



*Delivering brilliant, game-changing advances
to the pulp & paper industry!*

Ceregel[®]

Company Summary

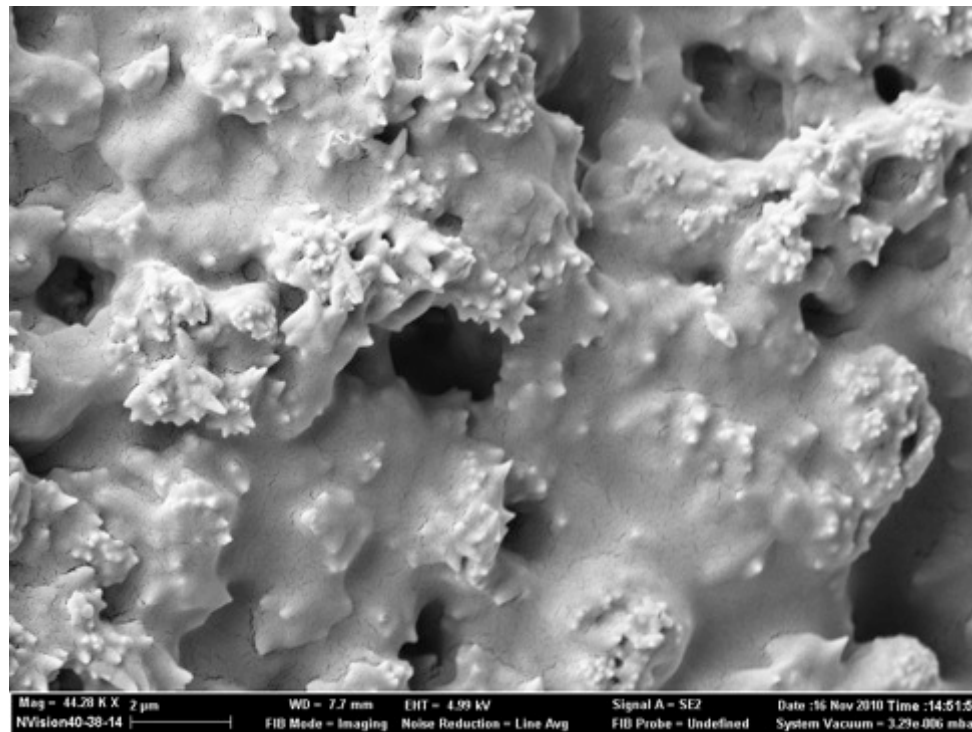
Cerealus is a product development company

- Founded in 2004
- Partners with the University Of Maine PDC
- Develops novel applications that are revolutionary
 - Zein Coatings
 - Agricultural Mulch Film
 - Encapsulation
 - Cerenano[®]

Ceregel

A patented, encapsulation technology for paper and paperboard.

We use starch to encapsulate either filler or fiber and allows the use of high levels of starch in the wet end.



CURRENT DRY STRENGTH TECHNOLOGY

Its all about hydrogen bonds!

Cationic Starch

- *Workhorse product*
- *Absorbed by cationic charge*
- *Increase hydrogen bonds*
- *Increase strength of fiber/fiber bonds*
- *Decreases localized stresses in sheet*
- *Limited to 1-1.5%*

CMC - carboxymethyl cellulose

- *Anionic carboxyl groups*
- *Hydrogen bonding*
- *Requires cationic retention aid*
- *More expensive than starch*

CURRENT DRY STRENGTH TECHNOLOGY

GPAM - SPAM

- *Glyoxylated polyacrylamide*
- *Increase bond strength*
- *Absorbed by cationic charge, anionic*
- *Hydrogen bonds*
- *Covalent bonds between polymer and fiber*

PVAm

- *Polyvinylamines*
- *Increased bond strength*
- *Absorbed by cationic charge*
- *Hydrogen bonds*
- *Can be combined with anionic PVAm*

CURRENT DRY STRENGTH TECHNOLOGY



Ceregel[®]

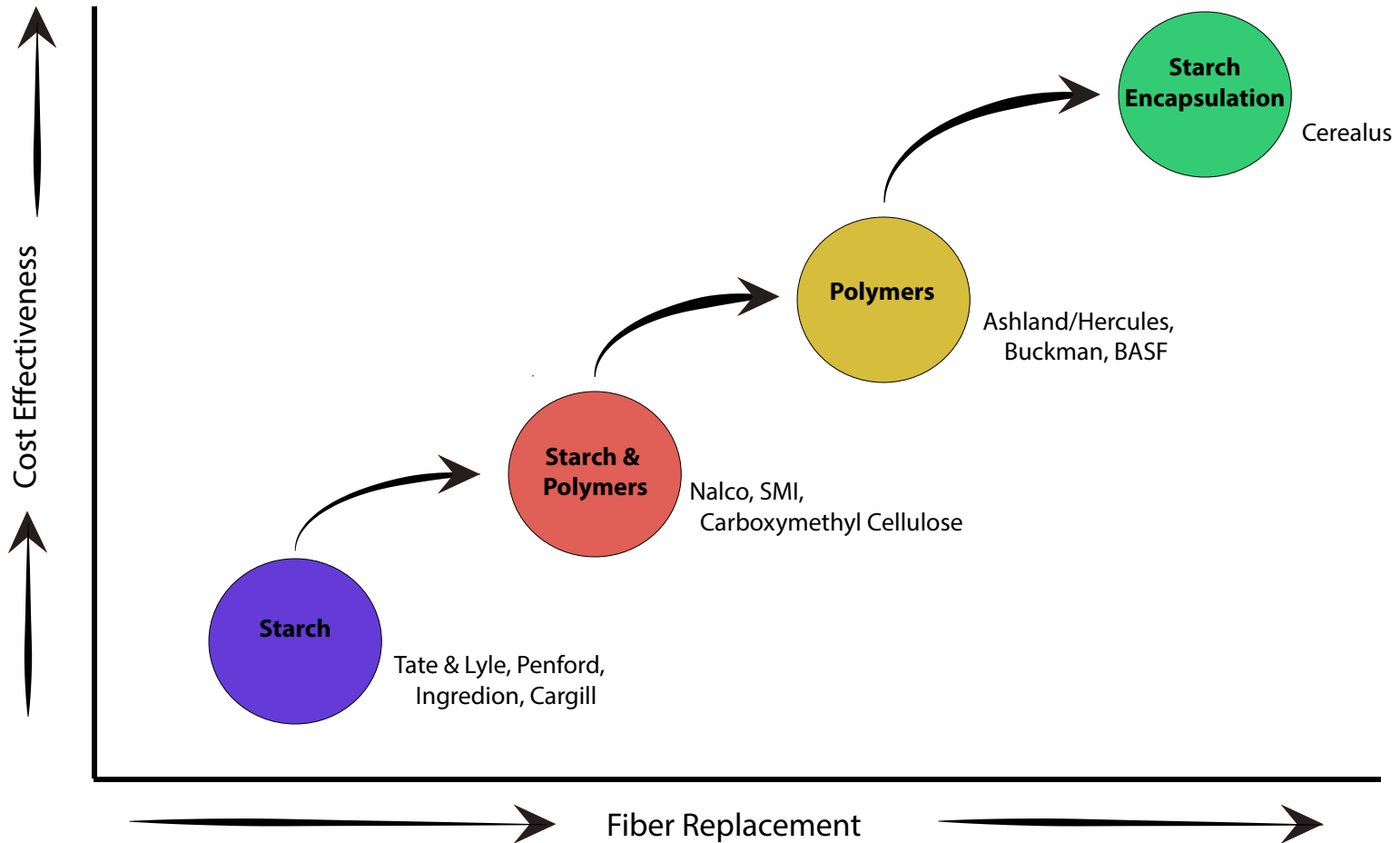
A patented encapsulation technology for paper and paperboard. We use starch to encapsulate either filler or fiber and allow the use of high levels of wet end starch.

- *Starch- Encapsulating agent – Ceregel A[®] - Filler/Fiber*
- *Increased bond strength*
- *Increased bonded area*
- *Decrease localized stress*
- *Hydrogen bonds*
- *Covalent bonds*
- *No limit on amount*

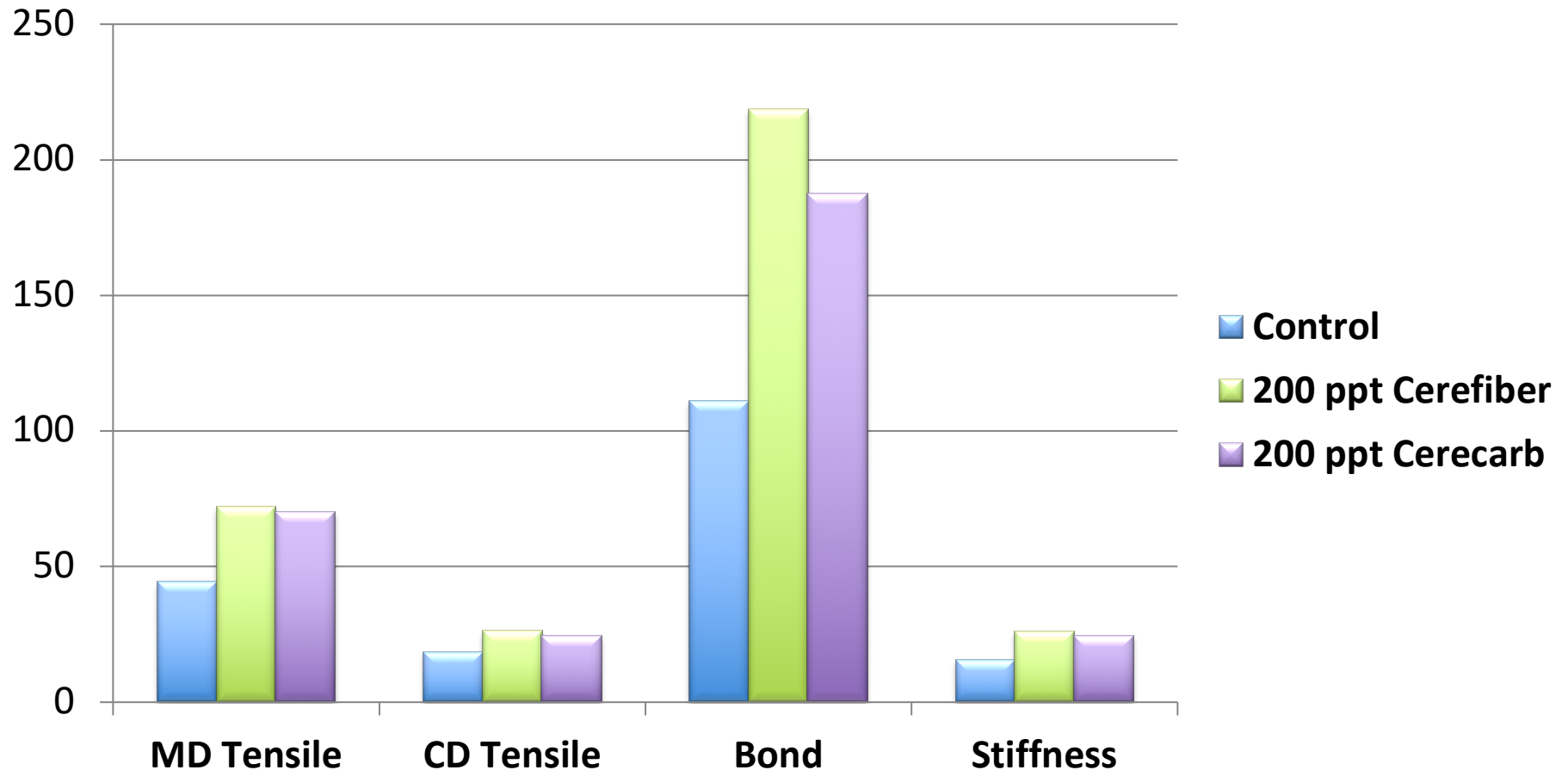
Best Commercial Technology



DRY STRENGTH ALTERNATIVES



Strength At Equivalent Ash (15% Nominal Sheet Ash)

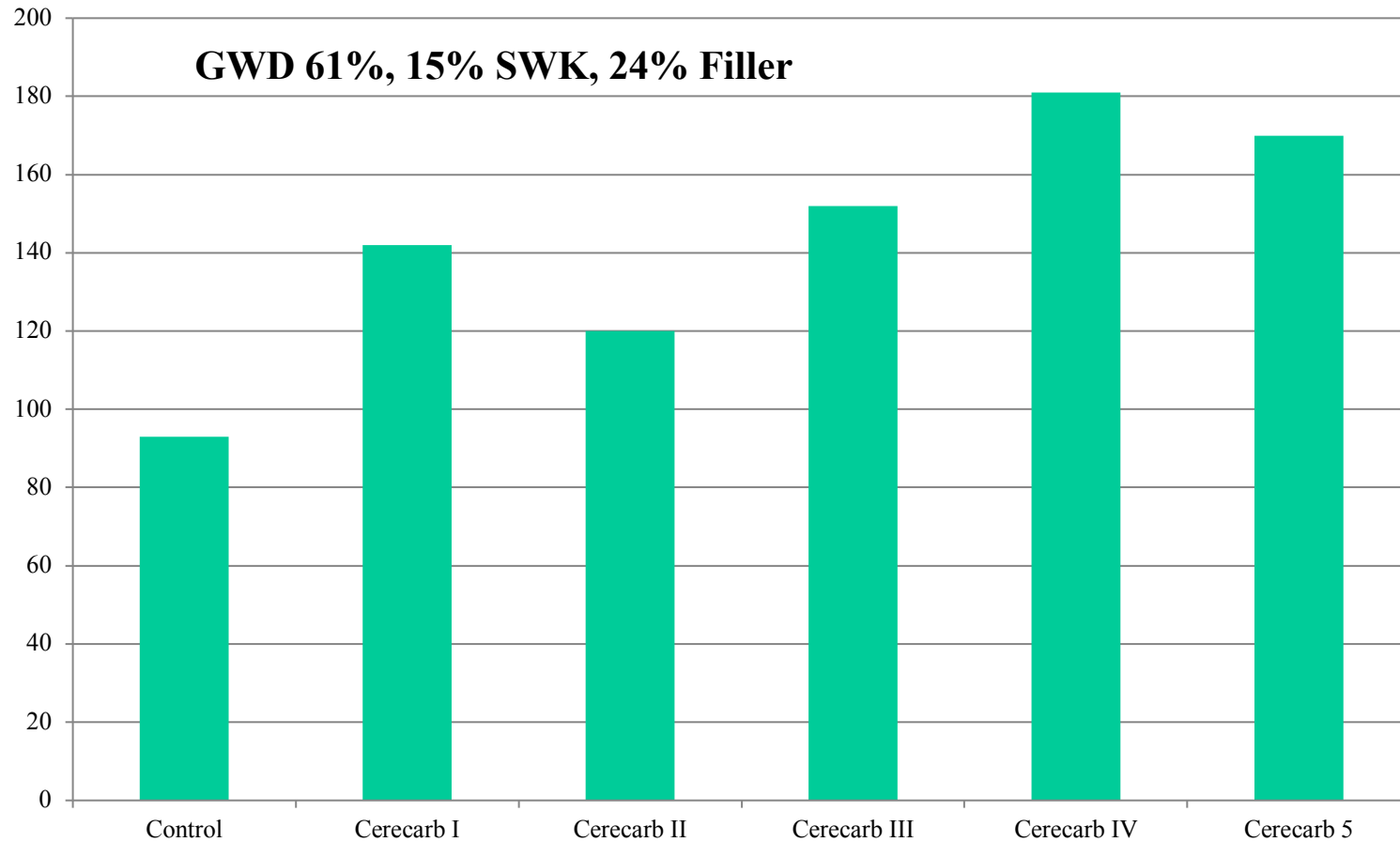


***70%NBHW, 30% NBSWK
Pilot Paper Machine Results***

5/29/19

Cerecarb[®] - Mechanical

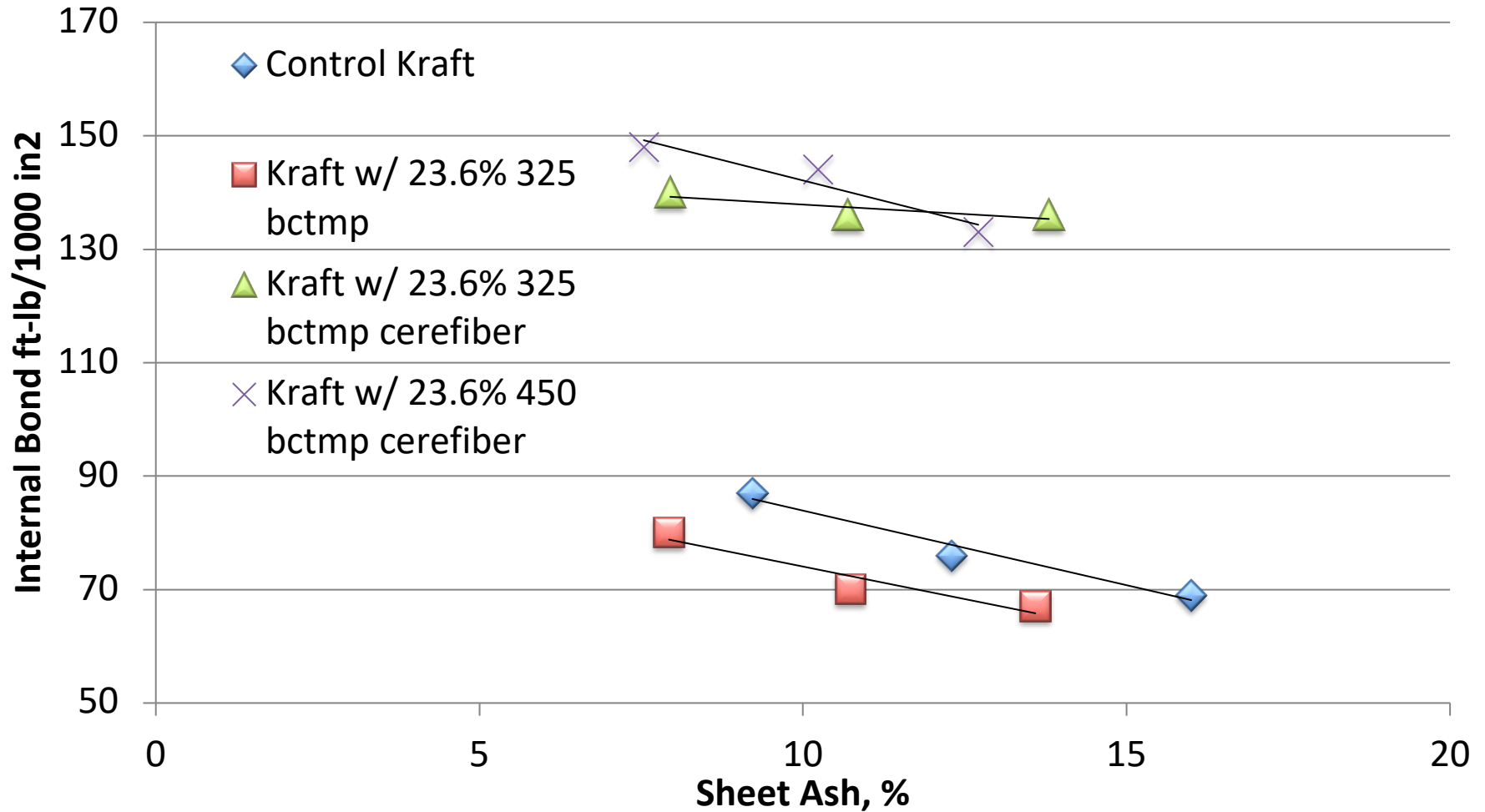
Internal Bond (uncal), ft-lb/1000 in²



Pilot Paper Machine study

Cerefiber[®] - Mechanical

Bond vs. Sheet Ash

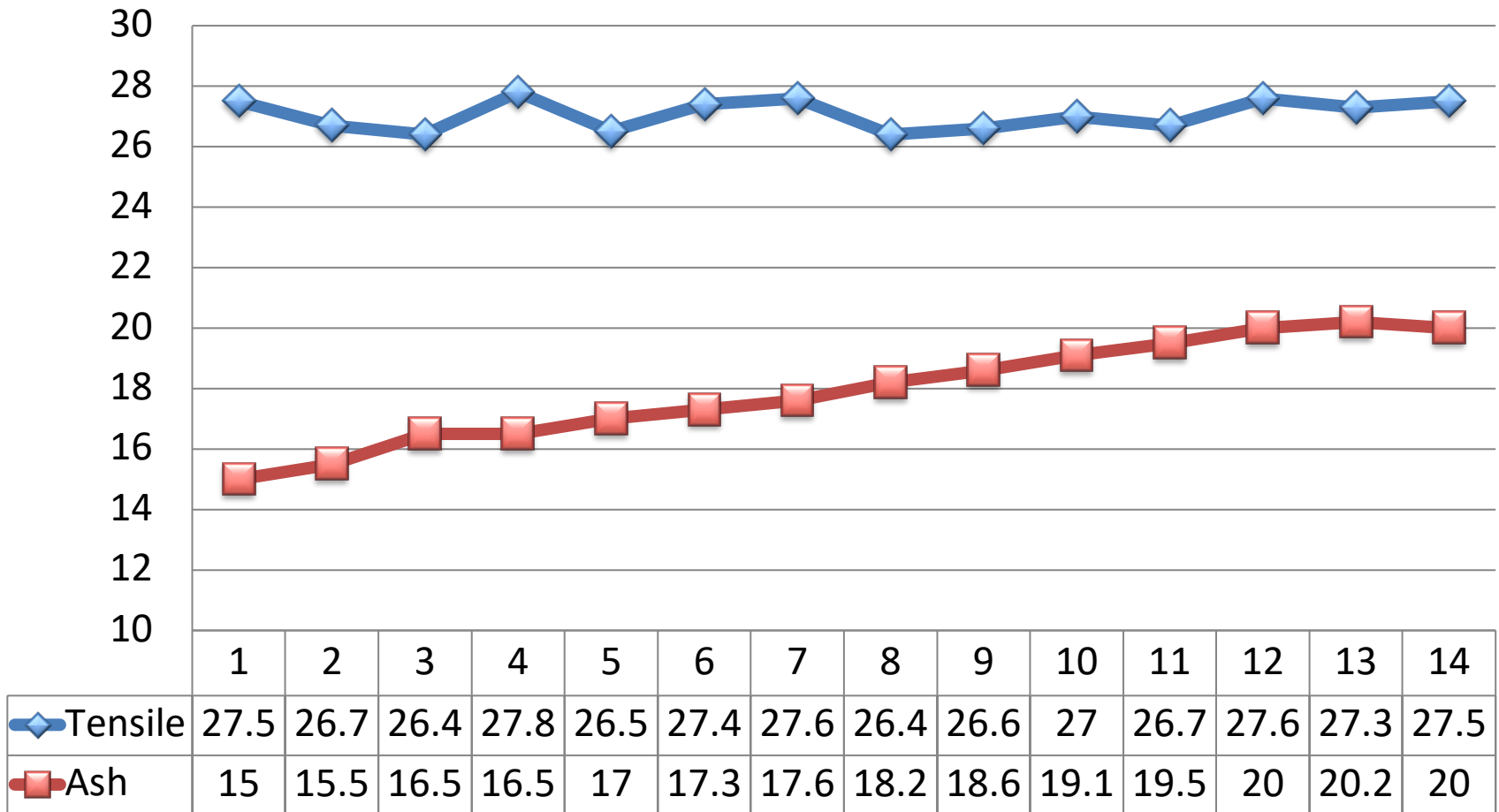


Kraft Replacement with BCTMP

Handsheet study

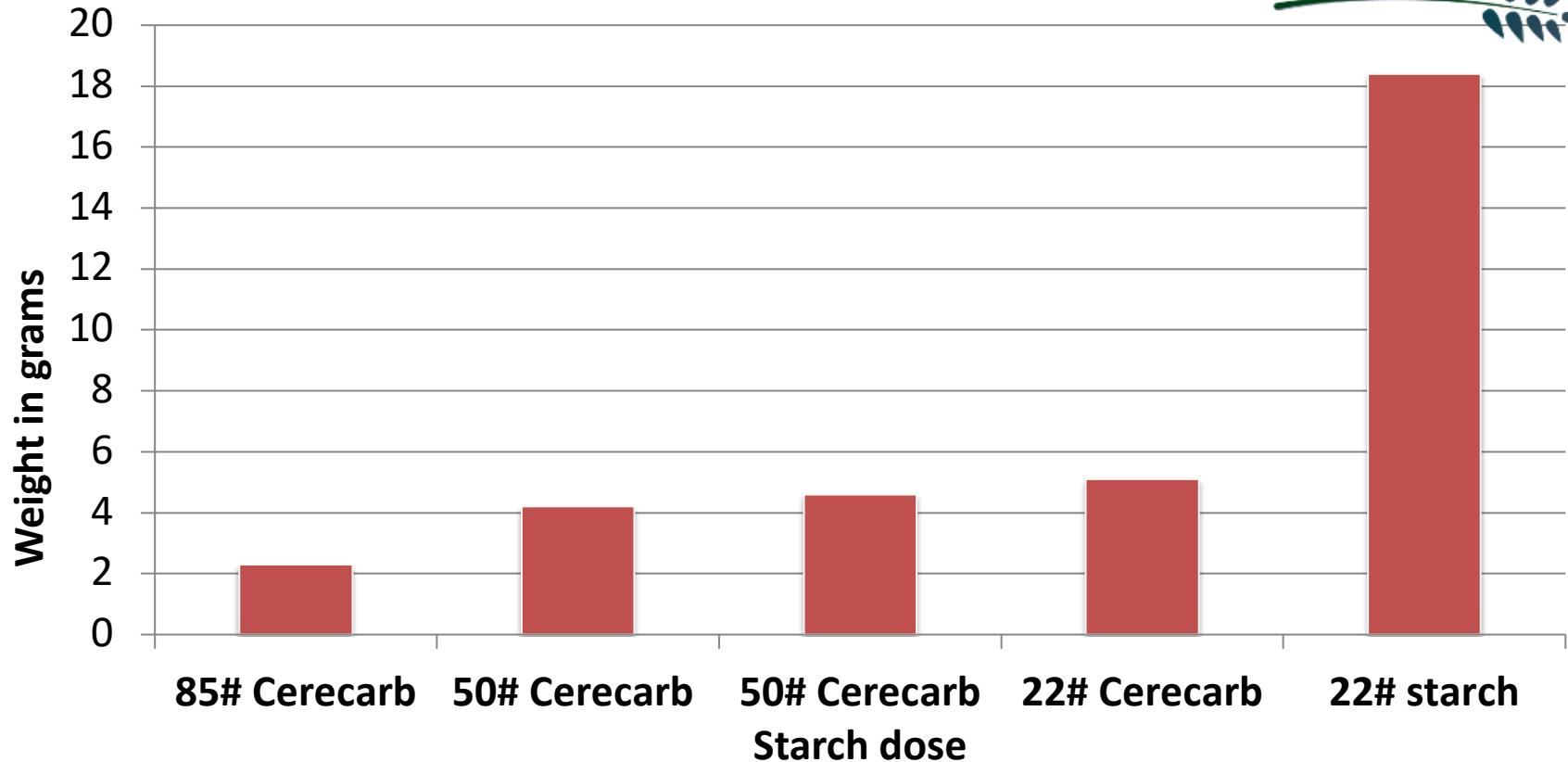
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CERECARB[®] Tensile vs % Ash



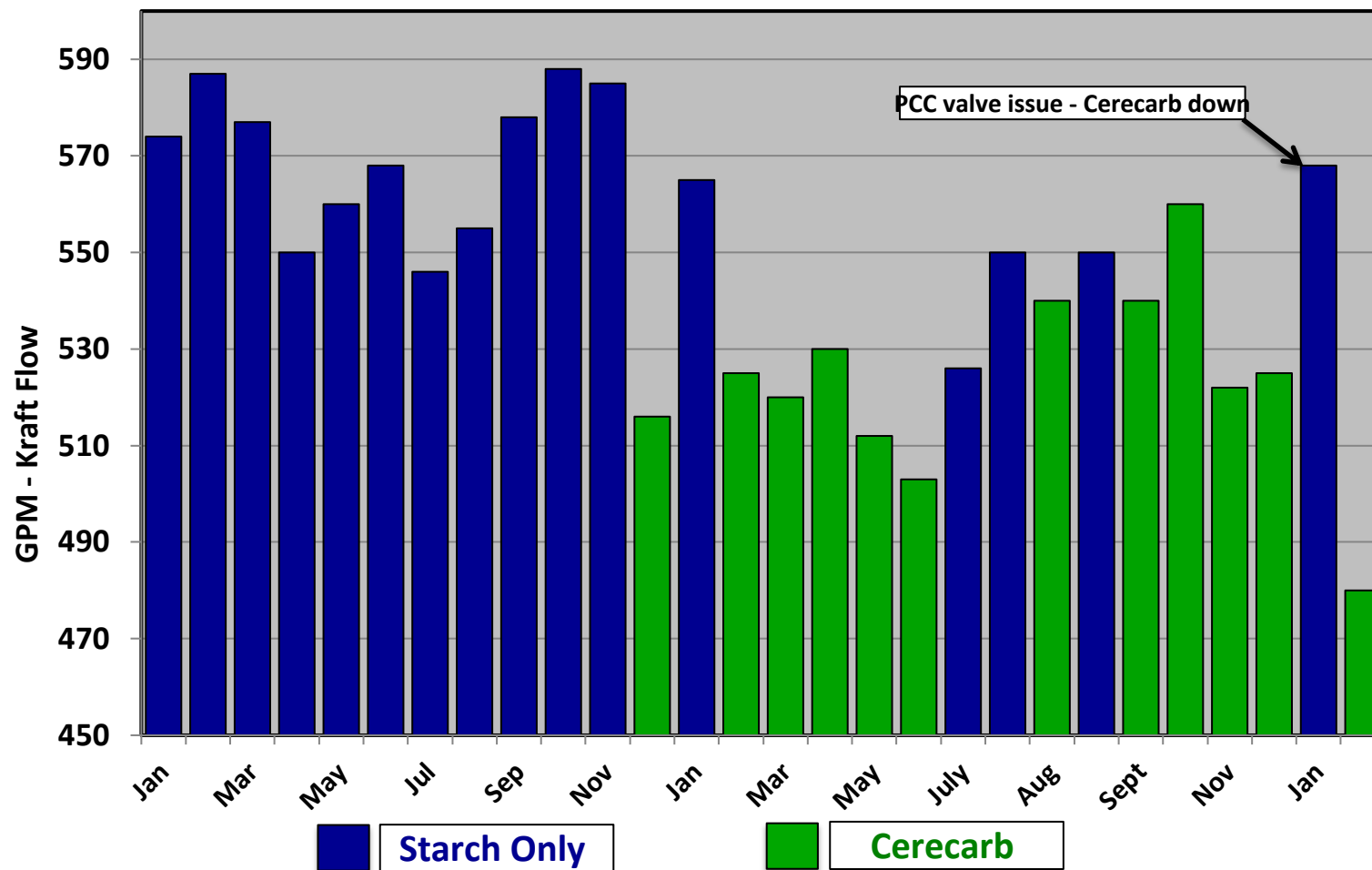
***Uncoated Offset –100% Recycled Fiber
Commercial Paper***

Adams Wet Rub Results

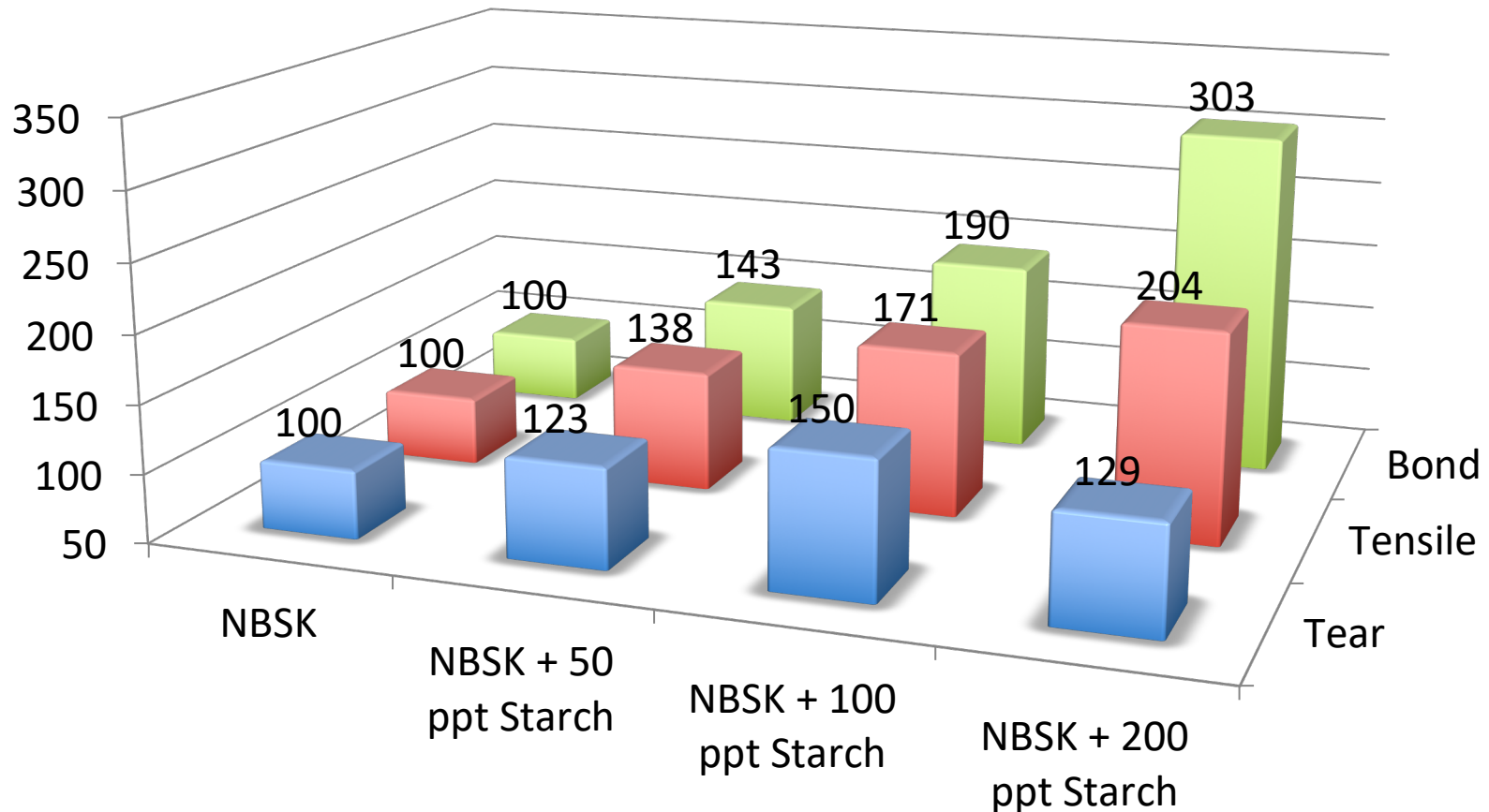


**85% GWD – Commercial
Cerecarb® Offset Printability Results
Cut blanket washes in half!**

Monthly Ave. SWK Usage - 30#

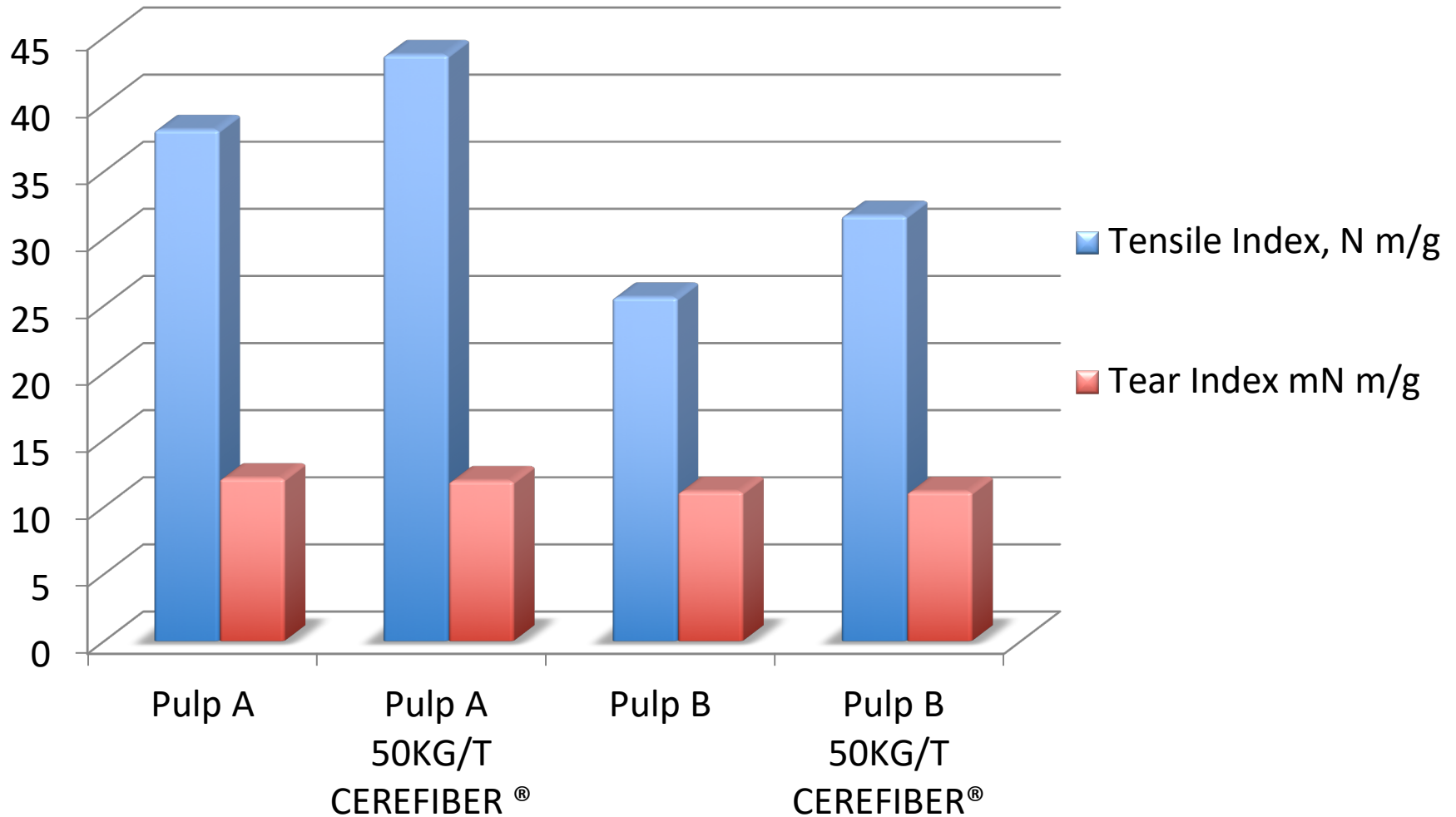


Cerefiber[®] Kraft Strength Development



Handsheet study

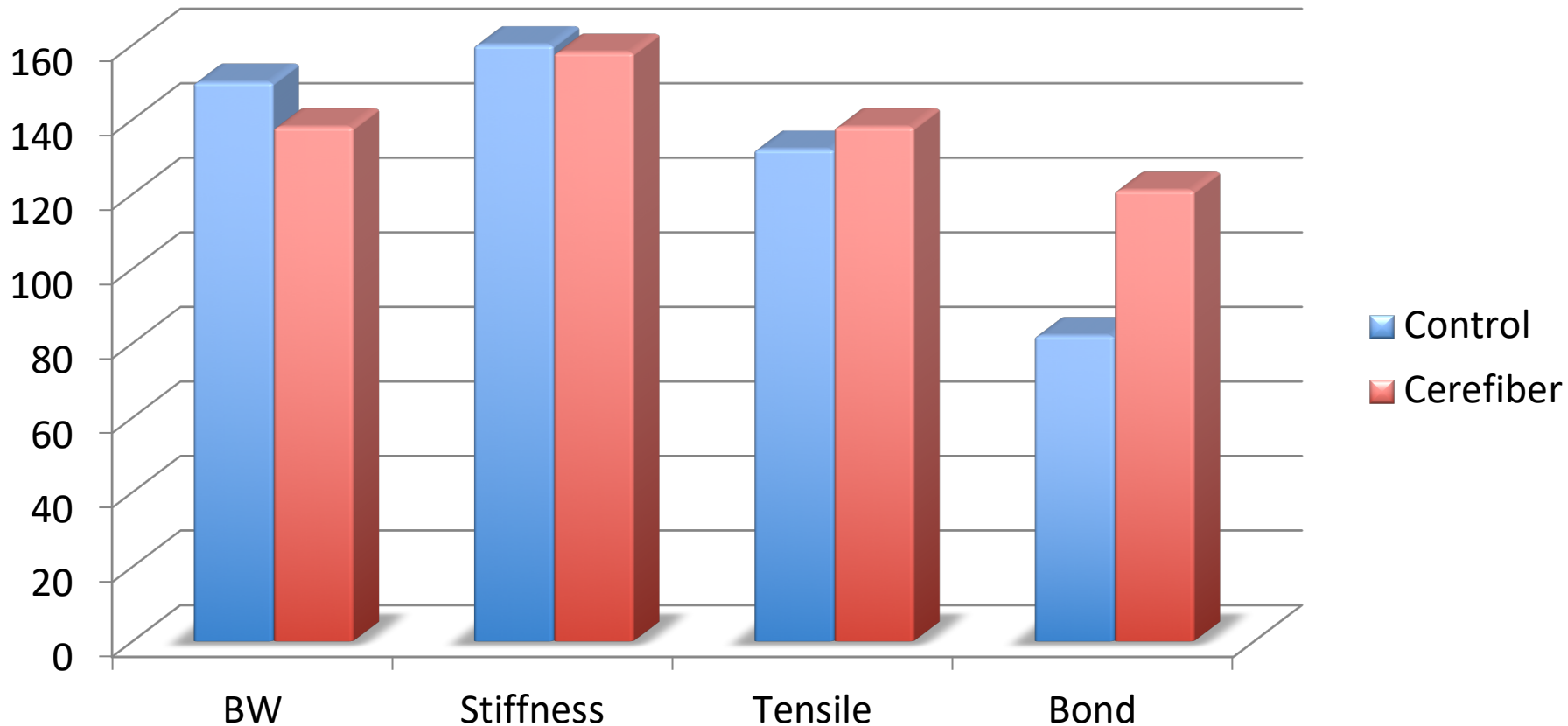
Cerefiber[®] Strength Development OCC



Cerefiber[®] BW Reduction Paperboard

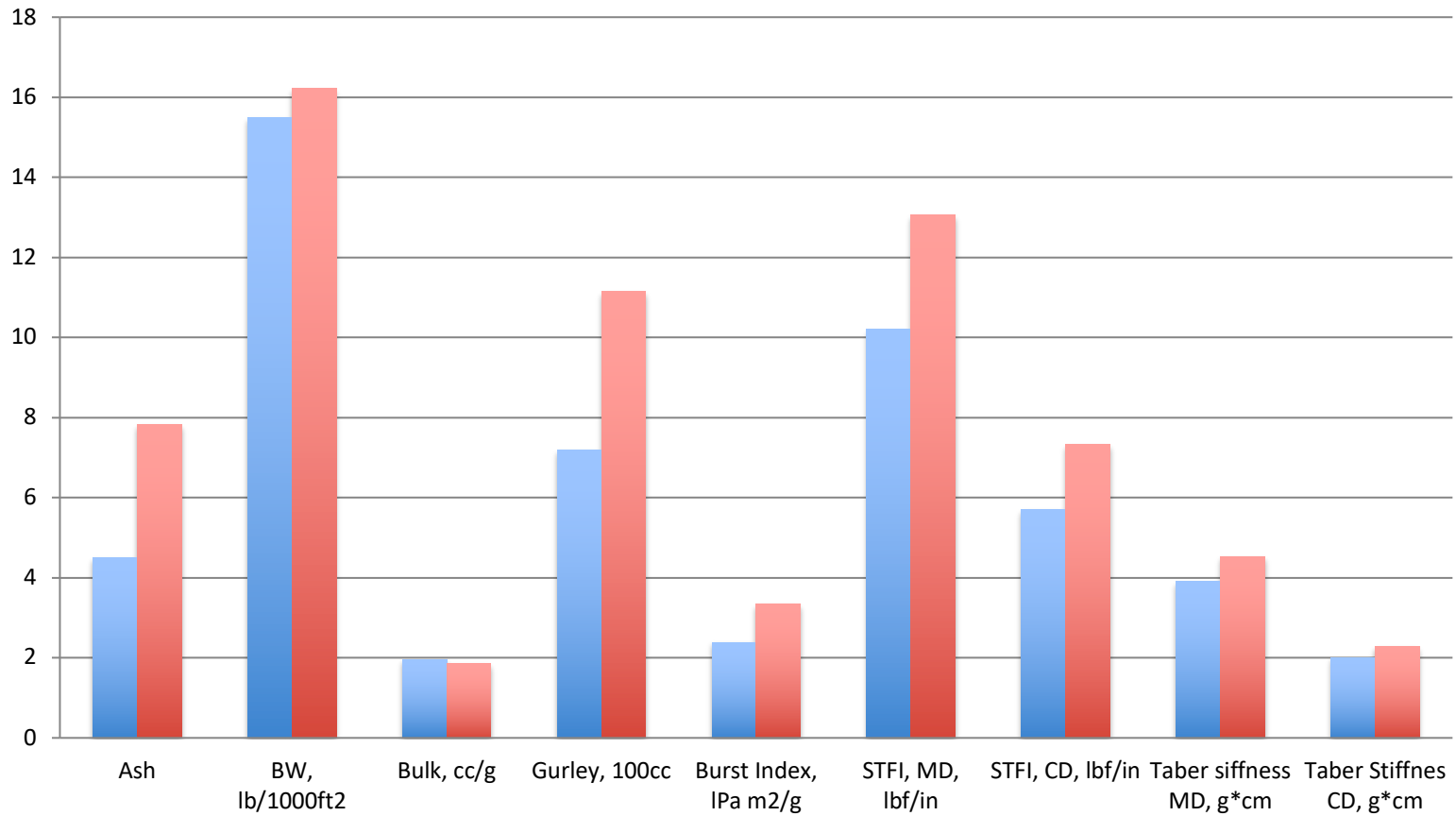


8 % Basis Weight Reduction Paperboard



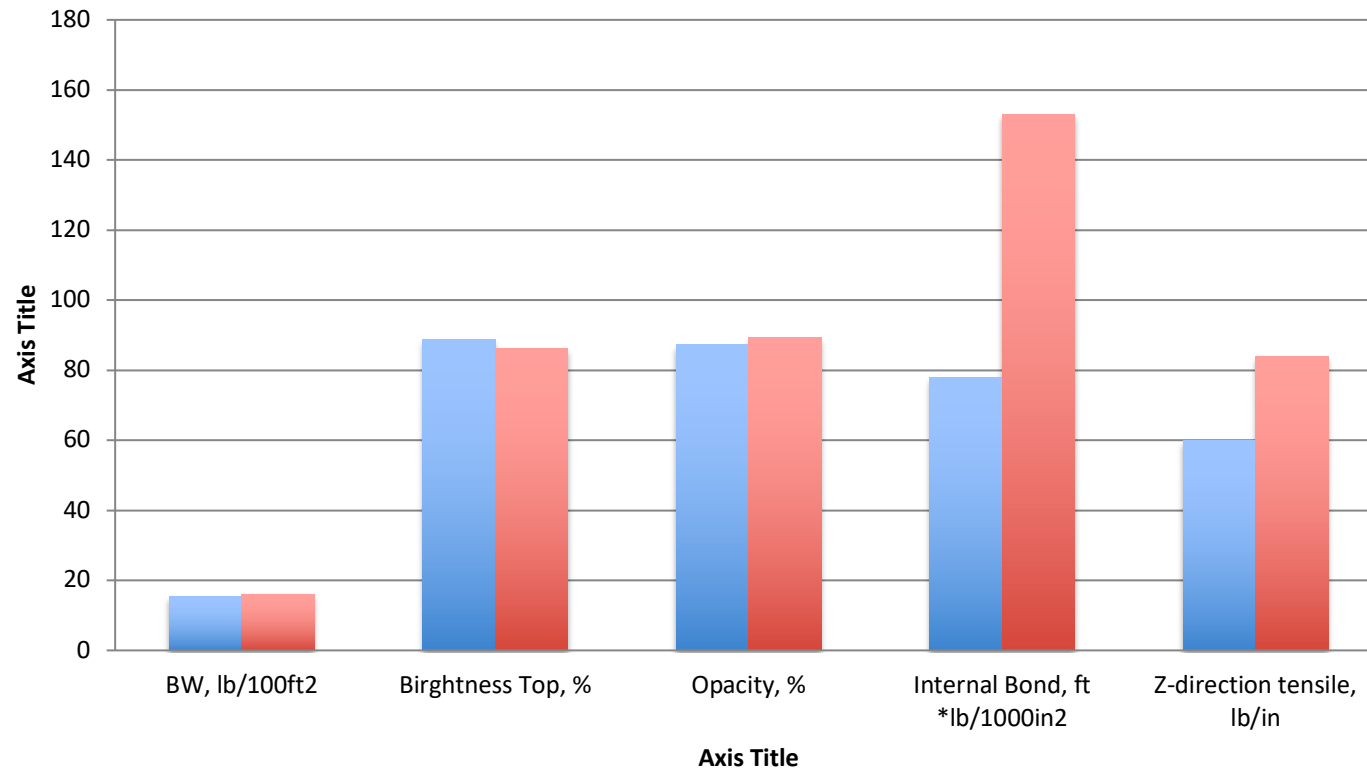
White Top Ply

Control vs 80lbs/T Cerecarb®

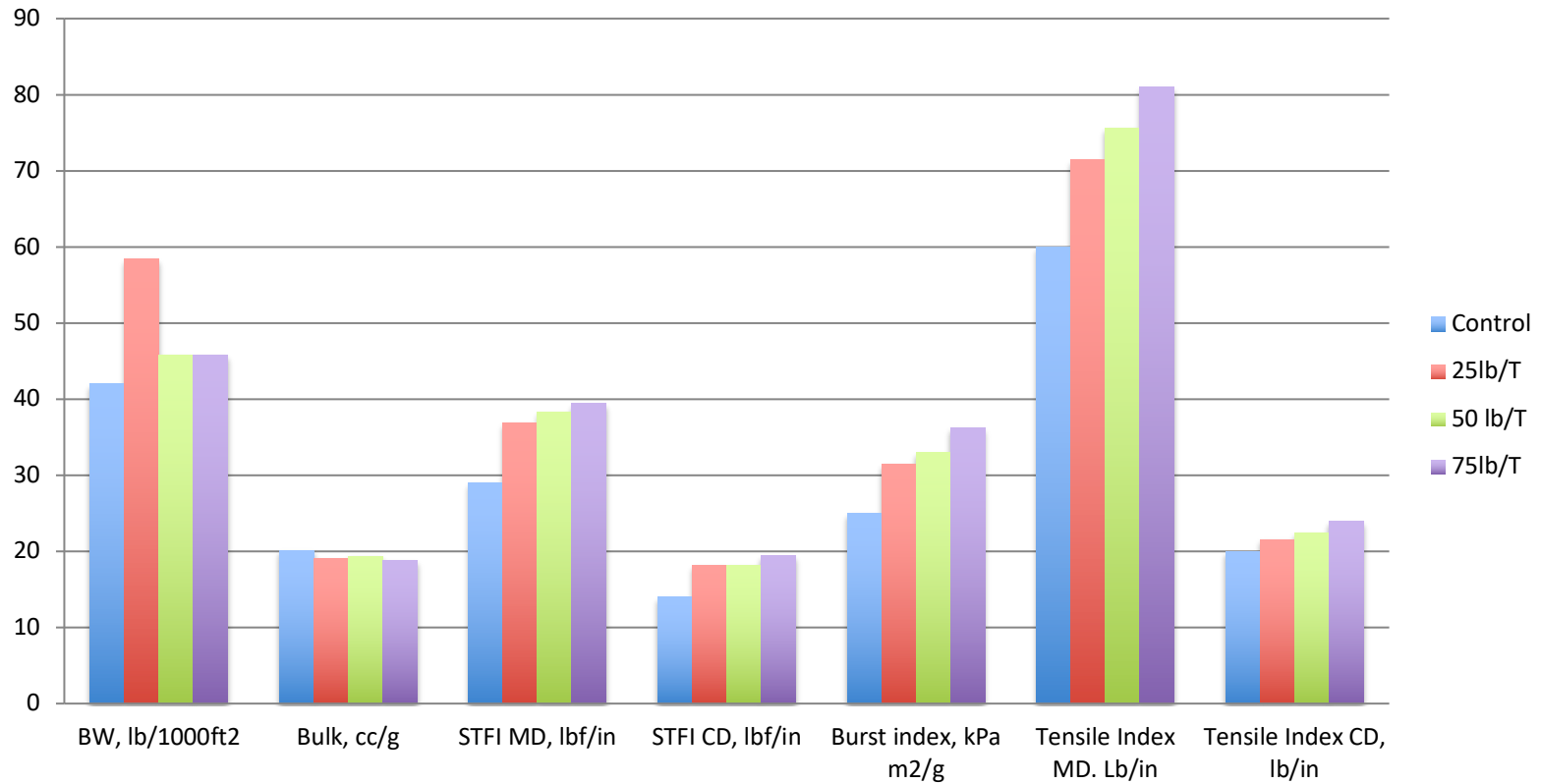


Commercial

White Top Ply Control vs 80 lbs/T Cerecarb®



Recycled Linerboard/Medium Cerefiber®



Commercial

SUMMARY

This high level of starch delivers high levels of strength that can be leveraged to reduce costs and/or improve quality

- ◆ **Replace fiber with filler or less expensive fiber**
- ◆ **Reduce basis weight for lower material costs**
- ◆ **Improve printability and improved press room runnability**
- ◆ **Increase production on drainage limited machines**
- ◆ **Increase productivity from better wet web strength**
- ◆ **With nanocellulose improved surface properties**