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Buckman develops third generation Maximize® for recycled packaging

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ABSTRACT

Development of biotechnology for the pulp and paper industry has been long studied. Twenty years ago, knowledge about enzyme mechanisms for different applications was limited. In addition, production of the appropriate enzymes on a commercial scale was costly. Only recently have we been able to produce enzymes that have acceptable costs and to achieve a more in-depth understanding of how enzymes work in the modification of wood and wood components.

Buckman has dedicated significant resources to fundamental enzyme research in order to gain a better understanding of their mechanisms. This work has provided a solid base for successful development and marketing of enzyme based technologies for the pulp and paper industry.

This dedication to identifying more effective ingredients and application expertise that drive improved program effectiveness is reflected in Buckman's new Maximize 3504. This third generation fibre modification product is designed specifically for recycled packaging. It addresses some of the "blind spots" experienced with generations 1 and 2: achieving an increase in mullen/burst and effectively treating recycled fibre in the absence of refining. This article will demonstrate the increased effectiveness of

Maximize 3504 over existing formulations.

HISTORY

The use of enzyme based products in the pulp and paper industry has grown extensively and will continue to expand in the future as environmental regulations become more stringent. The use of these technologies is interesting and attractive for several reasons, but most importantly: (1) they have a very low toxicity, making them quite safe to use, and (2) they are produced from natural, renewable sources with low energy requirements.

Ten years ago, after dedicating resources to fundamental enzymatic research in order to gain a better understanding of their mechanisms, Buckman introduced their first Maximize product. These first generation products were single-component enzymes stabilized with a patented technology to allow product storage in paper mill conditions for up to six months. While effective on bleached Kraft pulps, success in recycled packaging fibre systems was minimal. Continued research led to the blending of multiple single-component enzymes into one product, improving the product's access to unbleached, recycled fibre. This second generation of Maximize was and continues to be successful in delivering improved strength and productivity while often

reducing the energy required to manufacture recycled packaging grades. With these products, Buckman was awarded the US Environmental Protection Agency's Presidential Green Chemistry Challenge Award in 2012. However, there are some process conditions where the second generation was not economically viable. Second generation Maximize struggled with packaging grades requiring high mullen/burst specification. In addition, operations that ran without refining the fibre could not take economic advantage of Maximize. A more effective product was needed.

INTRODUCING MAXIMIZE 3504

The dedication to identifying more effective ingredients and application expertise that drive improved application effectiveness is reflected in Buckman's third generation product for fibre modification, Maximize 3504. This blend of several single-component enzymes, combined with potentiators that boost enzymatic activity and improve access of the enzyme molecules to the fibre surface, has demonstrated marked advantages to either first or second generation Maximize products.

After extensive testing, Maximize 3504 was introduced into the recycled packaging market, where it has clearly demonstrated improved effectiveness. The third generation

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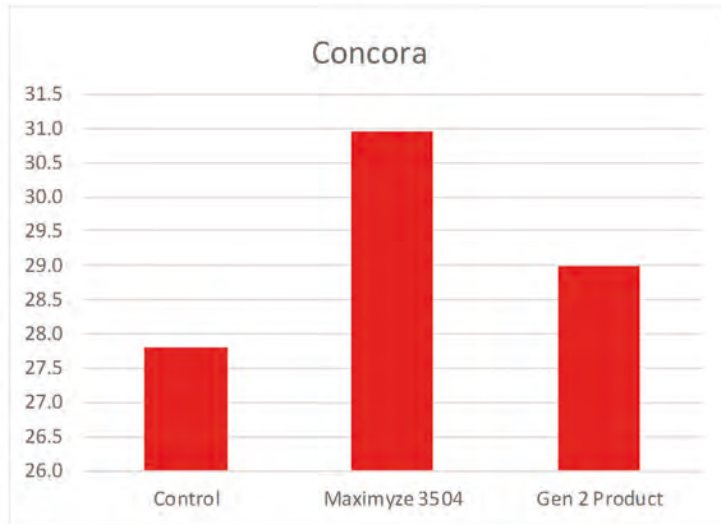


Figure 1. CMT 100% OCC without refining

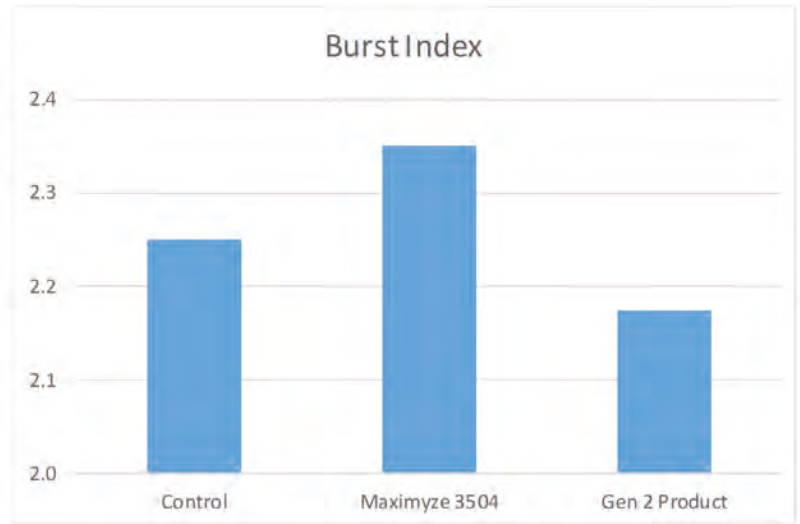


Figure 2. Mullen 100% OCC without refining

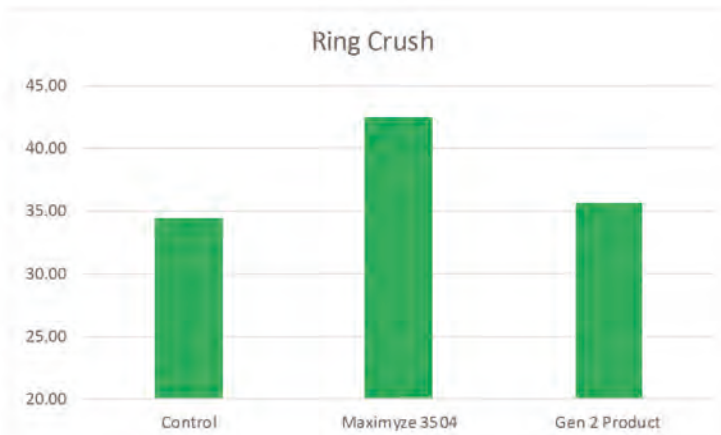


Figure 3. Ring crush 100% OCC refined

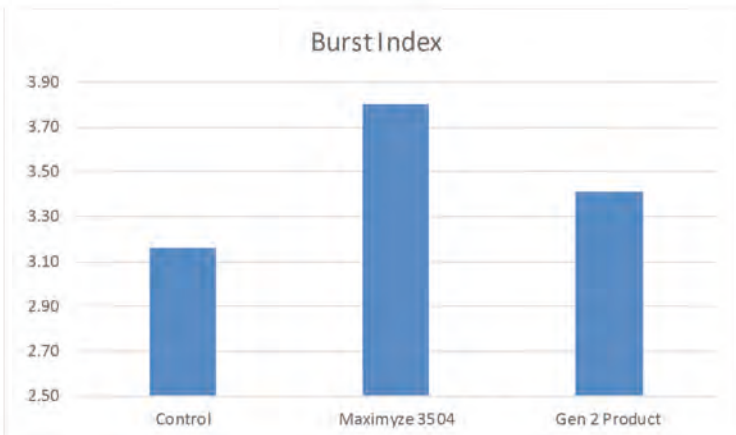


Figure 4. Mullen 100% OCC refined

product has shown improvements over the second generation with and without refining. Figures 1-2 show the effect of Maximize 3504 in recycled fibre without refining and Figures 3-4 show results applying 1000 revs using a PFI mill. In both studies handsheets were made using TAPPI standards test methods.

Currently, there are several applications using Maximize 3504. In one application, we replaced Buckman's second generation product with Maximize 3504. We achieved the same strength values (Concora and Ring

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Crush) with lower refining and higher machine speed. In another application, we evaluated both our second generation product and Maximize 3504. In this case, both products

allowed the mill to reduce grammage while maintaining Ring Crush slightly above the control as shown in Figures 5 and 6. However, Maximize 3504 enabled greater grammage reduction.

Application 2 Financial Return		
	Value	ROI \$/Day
Grammage Reduction	2.89 gsm	\$2,851
Refiner Loading Reduction	4 kWh/T	\$317
Maximize 3504 Cost		\$ 1,373
ROI		\$ 1,795/Day

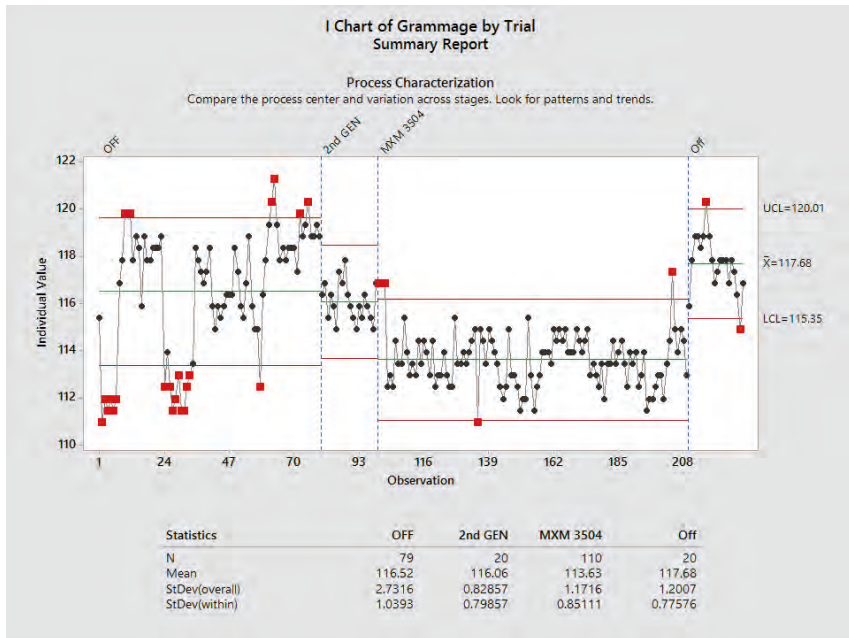


Figure 5.
Application 2:
Grammage

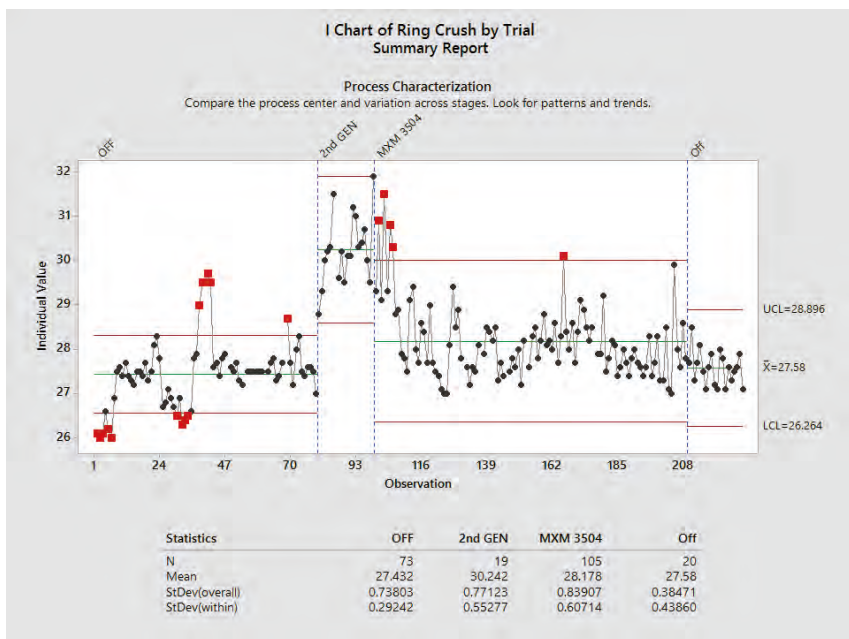


Figure 6.
Application 2:
Ring Crush

FEEDING MAXIMIZE PRODUCTS

Maximize utilises simple feeding systems as shown in Figure 7. Product makedown is not necessary. The product is typically fed with simple addition pumps. In some cases, post-dilution with either fresh water or clarified whitewater can improve mixing and product effectiveness. In paper machines with multiple plies we typically add the product to all plies at an equal

dosage. However, every system is different and sometimes dosing strategy for each ply is necessary. The specific application point for Maximize varies by system. Identifying the best application point is sometimes an iterative process. Several factors should be taken into consideration:

- Size of the stock preparation system in terms of time from the

pulper to the headbox; some operations have one hour or less while others as much as six hours. The correct application point needs to be close enough to the machine to allow for dosage adjustments with an appropriate response time. In most cases, the Maximize addition point is one hour or less in time from the headbox, which varies depending on temperature and pH of the system.

- Degree of closure of the whitewater system and water locks: The components in the third generation Maximize do not bind to the fibre, meaning there is a cycle-up effect of Maximize in the whitewater. The time to see the full effect of a Maximize application varies depending on the size and degree of closure of the whitewater system.

The ideal addition point is one that provides excellent mixing, promoting intimate contact between Maximize and the fibre. In most successful applications, Maximize is fed to a pump suction, utilising the pump impellor to thoroughly distribute the product throughout the entire stock stream. If refiners are utilised, feeding Maximize to the suction of the refiner feed pump has proven most effective in many applications.

IDEAL MAXIMIZE TARGET CHARACTERISTICS

There are several system parameters as well as operational variables that are conducive to success with third generation Maximize 3504:

- Recycled fibre (Old Corrugated Containers, Double-Lined Kraft, Curbside Waste, etc.)

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- Near-neutral pH
- System temperature greater than 45 deg. Celsius is preferred
- Some sort of production limitation:
 - Forming or press section drainage
 - Main dryer section capacity
 - Refining limits machine speed and production rate
 - Running grammage/basis weight above target to achieve strength
- A market for additional, incremental production

NEXT STEPS

The challenge of turning recycled fibre into first-quality packaging grades continues. Not only is fibre quality deteriorating, but the actual fibre content of recycled fibre is also decreasing as both filler and starch usage increase. The gradual deterioration of fibre quality is a valid concern and results in a high degree of operational variability. Pressure from both cost and environmental perspectives continues to drive reductions in fresh water usage, creating higher conductivity and

making it more challenging for all chemistries to perform. Maximyze has demonstrated the ability to maintain effectiveness in high conductivity systems that challenge traditional charged chemistries used to improve drainage and strength. Geographically, there are areas where system temperatures are not high enough to make Maximyze economically viable. Research efforts into formulating future generations of Maximyze will be focused on performance in even higher conductivity systems as well as at lower system temperatures in order to preserve existing recycled fibre length through reduction or elimination of refining. Buckman remains committed to continuously working to develop more effective Maximyze products.

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Figure 7. A Maximize® feed system for a two-ply paper machine

The gradual deterioration of fibre quality is a valid concern and results in a high degree of operational variability.