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STARCH MIXING SYSTEMS AND VISCOSITY CONTROL

FACTS AND PERCEPTIONS

Several times, I have been asked to write about the status of viscosity control in starch mixing systems, a subject that has gained much interest since the (re)introduction of 'No Carrier' mixing systems. It has also gained in interest, because it is being claimed that untreated wastewater can be used to make glue and still produce it correctly, with the right viscosity.

This is however only partially true; but since it appeals to the boxplants, some critical observations are sometimes ignored.

Let me briefly explain the functions of the glue's components — water, starch, NaOH (Caustic) and Borax.

- **Water function:**
Wet the paper;
Gelatinisation of the starch.

- **Starch function:**
Carrier of the adhesive (secondary starch); *and/or* Final bonding of the paper.

- **NaOH function:**
Reduce gelatinisation temperature;
Increase penetration into the paper.

- **Borax function:**
Increase of viscosity on gelatinisation;
Improvement of film-forming ability of the glue;
Reduce penetration into the paper.

In a Stein Hall principle system, the viscosity is determined by the ratio of primary over secondary. Of course, the carrier (primary) can have different ratios of water, starch and caustic. However, whatever these ratios are, the final viscosity depends on the ratio of primary (carrier) over secondary. This is why

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once this ratio is chosen, (and assuming all ingredients were dosed correctly), the viscosity can only deviate if one or more of these ingredients does not have the specifications as assumed.

This could be the water, with a different pH value, which influences the effect of caustic; residual starch in the (waste) water or other solids; and the starch quality (only in rare cases).

In modern systems, the glue is mixed aggressively in Hi-Shear mixers, which brings the viscosity reached to a threshold value which is stable, (under most circumstances).

I should emphasise that this flow viscosity, which is commonly used to analyze the characteristics of the glue, is then stable within +/-2 seconds SH and of course, related to the temperature when measured. Viscosity obviously changes with temperature. In practice, given correct ingredients, including wastewater, (but treated and stabilised), gives plenty of assurances for a reliable operation.

The excitement about 'No Carrier' (under the impression that it can use wastewater without treatment) has raised the requirement for Stein Hall systems to also have a viscosity control. We designed such a system and have it operational and another supplier did something similar. It makes the mixing process more complicated and the system more expensive. Basically, this solution allows the system to 'change' the ratio of primary over secondary at the end of the batch preparation, triggered by the viscosity meter, which records the threshold viscosity.

In a 'No Carrier' situation, this is quite different — the viscosity of the glue is developed by the amount of caustic in the complete batch and this development is stopped once the viscosity reaches a predetermined point. To a larger extent — indeed independent from the pH value of the water or other inconsistent ingredients — such viscosity development is stopped. The 'stopping' is achieved by adding Boric Acid. The viscosity reached however, is not the final viscosity, and in spite of the availability of reliable and accurate viscosity meters nowadays, the stability of the glue is not assured. This is why in most of these systems, additives are commonplace. If the pH value varies within a narrow bandwidth and the amount of solids is almost constant, every system can handle 'waste' water. When, however, the pH value changes beyond the narrow bandwidth or the solids amount is not stable, then formulation changes are needed — adding additives and/or creating completely new recipes.

Truthfully, if someone asks me whether to purchase our viscosity control, I usually advise them not to, since when proper ingredients are used, the consistent and repetitive performance of our systems makes it an overkill. ■