PAPTAC Bleaching Committee

Bleaching Practices for Oxygen-Delignified Softwood Kraft Pulp:

Analysis of the 2013 PAPTAC Bleaching Committee Mill Survey

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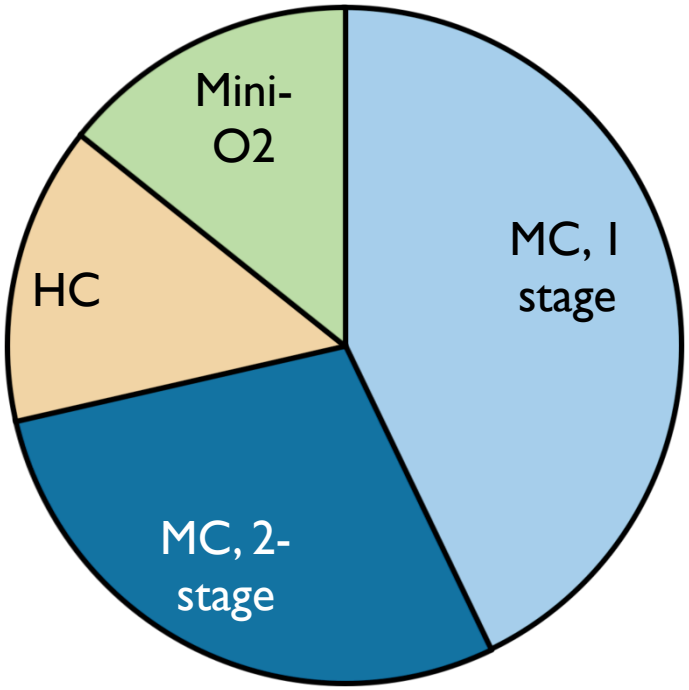
Background

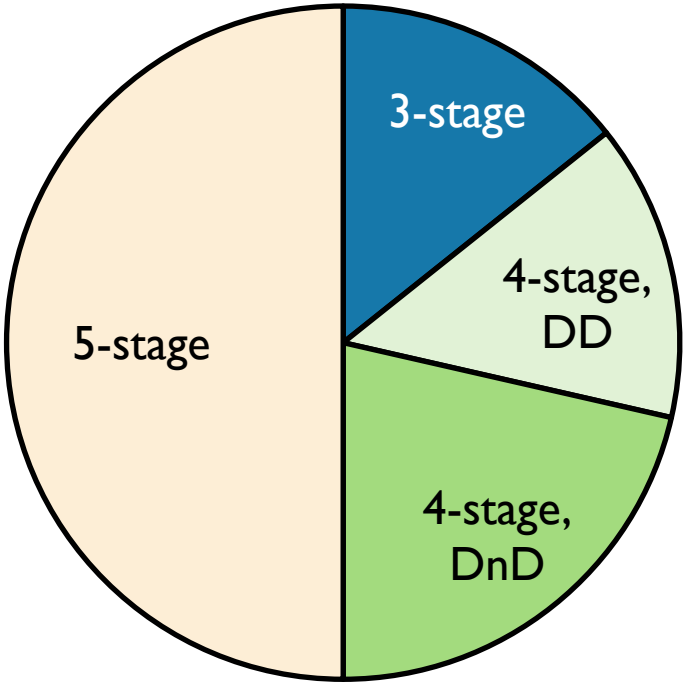
- Bleaching Committee of the Pulp & Paper Technical Association of Canada
  - Pulp mills, researchers, vendors, & consultants in Canada and the USA
- Bleach Plant Surveys carried out in early 1990's, 1998-99, 2003-04
- Survey of Operational Parameters
  - Chemical use
  - Bleaching stage variables (e.g. time, temperature, pH)
  - Washers and showers
  - Water and energy use
  - Process control
- Current survey sent to all member mills
  - 23 responses representing 37 separate fibrelines or pulp grades
  - 13 O2-SWD mills, representing 14 bleach plants

O2 Systems & Bleach Plants

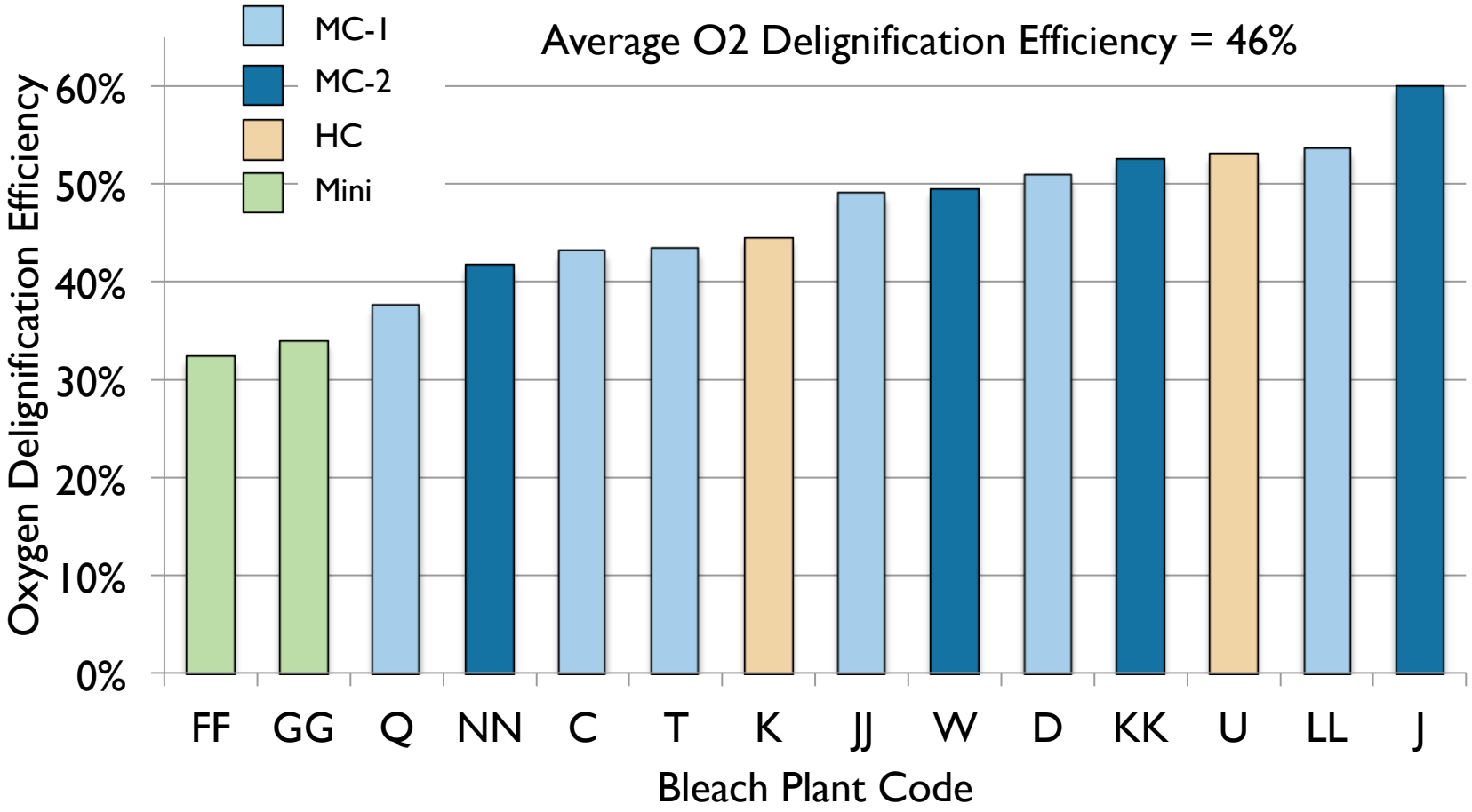
O2 Delignification



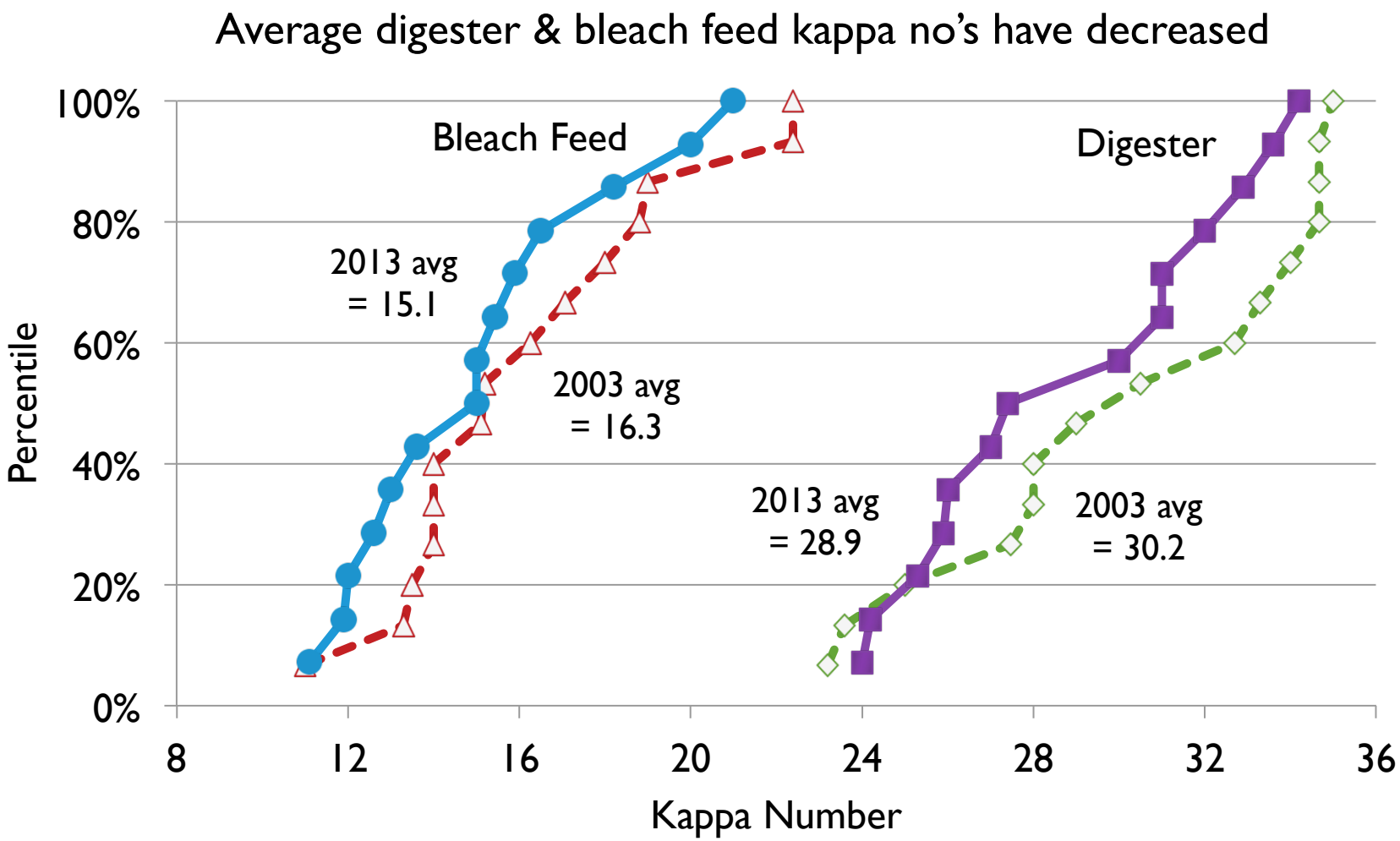
Bleach Plants



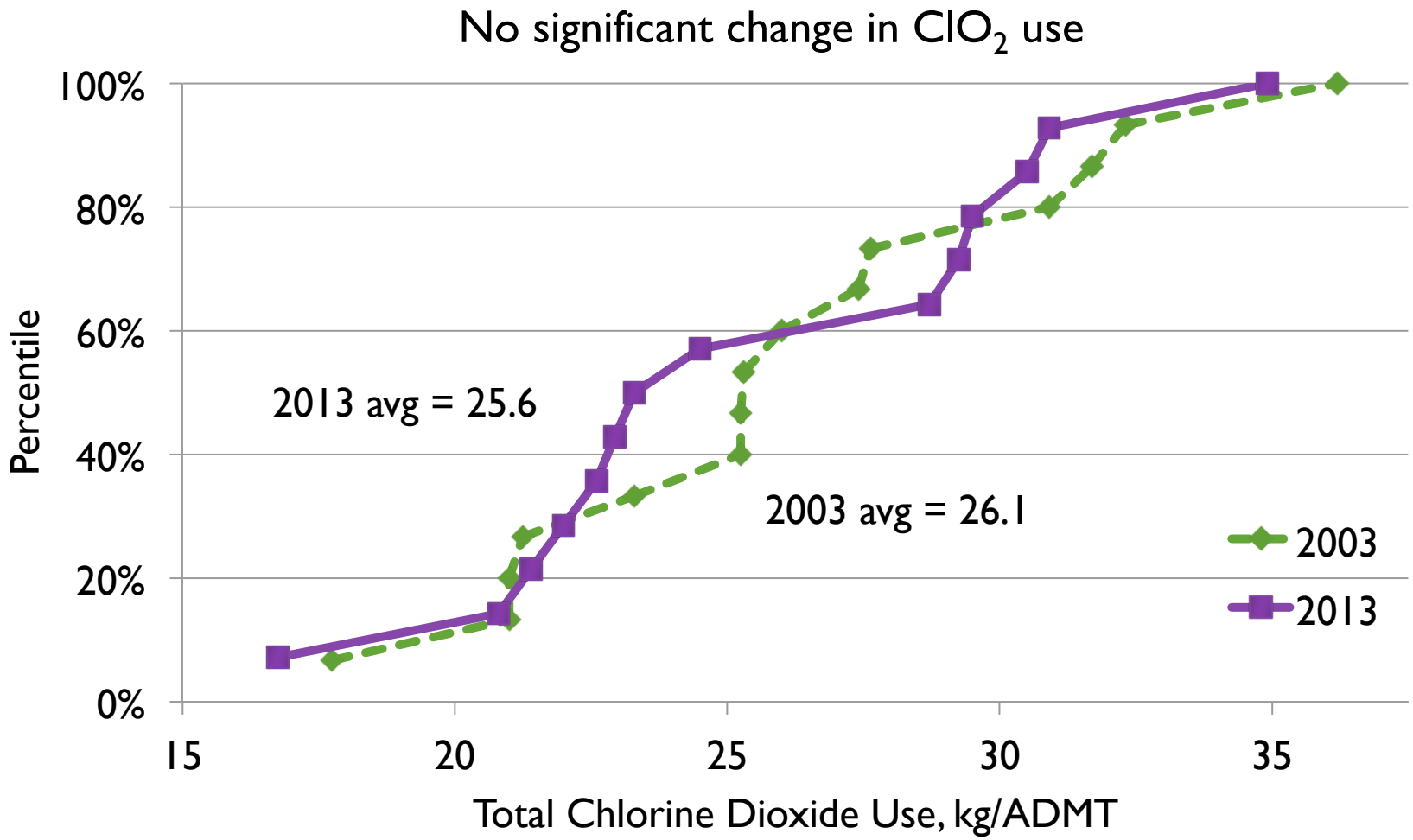
Oxygen Delignification



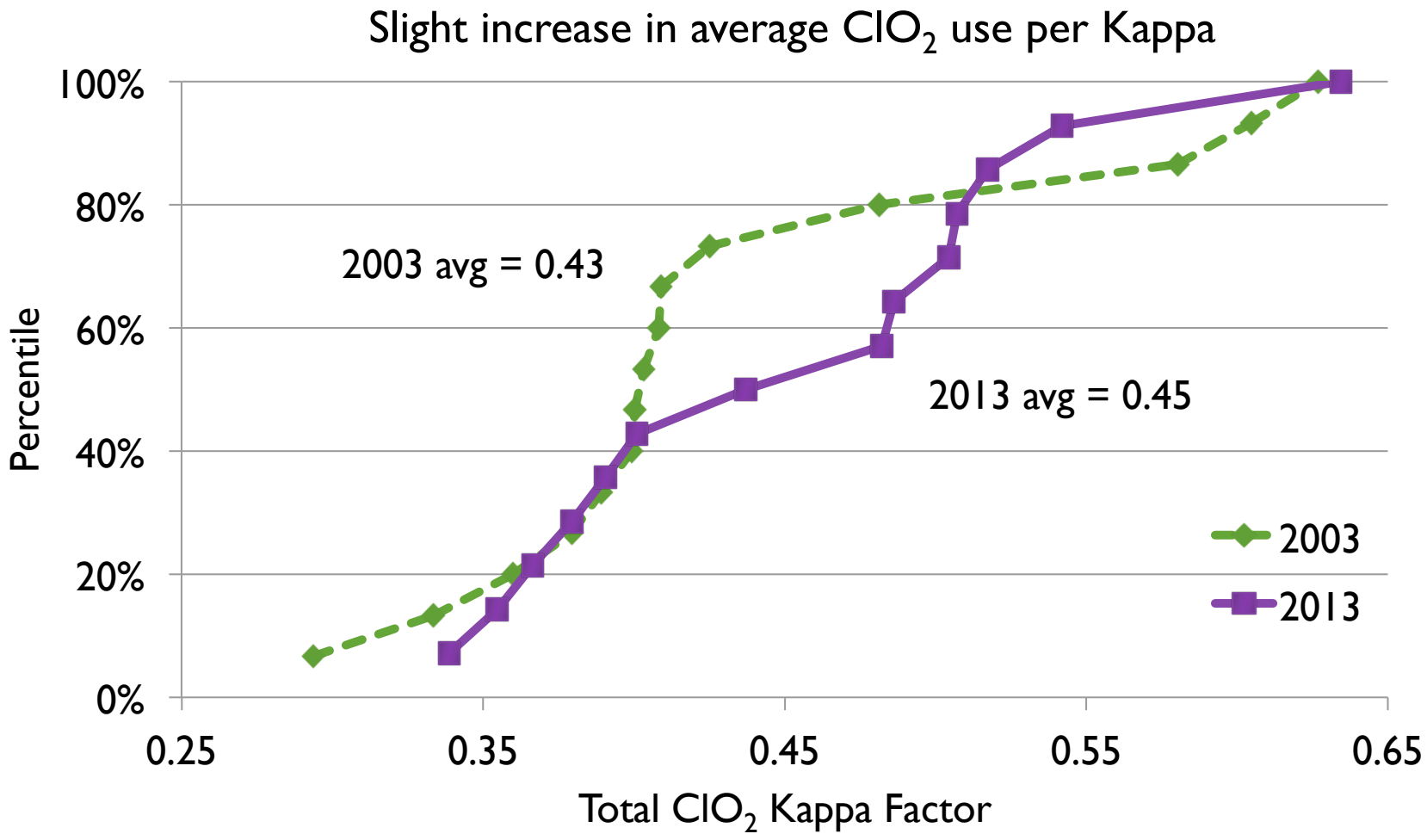
O2-SWD Kappa No's



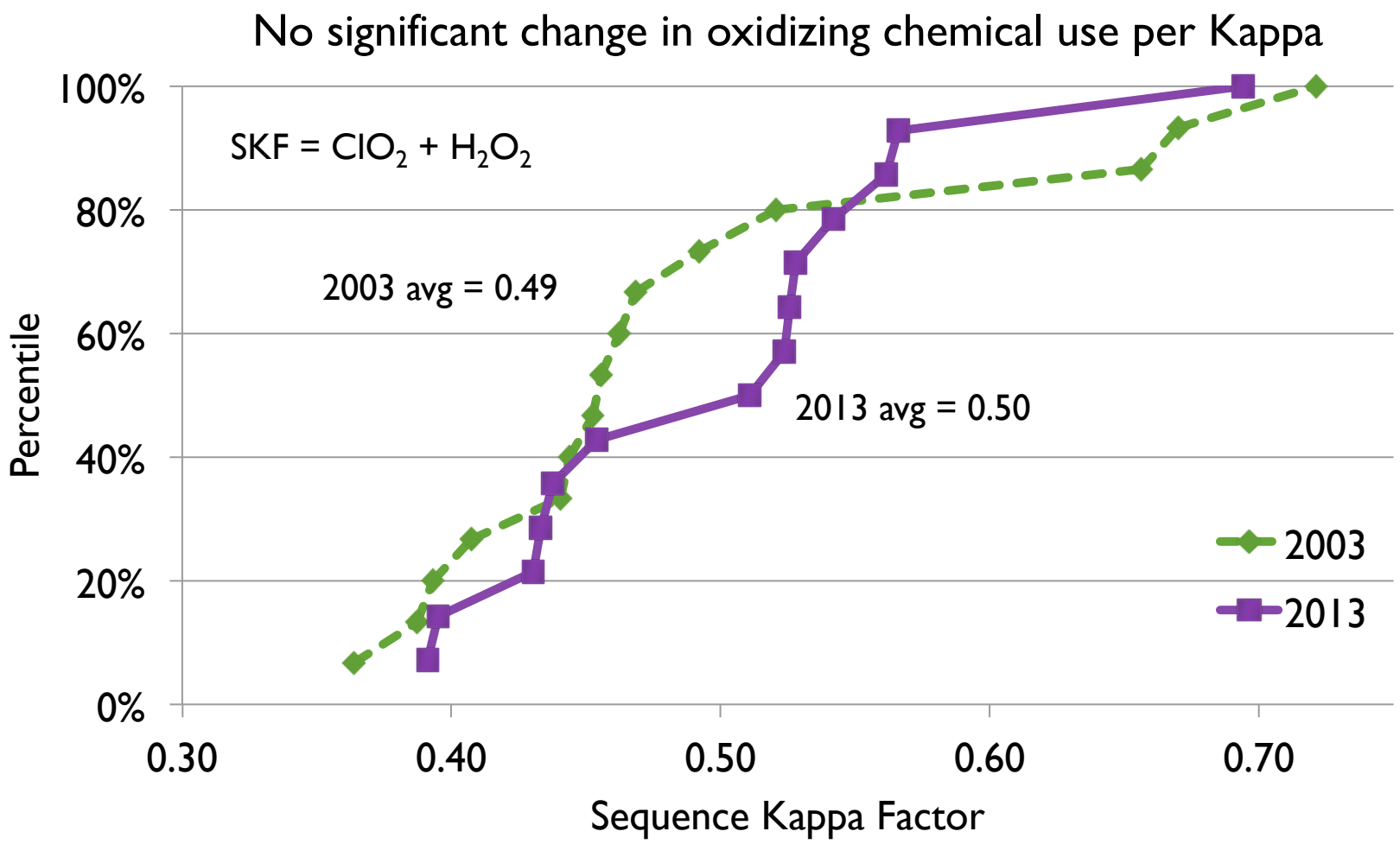
O2-SWD Total ClO_2 Use



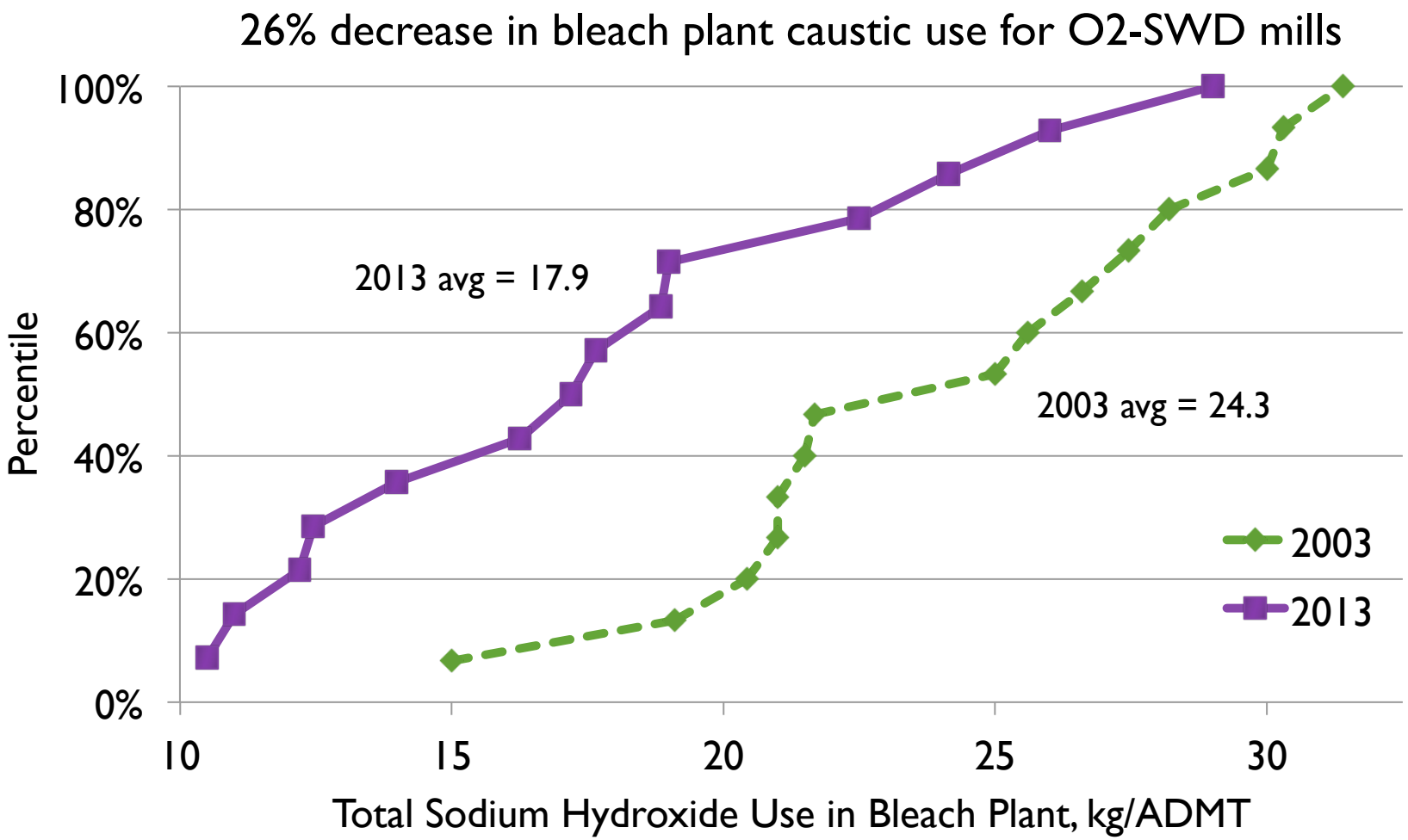
Total ClO_2 Kappa Factor



O2-SWD Sequence Kappa Factor



O2-SWD Total Caustic Use

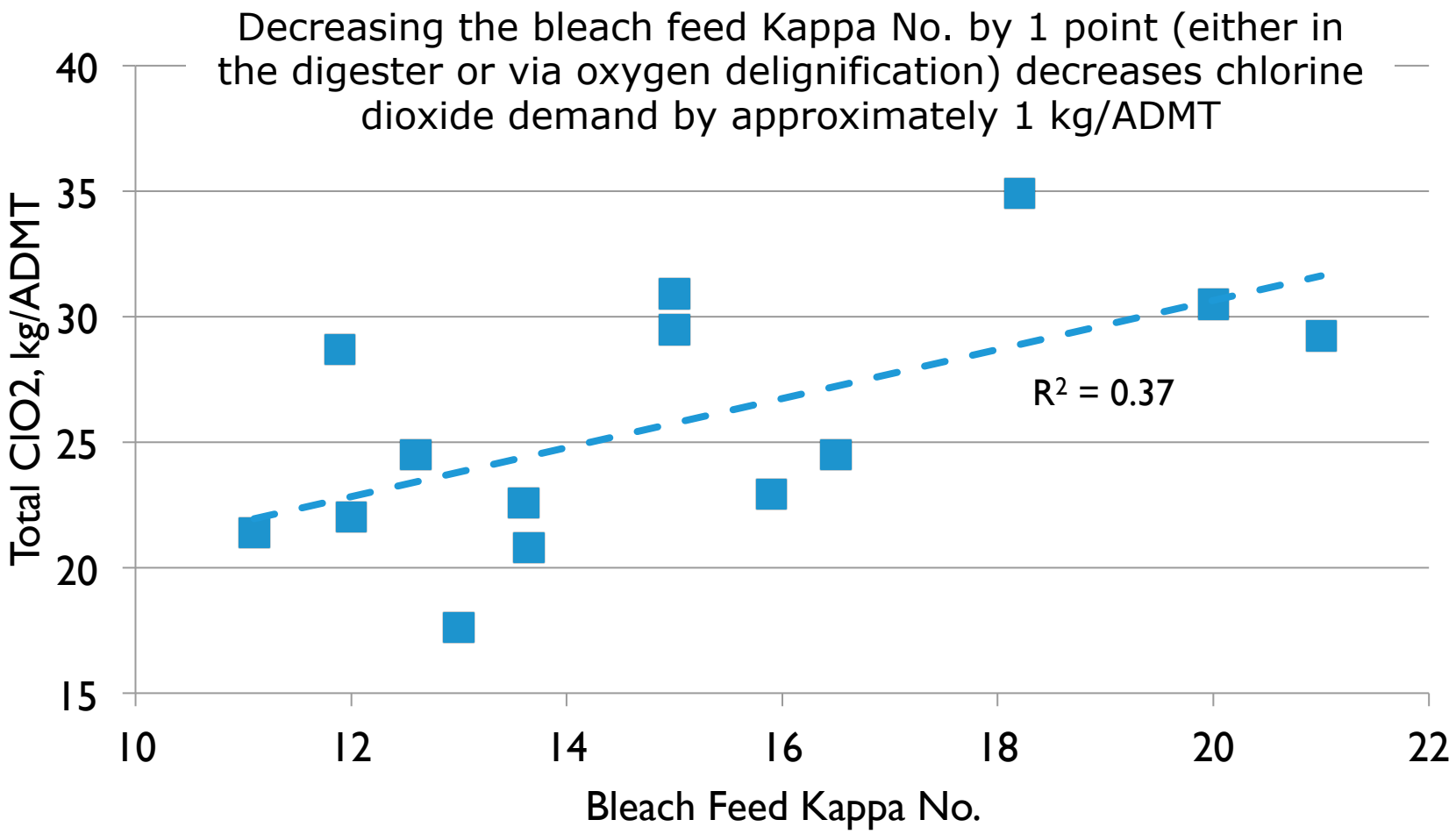


Summary: O2-Delignified Softwood

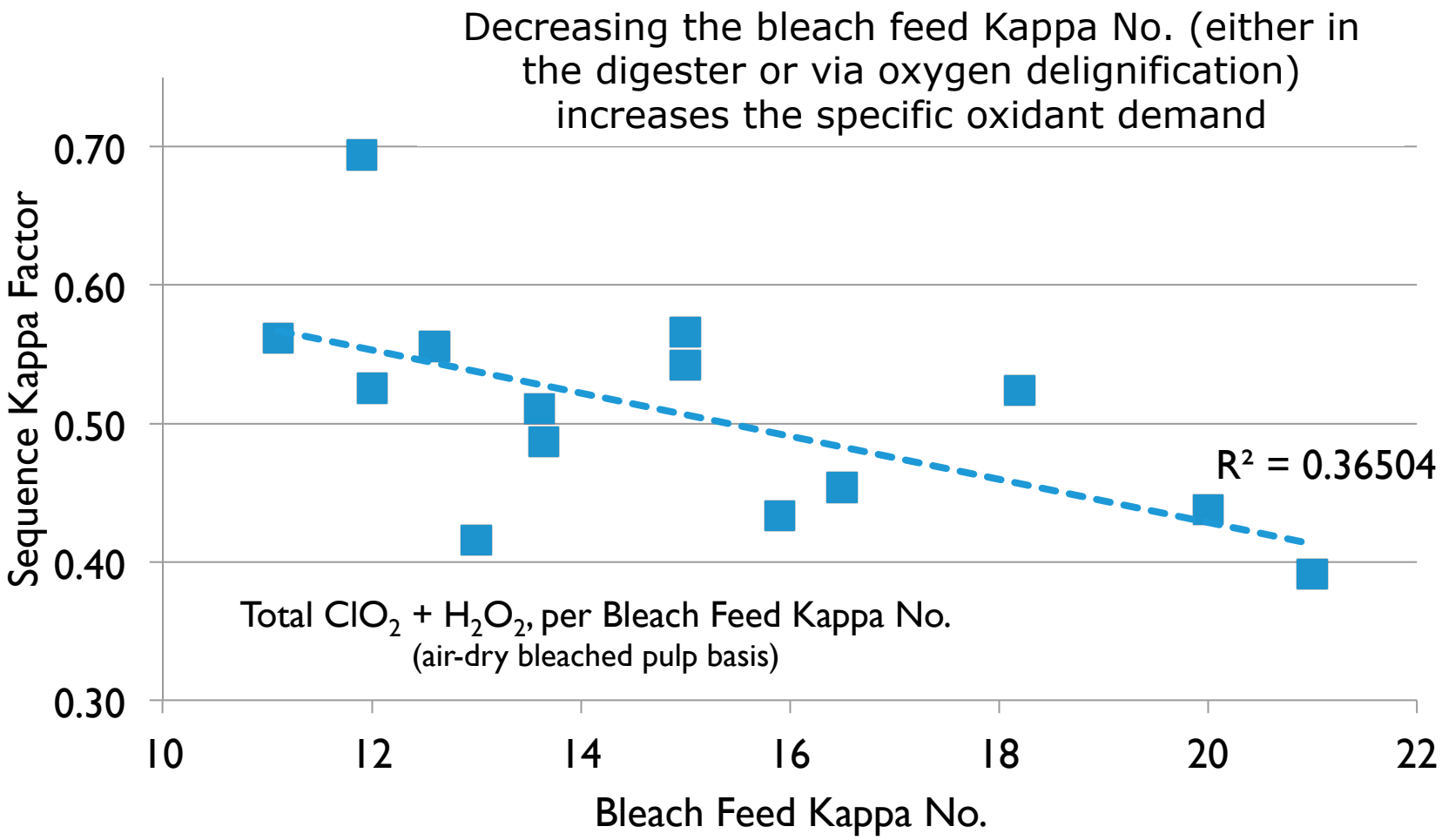
Since the last survey in 2003, the following changes have been observed for oxygen-delignified softwood kraft pulp:

- Pulp production has increased by an average of 6.5%;
- Final bleach plant brightness has increased by an average of 0.5% ISO;
- Digester kappa no. has decreased by an average of 1.3 kappa units, and bleach feed kappa no. has decreased by an average of 1.2 kappa units;
- Sodium hydroxide use in the bleach plant has decreased by an average of 6.4 kg/ADMT or 26%;
- Chlorine dioxide use has decreased by an average of 0.5 kg/ADMT, and hydrogen peroxide use has decreased by an average of 0.9 kg/ADMT.

ClO_2 Use vs. Kappa No.

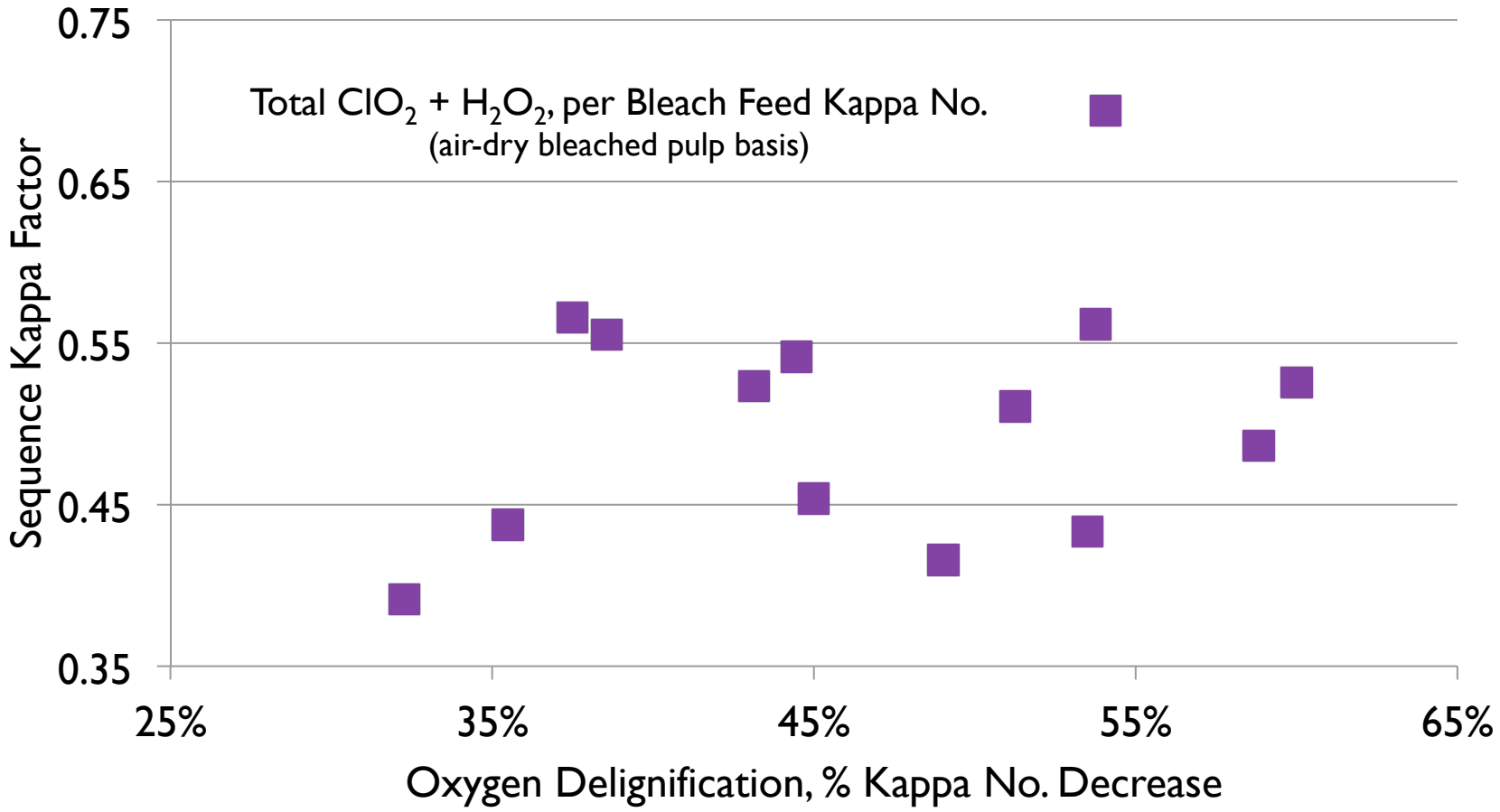


Oxidizing Chemical Use vs. Kappa No.



O2 Delignification & Chemical Use

No relationship between *degree* of O2 Delignification and Bleachability; Bleach Feed Kappa No. (*i.e.* free phenolic content) is more significant



Relative Chemical Consumption

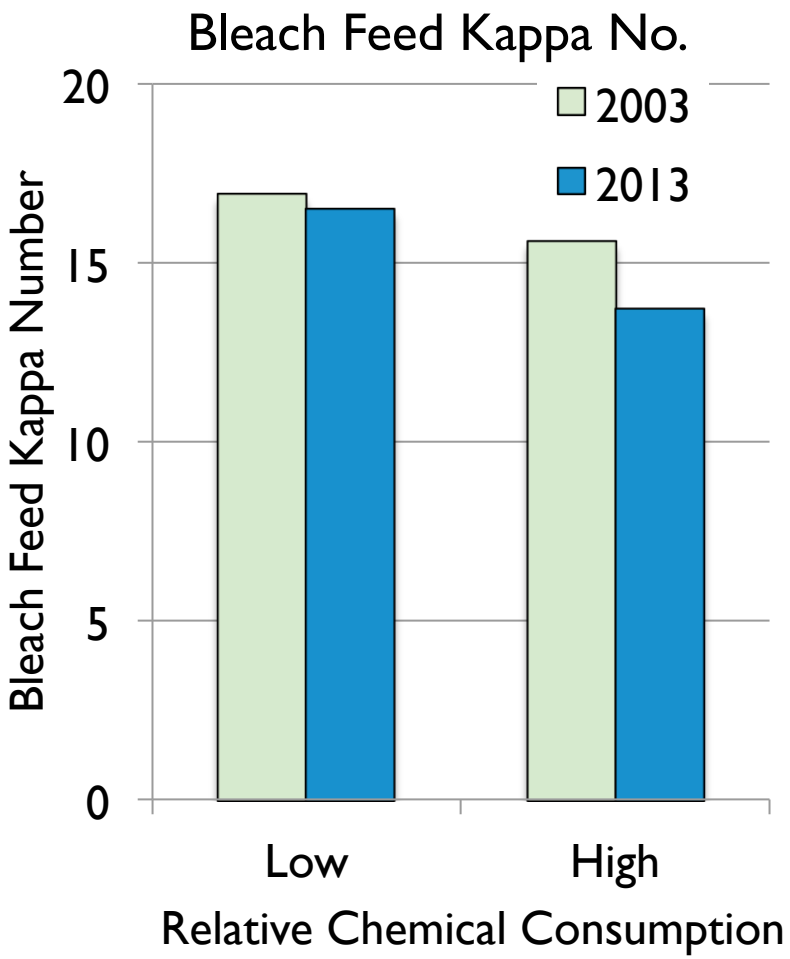
Bleach plants sorted by Sequence Kappa Factor & averaged into two groups

Parameter	Low Relative Chemical Consumption Average	High Relative Chemical Consumption Average
Pre-O_2 Kappa No.	30.4	26.2
Bleach Feed Kappa No.	16.5	13.7
O_2 Delignification	45%	47%
D_0-stage Kappa Factor	0.22	0.32
Eop-stage NaOH, kg/ADMT	13.2	13.6
Eop-stage H_2O_2, kg/ADMT	3.5	1.5
Post-Eop Kappa No.	3.4	3.0
D1-stage ClO_2, kg/ADMT	9.2	8.6
D2-stage ClO_2, kg/ADMT	2.0	1.8
Final Brightness, % ISO	89.2%	88.7%
Total ClO_2, kg/ADMT	23.9	27.2
Total H_2O_2, kg/ADMT	4.1	2.4
Total NaOH, kg/ADMT	17.2	18.6
Sequence Kappa Factor	0.44	0.56

"Low Relative Consumption" O2-SWD mills:

- Have a higher bleach feed Kappa No.
- Make a higher brightness pulp
- Use 3.3 kg/ADMT less total ClO_2 and 1.7 kg/ADMT more H_2O_2

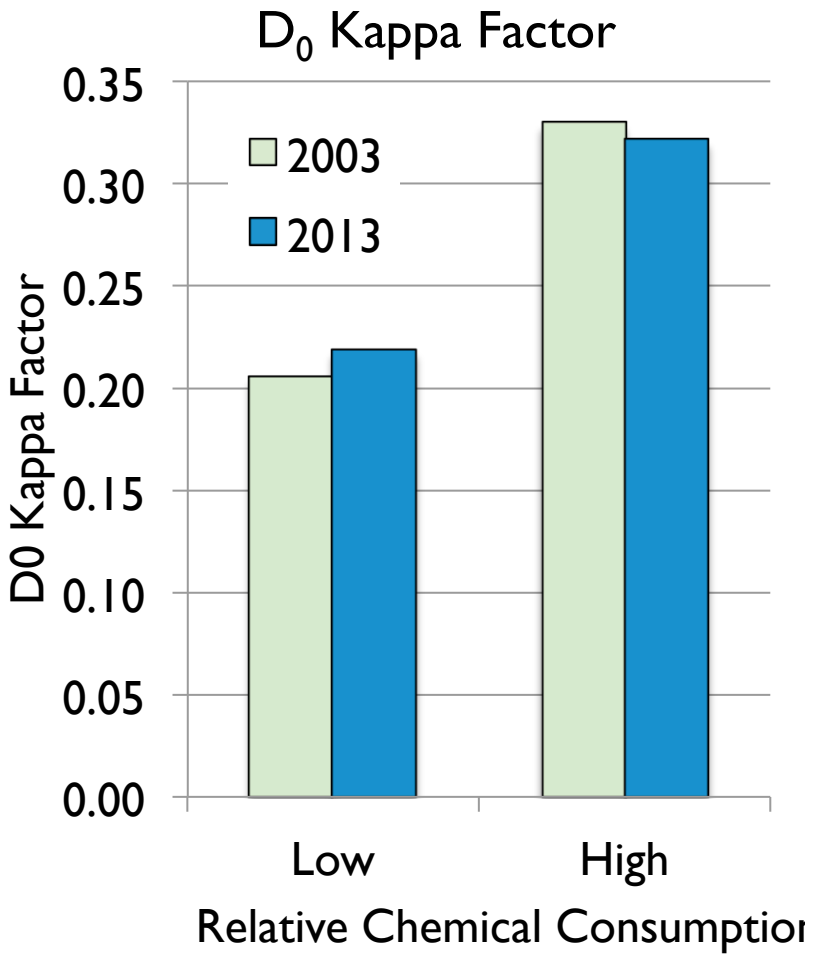
O2-SWD: Kappa No.



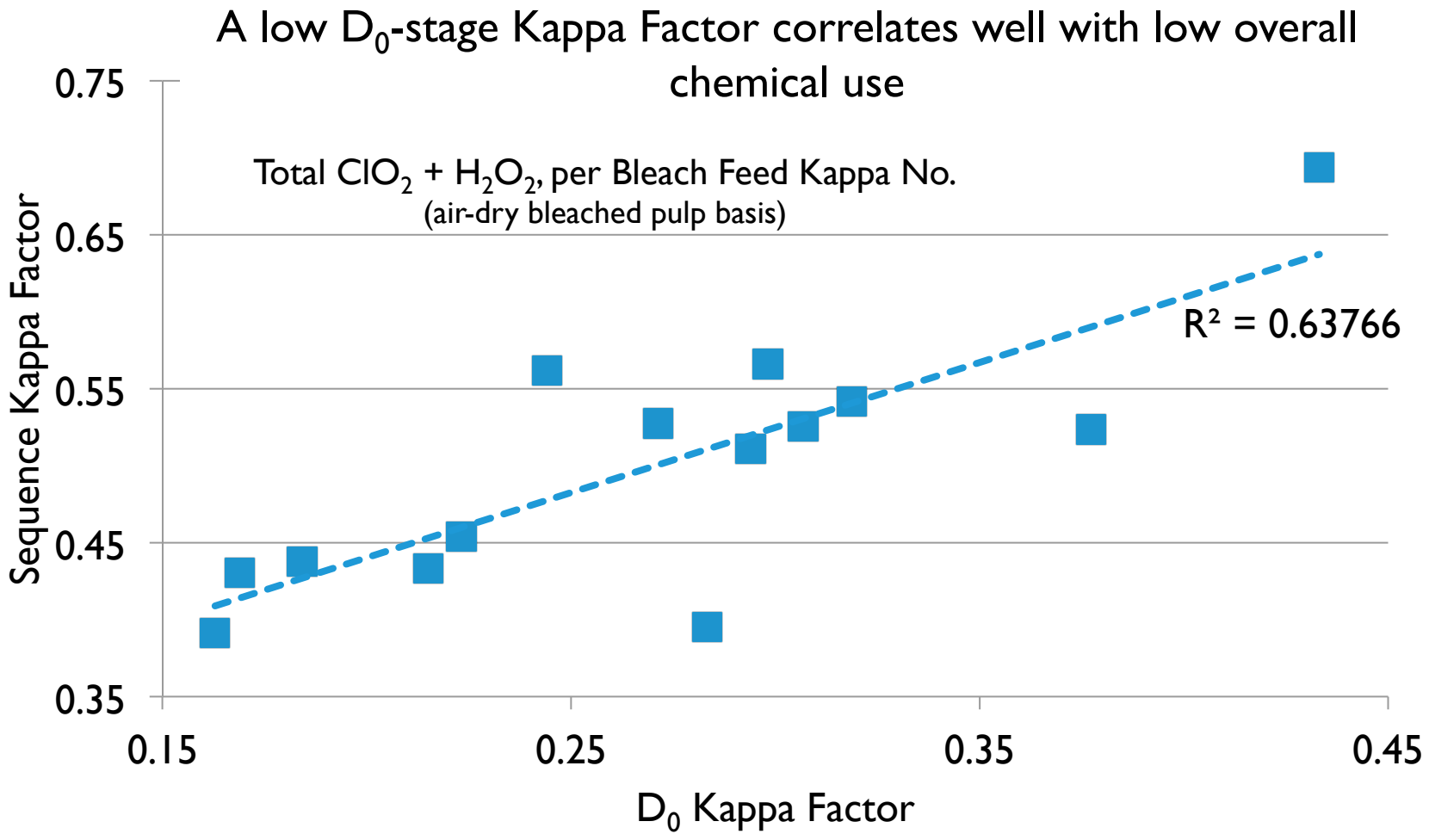
- Low relative chemical consumption mills have a higher bleach feed kappa no.
  - Produce a pulp with 0.5% ISO higher final brightness
- Wood species is not a significant differentiator
- Is higher-kappa pulp easier to bleach?

O2-SWD: D_0 Kappa Factor

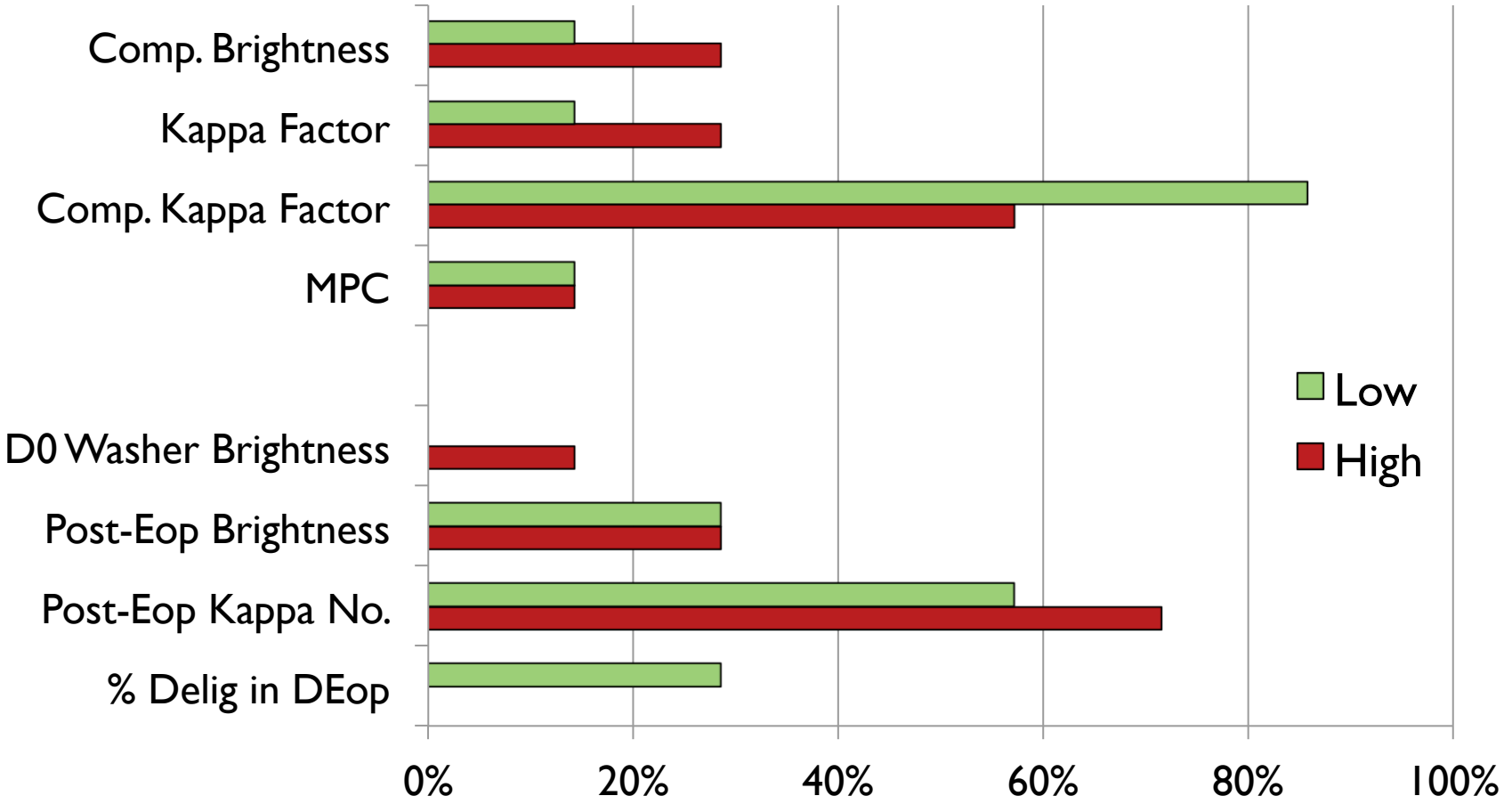
- Low relative chemical consumption bleach plants operate with a significantly lower Kappa Factor in the D_0 stage
  - No difference in carryover
  - Number of bleaching stages was not a factor



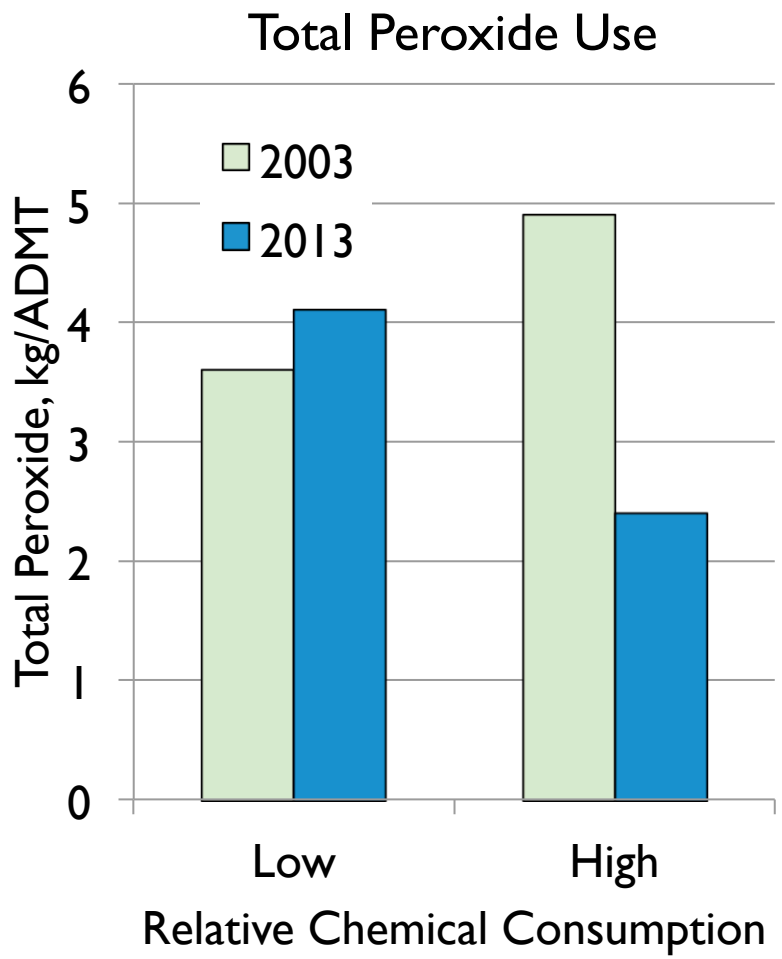
D_0 Kappa Factor & Chemical Use



D_0-stage Process Control



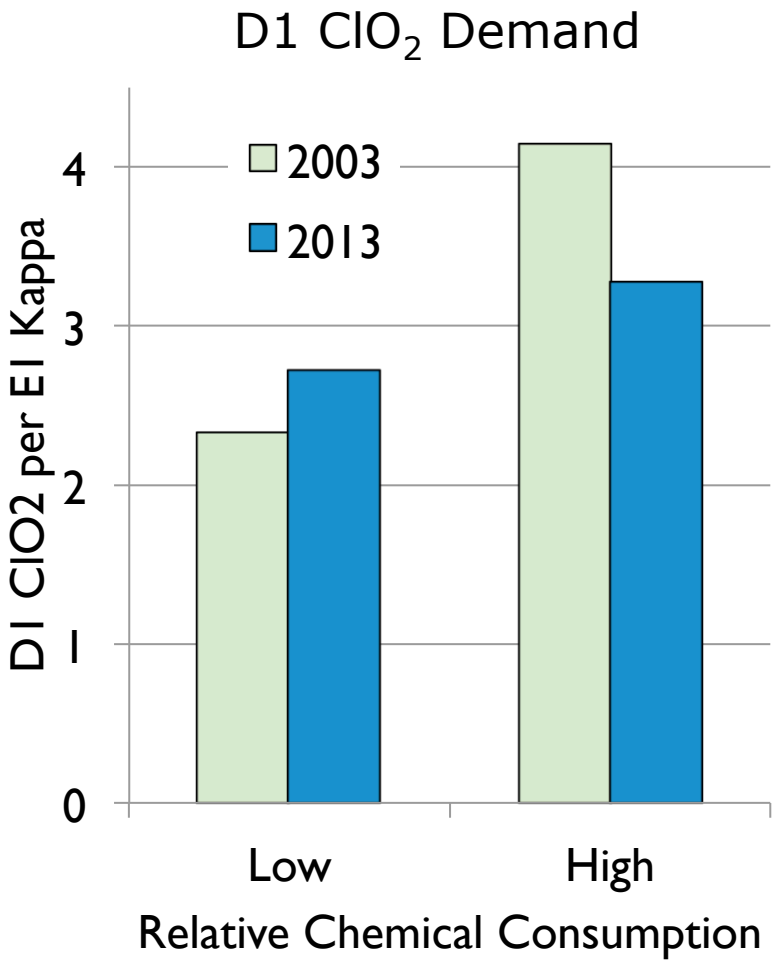
O2-SWD: Peroxide



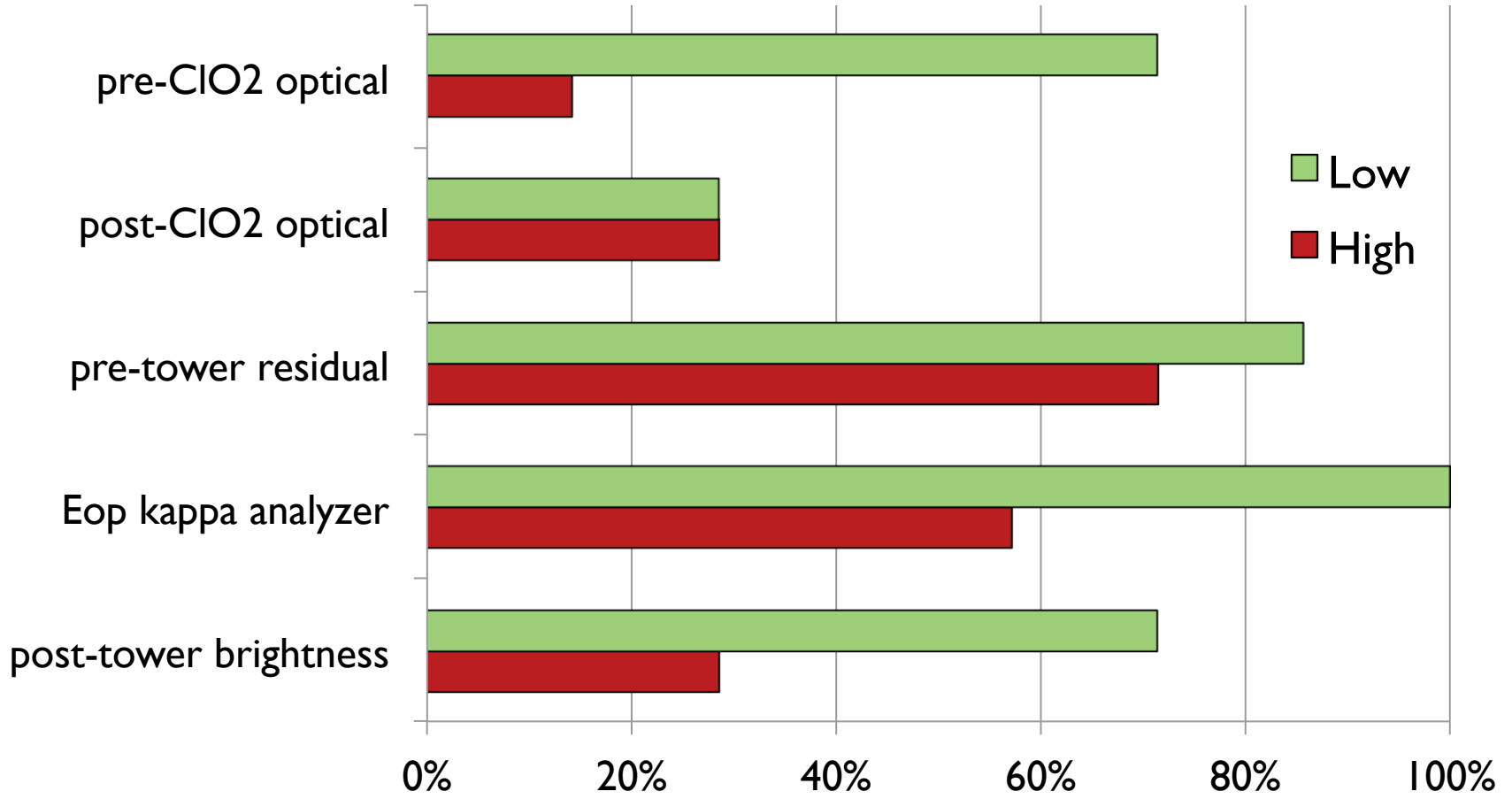
- High relative chemical consumption bleach plants use less peroxide
  - Reversal from 2003
- High D_0 Kappa Factors may leave insufficient lignin in the pulp to react with peroxide?

O2-SWD: D1-stage ClO_2 Demand

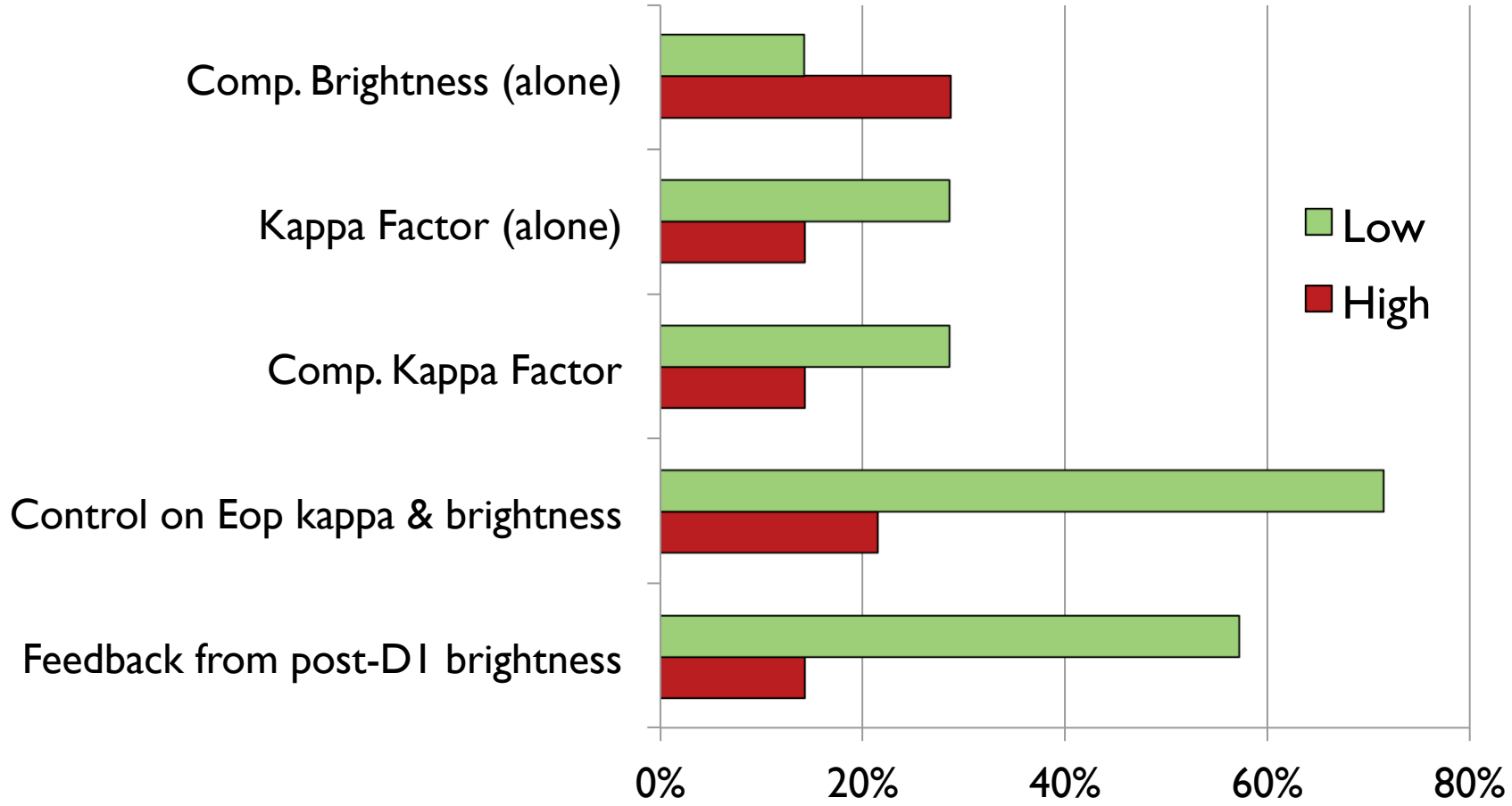
- Low relative chemical consumption bleach plants operate with a lower ratio of D1-stage chlorine dioxide to the Eop kappa number
  - Similar brightness
  - Similar terminal pH
- A high D1 ClO_2/Kappa ratio often indicates poor Eop-stage washing
  - Eop-stage carryover will increase ClO_2 demand



D1 Sensors & Analyzers



D1 Process Control



O2-SWD "Best Practices"

Comparison of mills with low and high relative chemical consumption indicates that "low chemical consuming" oxygen-delignified softwood bleach plants:

- Feed the bleach with a pulp having a kappa no. 2.8 units higher than the "high relative consumption" bleach plants;
- Produce pulp with 0.5 points higher final brightness;
- Use 3.3 kg/ADMT less chlorine dioxide, but 1.7 kg/ADMT more hydrogen peroxide;
- Operate with a significantly lower D_0-stage Kappa Factor;
- Are more likely to control the D_0 stage using an online kappa analyzer in combination with optical and residual sensors;
- Are more likely to control the D1 stage using a combination of post-Eop kappa no. and post-Eop brightness, with feedback from the post-D1 brightness;
- Have a lower ratio of D1-stage chlorine dioxide to the Eop kappa number;
- Operate with a higher pH in the D2 stage

Acknowledgement

- The authors would like to thank all of the pulp mill personnel who took the time to complete this survey. Only through their efforts are these reports made possible.

- Questions?