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All strength is not created equal

Strength is no longer a value-added component of creped products; it is a requirement for most if not all consumer brands. There are many methods employed in the industry to achieve a stronger product.

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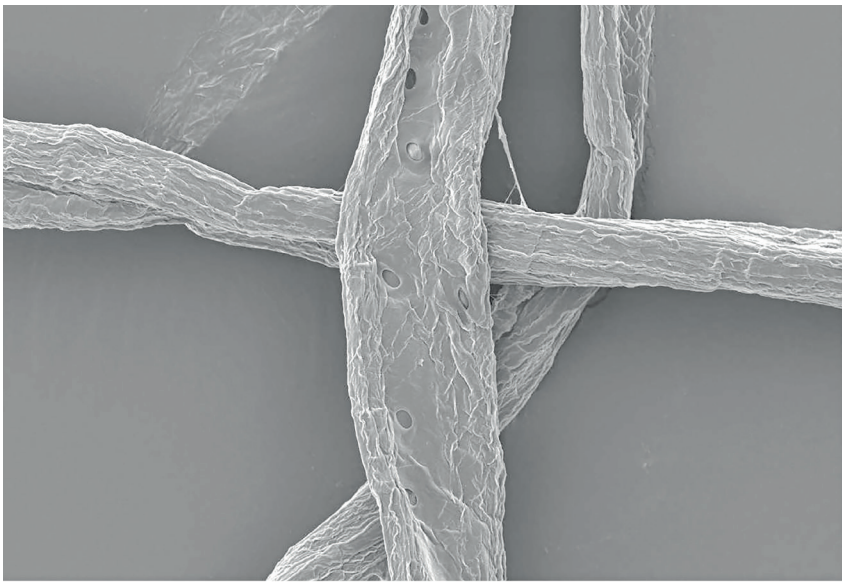
It is essentially impossible to have a strong final product on the shelf or in the dispenser without a properly strong base sheet. Stated another way, a strong tissue product begins with a strong base sheet. The process to achieve the required strength makes all the difference in the final product's appeal. All strength is not created equal. A discussion follows of the most common way to achieve strength, as well as a new way.

Refining: Most if not all tissue manufacturers utilize refining to get additional strength development. Fibrillation of the fibers creates bonding sites essential for strength development. The old adage that if a little is good, more must be better certainly does not apply to refining in tissue mills. Refining creates fines and flattens fibers. Flattened fibers are stiffer and less bulky. Loss of bulk is certainly not desirable. As drape and bulk are often used as measures of softness, these base sheet properties are going in the wrong direction for a soft sheet. Equally as detrimental are the fines that are created by refining.

These fines reduce drainage, reduce softness, impact hand feel, create dust and become part of the coating on the Yankee. The objective is three-dimensional structure of the fiber or creating excessive amounts of fines.

A new approach: what if there was a way to obtain the ideal amount of fibrillation without flattening or cutting the fibers? There may be

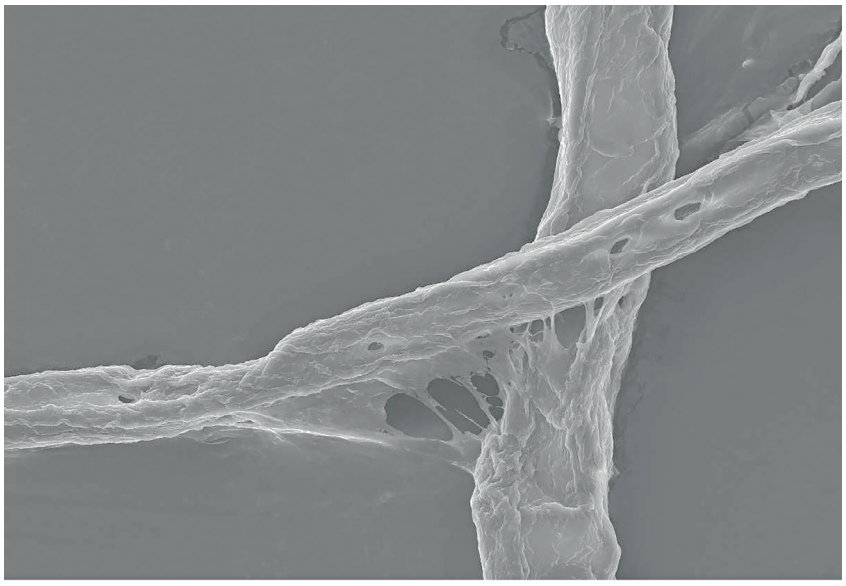


▼Refined & Untreated (SEM 500X).

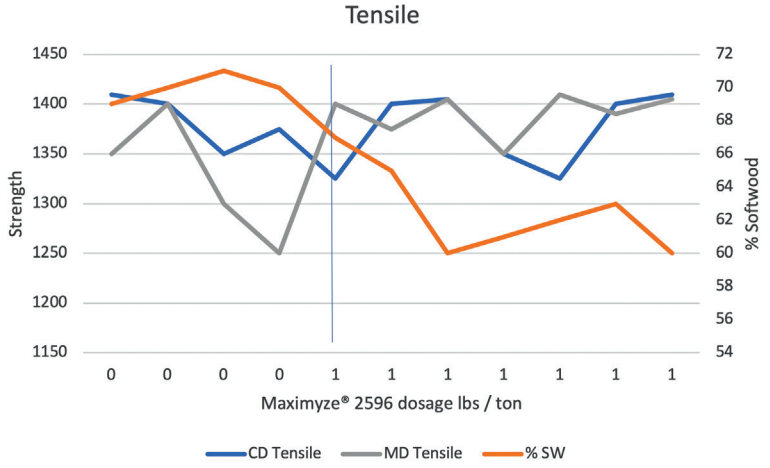
a way to approach perfection. Enzymes are the answer. Certain cellulase enzymes are effective at preconditioning the fiber ahead of refining. This **enzyme assisted refining** in tissue is known but not well adopted in the industry yet. How does it work? A cellulase is an enzyme found in nature that helps assist the microbial processing of cellulose. There are many classes of cellulases in nature. The ones that are useful for tissue makers are those that only react with the surface of the fibers. These specific enzymes break the bonds necessary to create fibrils that remain attached to the fiber. Breaking these bonds allows for refining to be more effective at lower energy input. This lowered energy input reduces cutting and flattening of the fibers while maintaining the desired bonding strength.

Why isn't it ubiquitous? There are many reasons or objections that tissue manufacturers will point to in order to resist the enzyme alternative. These objections have been mitigated over the last few years. In order to address these issues, it is necessary to cover the history of cellulases in tissue.

1st generation products: the first products used non-specific, unrefined, crude enzymes. These enzymes were not always stable, contained side activities and were expensive to produce. The manufacturing and purification techniques were not very effective. Advances in manufacturing, including separation techniques, led to the next generation.



▼Refined & Treated with Maximyze® (SEM 500X).



■ **With the addition of Maximyze® 2596, tensile target was maintained while softwood was reduced.**

2nd generation products: these products are cleaner, purer and have minimal side activities. These enzyme products use stabilization additives to keep the activity level even under tissue mill conditions. These products were generally a single, pure enzyme stabilized with other additives. This generation gained market acceptance.

3rd generation products: built upon the advances of the second generation, 3rd generation products use synergism by combining cellulases of different classes. Also, some non-enzyme additives that increase the activity rate of the cellulase are used. Increases in the overall activity and speed of activity leads to lower end use costs. The 3rd generation enzyme products address the concerns of the previous two. Stability, specificity, purity and cost of use have all been improved.

The following graphs show the value of using 3rd generation enzymes for strength development. The objective of this mill trial was threefold. The first objective was to increase strength with the existing furnish mix.

Once this strength was achieved, the second objective to reduce refining was employed. The third portion reduced the amount of softwood in the furnish. This strategy is not uncommon. It is the process of how to achieve the strength that allows for additional benefits such as fiber mix changes. This mill was making a towel grade and was aiming for increased bulk.

By achieving the strength target in a new way, using a 3rd generation enzyme, the additional bulk was gained as a result of the reduction of refiner energy and fiber mix changes. The enzyme allowed this mill to keep the strength, increase hardwood usage and reduce refiner energy, leading to a bulkier (higher caliper) sheet. How strength is achieved determines what properties the base sheet will have. When 3rd generation enzymes are used to reach strength targets, sheet properties such as bulk, hand feel and softness can all be improved. When these enzymes are used for strength development the window of operation is expanding for the tissue manufacturer. Flexibility in furnish mix, refiner energy and other options not previously available are now viable options. When it comes to tissue manufacturing, not all strength is created equal. ●

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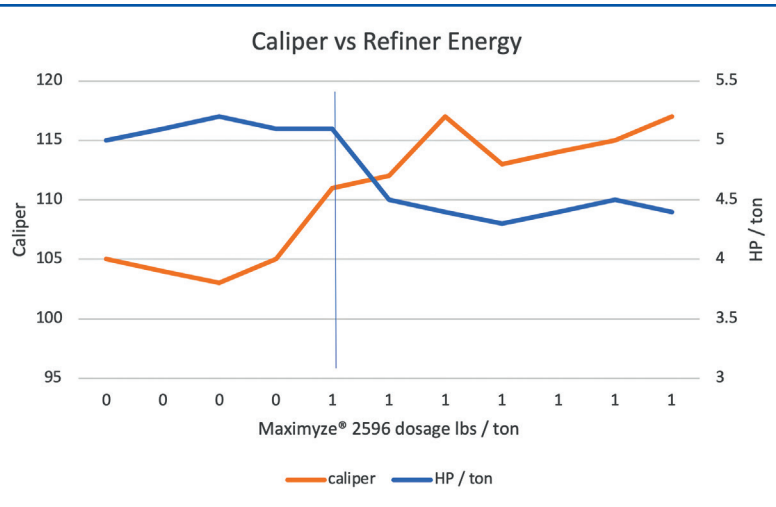

■ **With the addition of Maximyze® 2596, refiner energy was reduced and caliper was increased.**

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