

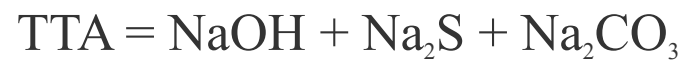
# White Liquor Sodium Carbonate Effects on the Pulping of Southeastern Softwood

Liam Ryan, Associate Research Scientist  
Fritz Paulsen, R&D Manager  
Peter Hart, R&D Senior Director  
WestRock



# White Liquor Composition & Cook Fundamentals

Liquor Component	Typical load as Na <sub>2</sub> O, gpl
NaOH	81-120
Na <sub>2</sub> S	30-40
Na <sub>2</sub> CO <sub>3</sub>	11-44
Na <sub>2</sub> SO <sub>4</sub>	4-18
Na <sub>2</sub> SO <sub>3</sub>	2-7
Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub>	4-9

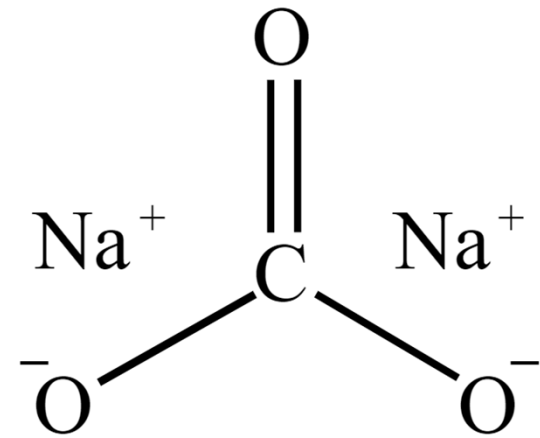


Component table adapted from "Kraft Pulping – A Compilation of Notes", Pyatte 1993  
Cook equations from "Handbook for Pulp and Paper Technologists 4<sup>th</sup> Edition", Smook 2016



# Sodium Carbonate Ionization

- $\text{Na}_2\text{CO}_3$  is considered deadload in liquor calculations
- Synthetic white liquor typically includes only  $\text{NaOH}$  and  $\text{Na}_2\text{S}$
- This study provides evidence that carbonate contribution is non-negligible in lab cooks

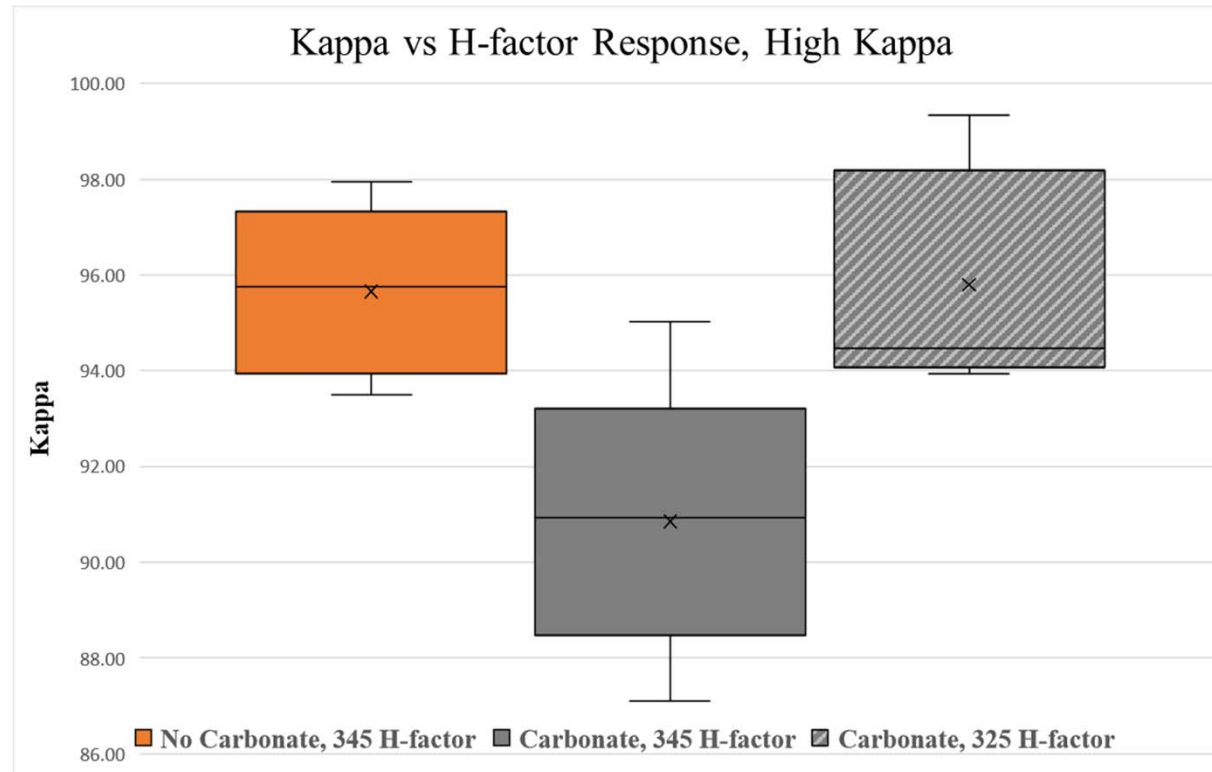


# Experimental

- 4 x 5 sets of 800 OD gram digester cooks on southern yellow pine
- 4:1 L:W ratio, 18% AA, 25% sulfidity on TTA basis
- Carbonate cooks contain 7.5%  $\text{Na}_2\text{CO}_3$  on OD wood
- 5 cooks each of the following conditions
  - bleachable grade (~30 kappa) with and without carbonate
  - liner grade (~95 kappa) with and without carbonate
- 5 point valley beater curve with handsheets



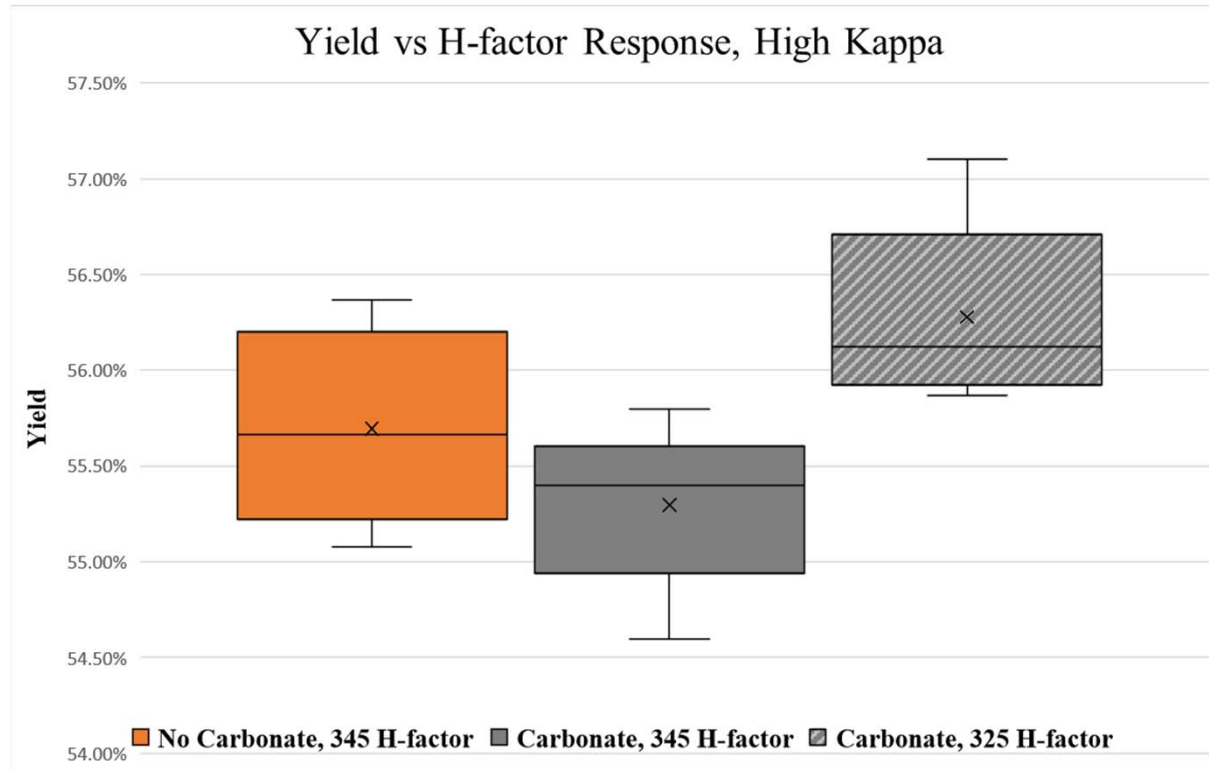
# High Kappa – Container Board Softwood



- High kappa shows statistical difference at same H-factor for delignification



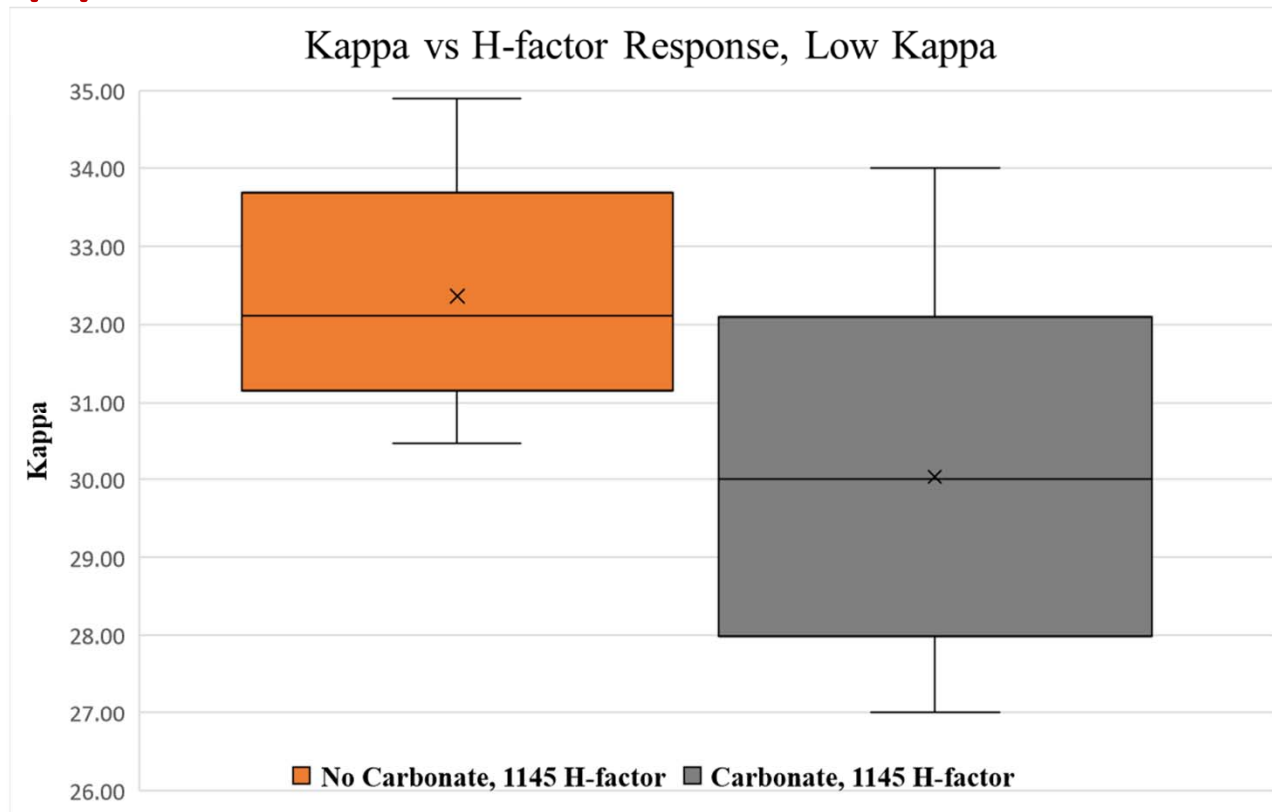
# High Kappa – Container Board Softwood



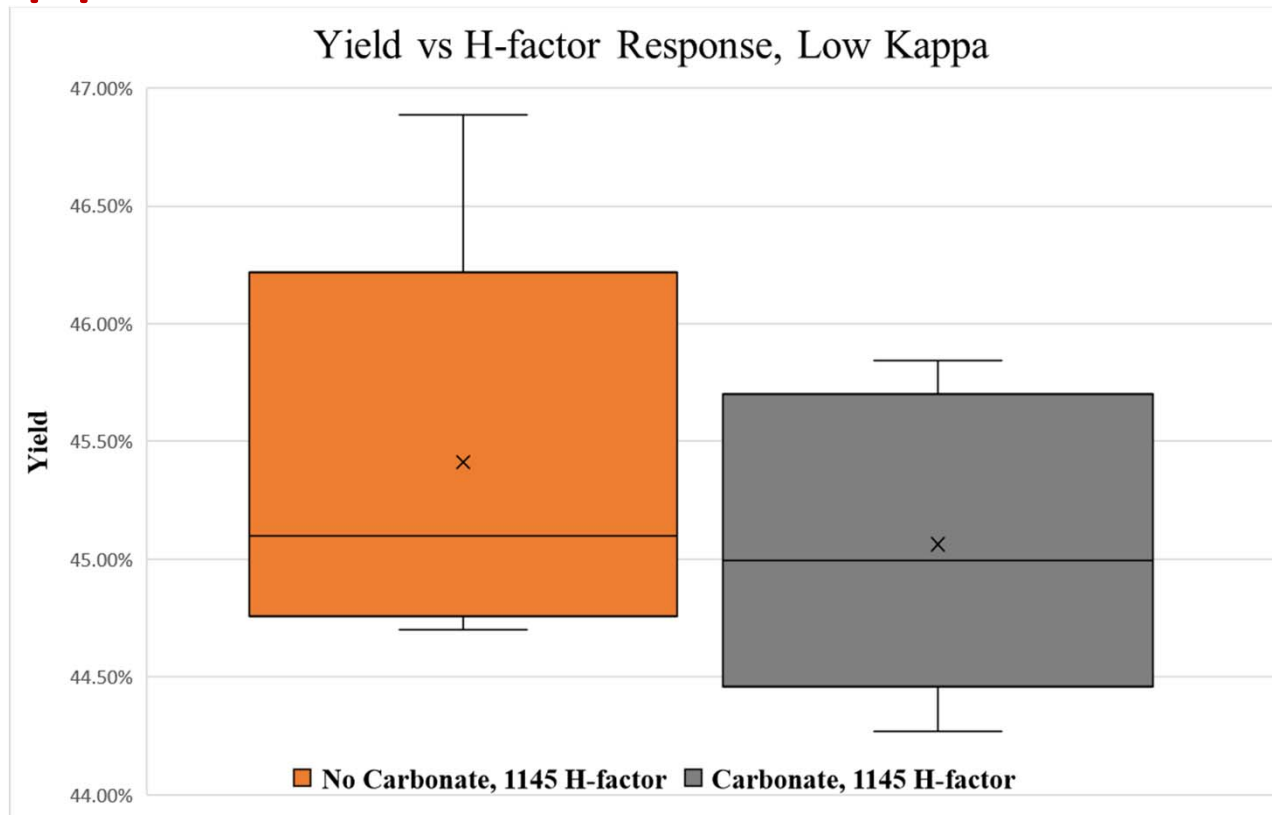
- One-half yield point increase with carbonate at similar delignification



# Low Kappa – Bleachable Grade Softwood

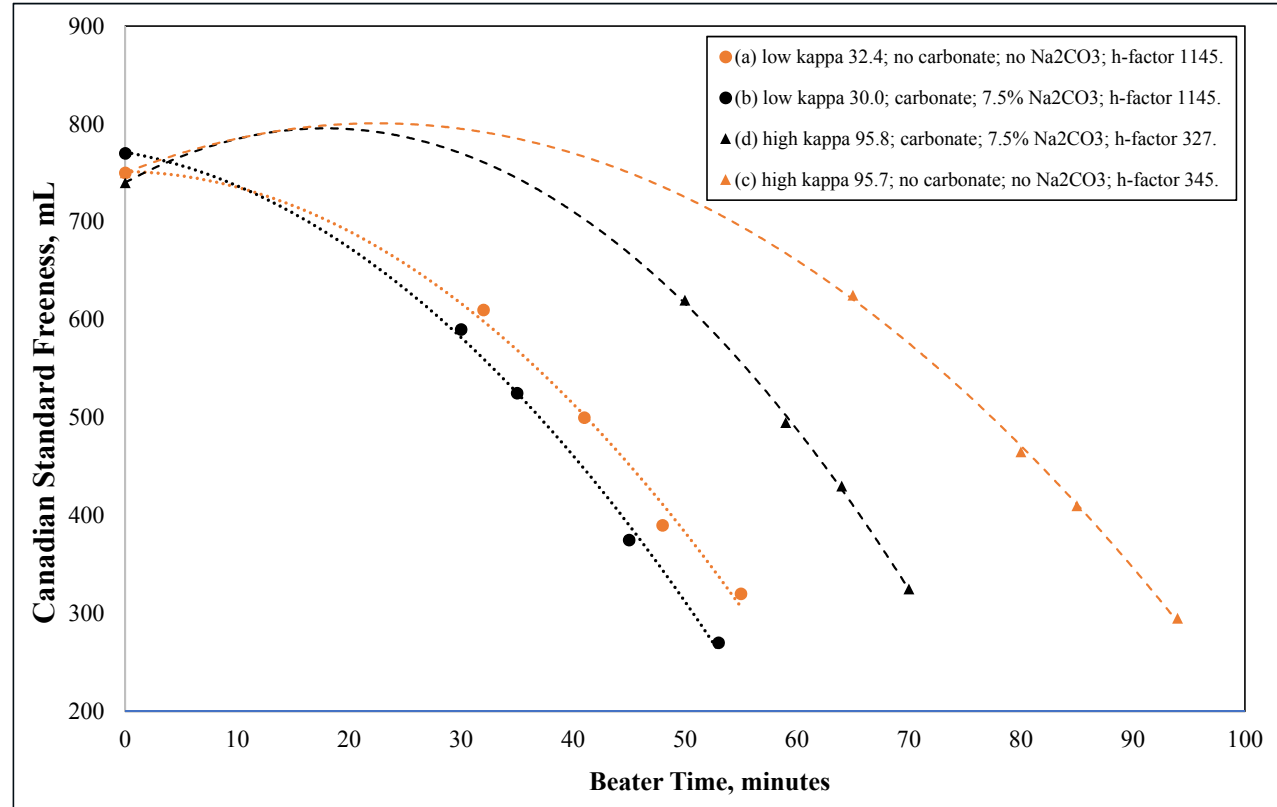


# Low Kappa – Bleachable Grade Softwood

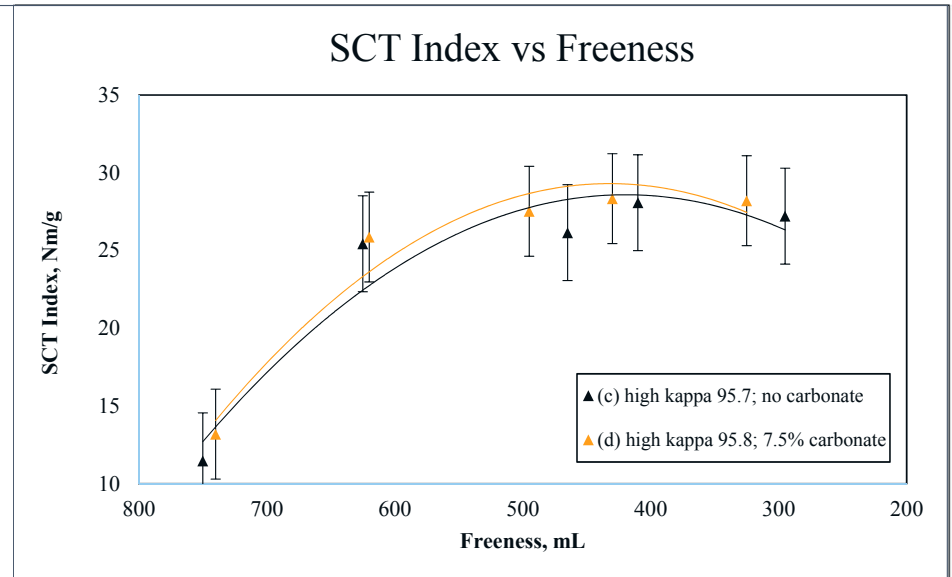
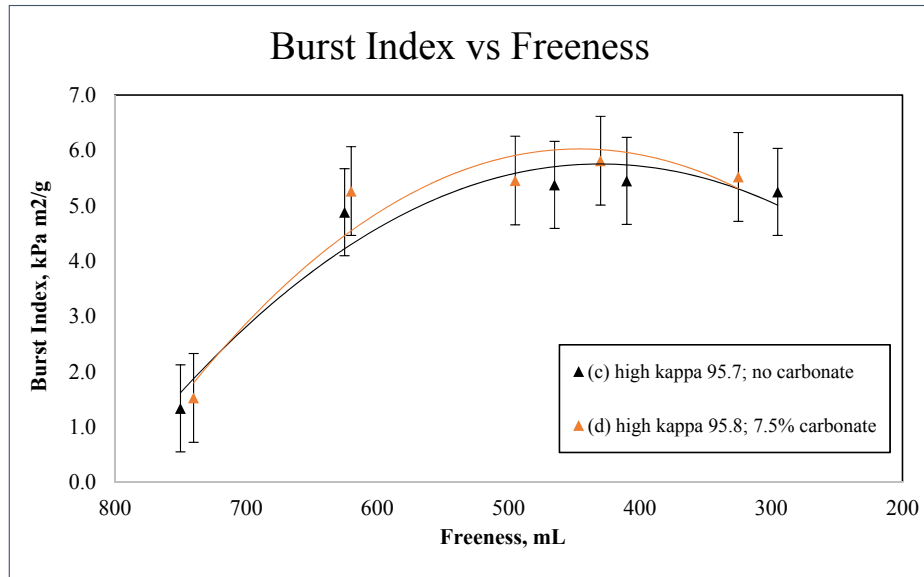


# Softwood Valley Beater Response

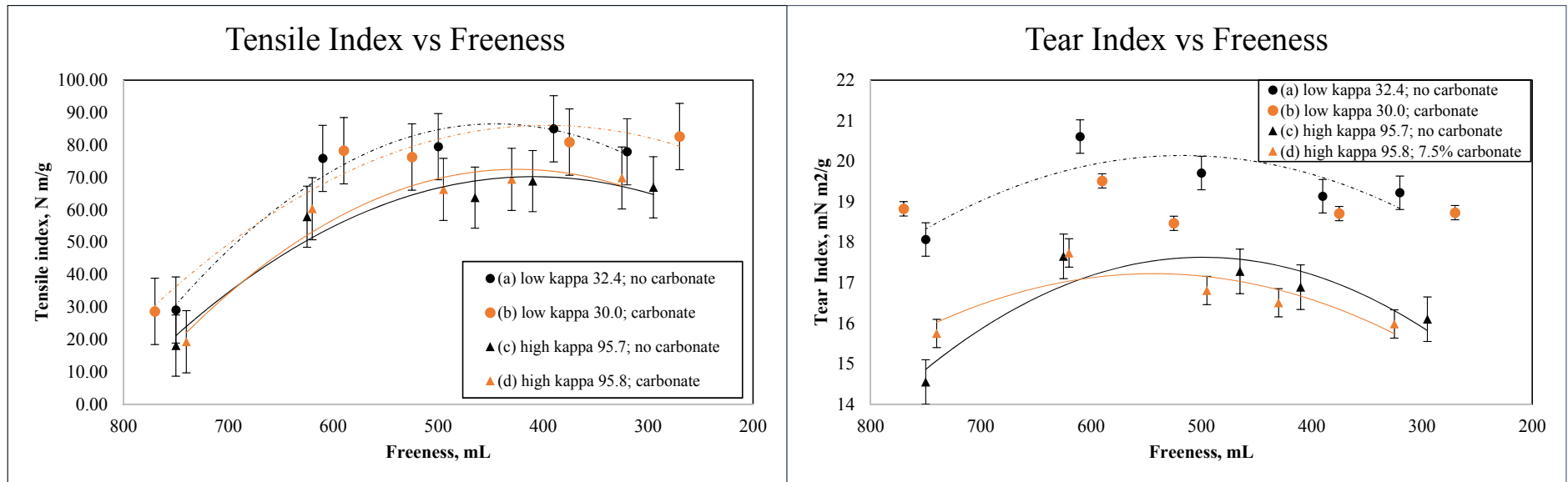
- Higher kappa softwood harder to refine
- High kappa carbonate cook develops freeness much faster when beaten
- Much smaller difference in development for low kappa



# Handsheet Properties – Containerboard



# Handsheet Properties – Unbleached



# Conclusions

- Carbonate addition in lab cooks provides tangible differences in cook and refining responses at high kappa
- Handsheet properties are largely unaffected by presence/absence of carbonate
- Synthetic white liquors should include a carbonate component

