Optimizing SW ECF Bleaching Technologies with a Poor Man's O

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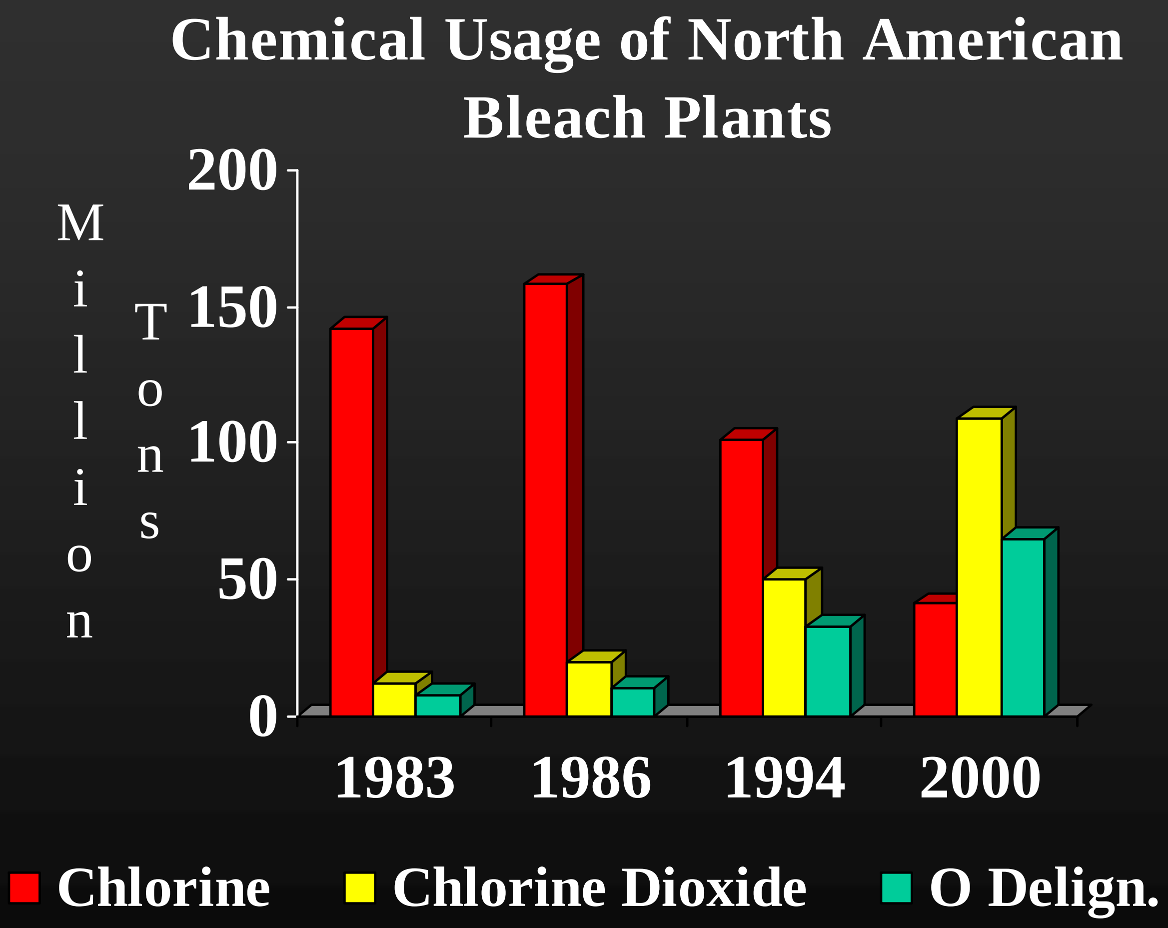
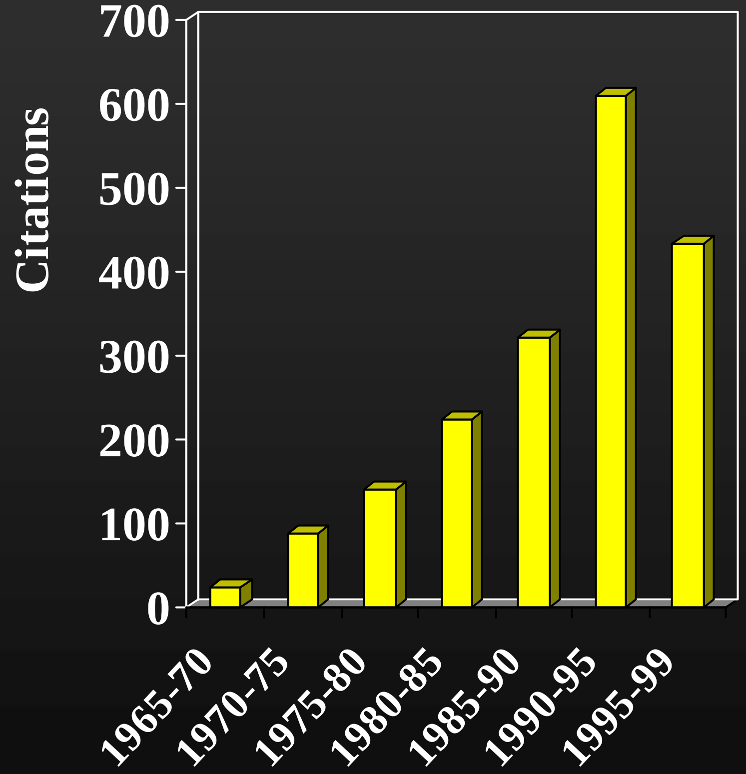
Oxygen Delignification



Improved environmental and operating cost performance

O Delignification: Background

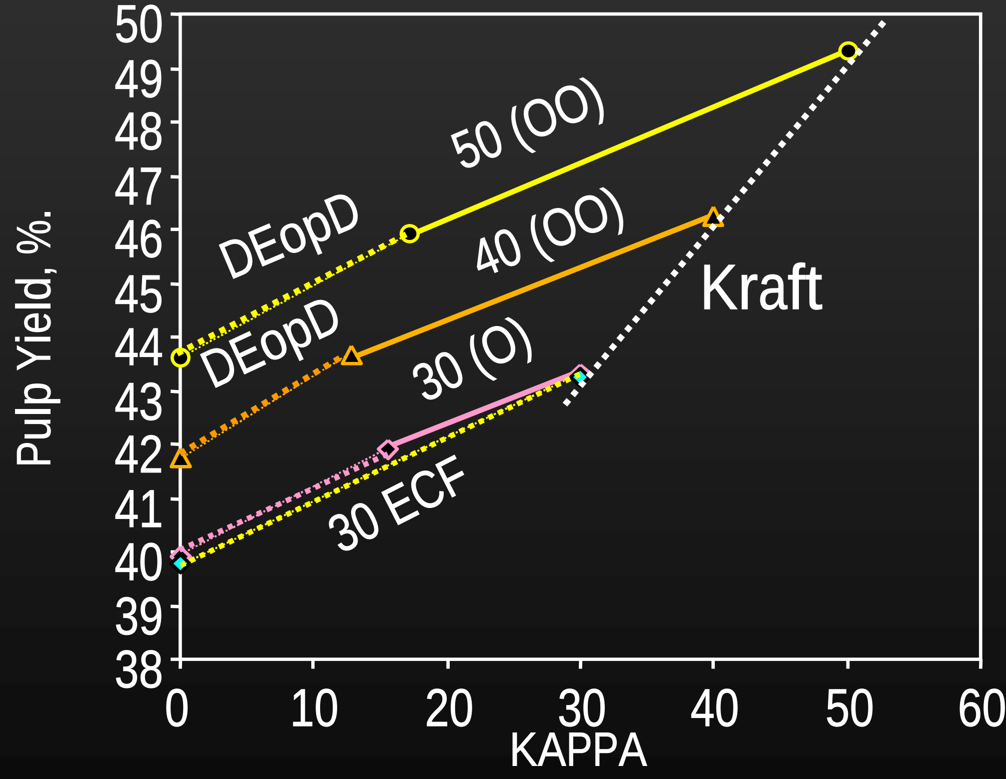


Literature

- 1960/70s
  - basic engineering & chemistry
- 1980/early 90s
  - process parameters, energy, environmental, pretreatments, fundamental chemistry, pulp properties
- Late 1990's
  - yield, selectivity, process parameters, lignin/carbohydrate chemistry, catalysts

Oxygen Delignification

Increased interest in one and two-stage oxygen delignification

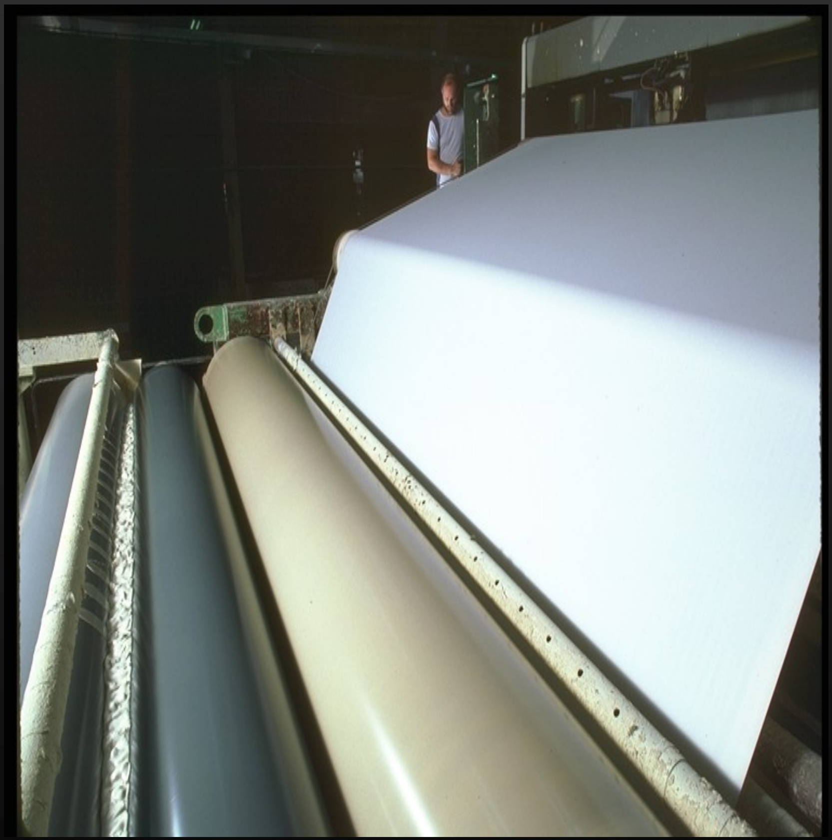


Yield and Operating Benefits

An Alternative Approach

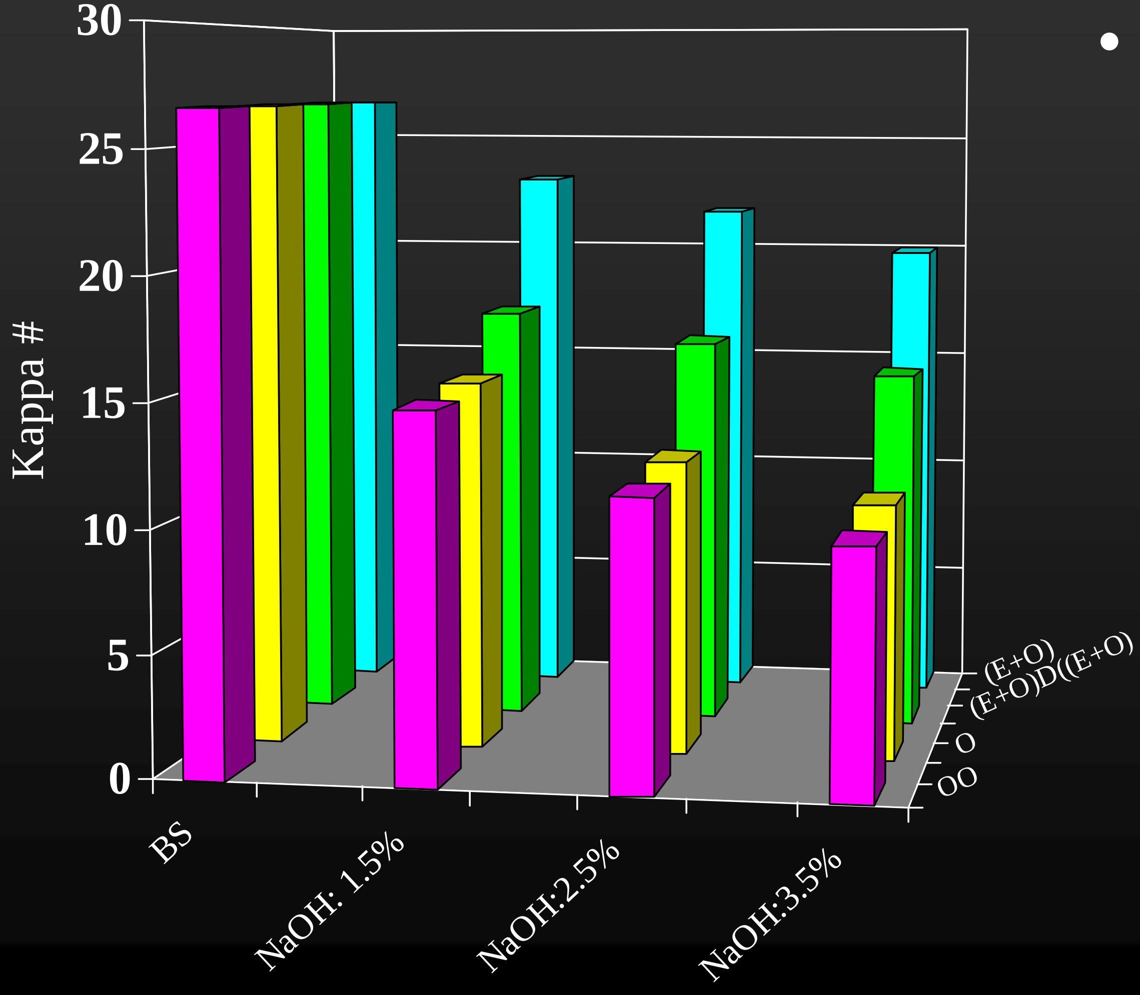
- Mini-O
  - Removes less lignin
  - Less capital
  - Easily retrofitted
- Enhanced Mini-O
  - Greater lignin removal
  - Multiple stages
  - H_2O_2 and/or ClO_2

Mill Application



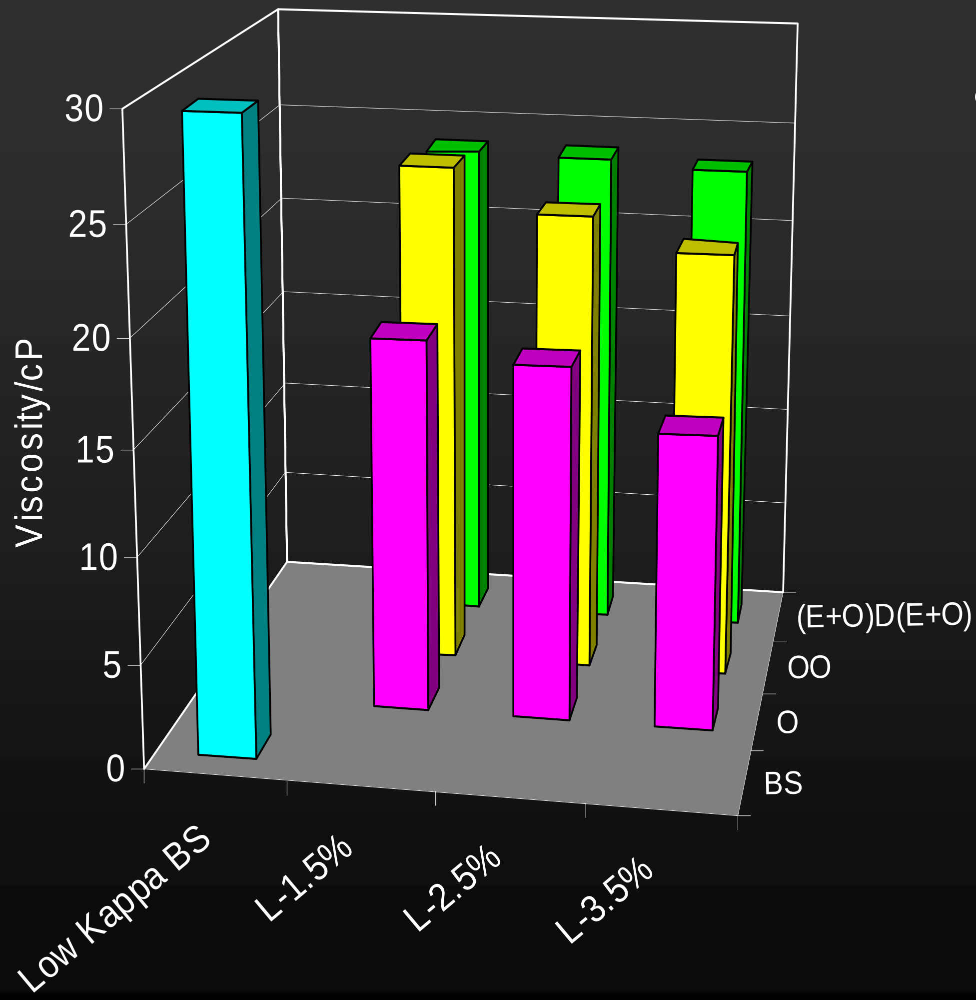
- McKenzie
  - Cook to normal target
    - Reduce lignin with O_2
  - Sodium hydroxide instead of oxidized white liquor
- Low AOX pulps
  - No production loss
  - No recovery bottleneck
  - 25% delignification

Recent Studies



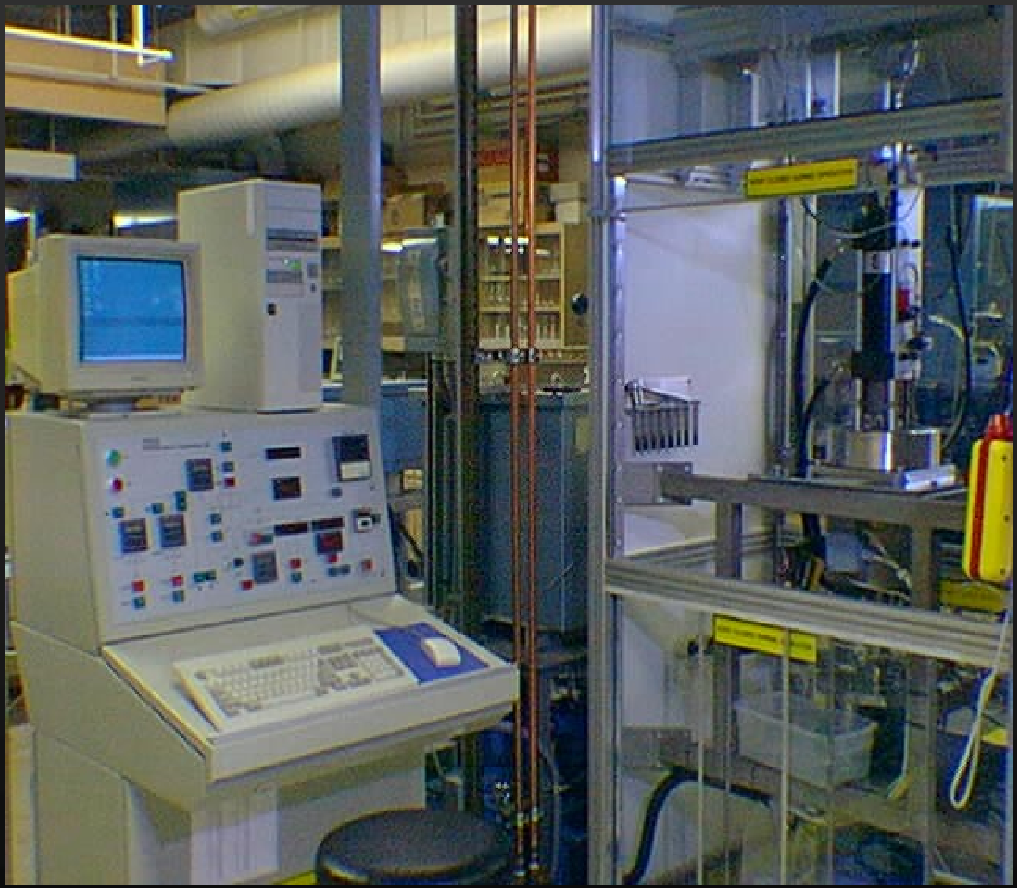
- Chakar, et al.
  - Compared O systems
    - O, OO, mini-O
  - Split the caustic charge in a (E+O)D(E+O)
  - Delignification
    - Lowest for mini-O
      - 13-25%, depending on caustic addition

Recent Studies

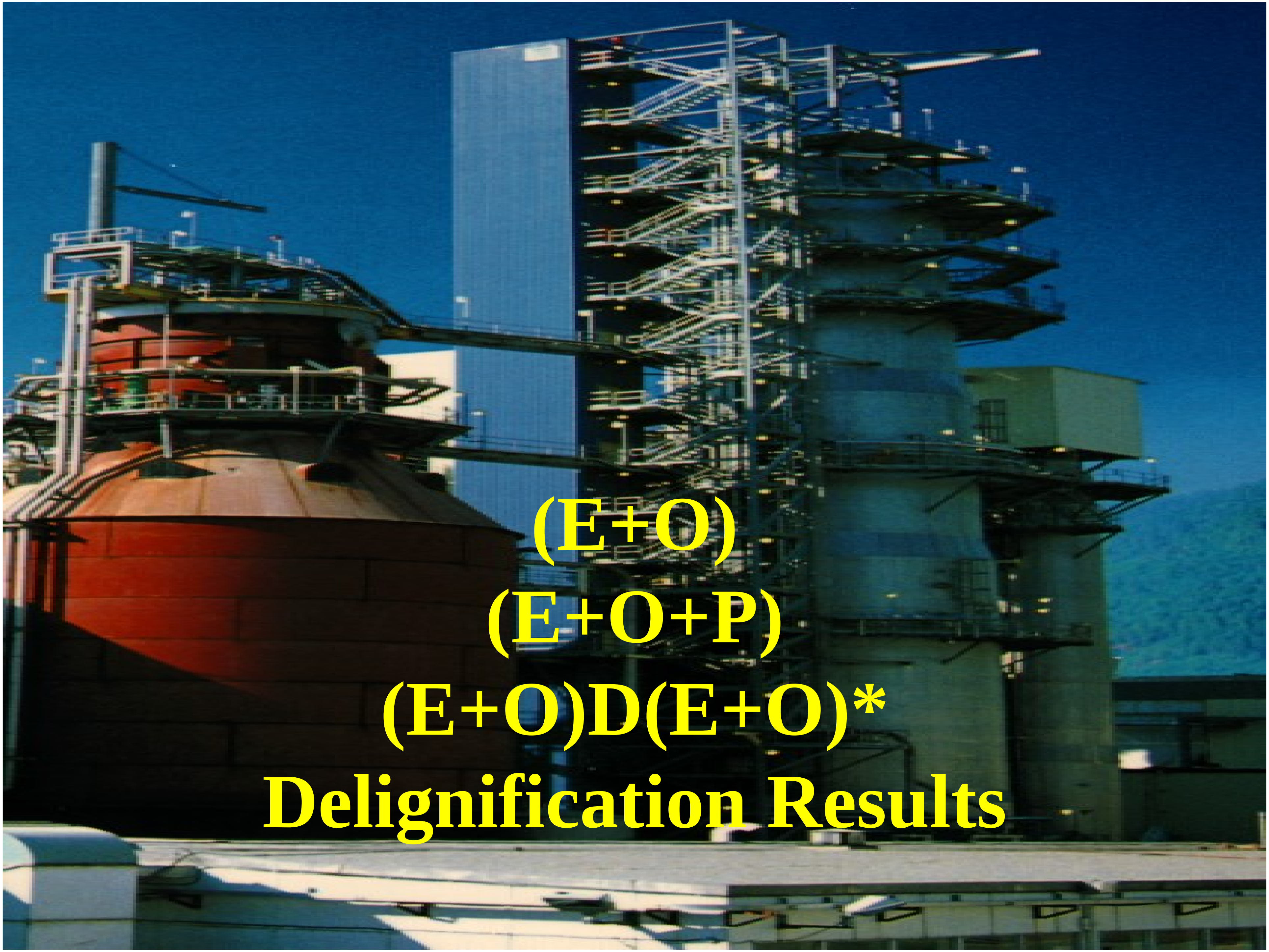


- Chakar, et al.
  - Viscosities
    - O vs. (E+O)D(E+O)
      - Same delignification at 3.5% as O at 1.5%
    - Improved viscosity

Recent Studies



- Chakar, et al
  - Does not mimic actual bleach plant conditions
  - Need to investigate impact of interstage washing and carryover on mini-O system


(E+O)
(E+O+P)
(E+O)D(E+O)*
Delignification Results

Mini-O Delignification Studies

<u>Research Objective</u>

- Examine impact of carryover
- 26.3 Kappa SW kraft
- Determine
  - Physical properties
  - Selectivity

- Contribute to future mini O-delignification road map to improve performance

Mini-O Delignification: Experimental Design

<u>Bleaching Sequences</u>

- (E+O)(E+O)
- D(E+O)
- (E+O)D(E+O)
- D(E+O)(E+O)

<u>BL Carryover</u>

- No carryover
- 2 kg/ton
- 10 kg/ton

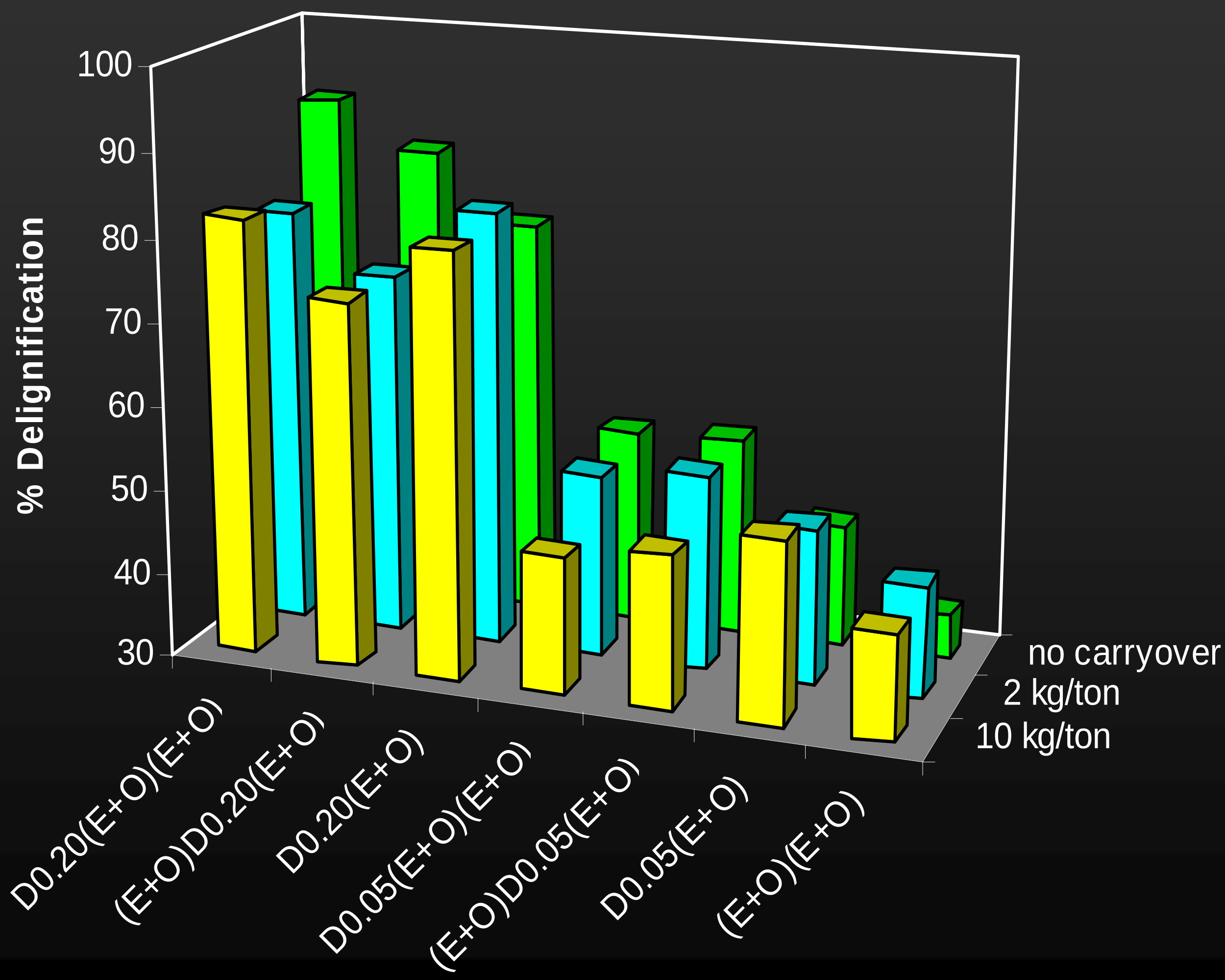
Experimental Conditions

Stage	O-Press./psi	% NaOH	Temp./^{o}C	Time/min.
(E+O)	90	1.25	80	20
$D_{0.05,\ 0.20}$	-	-	70	30
(E+O)D(E+O)	90/0/90	1.25/0/1.25	80/70/80	70

10% consistency

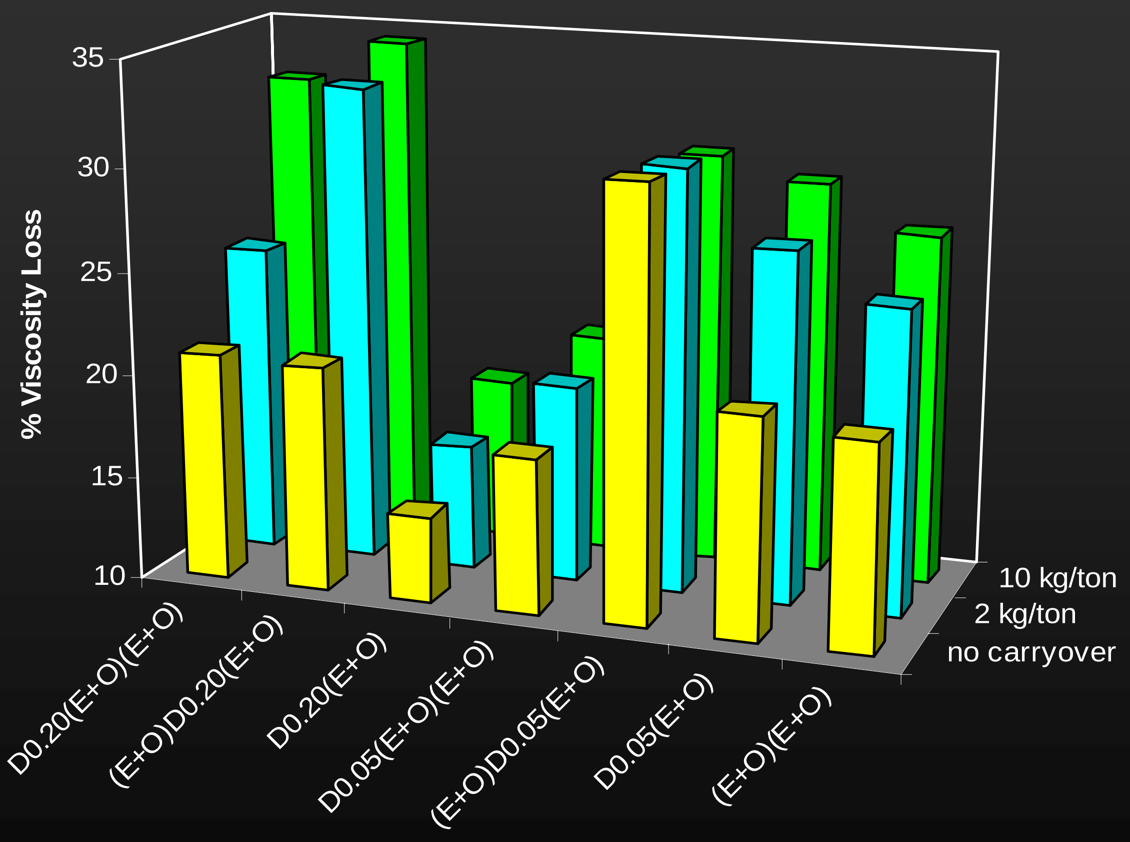
$MgSO_4$: 0.10%

Impact of Carryover



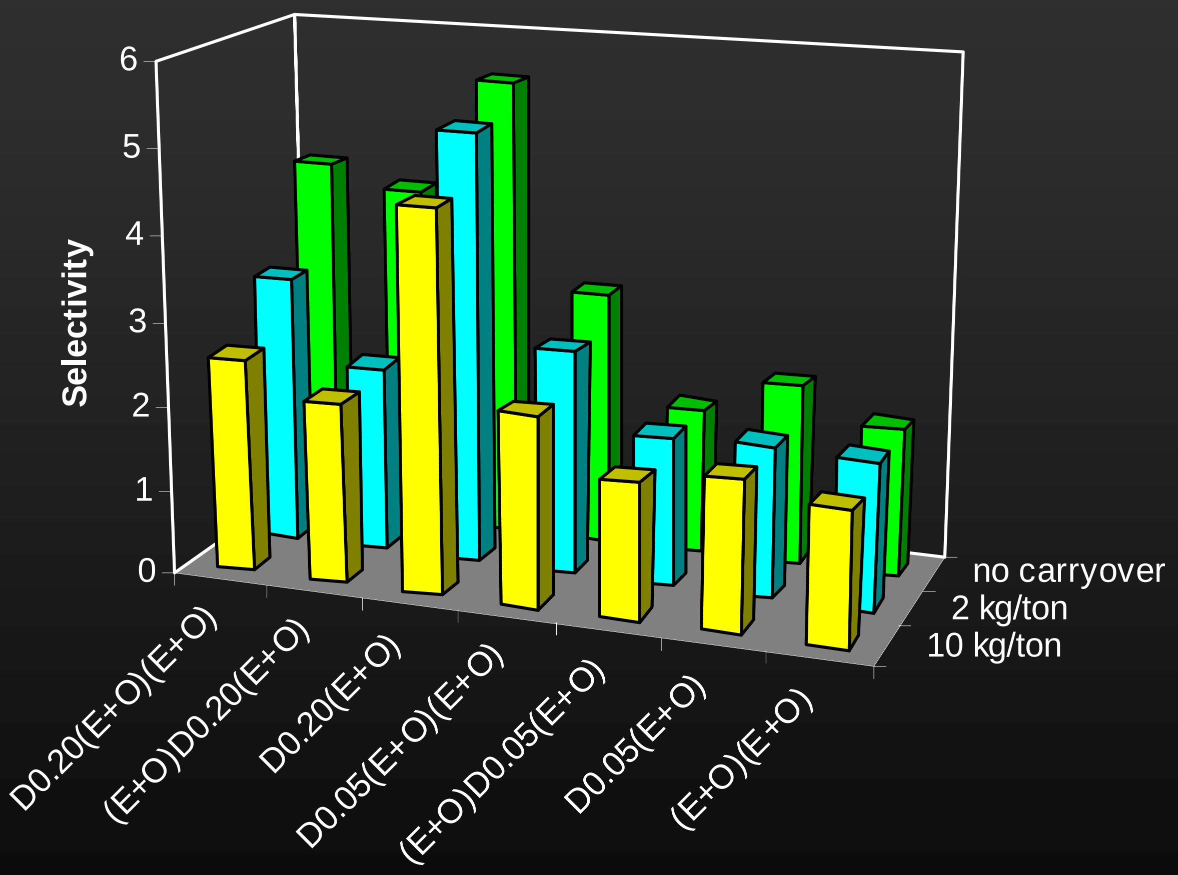
- Carryover decreases delignification
- Increased levels
  - Decreased response
- Splitting (E+O)
  - Improved response

Impact of Carryover



- Viscosity loss
  - Increases as function of carryover
- Carryover
  - May introduce transition metals
- Placement of (E+O)
  - Affects viscosity loss

Impact of Carryover



- Selectivity
  - Decreases as function of carryover
- Carryover
  - May introduce transition metals
- Placement of (E+O)
  - Affects selectivity

Mini-O with H_2O_2 Studies

<u>Research Objective</u>

- Examine impact of carryover
- Three SW kraft pulps
  - 26.3 Kappa pre-O_2
  - 24.3 Kappa pre-O_2
  - 8.9 Kappa post-O_2
- Determine
  - Physical properties
  - Selectivity

- Contribute to future mini O-delignification road map to minimize capital and enhance performance

Mini-O with H_2O_2 Delignification: Experimental Design

Bleaching Sequences

- O
- D(E+O)
- D(E+O+P)
- (E+O)*D(E+O)*
- D(E+O)*(E+O)*

Pulps

- Pre-Oxygen
  - 26.3 kappa
- Pre-Oxygen
  - 24.2 kappa
- Post-Oxygen
  - 8.9 kappa

Experimental Conditions

Stage	O-Press./psi	% NaOH	Temp./^{o}C	Time/min.
(E+O)	90	1.25	80	20
(E+O+P)	90	1.25	80	20
$D_{0.05,\ 0.20}$	-	-	70	30
(E+O)*D(E+O)*	90/0/90	1.25/0/1.25	80/70/80	70

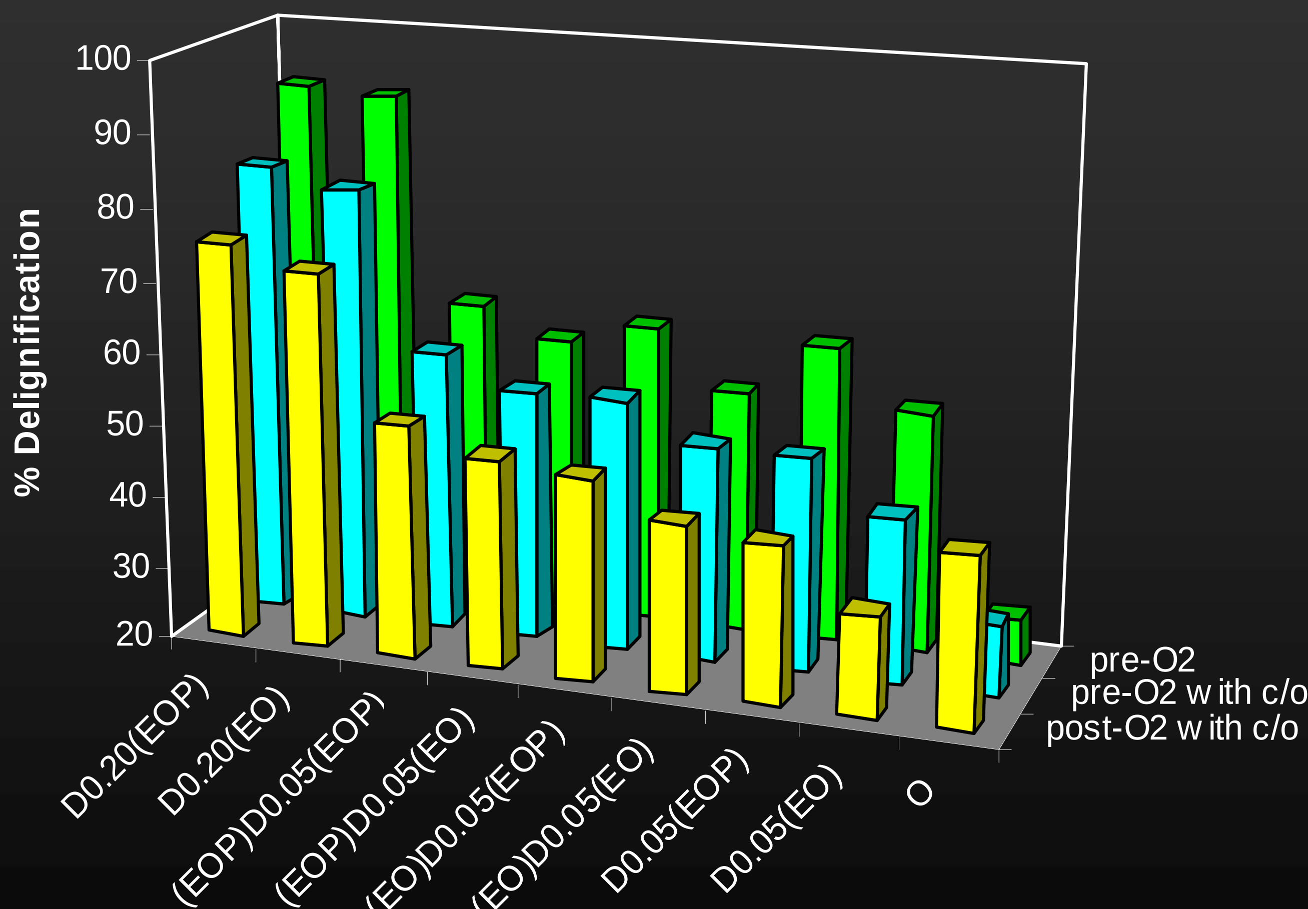
10% consistency

BL carryover: 10 kg/ton

H_2O_2 : 0.5%

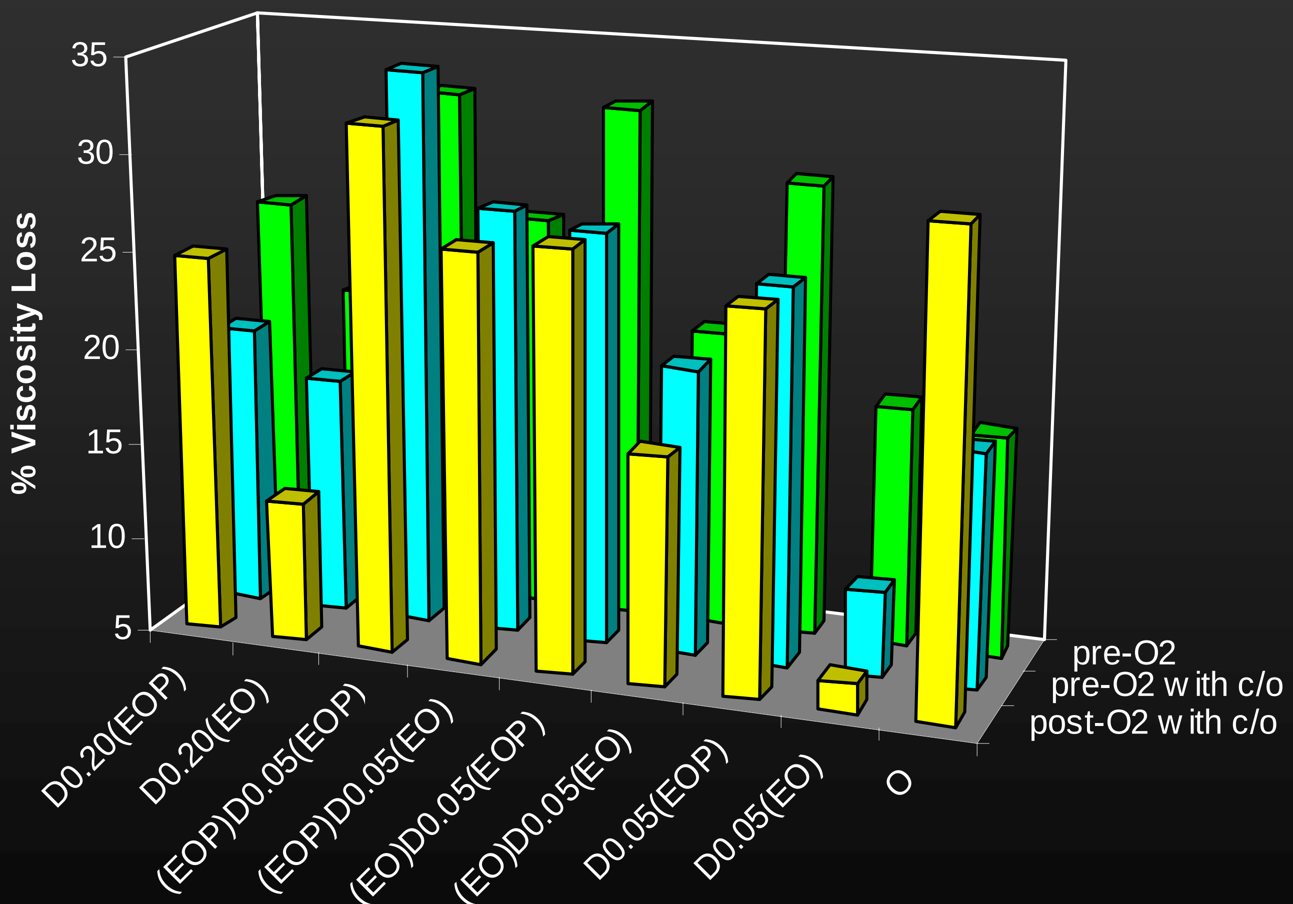
$MgSO_4$: 0.10%

Mini-O Reinforced with H_2O_2



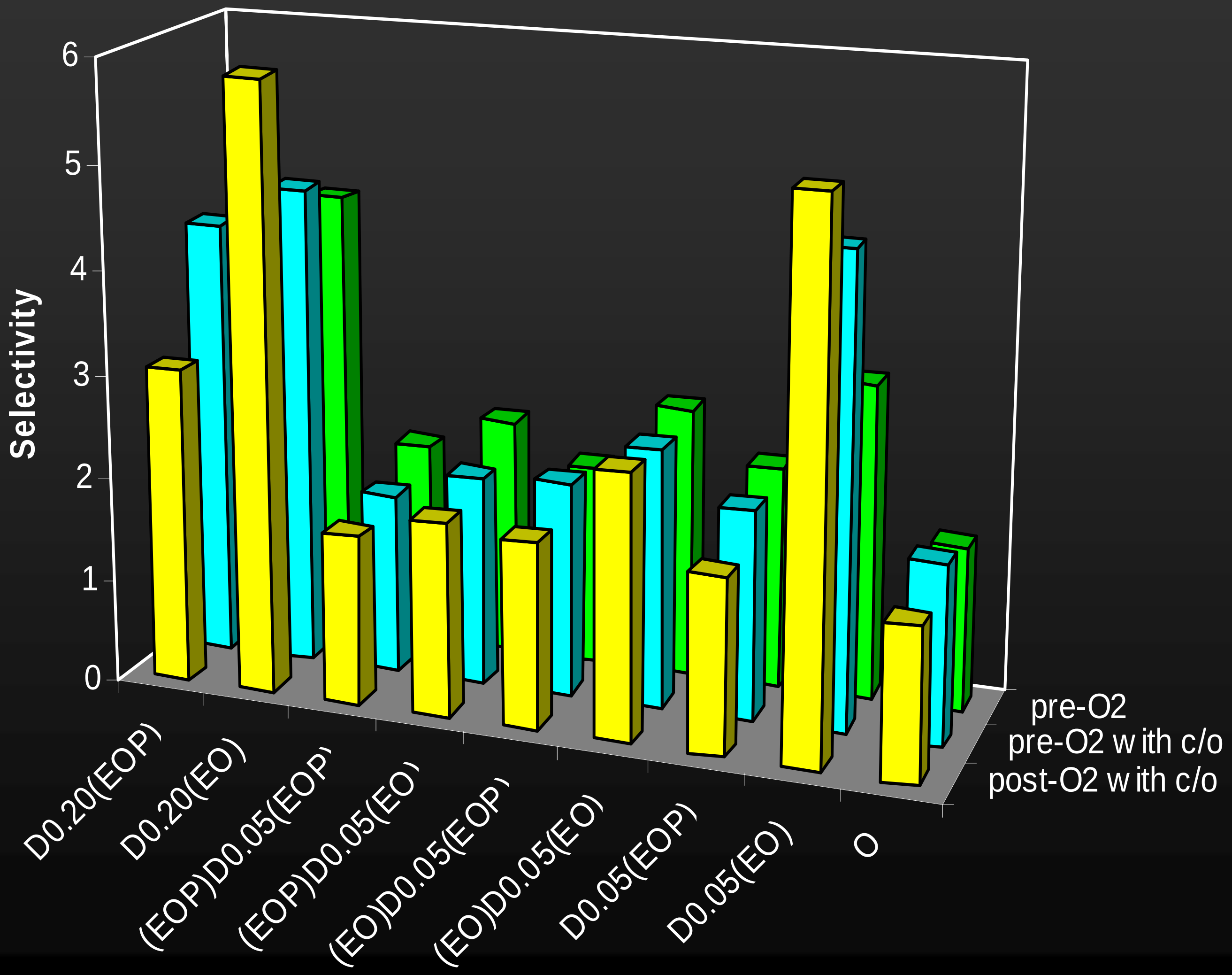
- Carryover at 10 kg/ton
  - Decreased response
- Pre-O_2 vs. Post-O_2
  - Decreased response in post-O_2
- Delig. Response
  - Proportional to H_2O_2
- (EO)*$D_{0.05}$(EO)*

Mini-O Reinforced with H_2O_2



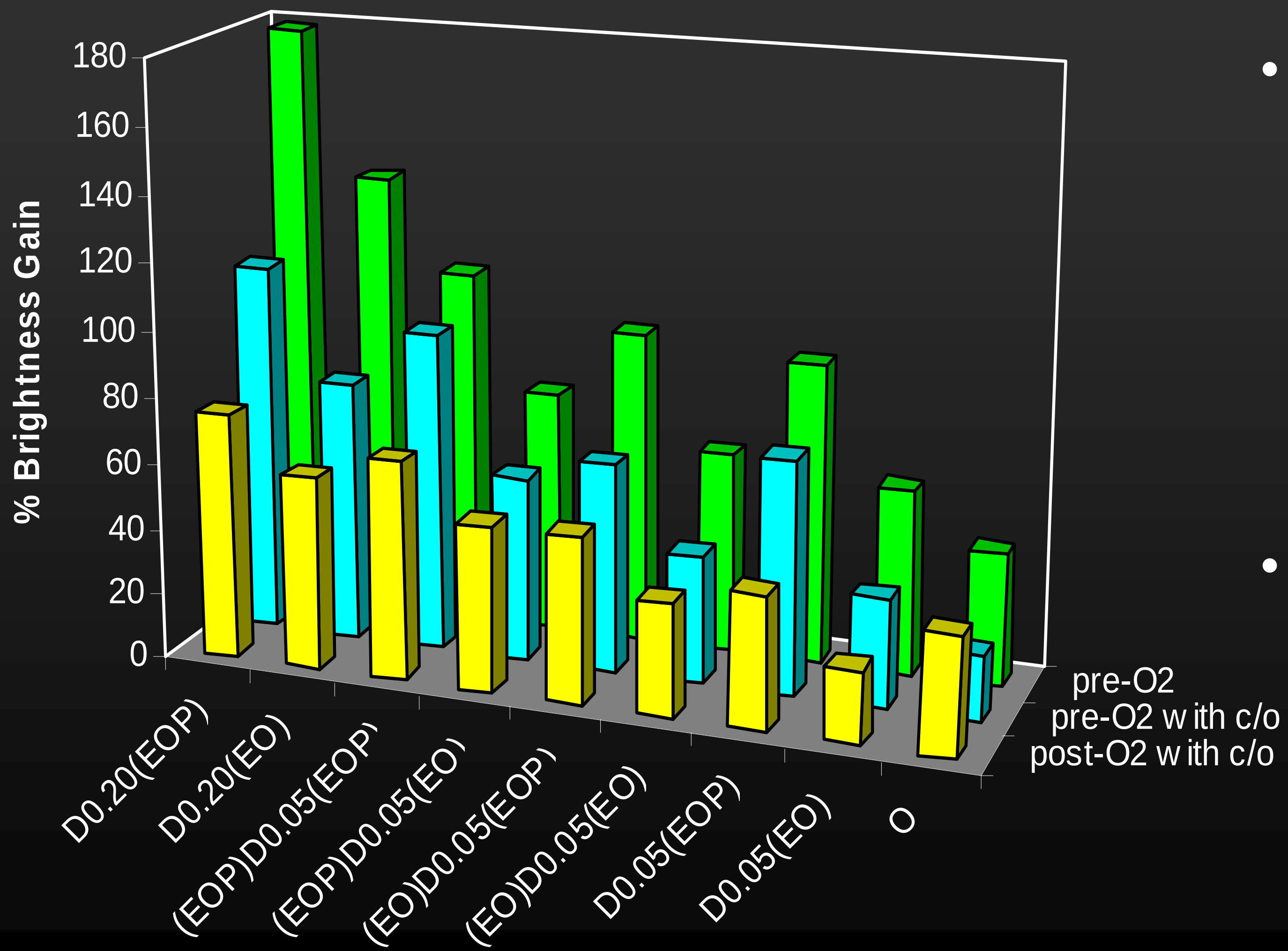
- Carryover at 10 kg/ton
  - Generally decreases viscosity loss
- Pre-O_2 vs. Post-O_2
  - Greater loss for pre-O_2 pulp
- Increased H_2O_2
  - Increased viscosity loss

Mini-O Reinforced with H_2O_2

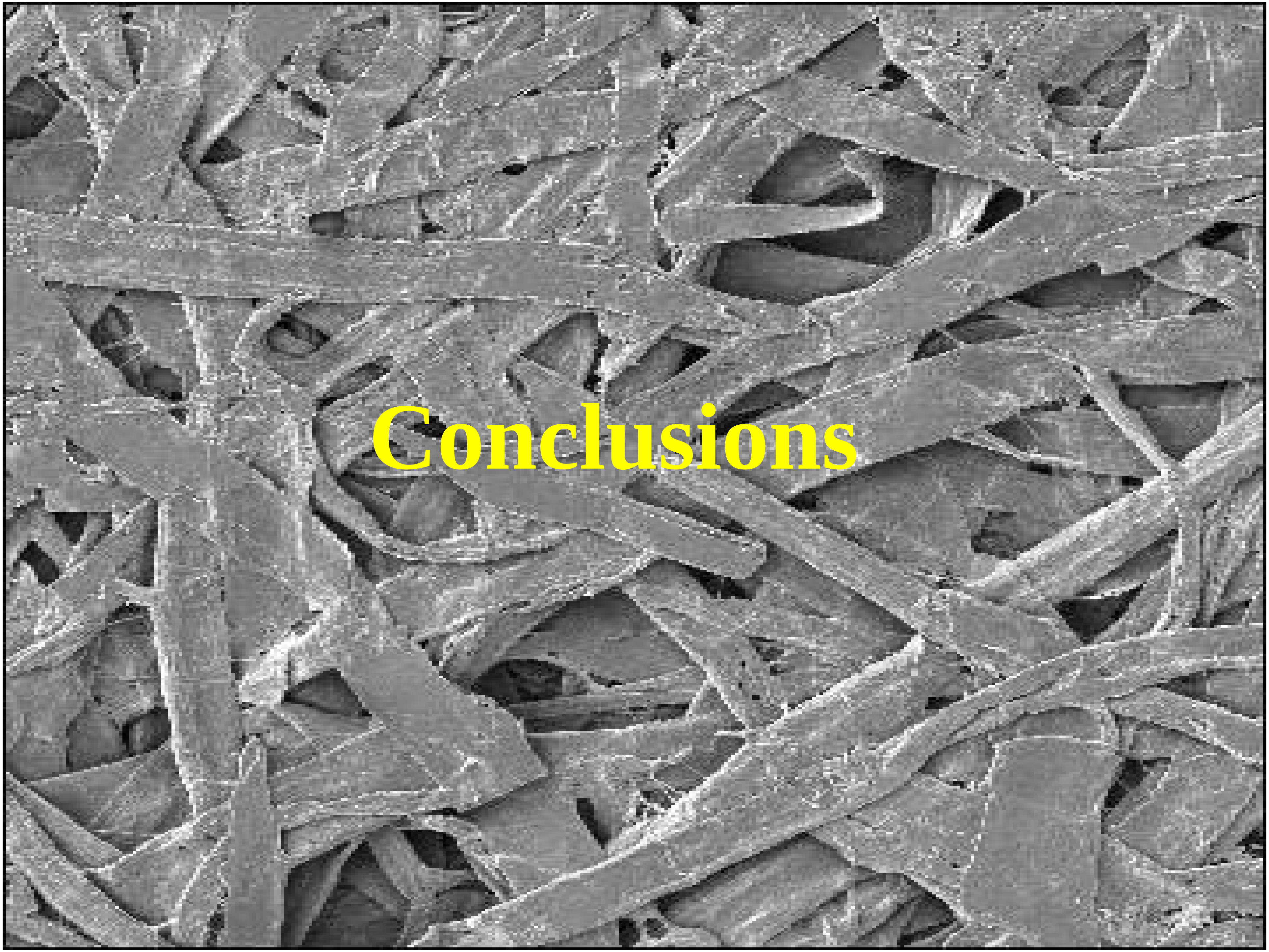


- Carryover at 10 kg/ton
  - Generally decreases selectivity
- Pre-O_2 vs. Post-O_2
  - Greater selectivity for pre-O_2 pulp

Mini-O Reinforced with H_2O_2



- Carryover at 10 kg/ton
  - Generally decreases brightness response
- (EO) vs. (EOP)
  - Exiting bleaching stage


Conclusions

Mini-O Delignification: Implications

- Promising technology
- Superior performance with pre-O_2 pulps when compared to post-O_2 pulps
- Benefits of enhanced poor man's O
- H_2O_2 in last stage of (EO)*D(EO)*
  - Increased bleaching performance

Acknowledgments

IPST Member Companies
U.S. Department of Energy

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