



*Optimized ECF
Bleaching Sequence Studies
Softwood Kraft Brownstock*

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Project Goals

Sequences Examine

D/C(EO)DED*

D/Z(EOP)DED

D/Z(EOP)D/Z(EP)D

ZQ(PHT)Z(PHT)

OZQ(PHT)

-softwood

OD(EOP)D*

OZ/D(PHT)D

OZ/D(PHT)D/Z

OZ(PHT)D

OZQ(PHT)Z(PHT)





Results D/C(EO)DED: Softwood Bleaching Conditions

D/C - 50% ClO₂ Substitution
KF 0.20, SW Kappa# 33.3
10% Black liquor carryover
3.5% csc, 50C, 45 min.

EO - 3.6% NaOH, 75C, 75 min
O₂=35 psi 15 min, 10% carryover

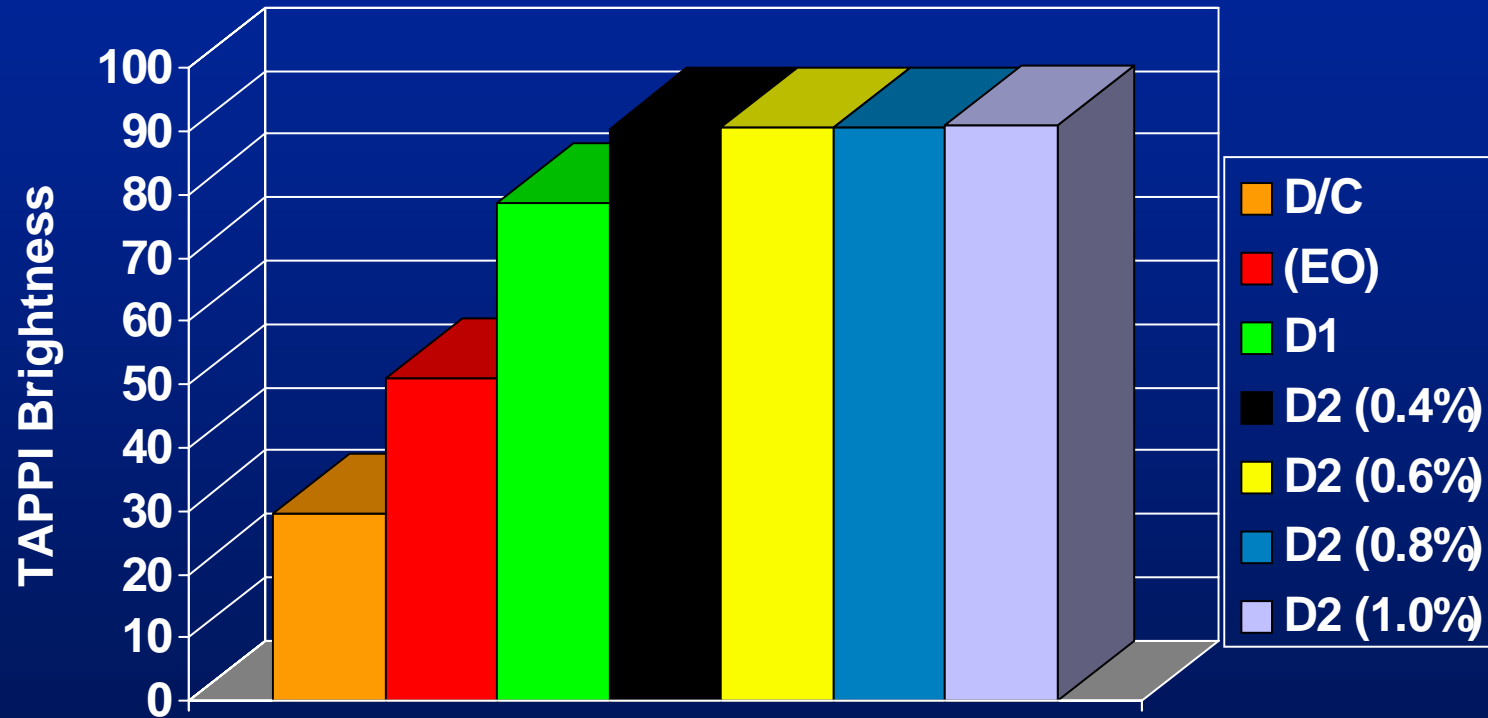
D1 - 1.0% ClO₂, 75C, 180 min
10% carryover, 10% csc

E - 75C, 60 min, 10% carryover, 10% csc
0.5% NaOH

D2
0.4%, 0.6%, 0.8%, 1.0% ClO₂
75C, 180 min., 10% csc



Results D/C(EO)DED: Softwood Bleaching Results



Results OD(EOP)D: Softwood Bleaching Conditions

O2 - initial washed kappa # 30.4
carryover
2.0% NaOH, 110C
30 min, 60 psi O2

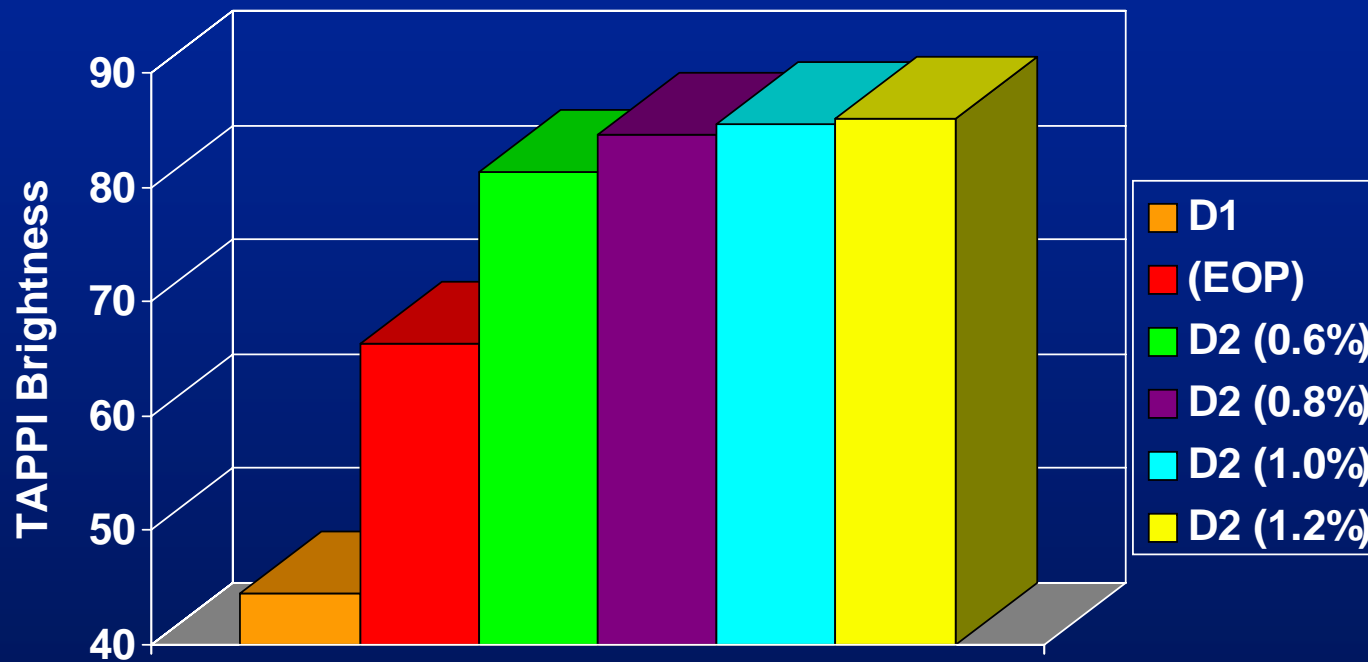
D1 - 0.22 KF (incoming kappa#=15.0)
O2=35 psi 15 min, 10% carryover
50C, 60 min

(EOP) - 1.82% NaOH, 0.4% H2O2
90C, 60 min., 10% carryover
35 psi O2/15min

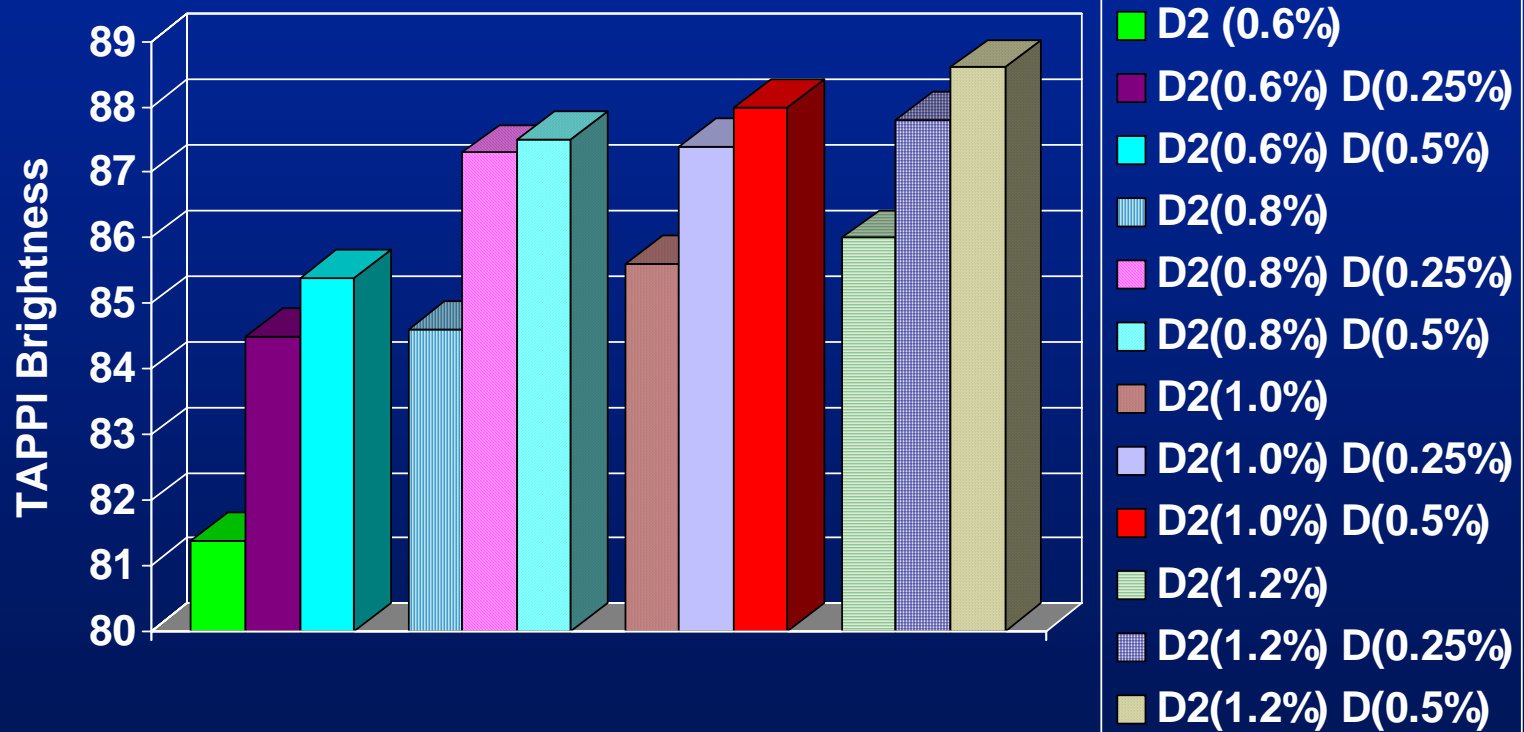
D2- 75C, 180 min, 10% carryover, 10% csc
0.6%, 0.8%, 1.0%, 1.2% ClO2

D2
0.4%, 0.6%, 0.8%, 1.0% ClO2
75C, 180 min., 10% csc

Results OD(EOP)D: Softwood Bleaching Results



Results OD(EOP)D: Softwood Bleaching Results



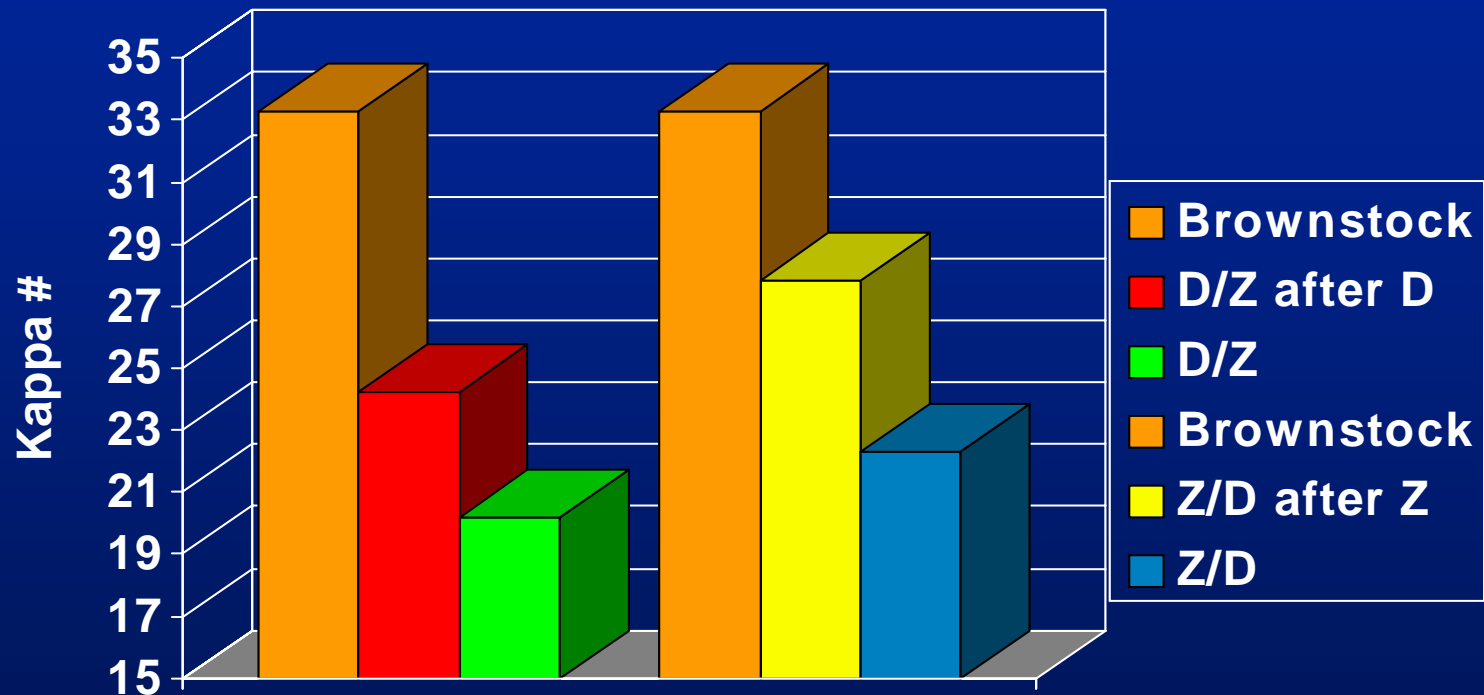


Results (D/Z) vs. (Z/D): Softwood before O₂

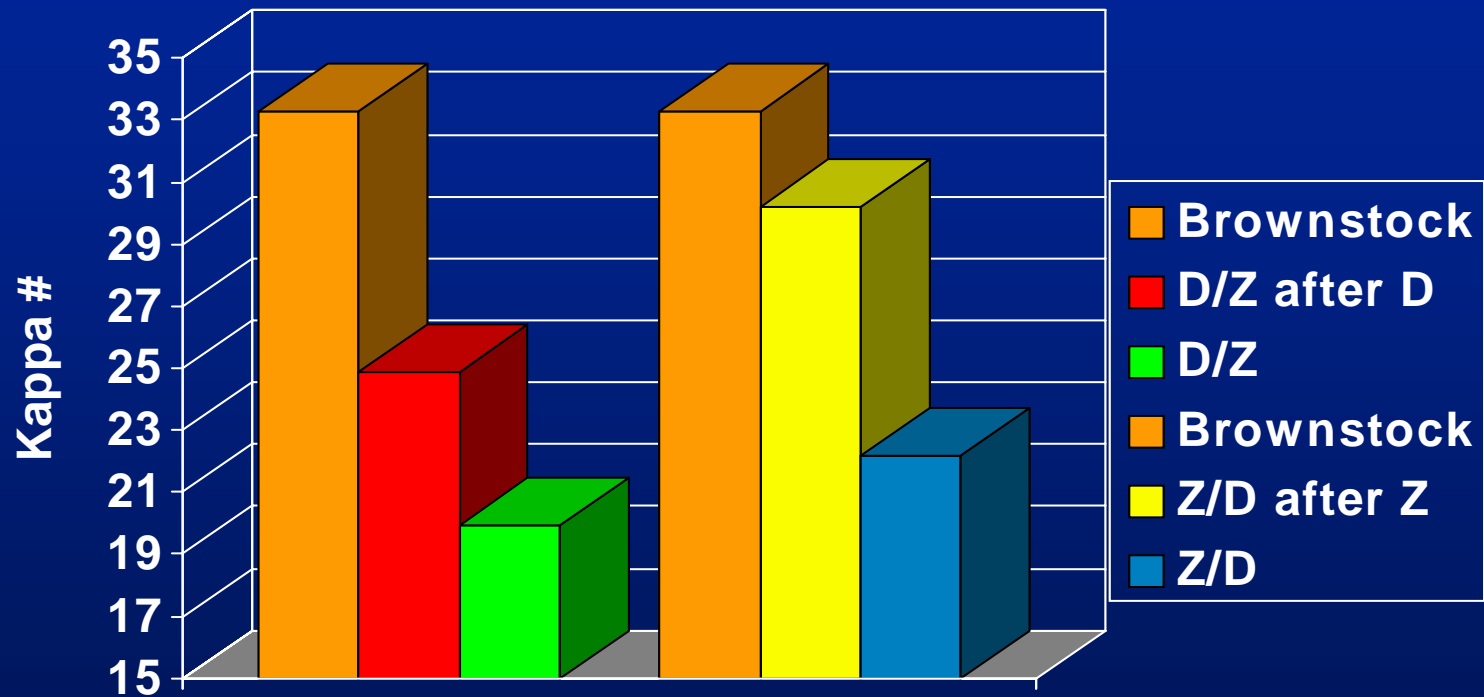
- | General Bleaching Conditions
 - 50°C
 - 0.20 KF
 - » 50% Z subst.
 - » pH_{initial}:2.5
 - » 10% carryover



*Results (D/Z) vs. (Z/D) at 3.5% CSC:
Softwood before O2*



*Results (D/Z) vs. (Z/D) at 10% CSC:
Softwood before O2*



Research Issues

- | Direction on D/Z
 - pre-O2 >> D/Z
 - post-O2 >> Z/D
- | Secondary Z stages to be at 10% CSC
- | Brightness target
 - OD(EOP)DD





Studies Directed on D/Z(EOP)DED & D/Z(EOP)Z/D(EP)D

| D/Z(EO)DED

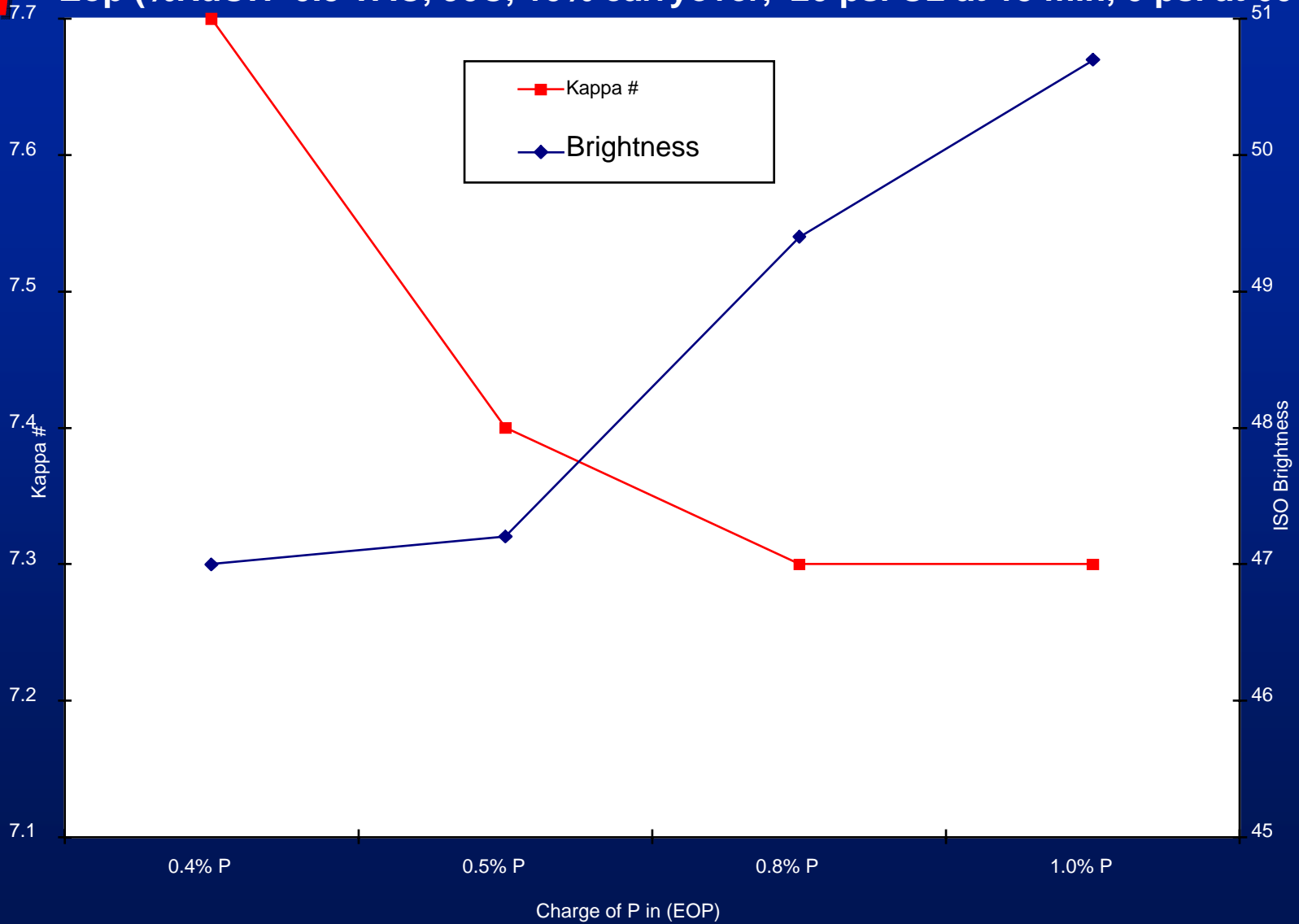
- D/Z 0.2 kf
 - » 50% Z sub
- EOP
 - » 0.4 & 0.8% P
- D1 0.8% charge
- E
- D2
 - » 0.2, 0.4, 0.6, 0.8%
 - » charge

| D/Z(EOP)Z/D(EP)D

- D/Z 0.2 kf
 - » 50% Z sub
- EOP
 - » 0.5 & 1.0% P
- Z/D
 - » 0.2% consumed
 - » 0.5% ClO₂
- D2
 - » 0.2, 0.4, 0.8% ClO₂

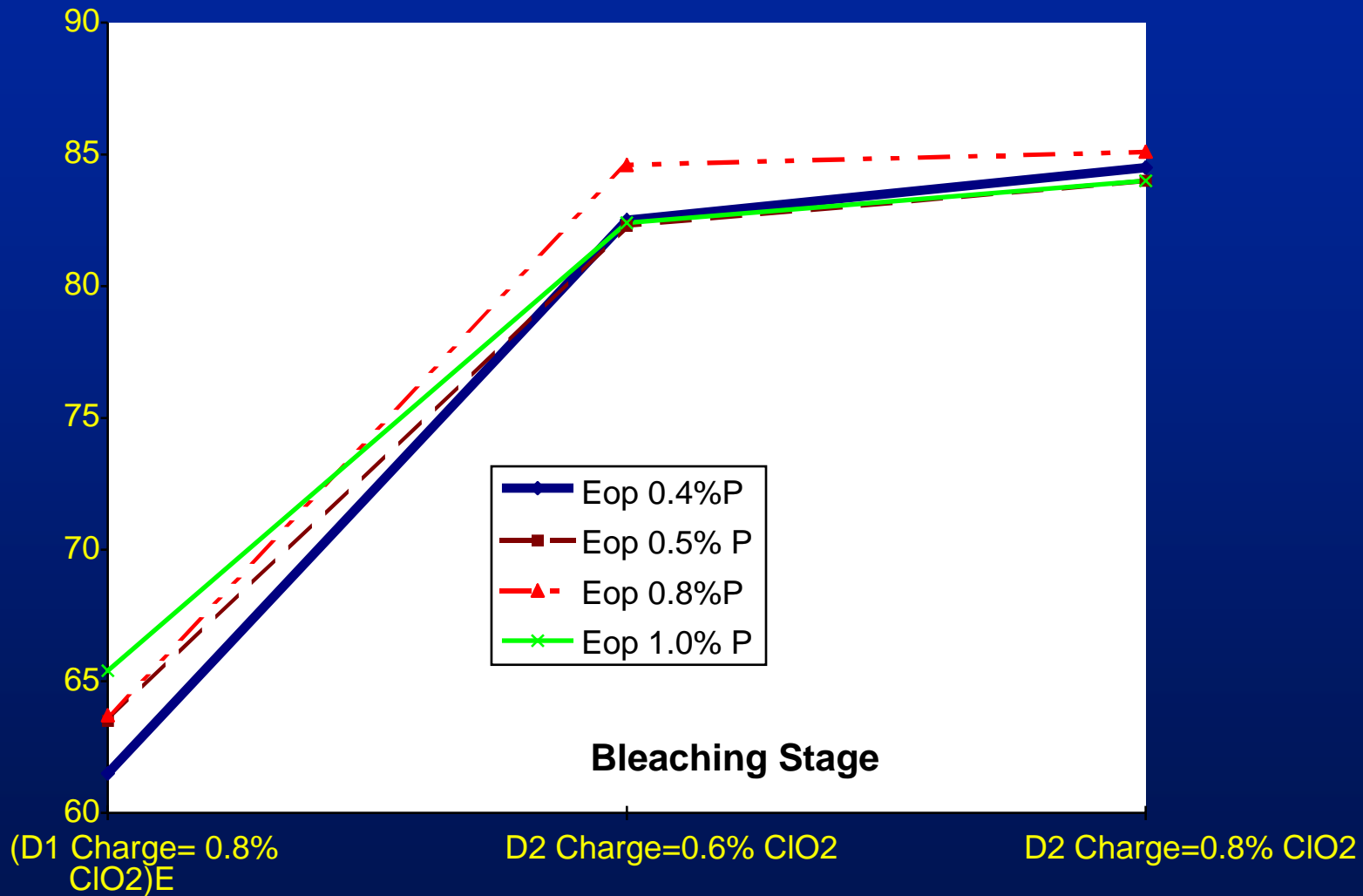


Kappa and ISO Brightness After D/Z (0.20 kf, 50% Sub., 50C, 10kg/ton carryover) & Eop (%NaOH=0.5 TAC, 90C, 10% carryover, 20 psi O2 at 15 min, 0 psi at 60 min)

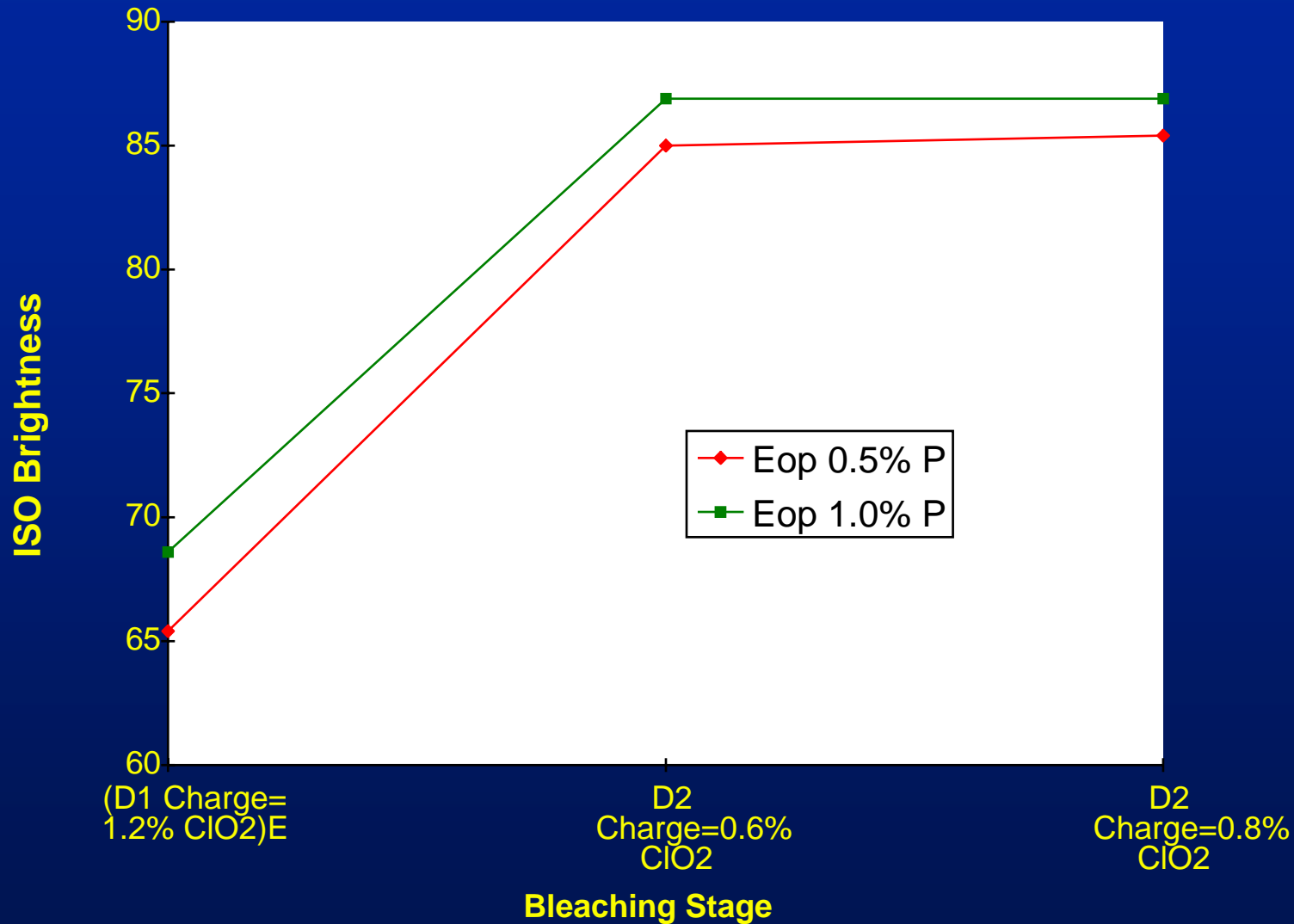


Brightness Changes for Bleaching Four (D/Z)(EOP) Pulps with DED
D₁ employed 0.8% ClO₂ and D₂ employed either 0.6% or 0.8% ClO₂

ISO Brightness



Brightness Changes for Bleaching (D/Z)(EOP) Pulps with DED D1 employed 1.2% ClO₂ and D2 employed either 0.6% or 0.8% ClO₂





Studies Directed on

OZ(PHT)D & OZQ(PHT)Z(PHT)

| OZ(PHT)D

- Z
 - » 0.3 & 0.5% Z consumed
- PHT
 - » 1.0 & 2.0% P
- D
 - » 0.2, 0.4, 0.6, 0.8%

| OZQ(PHT)

- Z
 - » 0.3% consumed
- PHT
 - » 1.0 & 2.0% P

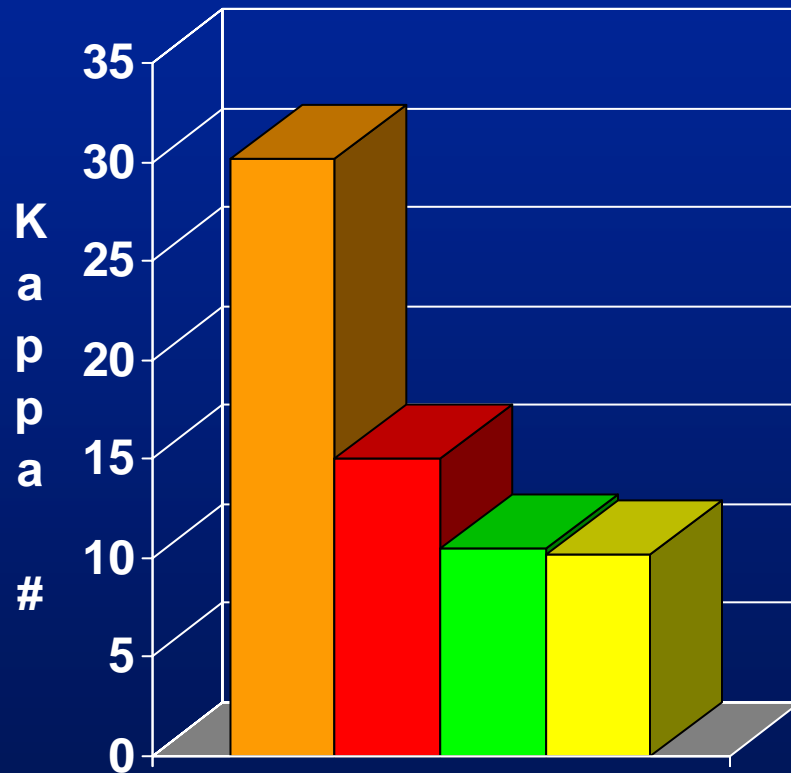
| OZQ(PHT)Z(PHT)

- Z
 - » 0.3% Z consumed
- Q
- PHT
 - » 1.0 2.0% P
- Z
 - » 0.3% Z consumed
- PHT
 - » 1.0, 1.5% P



OZ(PHT)Z(PHT) Studies

- | O-stage
- | Z-stage - 0.3% consumed, pH 2.2
 - 50C
- | Q - DTPA
- | 1.0% H₂O₂ - 1.3% NaOH
 - term. pH 9.4
 - ISO bright. 42.3
- | 2.0% H₂O₂ - 2.6% NaOH
 - term. pH 9.4
 - ISO bright. 46.1
- | Z-stage 0.3% consumed pH 2.2
- | 1.5% H₂O₂ - 2.0% NaOH
 - term. pH 9.2
 - ISO brightness 70



OZ(PHT)D Studies

- | O-stage
- | Z-stage
 - 0.3% consumed, pH 2.2
 - 50C
- | 1.0% H₂O₂ - 1.0%NaOH
 - term. pH 9.2
 - ISO bright. 41.3
- | 2.0% H₂O₂ - 2.0%NaOH
 - term. pH 9.2
 - ISO bright. 43.6

