C☆iGum™ modified starches for high bonding performance

Making the adhesive difference in your corrugated board production with your star for starch

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INTRODUCTION:

Machine performance, cost-in-use, glue-and energy-consumption are all key criteria for a successful and efficient operating corrugator. The impact of modified starch in the corrugating adhesive is often underestimated, with this key component instead treated as a simple commodity product. This is an oversight, as good quality modified starches can make the difference in corrugated board production. In fact, modified starches play an increasingly significant role in unlocking the full potential of modern corrugating machines. That's where Cargill comes in as "your star for starch" to help deliver the solutions for your success.

Starch types and process for glue formulation

Botanical origin has long been considered as the main criteria in starch selection when targeting specific gluing characteristics for a wide range of corrugated board products and applications.

Application specialists were confronted with the decision on which starch type to go for to reach enough machine and bonding performance, and how to define glue recipes accordingly.

The main botanical sources of starch used for glue formulations are wheat, corn, potato and pea (see Picture 1).

- Corn starch adhesives typically require more caustic and are less responsive to energy and Borax. This makes them well suited for boards that are produced at lower speeds and those that require more heat (e.g. Kraft liner papers) and heavy board production.
- Wheat starch glues can be set up for lower gel-point temperatures. They may require less energy and build up viscosity faster when exposed to heat. Hence, they are ideal for fast running machines with high production rates.
- Potato or pea starch glues are sometimes used to ensure good ply bonding if there is a lack of initial tack due to more difficult energy transfer. They are suitable for challenging applications, e.g., for the upper double backer on triple wall machines.

In this context, synthetic additives like rheology modifiers or performance enhancers have also made their way into glue formulations. However, this is increasing complexity in the glue kitchen and significantly affects adhesive cost.

While various glue preparation concepts have been developed during the last decades, the Stein-Hall process remains the most widely used by far. This process can either include the classical 1-tank concept or a modern 2-tank system, with the latter offering high glue preparation capacities with relatively small tank volumes.

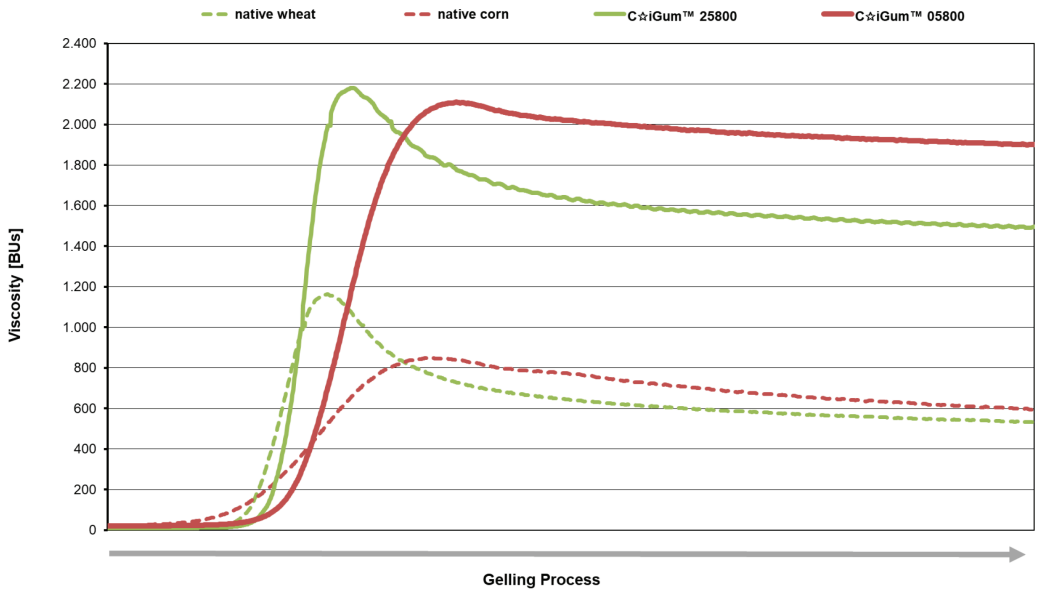
For the Stein-Hall adhesives, roughly 10-15% of the total starch in the adhesive is hydrolyzed to form a viscous fluid.

This fluid stabilizes the suspended secondary starch, but also helps to determine the rheological behavior of the adhesive during the various process stages and conditions along the corrugator.

The other 85-90% of the total starch content remains dispersed in the granular form and is not activated in the cold adhesive. When exposed to heat, however, it drives the overall glue viscosity level and so leads to glueing the paper plies together.

Picture 1:

Corn and wheat as raw materials of C☆iGum™



Graph 1:

C☆iGum™ starches show a more dynamic temperature response during the gelling phase and a higher viscosity level vs native starches

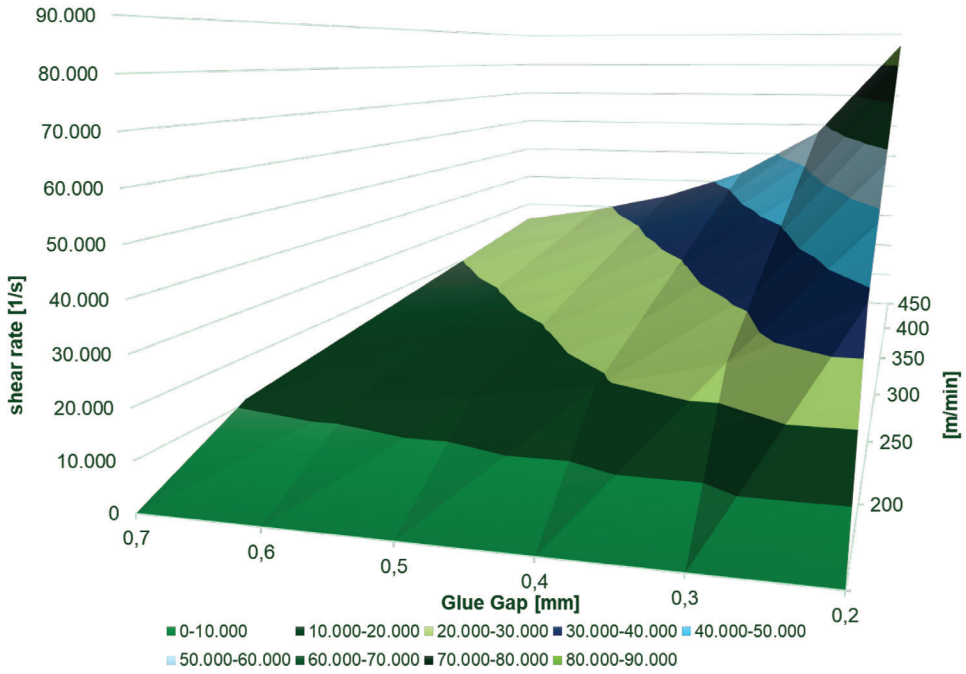
C☆iGum™: A new generation of corrugating starches

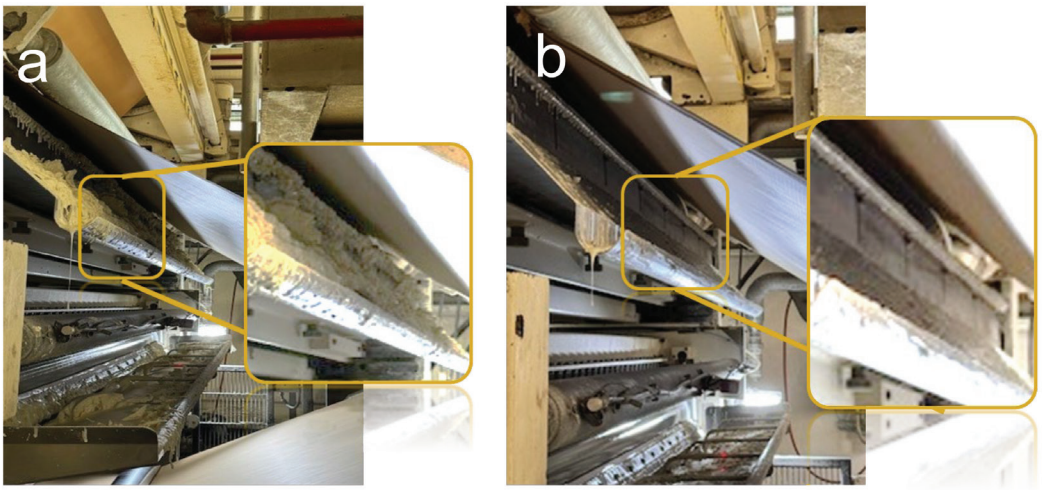
In this application environment, the new generation of modified starches is much more advanced when compared to the native starches. Modified starches like Cargill's new C☆iGum™ are specifically designed to unlock full machine performance, while keeping up with the latest machine trends and developments and also simplifying the glue formulation back to a minimum/its' basics (see Graph 1 above).

The basic technical requirements have not changed. Glue viscosity must be reproduceable and stable over a long period of time. But nowadays with modified starches, the glue characteristic becomes much more dynamic and optimized for its point of use.

Graph 2:

Expected Shear Rate [1/s] between Squeeze roll and Applicator roll





Picture 2:

Behavior of 2 glue recipes in a corrugator's gluing unit: a) glue with standard formulation causing glue build-up from splashing; b) glue with improved formulation showing much cleaner glue trays

The glue formulations need to take this into account and the glue batches are typically measured with higher cup viscosities (Stein-Hall, Lory, Love, etc.), when compared to native adhesives.

C☆iGum™ products bring significant advantages in both carrier and secondary starch functionality:

Carrier functionality: While in storage, a slightly higher adhesive viscosity is preferred to avoid sedimentation of the granular secondary starch and keeping it homogeneously distributed within the liquid.

In the glue gap, a low viscosity is beneficial to improve film dosage on the applicator role and to reduce hydrodynamic forces to the doctor roll. This is an aspect that becomes increasingly important the higher the corrugator speed gets and in cases where glue gaps are running at minimum (see Graph 2 bottom left). At this stage, it again becomes possible to control the amount of adhesive, and hence water, which gets in contact with the board. In this way, it ensures that there is always the right amount of glue available for achieving the targeted bonding strength.

The short glue texture achieved with C☆iGum™ helps to reduce the risk of splashing (see Picture 2 above) and a better controlled adhesive positioning to the flute tips becomes possible. At the same time, the glue can sufficiently penetrate into the paper to secure a good anchoring of the starch.

Secondary starch functionality: Another aspect is the gelatinization speed and glueing power of the secondary starch.

In a Stein-Hall adhesive, roughly 85-90% of the starch is still in its granular form and only starts gelling when a defined temperature is exceeded (gel-point temperature). At this point, it is important that the viscosity ramps up fast enough to an elevated level so that sufficient bonding force is created to pass the down-stream slitter-scorer unit securely (see Graph 1).

When using C☆iGum™, the just gelled gluing lines are more mature and rigid. This helps in avoiding common board defects like delamination issues or glue deposits on the circular knives. The board is ready earlier for further conversion without extended curing time.

The starch solution for corrugators

Modified starches from both wheat and corn, represented by Cargill's C☆iGum™ corrugated portfolio, can help take corrugators to a high performance level, without adding further process complexity to the adhesive preparation processes, and without compromising on machine efficiency or board quality.

Glues made with C☆iGum™ have more glueing power, as well as being more dynamic, responsive and easily controllable on the flute tips. This avoids excessive glue usage and helps to improve board flatness already at the stacker.

The rapid and strong heat response makes these solutions attractive for fast running corrugators. This is not only the case for single wall board but also for double and triple wall machines, running with heavy and Kraft papers.

Moreover, costly starches or additives can be avoided and simplified glue recipes can be obtained. This allows the corrugator to produce at the highest level of efficiency and maximum output, reaching better quality while reducing drying energy and glue consumption.

Visit our website Corrugated | Paper & Board | Bioindustrial | Cargill to learn more and connect with our experts.