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Some questions and answers on gel temperatures and on the gel temperature test for corrugating adhesives

Scope

The gel temperature is the temperature at which a water-starch mixture changes from a liquid slurry to a gelatin-like solid. This is the point at which the material begins to function as an adhesive.

Safety precautions

Eye protection should be used when mixing chemicals. Caution should be used when working with high temperature liquids.

Why should a gel temperature test be run?

The most important reason is to measure how uniformly your adhesive is being made. A consistent gel point range in fresh batches day after day will tell you that both your raw materials and your makeup procedures are holding constant. A change in gel point, outside of the normal range, will immediately alert you that something has changed. Have you just changed starch suppliers; received a new shipment of caustic, borax or starch, or started-up a new starch preparation unit; or is there a mechanical or electrical maintenance problem? Whatever the problem, running gel point on fresh batches in a consistent way can alert you to problems before they become serious.

Why are gel temperatures of corrugating adhesives different from plant to plant?

The most important reason gel temperatures vary is because of the needs of different corrugators.

High speed corrugators need starch adhesives with lower gel temperatures. Corrugators with high temperature preheaters and a sufficient number of hot plates can run successfully with higher gel points, whereas “cool” corrugators need lower gel points.

Many plants vary the gel points of the single-facer and double-facer adhesives. Plants often run gel points as low as possible on the double backer to assure quick bonding at high speed. They run higher gel points on the singlefacer to avoid premature gelling of starch in the pan and on fingers. On fingerless single facers, gelling in the pan is not a major concern if the cooling jackets are set correctly and functioning properly.

What are some typical gel temperatures?

In dual formula plants, typical gel temperatures are: singleface adhesive, 146-150°F (63-65.5°C); double-faced adhesive, 140-144°F (60-62°).

In plants that use a single formula, the gel point is often compromised in the 144-146°F (62-63°C) range.

TIP Category: Automatically Periodically Reviewed (Ten-year review)



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As corrugators run faster and faster, the need for lower gel temperatures increases. Some specialty starch formulations result in gel temperatures down into the middle 130°F (54°C) range. On corrugators that run substantial quantities of high density liners, care must be taken that the gel point is not too low, or it may contribute to forming of shallow or brittle bonds at both the single facers and glue machine. Targeting a gel point of 146° to 148°F aids in penetrating densified liners and mediums.

How can gel temperatures be varied?

Gel temperatures can be adjusted through changes to the starch adhesive formulation. Starch alone in a water suspension will gel at about 160°F (71°C).

The addition of caustic to the starch-water mixture causes a significant reduction in the gel point. This reduction varies with the weight of caustic soda added. The addition of borax to the starch-water-caustic mixture will raise the gel temperature slightly. This increase also varies with the amount of borax added.

Gel temperatures also vary because starch is a natural product. The characteristics of starch can vary from year to year or area to area due to variations in climactic conditions during growth and harvesting. Starch can also vary due to differences in processing conditions. Because of these variations, different batches of starch will react slightly differently to caustic and borax addition.

In addition, the pH of the water being used will influence adhesive gel point. Plants using recycled water from waste water treatment systems can see swings in viscosity and gel point due to fluctuations in water pH. Bacteria infestation, which will reduce pH, can also affect the gel point.

Another reason that gel points vary from plant to plant is formula and differences in starch supply.

Do gel temperatures drift with time of storage?

Yes. Generally speaking, the gel point will rise over time.

If the gel temperature drifts, how can you assure meaningful gel point test results?

The secret of obtaining meaningful test results is in the proper sampling of the adhesive. There are basically two kinds of adhesive on which you can run the gel temperature test. One is green adhesive which is freshly prepared adhesive. The other is process adhesive, which is older adhesive that has been circulating between storage tanks and the corrugator.

A green adhesive sample should be taken from the mixer right after the batch has been completed and just prior to its being pumped to storage.

Process adhesive samples are taken from either the storage tank or from the overflow lines from the adhesive pans on the corrugator. A good time to take this sample would be the first thing in the morning, prior to any fresh adhesive being added to the circulating system.

Green adhesive gel temperatures are usually lower than the corresponding process adhesive gel temperatures. Green adhesive gel temperatures are usually more reproducible than are process adhesive gel temperatures. This is because the drift referred to above has not progressed very far.

Once again, good sampling techniques involve getting samples at the same places as close to the same time as possible every day.

Who should run the gel temperature test?

The first choice would be the person closest to the adhesive preparation process. In the case of a manual system, this would be the person making the batches. In an automated system, it would be that person who supervises the system.

The technique of the primary tester should be audited occasionally by the box plant's quality control supervisor or by a technician from the company supplying starch to the box plant.

Keywords

Gels, Sodium hydroxide, Sodium borate, Single facers, Gluers, Temperature