Measuring Shives to increase productivity

White Paper: Measuring Shives to increase Paper making productivity

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Unbleached Chemical Pulp

The goal of any pulping operation is to completely convert wood into a Papermaking quality pulp. As 100% efficiency is not economically feasible, all pulping operations produce shives that contaminate the produced pulp.

What is a shive?

In theory, a shive is any particle larger than a single fiber.
In practice, a shive is a particle or fiber bundle large enough, or in enough quantity, to produce a paper and board quality or productivity problems. Normally this particle has a thickness, or third dimension, that separates if from being benign to being problematic.

For example:

- Shives in bleached pulps show up as dirt in paper or board.
- Shives in unbleached pulps reduce print quality, reduce end strength, decrease runnability, and present visual defects.
- Shives in mechanical pulps cause paper machine breaks, off set printer linting, pick outs, coater scratches, visual defects and reduce print quality.

In short, the presence of shives in pulp is problematic to meeting customer expectations and maintaining optimum production costs.

In any pulping operation, a practical balance is struck between theoretical desirability and economical feasibility.

This balance can be labeled and optimized by measuring the shives produced at each process location to develop a Shive Process Profile.

The quantity of shives in a pulp sample is normally only of concern when a pulp is delivered to a bleach plant or paper/board machine. However, both the quantity and the quality, or character, of the shive fraction is important when assessing the impact of changes in pulping condition. To comment on the quality and quantity of shives, they must first be isolated then measured.

A shive analyzer, such as the one make by Pulmac International, uses a low-consistency, rigidly controlled screening environment to repeatably separate a shive fraction from pulp using a pattern of narrow slots as a screening barrier.

The quantity of shives isolated by a shive analyzer depends on the percentage of shives in the pulp sample, the size of the pulp sample processed, and the specific dimensions of the screen plate slots. Control of the sample weight delivered to the analyzer and selection of the appropriate dimension for screen plate slots will ensure the isolation of a shive fraction that precisely reflects the character and quantity of shives in the original sample. Optical inspection of this shive fraction provides a reliable shive label. This optical analysis can be supplemented by weight determination for ongoing monitoring purposes.

Use of screen plates with different slot dimensions alters the shive retention probability. This is shown in Figure 1, where the retention probability of a shive is illustrated as a function of the shive size in relation to specific slot dimensions. The size relation of shives to fibers is also illustrated by including the particle size distributions for typical mechanical and chemical pulps. The data show that the selection of slot dimension is determined by particle size and quantity of the shive fraction. For example, typically 0.008" (200 um) slots are used for High Yield Kraft, 0.006" (150 um) for NSSC and softwood bleachable grade chemical pulps, and 0.004" (100 um) for mechanical pulps and hardwood bleachable grade chemical pulps .

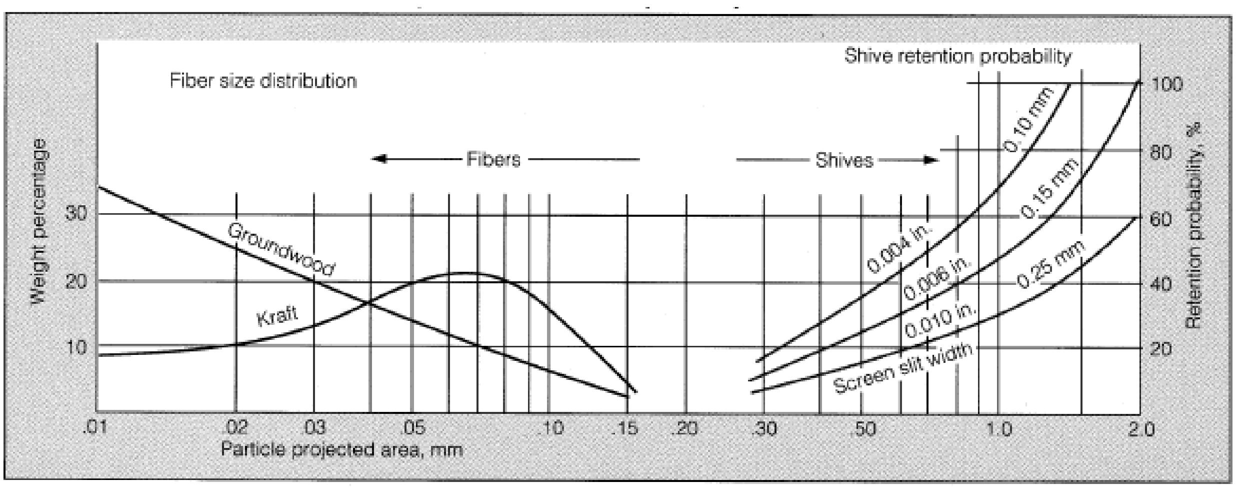

Figure 1: Shive retention probability compared to screen plate slot size

In chemical pulping, the kappa number is conventionally used to provide feedback that supports maintaining optimum pulping conditions. However, this test provides only partial and indirect statements of the papermaking quality of the pulp produced. Certain process variations can alter the papermaking quality of the pulp without inducing changes in the kappa number.

More directly related to the papermaking quality of pulp from any pulping operation is the quality and quantity of the shive fraction. A close relationship exists between the properties of the pulp produced by any pulping operation and the properties of the shive fraction. Both are an integral and inseparable part of the same material mix.

In a single pulping operation, it is not possible to “work” only on the shive fraction in the pulp without working on the rest of the pulp as well. So the properties of one part of the material mix will reflect those of any other part. It is for this reason that careful observation of the shive fraction can be used to label the papermaking quality of the pulp.

The general relationship between the kappa number of a particular unbleached kraft pulp and its shive content was measured. (see figure 2) Conventional wisdom suggests a strong relationship between kappa and shives where low kappa generates low shives and high kappa generates high shives. However, there are often conditions where shive content is increasing at a constant kappa. This occurs when the level of cook uniformity decreases. So non-uniform cooking will increase shives at the same kappa number. Increasing the H factor by temperature, chemical concentration or pressure to increase output (i.e. reduce overall cooking time) will target the same kappa number but can produce higher shive content. The more non-uniform chip size going into the digester, the higher the shive content will be. (Assuming the same kappa targets are in place.) Measuring shive content more accurately reflects chip variation than the kappa test. Information from shive analysis could be incorporated into digester control. (see figure 3)

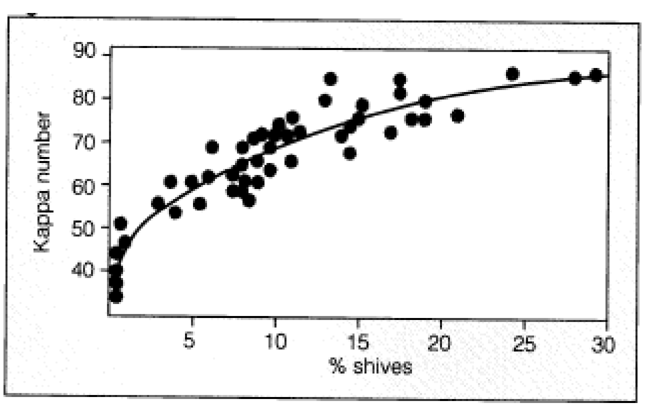

Figure 2: Data relationship between kappa and shives.

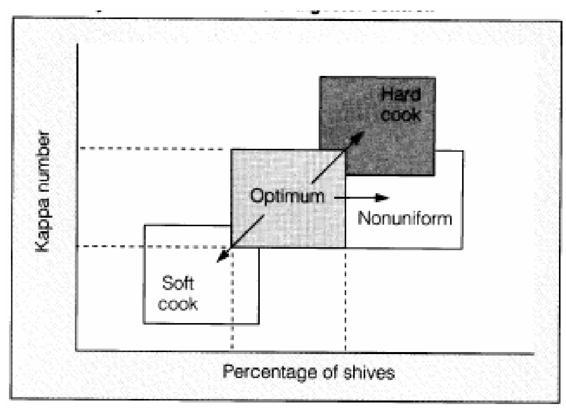

Figure 3: Qualitative relationship between kappa and shives.