepared polyvinyl alcohol solution was then added and stirred to dissolve.

Determining the Viscosity of the 1% Polyvinyl Alcohol Solution

1. The time each solution took to drain in the Cannon-Fenske Viscometer was measured five times, and the average was computed.
2. The viscosity of each solution and water was then determined.

Experimental Protocols

Equation 1 below illustrates the solution's flow through a capillary due to the gravitational force. In the equation, *B* is the viscometer constant, *r* is the density of water (0.997 g cm-3 at 25°C), *t* is the measured flow time in seconds, and *h* is the coefficient of viscosity (0.8937 cP for water).

$\frac{\eta}{\rho} = Bt$……………………………………………………………………equation 1.

Theoretical Development

1. The collected data for water was used to find *B*, and the viscometer constant was taken from the viscometer specifications used.
2. The drain times and *B* were used to determine each solution's coefficient of viscosity. The densities were assumed to be similar.
3. A graph of the coefficient of viscosity against the molecular weight for each polymer was then prepared.
4. Consequently, the polyvinyl alcohol laundry bag coefficient of viscosity and the graph were used to estimate the molecular weight.
5. The molecular weight of potassium periodate treated with polyvinyl alcohol was then determined.
6. The untreated polymer's molecular weight was divided by the periodate treated polymer's molecular weight to determine the approximate number of head-to-head polymerizations.

Statistical Analysis

The time each solution drained in the Cannon-Fenske Viscometer was arguably the most critical variable in the experiment. Thus, a distribution of five measurements was obtained to increase data accuracy and reliability. The arithmetic mean of the measurements was then computed and used for all calculations in the experiment.

Works Cited

Hershberger, Susan. *Intrinsic Viscosity, Evaluating the Polymerization Pattern in Polyvinyl Alcohol*. Miami University. www.terrificscience.org/lessonpdfs/PolymerLab26.pdf, Accessed 05 November 2021.