Solutions for the paints and coatings industry
Analysis of viscosity (rotational)

Viscosity can be determined at a single point with a rotational viscometer which is sufficient for a quick check at the production line. To fully understand the flow behavior of your sample, a flow or viscosity curve is needed. This curve shows the behavior of a sample under varying conditions such as different shear rates, speeds, or temperatures. It is also possible to simulate the sample behavior, at high shear rates, e.g., during application.

Yield/flow point determination

The yield/flow point can be determined in either a rotational or oscillatory test.

Rotational: Set a torque (shear stress) ramp and determine the point when the sample starts to move. For quality control the shear rate is used for determining the yield point.

Oscillatory: Perform an amplitude sweep and determine the crossover point of the elastic and the viscous part ($G' = G''$).
Analysis of sagging and leveling behavior

Sagging and leveling behavior in the paints and coatings industry can be determined with the analysis of thixotropic effects. Thixotropy describes the ability of a sample to recover its inner structure completely after being destroyed by a force applied from outside. In the past, tests like the determination of the "hysteresis area" were performed for describing this behavior. Today, with Anton Paar’s highly precise rheometers, the thixotropic behavior is measured with the 3 interval thixotropy test (3 iTT) which can be performed either in rotation or oscillation, depending on the instrument type and your needs. The test can be used to make sure the paint shows recovery within the right time without leaving brush marks or other leveling problems.

Investigation of sedimentation stability

To ensure a good stability against sedimentation of the solid parts of the material, the sedimentation stability can be determined either on a short time scale (rotation) or on a long time scale (oscillation).

Rotation: To determine the short-term storage stability in rotation, a viscosity curve at low shear rates is measured (<1 s⁻¹); the higher the viscosity in the low-shear range, the better the stability.

Oscillation: To simulate the long-term stability of your paint and to avoid sedimentation or phase separation, a frequency sweep within the linear viscoelastic region must be performed. At low frequencies, the elastic portion of the sample should be above the viscous portion.

Investigation of curing and drying behavior

Determination of shelf life/pot life, physical hardening, crosslink reactions, and all kinds of curing can be detected. In rotation, measurements are limited to the point at which the sample cannot be sheared any longer. A typical measurement of pot life is the measurement of the viscosity until the viscosity is doubled.

Oscillatory tests by which the sample can be monitored from liquid to solid across all stages of reaction are more common.

A special case is the curing process of a powder coating sample: It starts with a solid (powder), then it becomes a liquid (melt), and turns into a solid again (cured sample). In this process the exact crossover temperatures of the sample can be determined.

For the Anton Paar MCR X2i series, various accessories are available which allow measurements of all kinds of curing/drying processes, e.g. UV curing. Additionally, it is possible to control the environmental conditions such as temperature and humidity during the measurement.
The whole world of viscometry and rheometry

<table>
<thead>
<tr>
<th>Description</th>
<th>ViscoQC 100</th>
<th>ViscoQC 300</th>
<th>RheolabQC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toolmaster™**</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Magnetic/quick connect coupling**</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Common test methods</td>
<td>Single-point viscosity measurement</td>
<td>Flow/viscosity curve</td>
<td>Rotational test for yield/flow point determination</td>
</tr>
<tr>
<td></td>
<td>Yield point determination</td>
<td>Rotational 3 interval thixotropy test (3iTT)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Investigation of time-dependent behavior</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measurement geometries</td>
<td>Relative spindles (L/RH), DIN/SSA spindles, vanes, glass rod</td>
<td>Relative spindles (L/RH), DIN/SSA spindles, vanes, glass rod</td>
<td>Concentric cylinders and cups, double gap, stirrers including Krebs stirrers</td>
</tr>
</tbody>
</table>

- ** for automatic tool recognition and configuration to ensure easy handling and minimize user errors
- ** for easy one-handed attachment/exchange of spindles, bobs, and measuring systems

---

**Viscosity Measurement**

- Single-point dynamic viscosity of high- to low-viscosity liquids for quick quality control
- Multi-point dynamic viscosity of high- to low-viscosity liquids for quick quality control
- Rotational rheological tests of materials ranging from low-viscosity to semi-solid samples

**Rheology Measurement**

- Rotational rheological tests with cup-and-bob, plate-plate, and cone-plate measuring systems for liquid to semi-solid samples
- Rotational and oscillatory rheological tests with cup-and-bob, plate-plate, and cone-plate measuring systems – for almost all kinds of samples
- Investigations into the viscoelastic properties of raw materials, formulations, and final products from QC to R&D
- Complete material characterization in research and development

**Common Test Methods**

- Single-point viscosity measurement
- Flow/viscosity curve
- Yield point determination
- Investigation of time-dependent behavior
- Rotational test for yield/flow point determination
- Rotational 3 interval thixotropy test (3iTT)

**Measurement Geometries**

- Relative spindles (L/RH), DIN/SSA spindles, vanes, glass rod
- Relative spindles (L/RH), DIN/SSA spindles, vanes, glass rod
- Concentric cylinders and cups, double gap, stirrers including Krebs stirrers
- Cone and plate, plate and plate, cylindrical geometries
- Cone and plate, plate and plate, cylindrical geometries
- Solid fixtures for films, fibers, and bars, fixtures for extensional rheology
- Three-point-bending, cantilever

---

**Viscosity Measurement**

- Single-point dynamic viscosity of high- to low-viscosity liquids for quick quality control
- Multi-point dynamic viscosity of high- to low-viscosity liquids for quick quality control
- Rotational rheological tests of materials ranging from low-viscosity to semi-solid samples

**Rheology Measurement**

- Rotational rheological tests with cup-and-bob, plate-plate, and cone-plate measuring systems for liquid to semi-solid samples
- Rotational and oscillatory rheological tests with cup-and-bob, plate-plate, and cone-plate measuring systems – for almost all kinds of samples
- Investigations into the viscoelastic properties of raw materials, formulations, and final products from QC to R&D
- Complete material characterization in research and development

**Common Test Methods**

- Single-point viscosity measurement
- Flow/viscosity curve
- Yield point determination
- Investigation of time-dependent behavior
- Rotational test for yield/flow point determination
- Rotational 3 interval thixotropy test (3iTT)

**Measurement Geometries**

- Relative spindles (L/RH), DIN/SSA spindles, vanes, glass rod
- Relative spindles (L/RH), DIN/SSA spindles, vanes, glass rod
- Concentric cylinders and cups, double gap, stirrers including Krebs stirrers
- Cone and plate, plate and plate, cylindrical geometries
- Cone and plate, plate and plate, cylindrical geometries
- Solid fixtures for films, fibers, and bars, fixtures for extensional rheology
- Three-point-bending, cantilever

---

**Viscosity Measurement**

- Single-point dynamic viscosity of high- to low-viscosity liquids for quick quality control
- Multi-point dynamic viscosity of high- to low-viscosity liquids for quick quality control
- Rotational rheological tests of materials ranging from low-viscosity to semi-solid samples

**Rheology Measurement**

- Rotational rheological tests with cup-and-bob, plate-plate, and cone-plate measuring systems for liquid to semi-solid samples
- Rotational and oscillatory rheological tests with cup-and-bob, plate-plate, and cone-plate measuring systems – for almost all kinds of samples
- Investigations into the viscoelastic properties of raw materials, formulations, and final products from QC to R&D
- Complete material characterization in research and development

**Common Test Methods**

- Single-point viscosity measurement
- Flow/viscosity curve
- Yield point determination
- Investigation of time-dependent behavior
- Rotational test for yield/flow point determination
- Rotational 3 interval thixotropy test (3iTT)

**Measurement Geometries**

- Relative spindles (L/RH), DIN/SSA spindles, vanes, glass rod
- Relative spindles (L/RH), DIN/SSA spindles, vanes, glass rod
- Concentric cylinders and cups, double gap, stirrers including Krebs stirrers
- Cone and plate, plate and plate, cylindrical geometries
- Cone and plate, plate and plate, cylindrical geometries
- Solid fixtures for films, fibers, and bars, fixtures for extensional rheology
- Three-point-bending, cantilever

---

**Viscosity Measurement**

- Single-point dynamic viscosity of high- to low-viscosity liquids for quick quality control
- Multi-point dynamic viscosity of high- to low-viscosity liquids for quick quality control
- Rotational rheological tests of materials ranging from low-viscosity to semi-solid samples

**Rheology Measurement**

- Rotational rheological tests with cup-and-bob, plate-plate, and cone-plate measuring systems for liquid to semi-solid samples
- Rotational and oscillatory rheological tests with cup-and-bob, plate-plate, and cone-plate measuring systems – for almost all kinds of samples
- Investigations into the viscoelastic properties of raw materials, formulations, and final products from QC to R&D
- Complete material characterization in research and development

**Common Test Methods**

- Single-point viscosity measurement
- Flow/viscosity curve
- Yield point determination
- Investigation of time-dependent behavior
- Rotational test for yield/flow point determination
- Rotational 3 interval thixotropy test (3iTT)

**Measurement Geometries**

- Relative spindles (L/RH), DIN/SSA spindles, vanes, glass rod
- Relative spindles (L/RH), DIN/SSA spindles, vanes, glass rod
- Concentric cylinders and cups, double gap, stirrers including Krebs stirrers
- Cone and plate, plate and plate, cylindrical geometries
- Cone and plate, plate and plate, cylindrical geometries
- Solid fixtures for films, fibers, and bars, fixtures for extensional rheology
- Three-point-bending, cantilever

---

**Viscosity Measurement**

- Single-point dynamic viscosity of high- to low-viscosity liquids for quick quality control
- Multi-point dynamic viscosity of high- to low-viscosity liquids for quick quality control
- Rotational rheological tests of materials ranging from low-viscosity to semi-solid samples

**Rheology Measurement**

- Rotational rheological tests with cup-and-bob, plate-plate, and cone-plate measuring systems for liquid to semi-solid samples
- Rotational and oscillatory rheological tests with cup-and-bob, plate-plate, and cone-plate measuring systems – for almost all kinds of samples
- Investigations into the viscoelastic properties of raw materials, formulations, and final products from QC to R&D
- Complete material characterization in research and development

**Common Test Methods**

- Single-point viscosity measurement
- Flow/viscosity curve
- Yield point determination
- Investigation of time-dependent behavior
- Rotational test for yield/flow point determination
- Rotational 3 interval thixotropy test (3iTT)

**Measurement Geometries**

- Relative spindles (L/RH), DIN/SSA spindles, vanes, glass rod
- Relative spindles (L/RH), DIN/SSA spindles, vanes, glass rod
- Concentric cylinders and cups, double gap, stirrers including Krebs stirrers
- Cone and plate, plate and plate, cylindrical geometries
- Cone and plate, plate and plate, cylindrical geometries
- Solid fixtures for films, fibers, and bars, fixtures for extensional rheology
- Three-point-bending, cantilever