



MAXIMYZE[®] 3504

Buckman's 3rd Generation of
Enzymatic Technologies

Buckman

Commitment makes the best chemistry.

Enzymes for Packaging

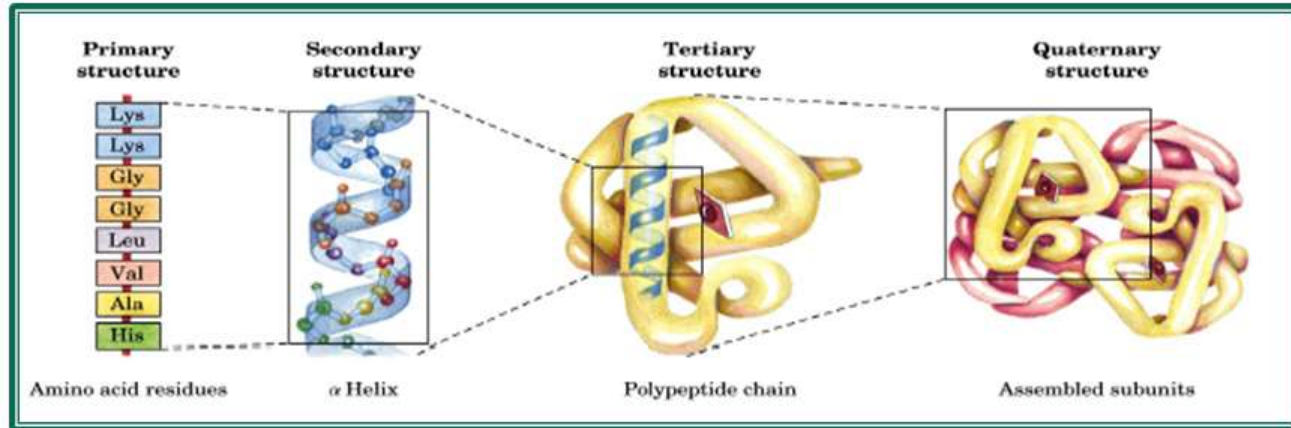
- Enzyme basics
- Historical overview of enzyme technology in pulp and paper
- Enzymatic fiber modification
- Maximyze[®] 3504

Enzymes

- Enzymes in everyday life
- Smart solutions that are:
 - specific
 - green
 - sustainable

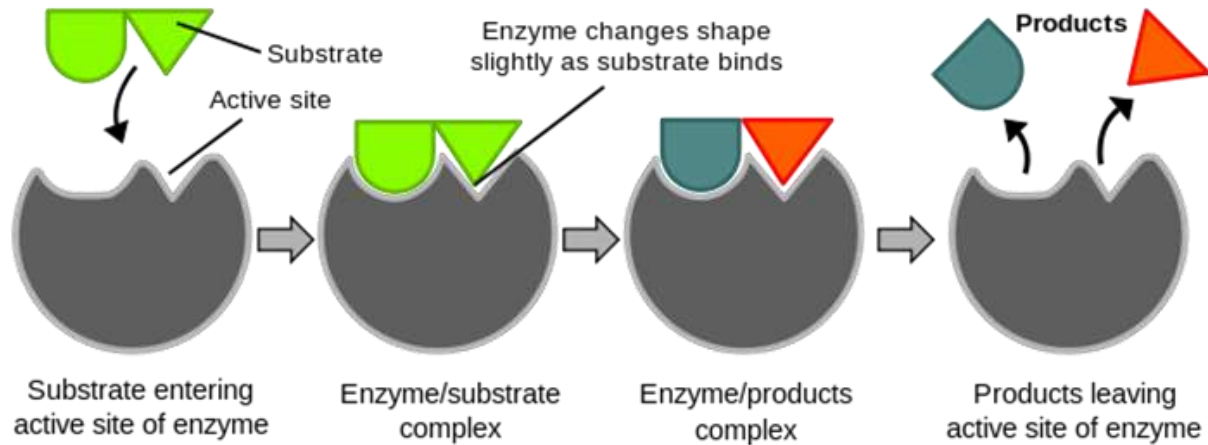


- Enzymes are:
 - Produced by microorganisms
 - Not living
 - Proteins
 - Macromolecules of amino acids
 - 3° and 4° structures with an active site for a specific substrate



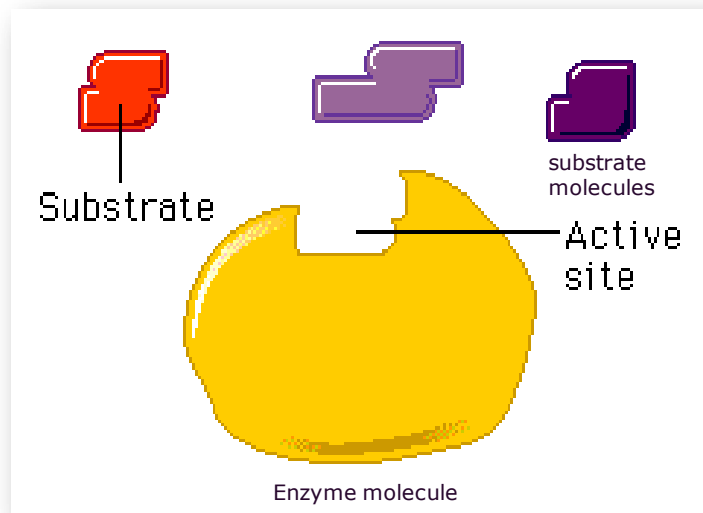
Enzyme Basics

- Enzymes are proteins produced by bacteria or fungi
- Enzymes are catalysts; they increase the speed of reactions by lowering the activation energy required to drive the reaction
- Enzymes are not consumed in the reaction



Enzyme Basics

- Enzymes are very specific in their activity
- This is one reason for the wide variability within major enzyme classifications





Benefits of Using Enzymes

- They are bio-engineered to conduct specific reactions
- Greener technology
 - worker health
 - environmental impact; fully biodegradable
 - produced from renewable resources
- Small dosages required
- Not consumed in the desired reaction; one enzyme can conduct many reactions
- Stable liquid formulated products
- Pump-and-go technology; simple feed systems
- Economic and environmental feasibility

Commercial Enzyme Types Used in P&P

Enzyme	Industrial application
Amylases	Starch modification for paper coating Paper machine cleaning / boilout Deinking and stickies reduction
Cellulases	Paper machine drainage improvement Tissue fiber modification (e.g., softness) Refining energy reduction Fiber modification in general - including strength improvement Vessel picking reduction Deinking (brightness increase & dirt reduction)
Lipases Esterases	Pitch control of mechanical pulps Stickies control of recycled pulps Paper machine clean-up Deinking of old newsprint
Proteases	Paper machine clean-up and slime removal
Catalase	Removal of residual peroxide after bleaching
Hemicellulases (xylanases)	Bleach boosting in chemical pulps Refining energy reduction
Laccases	Lignin modification, fiber strength improvement Waste water treatment – COD reduction
Pectinases	Anionic trash reduction



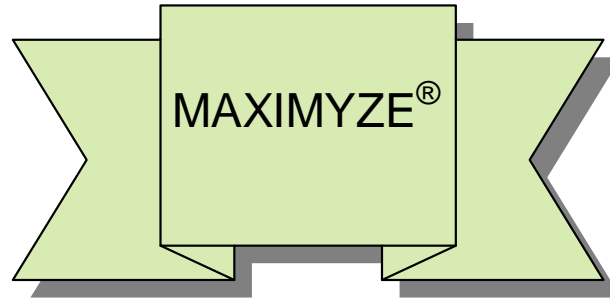
Cellulases

- Cellulases are a broad classification of hydrolysis enzymes
- Cellulases selectively cleave superficial cellulose chains which leads to increased aldehyde groups and uncovered (carboxyl groups, hemicellulose-linked) which can participate in fiber to fiber bond strengthening

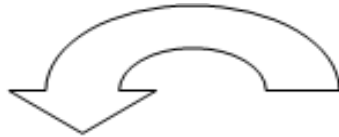


Fiber Modification

- Reduces energy input required to arrive at a given freeness target.
- Provides “pre-refining” action without excessive cutting of the fiber.
- The result is a new operational window for the papermaker to harness specific benefits
- Potential to provide improved fiber-to-fiber bonding by increased fibrillation, thereby increasing wet web strength.



+ REFINER



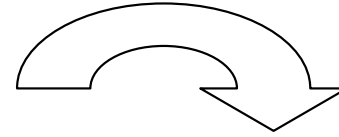
KEEP REFINER ENERGY

increase

°SR
Tensile strenght
Scott bond
% short fiber
capacity refiner

decrease

porosity
vesselpicking
coating uptake
strength additives
refining time



REDUCE REFINER ENERGY

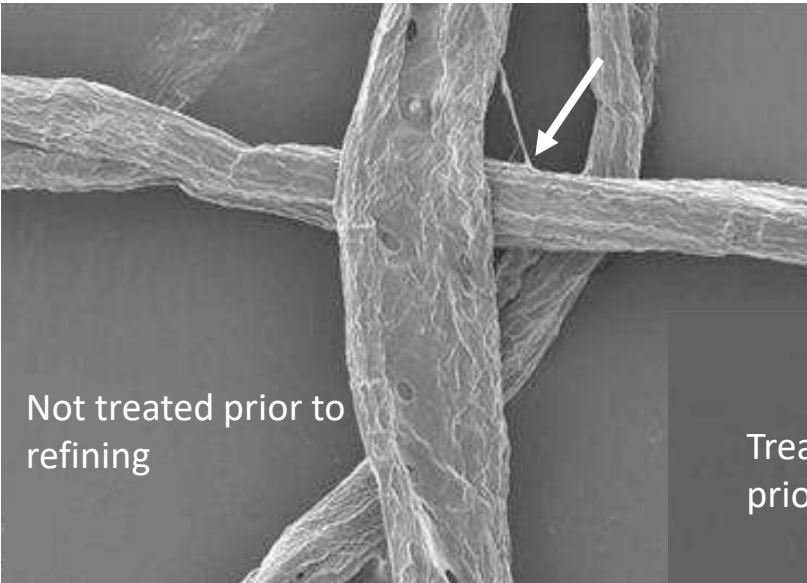
increase

porosity
speed machine
formation
bulk
softness

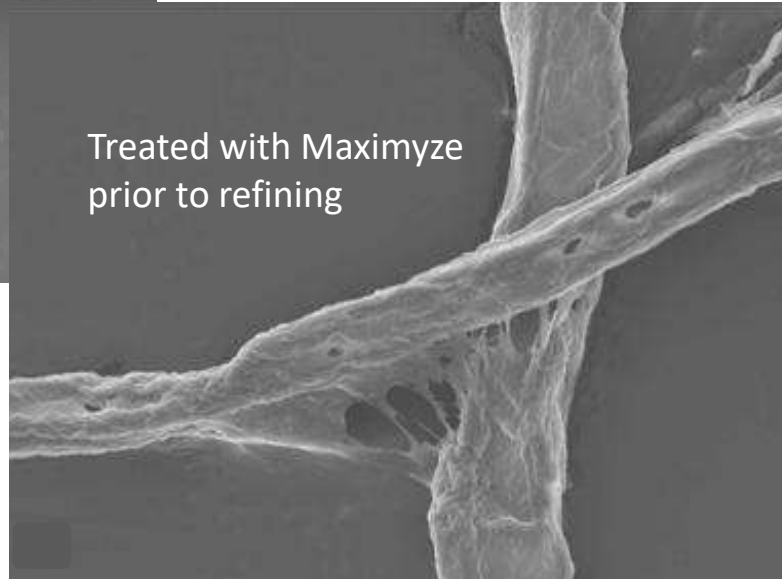
decrease

°SR
energy consumption
steam consumption
dust

Maximize[®] effect on fiber bonding



Not treated prior to refining



Treated with Maximize prior to refining

Generally, with Maximize, the SAME refining intensity gives HIGHER strength. In most cases, REDUCED refining gives SAME strength with HIGHER drainage.





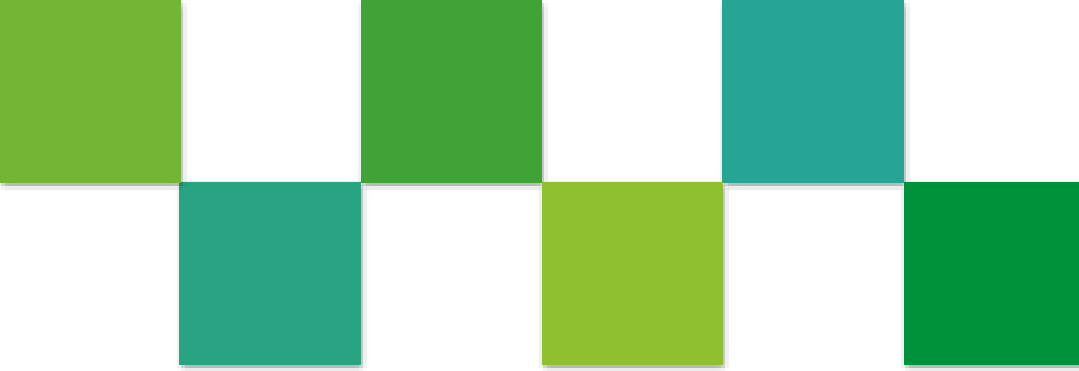
It's not always easy...

- In a given operation, the relationship between refining, freeness, and strength is often well understood
- Introducing Maximyze[®] can change this relationship, requiring new freeness targets
- Recognizing and reacting to the change in this relationship is often necessary for success



MAXIMYZE[®] 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 fiber modification
- The 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 MaximYZe products.
- This product has been specifically designed for the recycled packaging market



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LABORATORY WORK

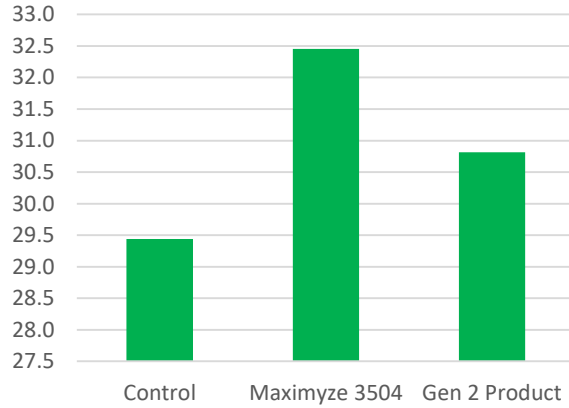


Laboratory work

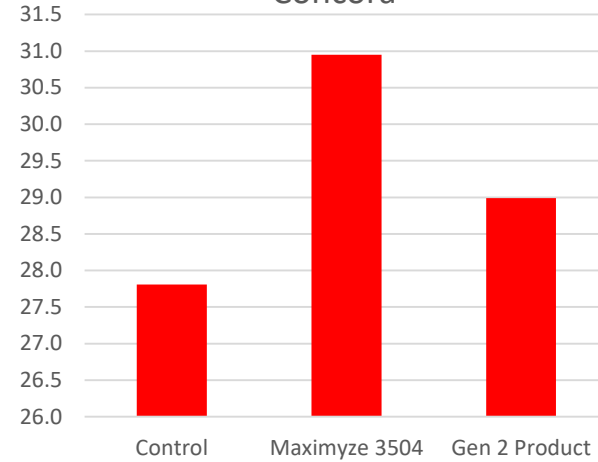
- Extensive work was done during the development phase
- This generation product has shown clear improvements over the second generation product with and without refining
- In all studies handsheets were made using TAPPI standards test methods.

100% OCC without refining

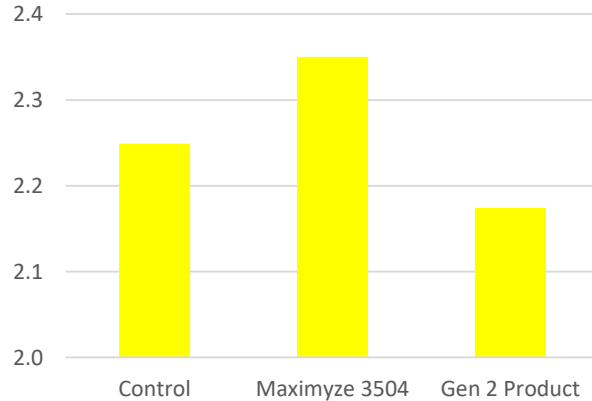
Ring Crush Index



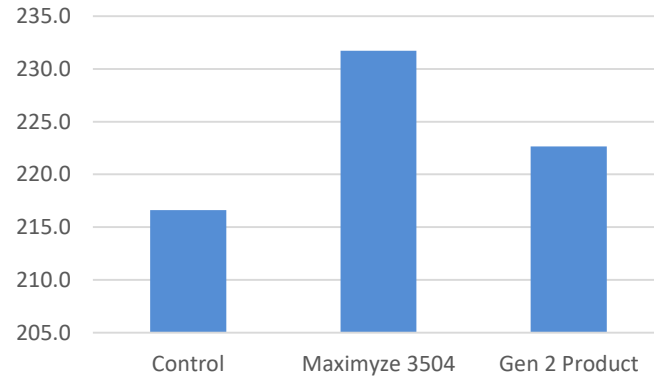
Concora



Burst Index

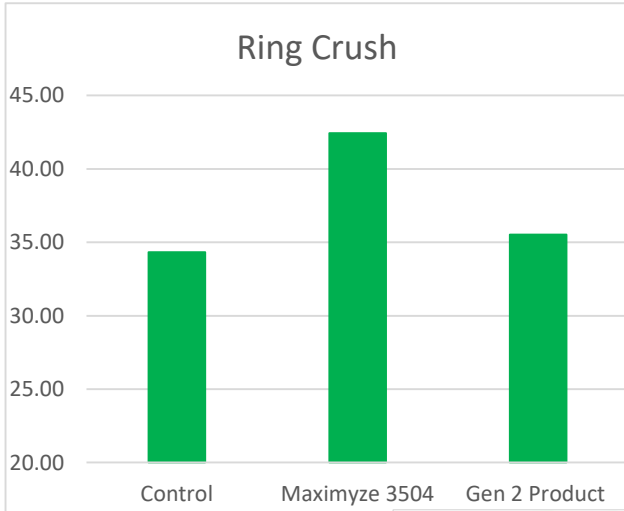


Scott Bond

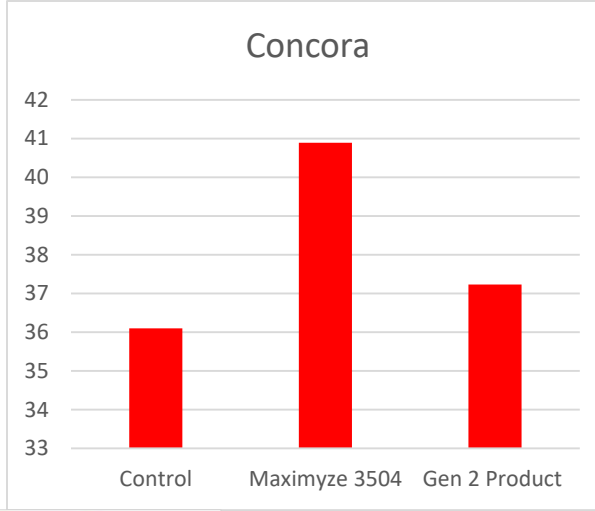


100% OCC refined

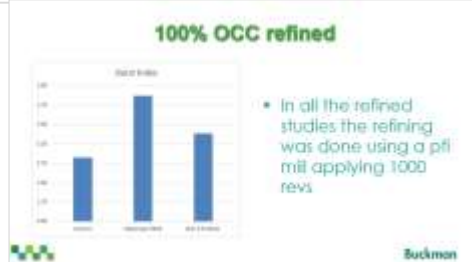
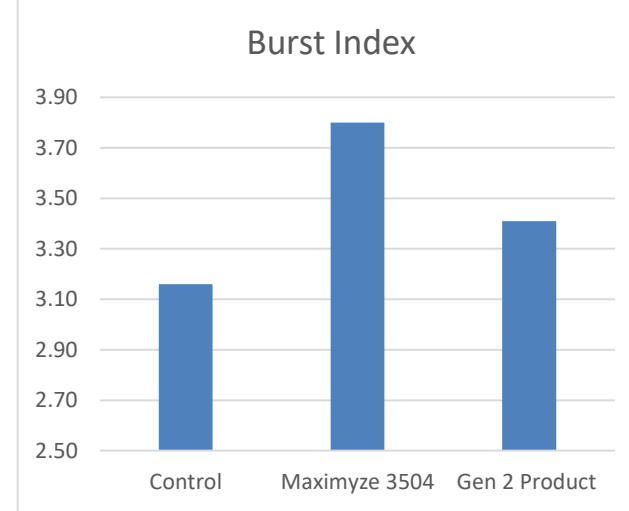
Ring Crush



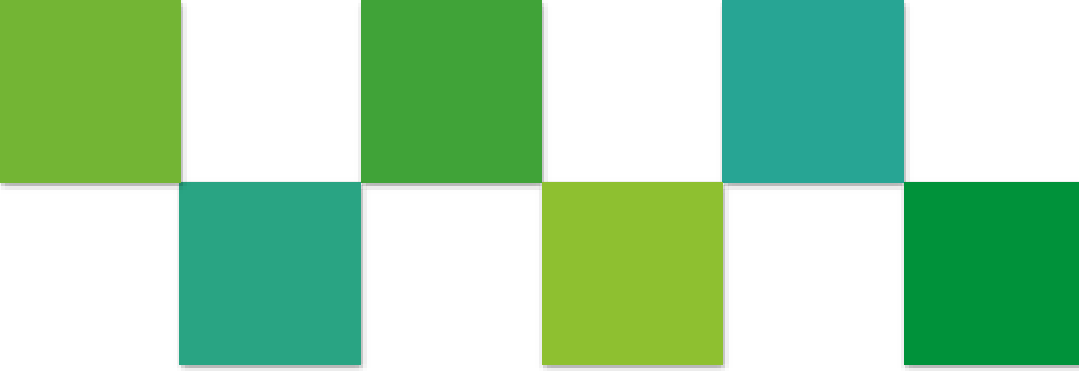
Concora



Burst Index



- In all the refined studies the refining was done using a pfi mill applying 1000 revs



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CASE STUDIES



Case History 1

- This is a fourdrinier papermachine making corrugating medium
- 100% recycled OCC
- Production: 135,000 MT/Y
- Speed 625-650 mpm
- The main objective was to reduce basis weight while maintaining ring crush. Other objectives were to reduce refining and optimize process chemistry
- Maximyze[®] 3504 was fed to the recirculation loop of the HD.
- Optimum dosage as determined by initial trials is 0.8#/ton.

Results and ROI

Parameter	Change	Value	%
Basis Weight	Decreased	0.861 lb	3.6%
Ring Crush	Increased	0.545	2.0%
Concora	Increased	1.12	2.2%
HPDT	Decreased	4.00kWh/T	16%
Concora/Basis Weight	Increased	0.1105	5.20%
RC/Basis Weight	Increased	0.0668	5.80%

Actual return on investment shown below. Total return for the No. 2 PM is \$1,795.20/Day or \$655,248/Year.

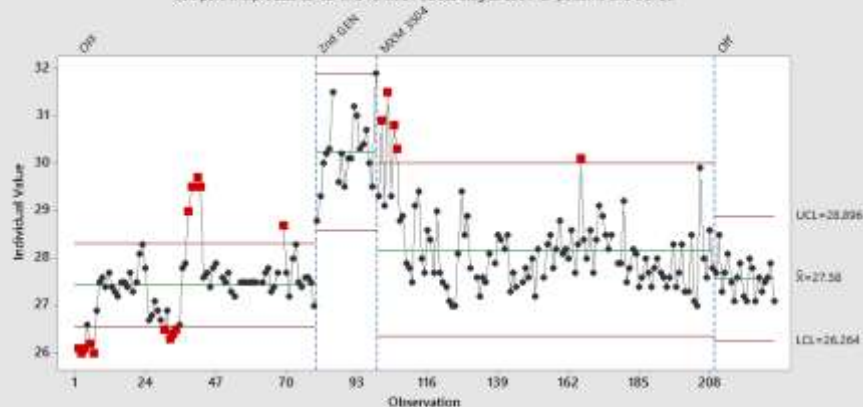
	Value	Percent	Est ROI \$/Day
Basis Weight Reduction	0.861lb	3.60%	\$ 2,851.20
Refining Reduction	4.00kWh/T	16%	\$ 316.80
Total			\$ 3,168.00
Product			\$ 1,372.80
ROI			\$ 1,795.20



I Chart of Ring Crush by Trial Summary Report

Process Characterization

Compare the process center and variation across stages. Look for patterns and trends.

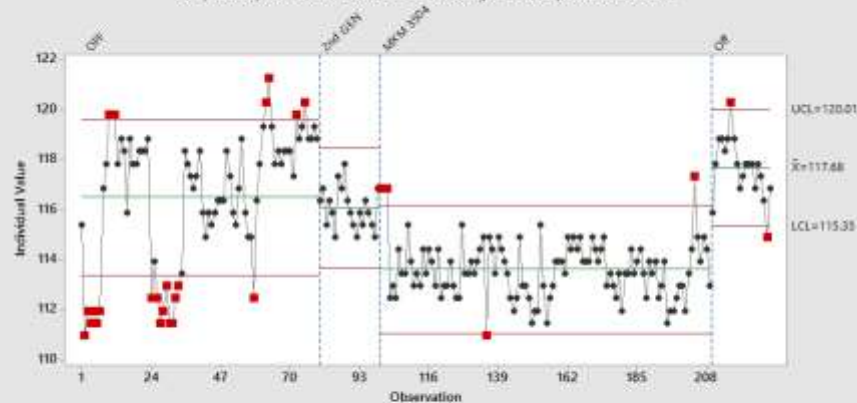


Statistics	OFF	2nd GEN	MXM 3504	OFF
N	73	19	105	20
Mean	27.432	30.242	28.170	27.58
StDev(overall)	0.73805	0.77123	0.83907	0.38471
StDev(within)	0.29242	0.55277	0.60714	0.43860

I Chart of Grammage by Trial Summary Report

Process Characterization

Compare the process center and variation across stages. Look for patterns and trends.



Statistics	OFF	2nd GEN	MXM 3504	OFF
N	79	20	110	20
Mean	116.52	116.06	113.63	117.68
StDev(overall)	2.7316	0.82857	1.1716	1.2007
StDev(within)	1.0393	0.79857	0.85111	0.77576



Case History 2

- This is a fourdrinier papermachine making linerboard corrugating medium
- 100% recycled OCC
- Production: 250,000 MT/Y
- Speed 750-800 mpm
- This mill had been using the second generation product for two years and the main objective was to evaluate the third generation as continuous improvement



Case History 2

- Initial evaluation was run in 23lb medium grade
- Application rate for the 2nd generation product and Maximyze[®] 3504 were both 0.8 lb/ton.
- Maximyze 3504 gave the same strength numbers (Concora and STFI) with lower refining and higher machine speed
- We also seen that with Maximyze 3504 we get improvements in Burst which we had not seen with the second generation product in the liner grades



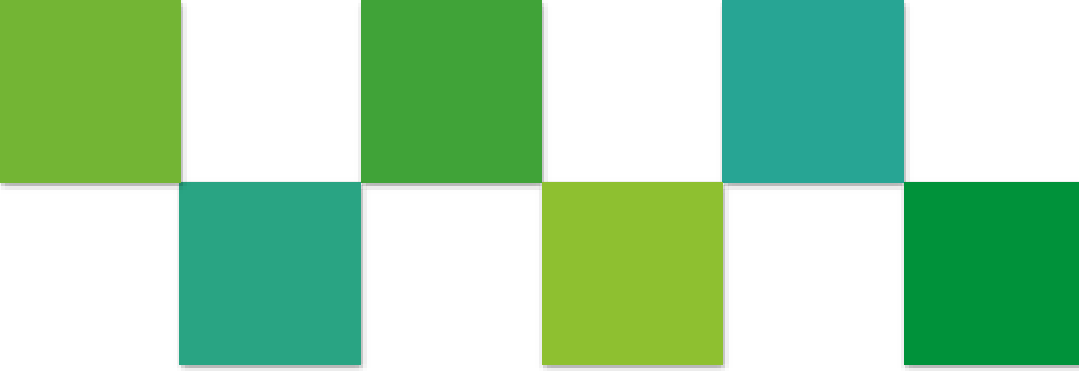
Results

	2nd Gen	Maximize 3504	% change
Basis Weight	23.84	22.82	-4.3
Concora	51.3	50.9	-0.8
Total Refiner	202	164	-18.8
Speed	2465	2588	5.0



CONCLUSIONS

- The use of Maximyze[®] enzyme formulations to enhance strength, quality, and productivity in recycled packaging is economically and environmentally valid in today's market
- Maximyze widens the manufacturing window, offering the paper maker options to:
 - Increase production
 - Increase strength
 - Reduce manufacturing costs
 - Reduce environmental impact



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THANK YOU!!