December 06, 2018

SYSTEM FOR SUPPLYING HIGH SHEAR STARCH TO A GYPSUM BOARD MACHINE AND METHODS OF MANUFACTURING GYPSUM BOARD USING HIGH SHEAR STARCH

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NGC-65-DPUB

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SYSTEM FOR SUPPLYING HIGH SHEAR STARCH TO A GYPSUM BOARD MACHINE AND METHODS OF MANUFACTURING GYPSUM BOARD USING HIGH SHEAR STARCH

[0001] The present disclosure provides systems for supplying high shear starch to a gypsum board machine and methods of manufacturing gypsum board using high shear starch. These systems and methods may improve the effectiveness and efficiency of starch utilized as a gypsum core binder and may further improve the core qualities of wallboard.

[0002] The adhesive and/or pasting properties of starch are important in improving the core qualities of gypsum board, such as paper to core bond and strength of gypsum board while curing during the manufacturing process. In order to further improve these qualities in the board, cementitious material containing gypsum may be hydrated in the presence of high shear starch produced according to the present disclosure.

[0003] The present disclosure may provide starch with enhanced adhesive properties by increasing its peak viscosity and decreasing its gelling/pasting temperature. This may allow for improved strength properties of the gypsum board and/or a reduction in the amount of starch utilized in the gypsum board manufacturing process.

[0004] As shown in Figure 1, the starch gelling temperature can be lowered (shifted to left as shown in dotted red line) by dispersing starch in hot water (150 °F) and shearing it with a high shear pump as shown in Figures 2 and 3. Sodium trimetaphosphate (STMP) may also be added together with the starch, which may further improve the adhesive properties of the starch, as well as the peak viscosity and gelling temperature. Figure 1 shows a starch viscosity profile, or amylogram. The adhesive property of starch can be enhanced by improving the peak viscosity and reducing the gelling temperature. This is shown in Figure 1 as a reduction in peak viscosity, which may be accomplished through mechanical means (e.g., high shear) and/or through chemical means (e.g., adding STMP).

[0005] All or a portion of the starch used in the gypsum board manufacturing process may be high shear starch, supplied as shown in Figures 1 and 2. The starch may be sheared continuously using the setup shown in Figures 1 and 2 and fed to the slurry in the pin mixer. The high shear starch may be produced by feeding desired amounts of dry starch, water (of various temperatures up to 180 °F) and any additives that may be desirable through an Axiflow pump (twin screw pump) and then passing this blend of starch, water and additive mix through a high shear pump. This high shear starch may then be fed to a pin mixer directly or through gauging water. Various additives such as lime, STMP, enzymes, etc. can also be added to the system to decrease the gelling/pasting temperature of the starch. The presently disclosed systems and methods may enhance adhesive property of starch, which may improve not only the paper to core bond, but also the strength of gypsum crystal strengths as gypsum crystals formed during the stucco hydration may become coated with the high shear starch prior to drying in the kiln. By contrast, with dry starch, gypsum crystals are coated during the drying process in the kiln.

[0006] Gypsum board was produced using high shear starch. It will be appreciated that the quantities and values reported upon are not to be limiting. In fact, other values and quantities are contemplated, all of which are within the spirit and scope of the present disclosure. High shear starch was produced by feeding 10 lbs/msf of starch along with 150 °F hot water (50 lbs /msf) and 1 lb. STMP through an axiflow pump and then by passing it through high shear pump. This blend was then introduced into a pin mixer.

[0007] Gypsum board was produced. The gypsum board was ½” HSL board. Total starch was kept constant at 26 lbs/min. The manufacturing process was allowed to stabilize, and then 10 lbs of high shear starch were introduced at 5 lb increments, while dry starch was correspondingly removed. The manufacturing process was again allowed to stabilize, and STMP was added along with the high shear starch. The manufacturing process was again allowed to stabilize and then 5 lbs of dry starch were removed, reducing the total starch to 21 lbs/msf. The manufacturing process was again allowed to stabilize and then an additional 5 lbs of starch were removed, reducing the total starch to 16 lbs/msf. The drying kiln was adjusted corresponding to the reduction in starch, and in total about 80^{o}F heat was removed. Lastly, in order to further improve the bubble structure in the core, the alkyl ether sulfate anionic surfactant was adjusted (lowered) and the foam air was adjusted (increased). This increased the bubble size from about 150 microns to about 250 to 325 microns.

Figure 1: Viscosity of Starch as a function of Temperature and Time.

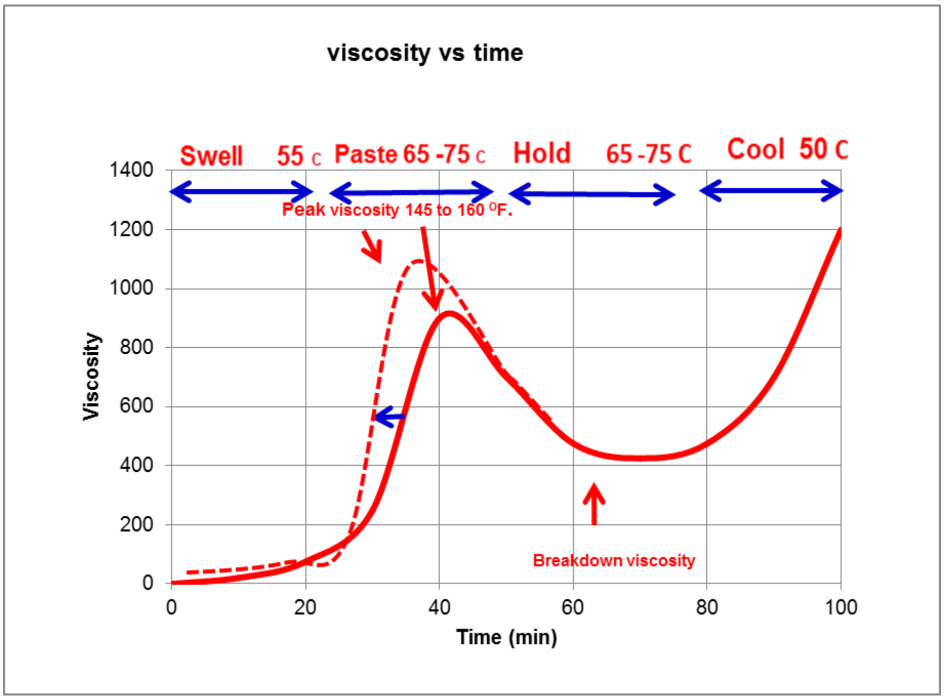

Figure 2: Flow diagram of set up for shearing the starch.

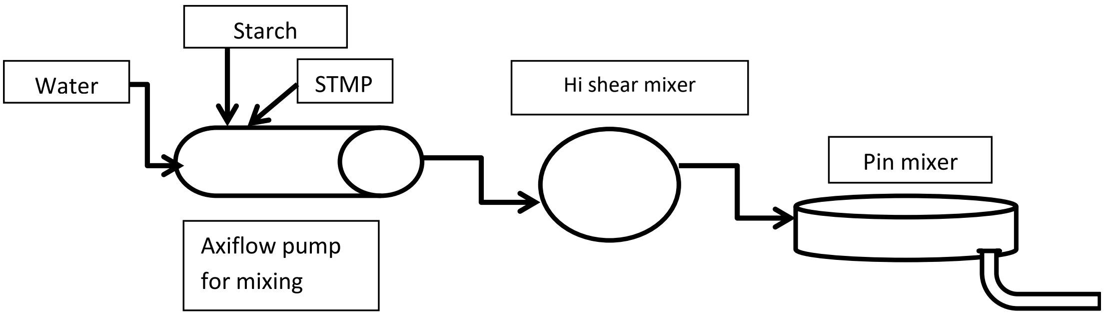

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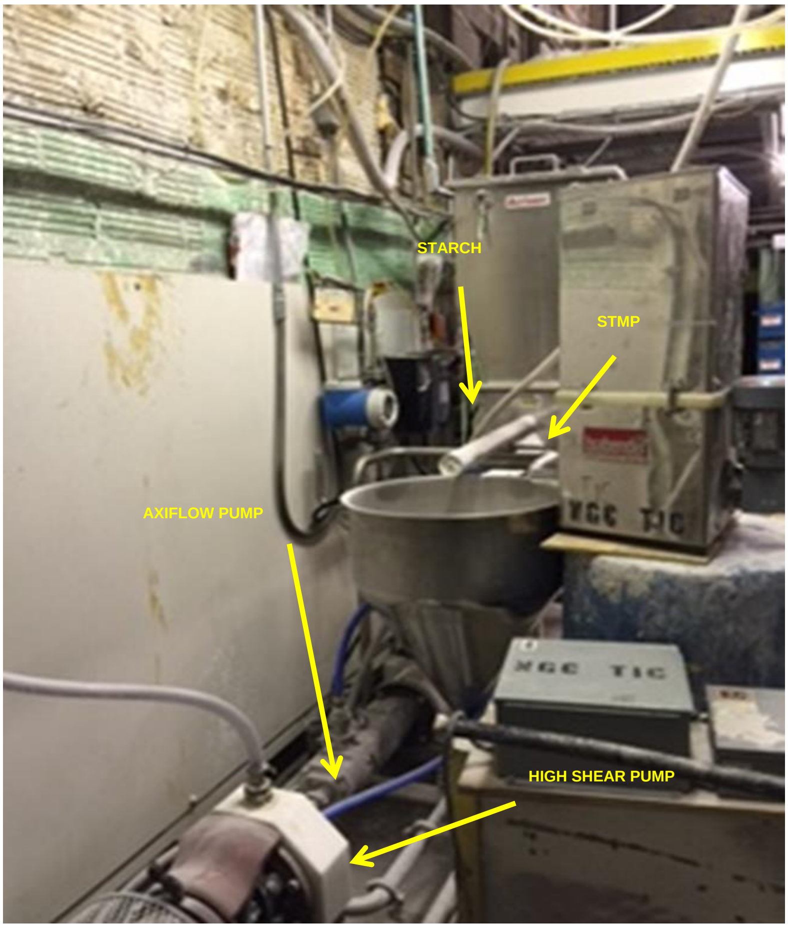
Figure 3: High shear starch system setup.



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