Fast determination of Average Molecular weight using viscosity measurements

FLUIDICAM® Rheo

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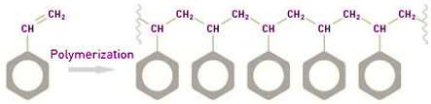
Introduction

Molecular weight, M_w, is a key factor for the determination of **physical properties** such as mechanical strength, solubility or brittleness of polymers.



Molecular weight is related to the relative weight of monomers, this means it can be used to estimate chain length.

FLUIDICAM^{RHEO} offers a new method for fast and precise determination of average molecular weight of polymers in solution using viscosity measurements.

Method

- To determine M_w the intrinsic viscosity must be determined. There are 2 methods commonly used:

  Method 1: **Huggins-Kraemer** - multiple concentrations
  Method 2: **Solomon-Ciuta** - single concentration

- The polymer must be completely dissolved in a solvent of choice and at a concentration lower than its C*.
- Viscosity measurements of diluted polymer are performed with high precision using FLUIDICAM^{RHEO}
- Once the intrinsic viscosity has been determined the Mark-Houwink equation can be used to determine M_w

$$[\eta] = KM_w{}^a$$

k and a are parameters that depend on the polymer/solvent system and can be found in the literature or by calibration

Flow curve determination

High Precision:

Small changes in viscosity are detected

Fast and simple method

With minimum sample requirements

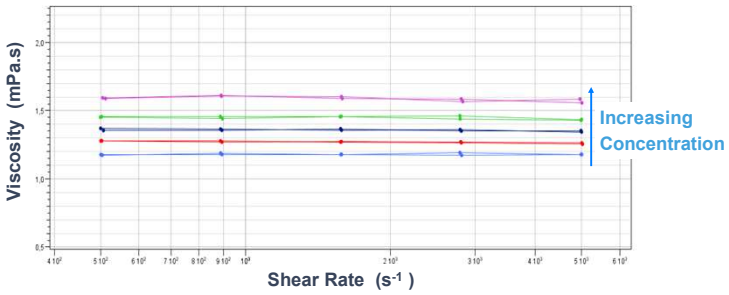
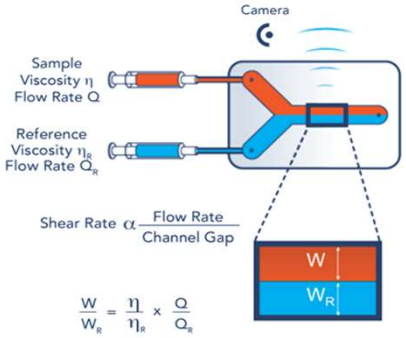


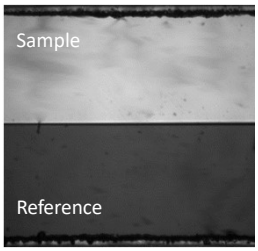
Figure 2: Viscosity of HEC LR 250 solutions at different shear rates.

Precise and quick flow curve determination. Each flow curve is plotted in just a few minutes.

Measurement principle

FLUIDICAM^{RHEO} uses a co-flow microfluidic principle to measure viscosity. The sample and a reference solution are simultaneously introduced into the microfluidic channel (typically 2.2mm X 150µm) with controlled flow rates. This results in a laminar flow where the interface position between sample and reference relates the viscosity ratio and flow rates. Images acquired during the measurement allow the software to calculate the position of the interface and directly plot an interactive flow curve.





Results

Intrinsic viscosity
Method 1

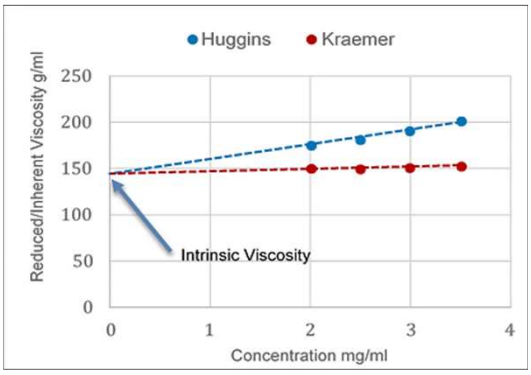


Figure 1: Method 1, Huggins-Kraemer, for a HEC LR 250 solution

Polymer	FLUIDICAM^{RHEO}		Literature or Supplier
	M_w (g/mol) Method 1	M_w (g/mol) Method 2	M_w Range (g/mol)
HEC LR	69 000	70 000	64 000 - 90 000
HEC GR	257 000	200 000	190 000 - 300 000
PVA	89 600	93 000	89 000 - 98 000

FLUIDICAM^{RHEO} gives accurate results that correspond to literature values.

Conclusion

Molecular weight determination is made fast and easy with FLUIDICAM^{RHEO}. This innovative microfluidic method allows accurate viscosity determination in just a few minutes with low sample consumption.