Intrinsic Viscosity Measurements of Polycarbonate (PC):

Rapid, Automated and Precise

Haiku Instruments
Precision | Compliance | Quality

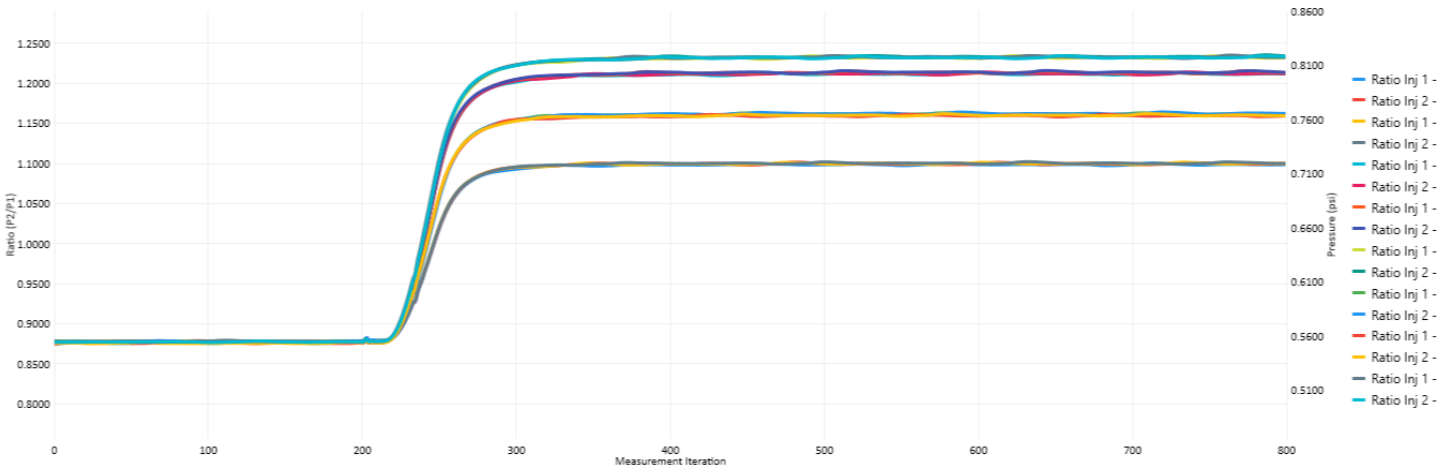
Polymer Insights: Polycarbonate (PC) is used in advanced electronics and wearable technology, where its durability and transparency are critical. The automotive industry uses PC in lightweight, impact-resistant vehicle components like headlight lenses and panoramic roofs, enhancing fuel efficiency and safety. In the medical field, PC is utilized for 3D-printed custom implants and high-performance medical devices due to its biocompatibility and sterilizability. Polycarbonate's excellent optical properties are leveraged in high-performance optics and augmented reality (AR) devices, while its robust mechanical properties support applications in aerospace engineering and sustainable building materials.

Experiment Protocol

Overview: Four PC samples (two each from supplier S and supplier C) were dissolved in chloroform at 30°C for 45 minutes. Each sample was prepared in duplicate, and after dissolution each sample IV was measured twice. Samples were conditioned to 25°C inline during loading, and measurements were made at 25°C.

Sample Preparation workflow: Sample mass was recorded in the HaikuFlow software using a connected XSR64 balance. Vials were placed in the sample preparation block with individually stirred positions after a PTFE stir bar and cap were added. No further user intervention was required. Dissolution solvent volume was calculated by the software and added to samples by the integrated syringe dosing pump. After a preset dissolution timer expired, samples were loaded and analyzed automatically.

Figure 1: P2/P1 Ratio Overlay 4 Polycarbonate samples, 2 replicates per sample. IVs range from 0.585 to 0.900 dL/g



Viscometers for Plastics and Polymers
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Experiment Results

These four grades ranged in Intrinsic Viscosity from 0.585 to 0.900 dL/g. All samples dissolved easily in chloroform, showing no signs of degradation over the course of the measurement. From vial to vial, less than 0.3% variability was seen indicating both a consistent preparation as well as uniformity in the polymer pellets and powders. From the start of sample weighing, through dissolution to analysis only 95 minutes elapsed and a total of 10 minutes of user attention was required.

Table 2: Results for 4 Polycarbonate Samples, 2 Injections Each

Sample Details			IV Results			Repeatability	
Sample ID	**Conc. (g/dL)**	**Analysis Time**	IV1	IV2	**Average IV**	Within Vial % RSD	**Vial-to-Vial % RSD**
S1	0.4000	16:26:22	0.5828	0.5870	**0.5849**	0.3586	**0.066**
S1a	0.4000	16:31:34	0.5854	0.5860	**0.5857**	0.0544	
S2	0.4000	16:36:46	0.7352	0.7355	**0.7354**	0.0213	**0.005**
S2a	0.4000	16:41:58	0.7348	0.7361	**0.7354**	0.0879	
C1	0.4000	16:47:10	0.8559	0.8567	**0.8563**	0.0435	**0.124**
C1a	0.4000	16:52:22	0.8579	0.8590	**0.8584**	0.0636	
C2	0.4000	16:57:34	0.8988	0.9009	**0.8999**	0.1157	**0.259**
C2a	0.4000	17:02:46	0.9031	0.9059	**0.9045**	0.1539	

Discussion

Each replicate finished in around 2.5 minutes, giving a total analysis time of approximately 5 minutes for each sample.

The low variance between **duplicate injections** shows complete **dissolution without degradation**.

The low variance between **replicate preparations** shows the **precision of the sample preparation**.

This data set was chosen from a larger array of PC samples to display the precision and resolution of the instrument. The tight tolerances allow polymer grades that differ by as little as 0.02 dL/g to be readily distinguished using this technique.

The viscosity measurement method used is in full compliance with internationally recognized standards including ASTM D5225 and ISO 1628-1 and represents the most advanced iteration of this technology available on the market.

For Polycarbonate samples, Intrinsic Viscosity (IV) is a critical-to-quality indicator of molecular weight, impacting mechanical properties and processability. High IV enhances toughness, strength, and impact resistance, essential for durable applications like automotive parts and medical devices. Low molecular weight eases processing but results in reduced strength and durability. IV also affects melt flow and stability during manufacturing, ensuring consistent quality.

The Model 575 Intrinsic Viscometer
Generation 2

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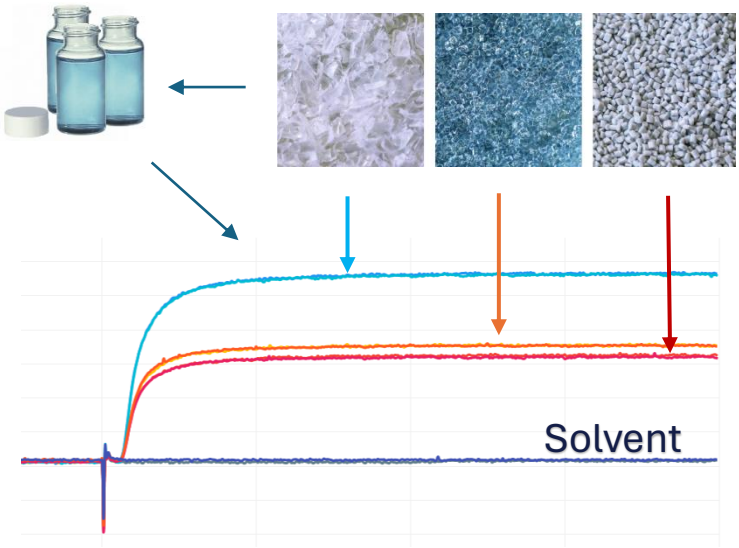
The Most Rapid and Reliable Measurement of Molecular Weight and Intrinsic Viscosity

Fully Automated Sample Preparation and IV Analysis According to ISO 1628 and ASTM D5225



Workflow Step	**Critical Advantages**
Sample Mass Determination	Guided Workflow with connected Analytical Balance
Solvent Dispensing	Fully Automated; no user interaction with solvents
Dissolution	24 Individually Stirred Autosampler Positions
Sample Analysis	Begins automatically after dissolution
Criterion	**Specification**
Viscosity Measurement Type	Dual Differential, Relative Viscosity, Forced Flow
IV Measurement Resolution	0.005 dL/g
Measurement Precision	Better than 0.2% RSD RV @ 0.800 dL/g
Shear rates	200-500 s^{-1} (typical, depending on application)
Sample Analysis Time	4-6 minutes per sample, includes duplicate injection
Solvent Compatibility	Organic, Aqueous, Acids, Halogenated
Temperature Range (Dissolution)	30°C to 160°C
Temperature Range (Analysis)	10°C to 160°C
Total Solvent Per Sample (prep + analysis + wash)	25mL
Integration, Compliance, Connection	LIMS/ERP, 21CFR part11, USB 2.0 / Windows 10

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