Rotational Viscosity Testing of Isocyanates with ViscoQC

Isocyanates are important raw materials in the chemical industry, for producing polyurethane foams/resins, paintings and glues. Easy and reliable viscosity testing with the ViscoQC series helps you characterizing your isocyanates and guarantees high quality of your end products.

1 Introduction

Isocyanates are a large group of organic chemicals used in the production of resins, paints and glues. A large application area is the manufacturing of polyurethanes which are synthetized from isocyanates. Depending on the type of isocyanates used, polyurethanes with different mechanical properties and characteristics can be created. They are used in the form of foams in vehicle construction or in paints and coatings because of their good adhesion properties to name only two of various available applications. The viscosity of isocyanates is used for classifying them and has a major influence on their properties and performance.

1.1 Keywords

Viscometer chemicals, isocyanates, diisocyanates, polyurethane, paintings, resins, glue, viscosity quality control, touch viscometer, rotational viscometer, dynamic viscosity, digital viscometer, determination of viscosity

2 Experiment

The viscosities of two different diisocyanate types were determined according to ASTM D 4889 - 04 using ViscoQC series with L-spindles. For quick single point checks a ViscoQC 100 - L is used. For multiple point measurements a ViscoQC 300 - L was used. The measurement method Speed Scan (SpS) even allows to determine a flow curve of the diisocyanate sample.

	Diisocyanate MDI and HDI	
Instrument	ViscoQC 100 - L	ViscoQC 300 - L
Measurement type	Single point	Multi point
Spindle/Guard	L1 / L-Guard	L3 / L-Guard
Speeds [rpm]	MDI: 12; HDI: 60	HDI:12 to 100
Temperature	Ambient conditions	
Accessories	Flexible Cup Holder	

Table 1: Configuration and measurement conditions for diisocyanate measurements.

2.1 Test Procedure and Conditions

- 500 mL of the sample were filled into a 600 mL glass beaker.
- Spindle guard and spindle were immersed into the sample.
- For temperature equilibration and homogenization, the sample was stirred at 1 rpm for 30 min prior to the measurements.

- For single point measurements with the ViscoQC 100, 10 measurements with a target time of 30 s were performed at 12 rpm and 60 rpm for the MDI and the HDI diisocyanate, respectively.

- For Speed Scan (SpS) measurements with the ViscoQC 300 a method with 2 steps was defined. Step 1 was defined as Speed Scan from the lowest to the highest speed (12 to 100 rpm) and step 2 was defined in the opposite direction (100 to 12 rpm). For both steps 15 points with a target time of 30 s were set.

As the ASTM D4889-04 requires only single point measurements, the speeds for the Speed Scan were selected in a way that they are recorded within the valid measurement range of 10 to 100 % torque.

3 Results and Discussion

The single-point viscosity value of each diisocyanate sample determined with ViscoQC 100 - L is given in Table 2.

	MDI diisocyanate	HDI diisocyanate
Speed [rpm]	12	60
Torque [%]	42	54
Viscosity [mPa·s]	208.0 ± 0.8	1085 ± 2

Table 2: Average viscosity values (n=10) of two diisocyanates (MDI and HDI) at 12 and 60 rpm measured with a ViscoQC 100 - L.

With ViscoQC 300 - L and the activated V-Curve software package, step programming is easily possible to obtain viscosity information at several speeds in e.g. an upwards and downwards Speed Scan (Figure 1).

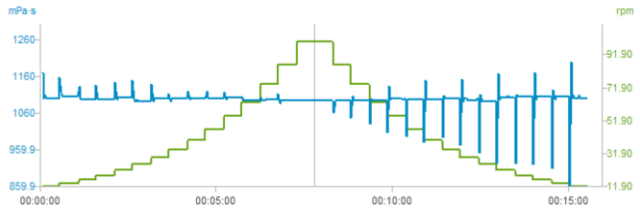

Figure 1: Step programming to investigate the flow behavior of diisocyanates at certain speeds *using the ViscoQC 300 with the software package V-Curve.*

With ViscoQC 300 and the activated V-Curve software package the high viscosity HDI diisocyanate was measured at several speeds. Newtonian flow behavior was observed. This means that the sample viscosity stays the same, no matter which speed/shear rate is applied to it. Results are given in Table 3.

	HDI diisocyanate
Speed [rpm]	12 to 100
Torque [%]	11 to 91
Viscosity [mPa·s]	1097 ± 4

Table 3: Average viscosity value of the HDI diisocyante at various speeds between 12 and 100 rpm (n=30), measured with a ViscoQC 300 - L.

Knowing the viscosity of diisocyanates is essential for determining their properties and when processing them into end products to meet their specifications. The right viscosity will ensure that e.g. glues do harden in a reasonable time and show good adhesion on the materials they are applied on. For time-dependent viscosity changes, like during a hardening process, Times Scans (TiS) can also be measured using the ViscoQC 300.

4 Summary

The ViscoQC series (Torque model L) with the L1 or L3 spindle that are contained in the standard delivery, is well suited for quality control measurements of diisocyanates. ViscoQC allows to find the correct application of this important group of raw materials with regard to their viscosity/flow properties.

The ViscoQC 100 offers fast single point viscosity checks at a certain speed.

Upgrading ViscoQC 300 with the V-Curve software package is adding step programming functionality for investigating the flow behavior in e.g. an upwards and downwards Speed Scan (SpS) of the samples at certain speeds.

If you have further questions regarding this application report, please contact your local Anton Paar representative.

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