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Proper methods of measuring starch adhesive viscosity

Scope

This Technical Information Paper provides information on the proper methods of measuring starch adhesive viscosity using the Stein Hall cup and the Harper Love cup. It has been prepared for the benefit of the corrugating industry by the In-Process Subcommittee of the Process Control and Quality Assurance Committee.

What is viscosity?

The viscosity of starch adhesive or any other liquid is defined as *resistance to flow*.

Safety precautions

Wear eye protection when handling starch based corrugating adhesive. Avoid prolonged skin contact of starch based corrugating adhesive. Wash your hands after each viscosity evaluation.

Properties

Why is starch adhesive viscosity important?

Starch adhesives viscosity has a direct or indirect impact on the following: raw starch suspension, water holdout, initial starch adhesive penetration, initial adhesive tack, film forming properties, and pick up and transfer characteristics.

How is starch adhesive viscosity measured?

Starch adhesive viscosity can be measured by a variety of cup flow devices. Regardless of the type of device used, it is important that the cup be clean and warmed to the adhesive operating temperature. A reliable timing device must be used during each measurement.

The two most common methods and equipment used for starch adhesive measurement are explained below.

Stein Hall cup

This familiar device is an open top tube with a flow control orifice on the bottom and two flow level pins mounted on the inside Viscosity unit = second(s).

Calibration

1. Fill the Stein Hall cup to the top with room temperature [$22^{\circ}\text{C} \pm 0.5^{\circ}\text{C}$, ($72^{\circ}\text{F} \pm 0.5^{\circ}\text{F}$)] water.
2. Allow the water to flow out of the bottom orifice.
3. Using a stopwatch, measure the time it takes for the water level to pass from the point of the top flow level pin to the point of the bottom flow level pin.
4. The measured time should be $15 \text{ s} \pm 0.5 \text{ s}$.
5. If elapsed time is out of the prescribed range, bend the pins to accommodate.
6. Repeat steps 1,2,3,4, and 5 until a consistent reading of $15 \text{ s} \pm 0.5 \text{ s}$ is obtained.

Viscosity measurement

1. Using a strainer, fill the Stein Hall cup with starch adhesive that is free of small particulate contamination.
2. Allow the adhesive to warm the cup to the adhesive operating temperature.
3. Refill the Stein Hall cup with fresh strained adhesive.
4. Allow the adhesive to flow out the bottom orifice.
5. Using a stopwatch, measure the time it takes for the adhesive to pass from the point of the upper flow level pin to the point of the bottom flow level pin.
6. Record the elapsed time.
7. Repeat at least twice to ensure reproducibility.

Harper Love cup

The Harper Love cup is an open top tube with a flow control orifice on the bottom and a low level crossbar positioned 3 3/4 in. below the open top. A handle is attached to the cup to facilitate its use. Viscosity unit = second(s).

Calibration

1. Using the handle attached to the cup, lower the Harper Love cup into room temperature [$22^{\circ}\text{C} \pm 0.5^{\circ}\text{C}$, ($72^{\circ}\text{F} \pm 0.5^{\circ}\text{F}$)] water.
2. Lift the cup out of the water with a deft motion and use a stopwatch to time the flow once the top of the cup clears the surface of the water.
3. Stop the timing sequence when the water level passes the low level crossbar.
4. The measured time should be 6.25 seconds (± 0.25 seconds).
5. If the measured time is outside of the given range, a new Harper Love cup should be obtained.

Viscosity measurement

1. Immerse the Harper Love cup into the starch adhesive for at least 10 s to allow the cup to warm to the adhesive operating temperature.
2. Lift the cup with a deft motion out of the adhesive and use a stopwatch to time the flow once the top of the cup clears the surface of the adhesive.
3. When the adhesive level passes the low level crossbar, stop the timing sequence.
4. Record the elapsed time.
5. Repeat at least twice to ensure reproducibility.

Keywords

Starch, Viscosity, Adhesives