



IMPACT OF OWL & OWL(T) ON OXYGEN DELIGNIFICATION

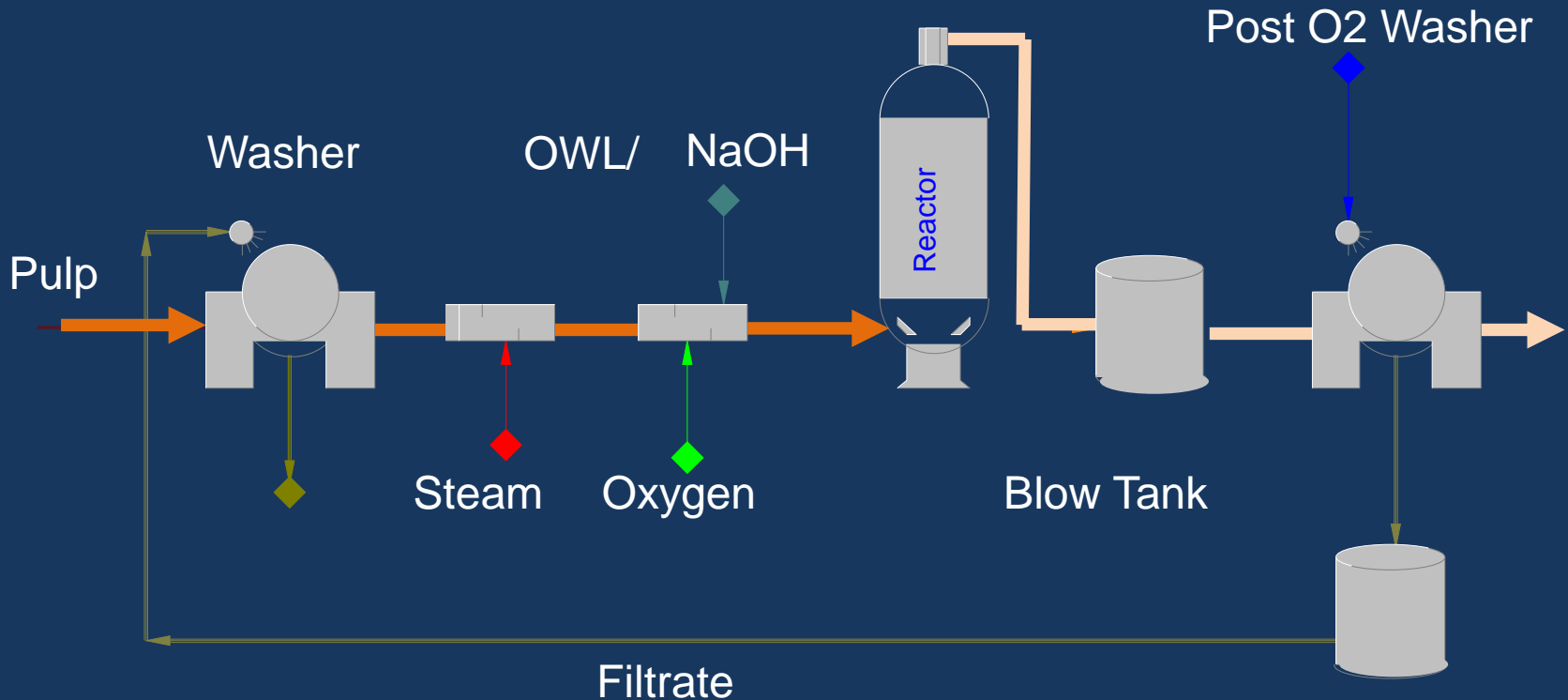
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Process Innovations



Presentation Format

- Oxygen delignification
- White liquor as the alkali source
- O₂ stage oxygen requirement
- Oxygen mixing
- Oxygen stage model

Oxygen Delignification



Operating Parameters (SWD)

- Consistency: 10-14%
- Pressure: 100-200 psig
- Temperature: 90-105°C
- Inlet Kappa: 24-32
- Oxygen charge: 1.8kg/ Δ kappa
- Caustic charge: 1.7-2.0 kg/ Δ kappa
- % Delignification: 30-60%

White Liquor Oxidation



White Liquor Composition (g/l as Na₂O)

Parameter	WL	OWL(T)	OWL(S)
NaOH	85	107.5	85
Na ₂ S	45	0	0
Na ₂ CO ₃	20	20	20
Na ₂ SO ₄	2	2	2
AA	130	107.5	85
EA	107.5	107.5	85

Sulphidity (on AA): 35%

O₂ Delignification Oxygen Consumption

- White liquor
- Lignin/Carbohydrate
- Raw black liquor carryover

White Liquor

- $\text{Na}_2\text{S}/\text{NaOH}$ ratio (molar): $45/85=0.53$
- $\text{O}_2/\text{Na}_2\text{S}$ ratio (molar): 2.0 WL to OWL(S)
- $\text{O}_2/\text{Na}_2\text{S}$ ratio (molar): 1.0 OWL(T) to OWL(S)
- O_2 , WL to OWL(S): 0.42kg O_2/kg NaOH
- O_2 , OWL(T) to OWL(S): 0.21kg O_2/kg NaOH

White Liquor

WL and OWL(T) is converted to OWL(S) in the oxygen reactor.

Value used 2.0 kg NaOH/ Δ kappa:

- WL to OWL(S): 0.85kgO₂/ Δ kappa
- OWL(T) to OWL(S): 0.42kgO₂/ Δ kappa

Lignin/Carbohydrate

- Commercial system¹: 0.7kgO₂/Δkappa
- Laboratory¹¹: 1.4kgO₂/Δkappa
- Other: 0.6-1.0 kgO₂/Δkappa

- Value used: 0.9kgO₂/Δkappa

Raw Black Liquor

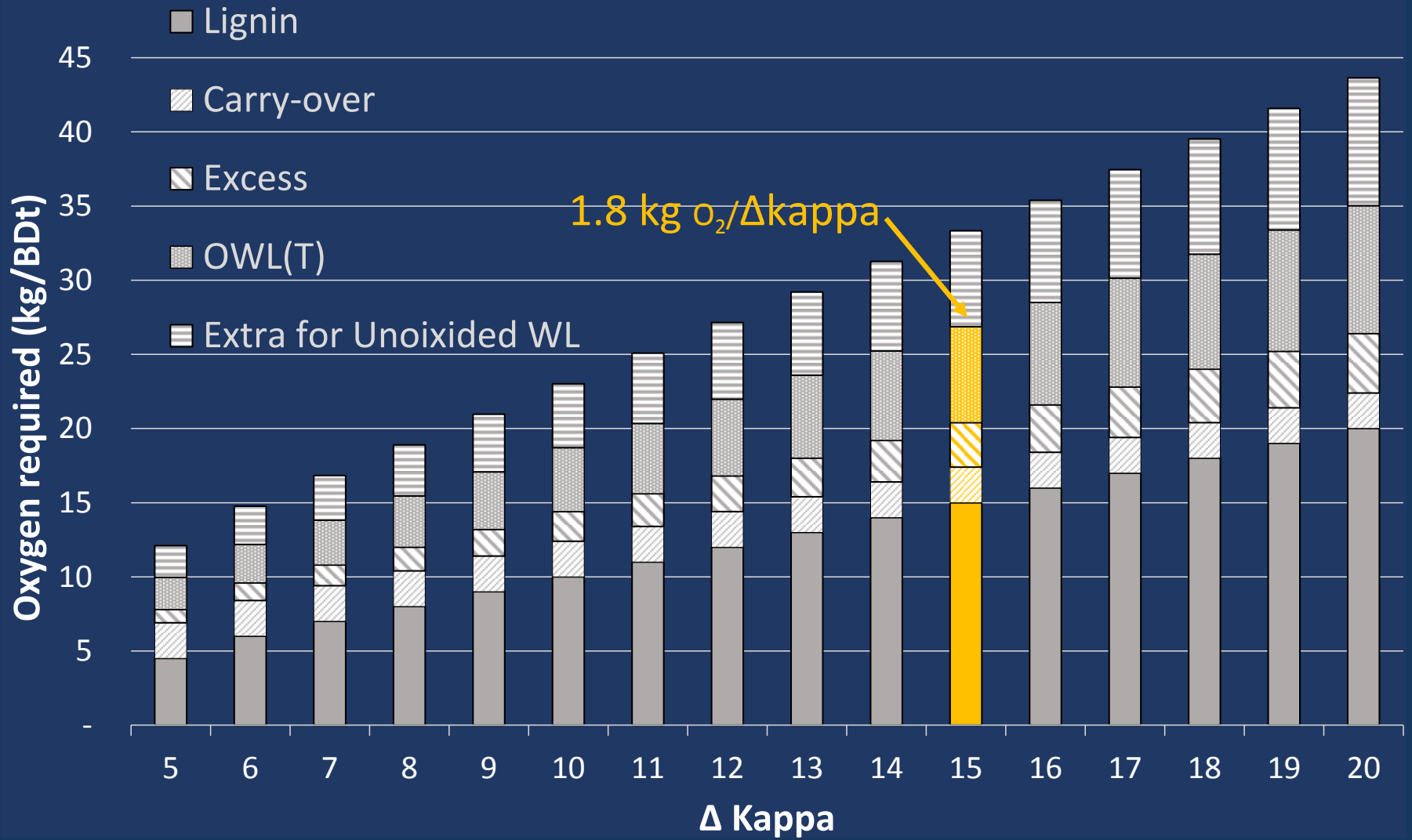
- Literature values: 0.08-0.09kgO₂/kg RBL
- Reference 3: 0.14kgO₂/kg RBL (calculated)
- Reference 11: 0.11kgO₂/kg RBL

- Value used: 0.11kgO₂/Kg RBL
- 25kg RBL/BDMT (conservative)

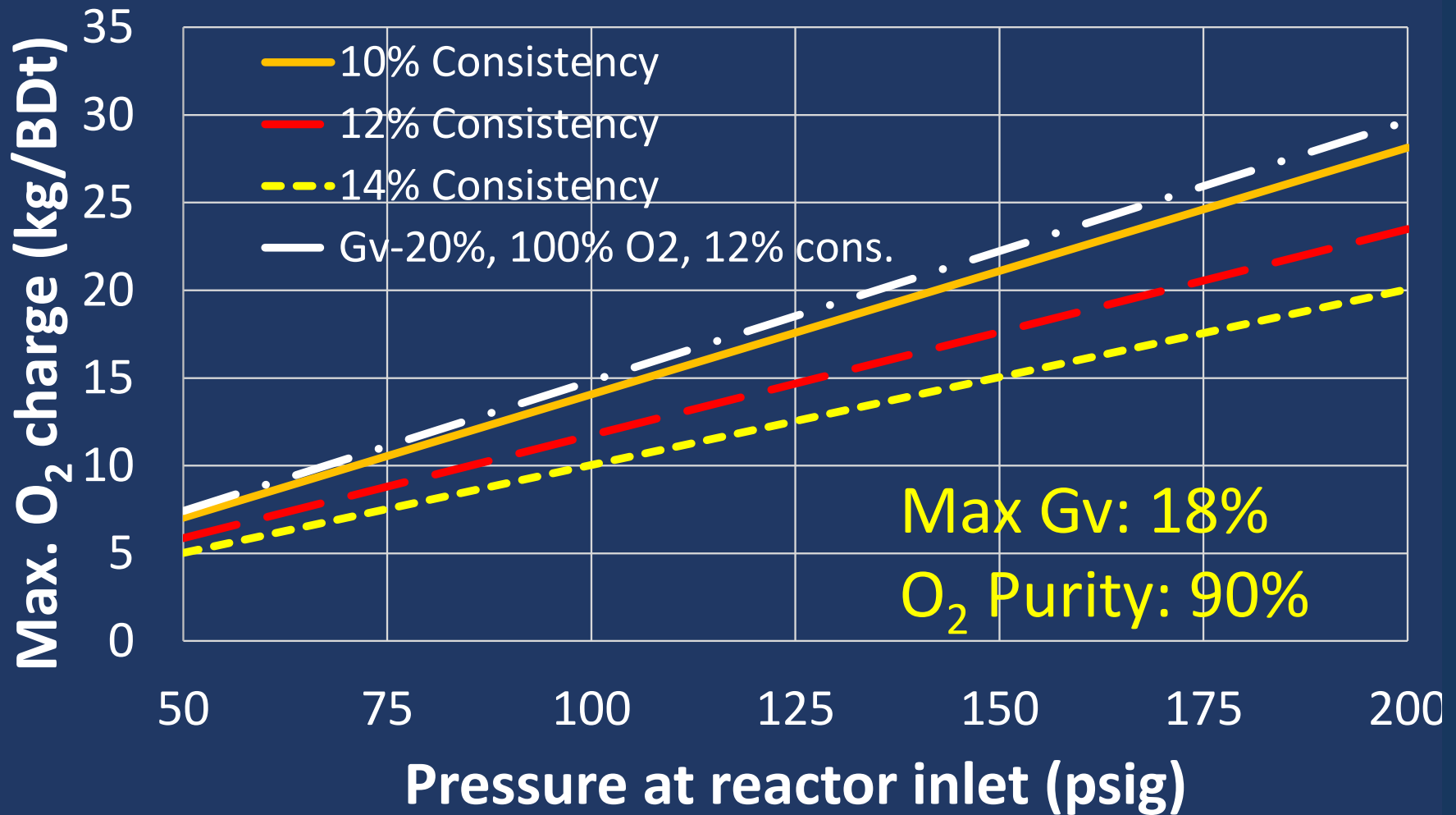
Excess

- Reference 1, Run 1, oxygen mass transfer limited at 33% excess
- Value used: 20% based on oxygen for delignification only (no WL or RBL)

Total Oxygen Demand



Mixer maximum mass charge



Oxygen Stage Kinetic Model

$$-\frac{dL_c}{dt} = 0.175 \frac{[OH]}{0.111 + [OH]} * \frac{P_{O_2}}{1 + 3.39P_{O_2}} * L_c$$

L_c = mg lignin/g
pulp (HexA free)

$[OH]$ = mol/l

P_{O_2} = MPa

Adjusted from temperature: 100 vs 90°C

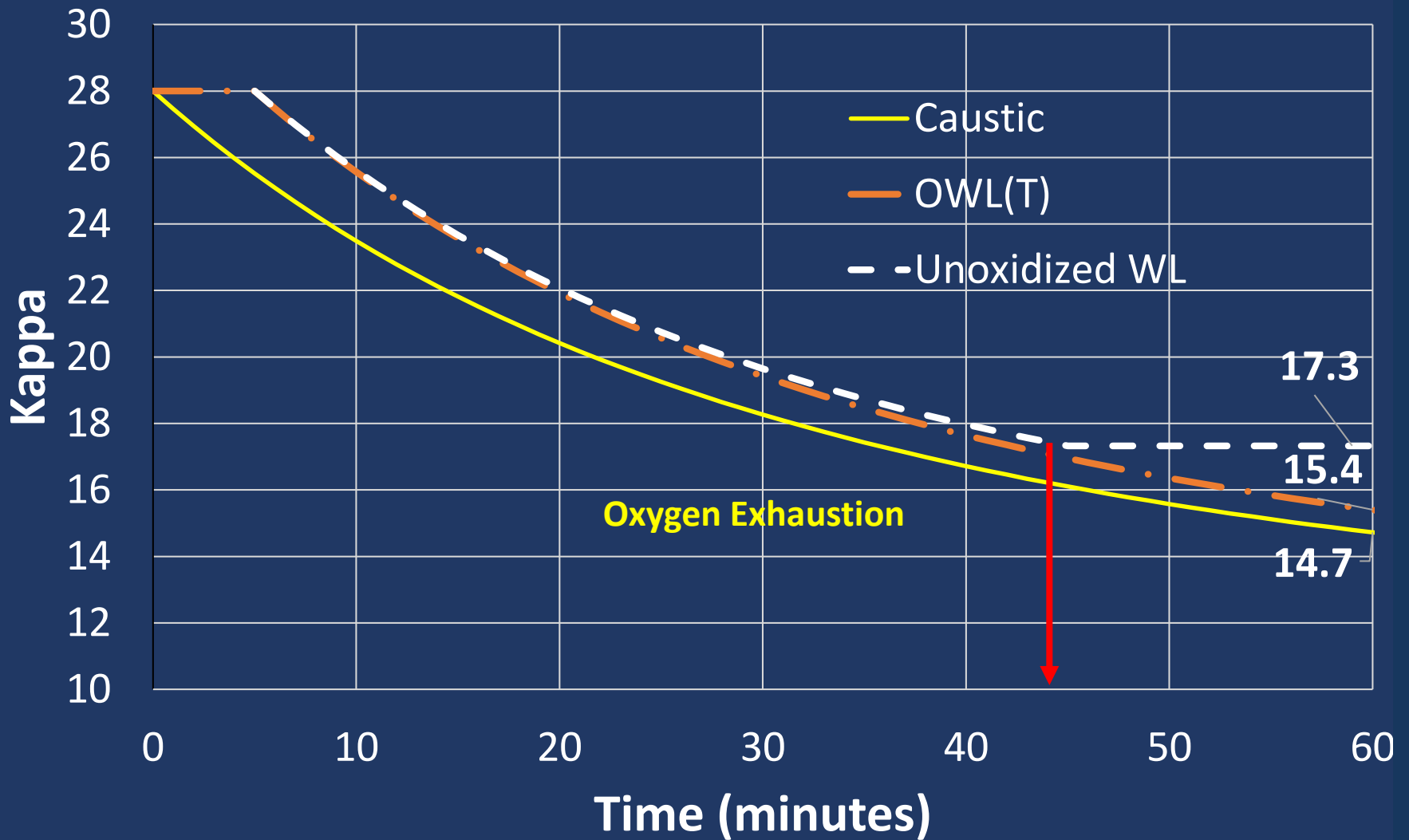
Model Parameters

- Inlet kappa: 30
- Caustic charge: 1.8kg/ Δ kappa
- Oxygen charge: 18% void fraction
- Oxygen purity: 90-100%

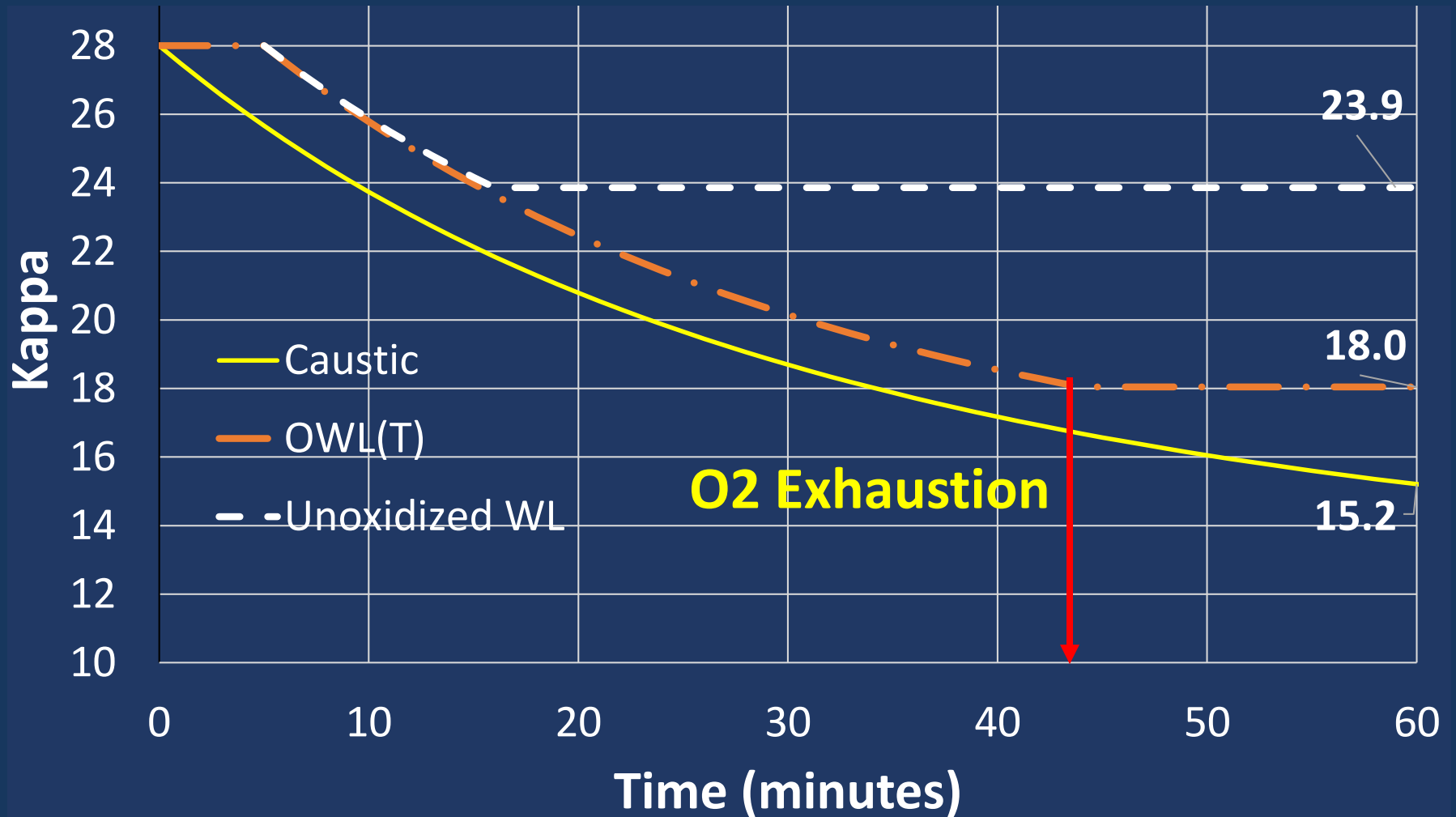
Reactor

- Pressure: 0.7-1.38 Mpa
- Static head: 0.4Mpa
- Residence time: 60minutes at 12% cons and O₂ not considered

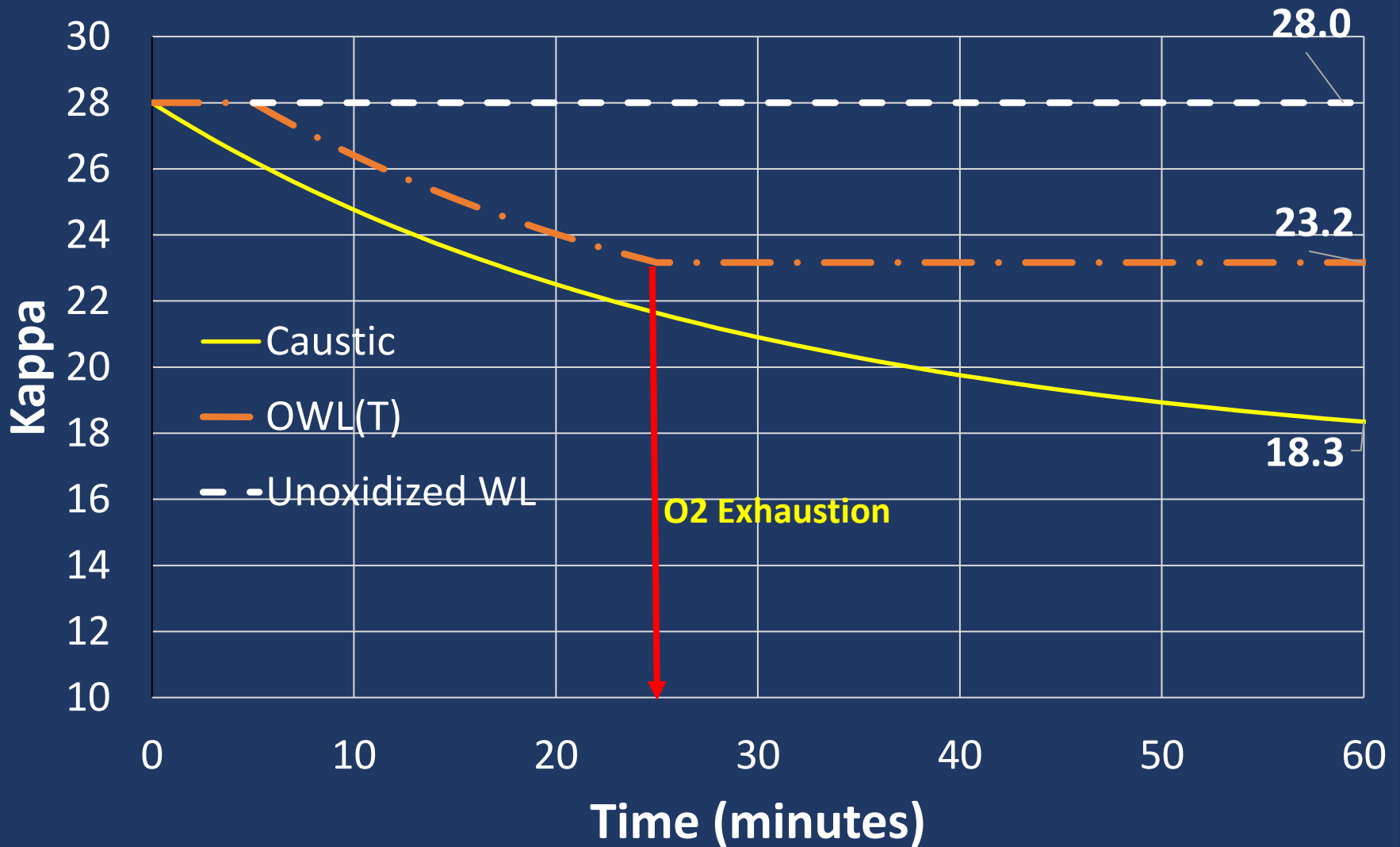
Model Delignification at 200psig



Model Delignification at 150psig



Model Delignification at 100psig



Conclusions and Comments

- Minimize the use of WL or OWL(T)
- Using OWL(S) is the same as NaOH
- Increasing the WL, OWL(T) charge will decrease delignification if insufficient O₂
- Increasing consistency may limit the O₂ charge due to maximum void fraction
- O₂ charge: RBL + WL/OWL + Delignification

Questions

Parameter	Units	NaOH	OWL(T) ¹
Δ kappa		15	15
Alkali	kg/ Δ kappa	1.7	1.7
Caustic	kg/BDt	25.5	25.5
RBL carryover	Kg/BDt	15	15
Post O2 Washer Filtrate			
Total Organic	Kg/BDt	124	124
Inorganic			
Na	kg/BDt	51	97
CO ₃	kg/BDt	30	43
SO ₄	kg/BDt	3	51
S ₂ O ₃	kg/BDt		
Total Inorganic	kg/BDt	84	191
Total solids	kg/BDt	208	315
Inorganic/Organic ratio			
		0.68	1.54
1 White liquor composition as per table 1.			