The University of Texas at Austin
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U.S. DEPARTMENT OF ENERGY

Thermal Reclaiming of Aqueous PZ

PCCC-8

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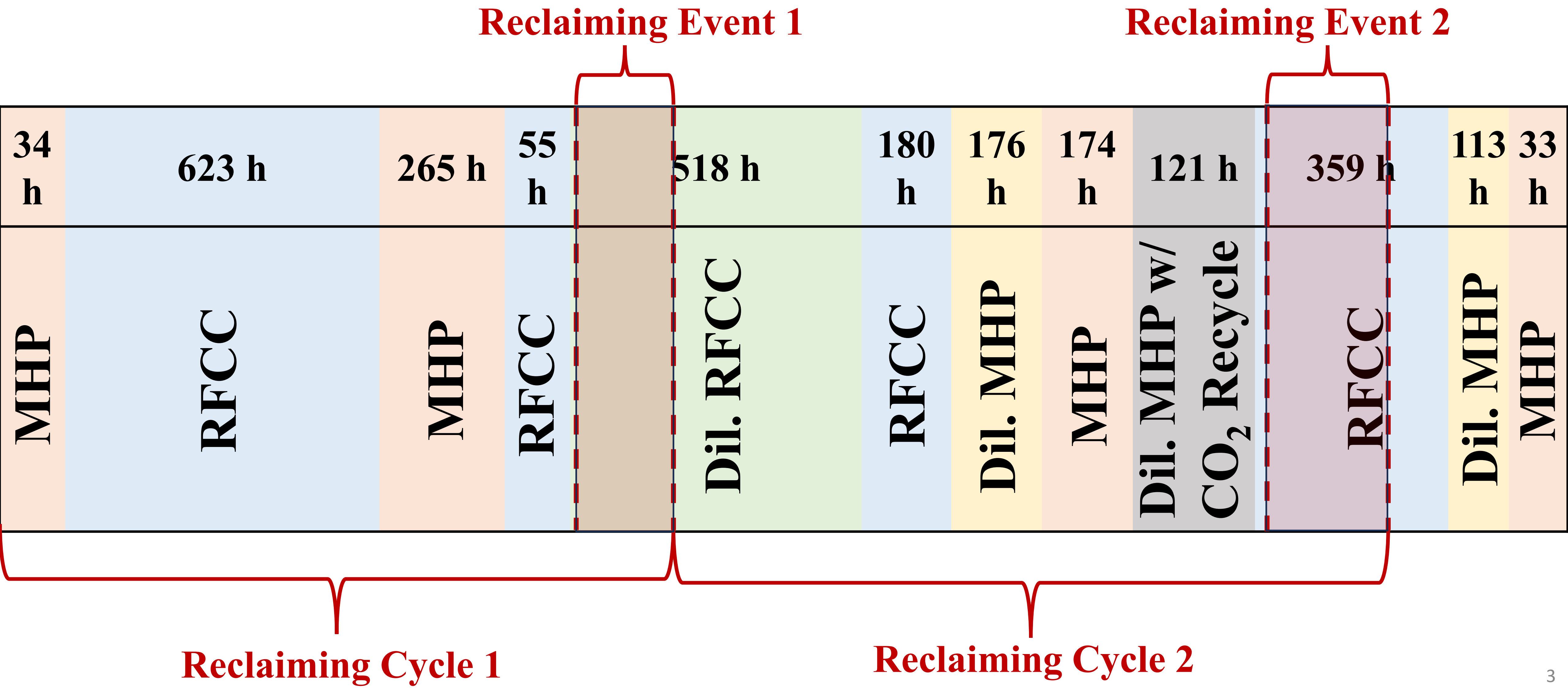
TxCCMP

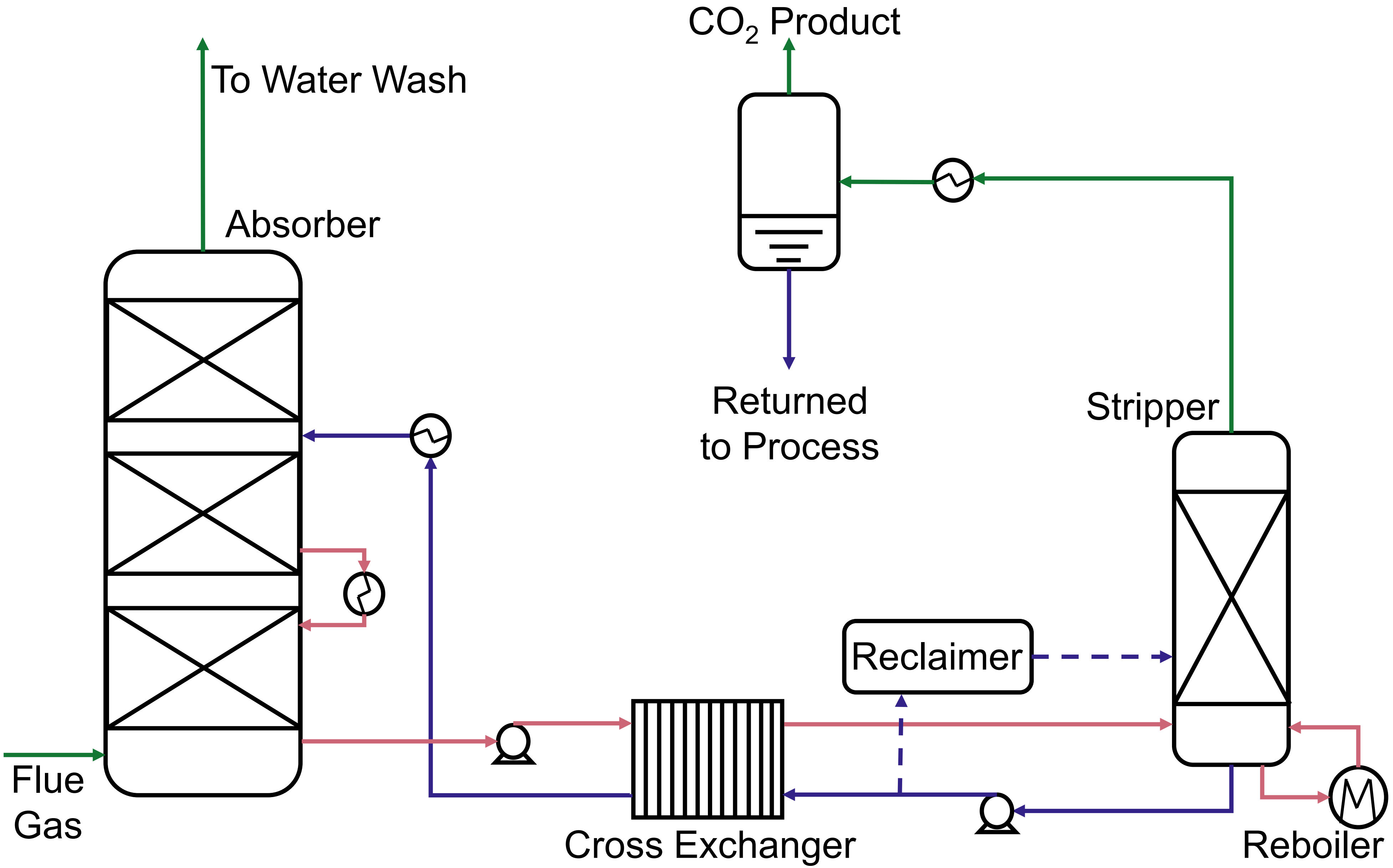
Reclaiming Aqueous PZ

- TCM 2025: 2nd Test of Aqueous PZ Reclaiming
  - Improved PZ recovery due to caustic treatment and water feed (boiloff)
  - Caustic requirement increases when fed simultaneously with solvent
  - Reclaiming 3 inventories removes Fe and suspected chelating agents
- Techno economic analysis of reclaiming based on 2022 NETL cost baseline

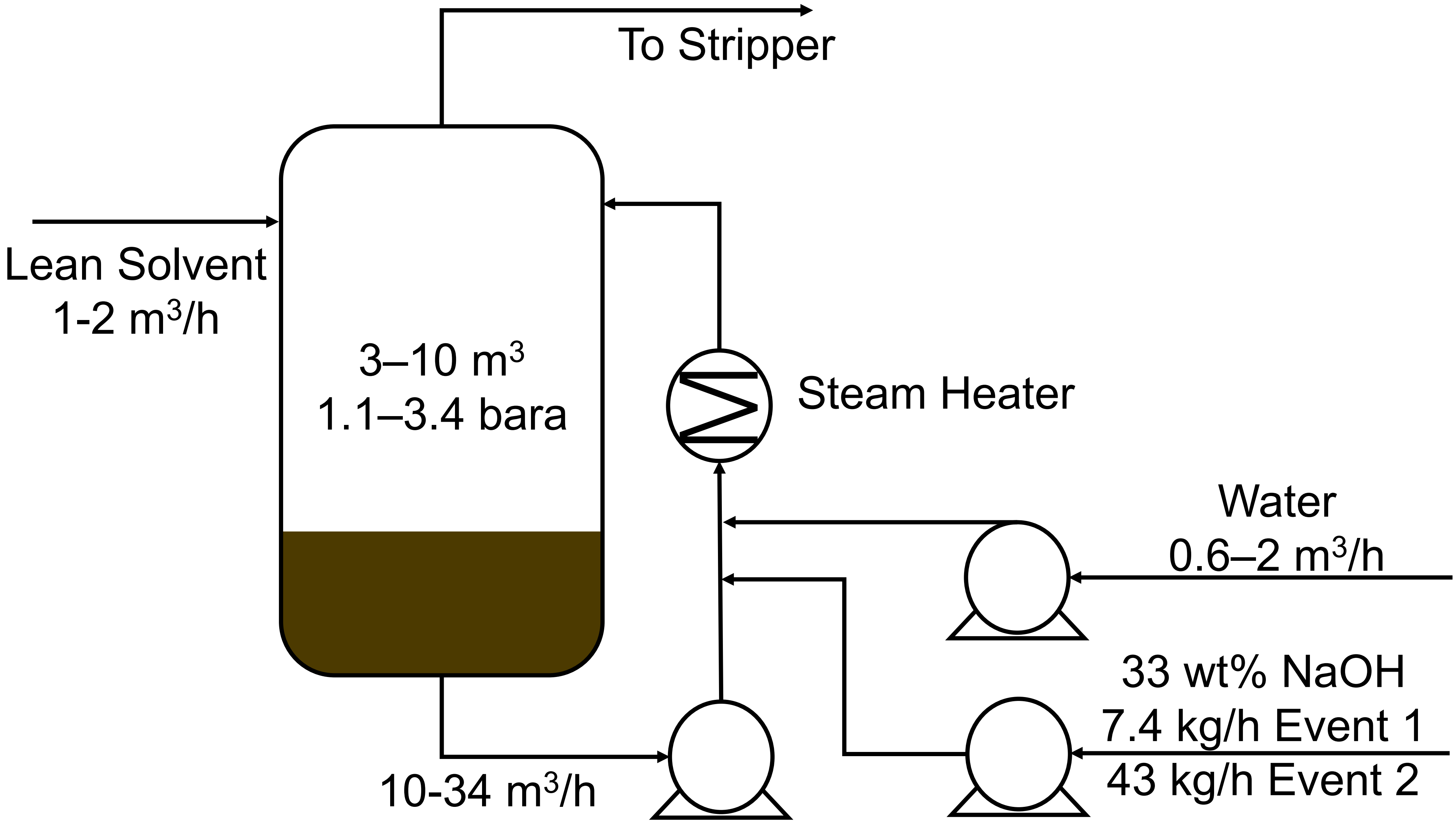
TCM 2025 Tested Different Flue Gases: Reclaiming Operated Twice when MNPZ + OPZ + NFPZ + MPZ > 0.8 wt%



Reclaimer Treated Lean PZ and Returned Vapor to Stripper



Inventory Stayed in Vessel Between Reclaiming Events



The Reclaimer Heat Duty for the Entire Campaign Was About 2% of Typical PZAS Stripper Duty

	Reclaiming 1	Reclaiming 2	Entire Campaign
Length of Event (h)	208	284	
Inventories Treated	3	5	8
Average Event Operating Temperature (°C)	~120	~150	
Event Operating Pressure (bara)	1.1	1.8–3.4	
Heat Duty for Reclaiming Cycle (GJ/mt CO_2)	0.04	0.05	0.04

Optimal Operation Feeds NaOH After Solvent to Minimize Amount of NaOH Needed for CO_2 Neutralization

<table>
<tr><th colspan="2"></th><th colspan="3">kmol</th></tr>
<tr><th colspan="2"></th><th>Reclaiming 1</th><th>Reclaiming 2</th><th>Entire Campaign</th></tr>
<tr><td colspan="2">Unhydrolyzed Amides in Residue</td><td>2.2</td><td></td><td>8.8</td></tr>
<tr><td colspan="2">Estimated NaOH Addition</td><td>11</td><td>9–18</td><td>20–29</td></tr>
<tr><td rowspan="2">Estimated NaOH Requirement</td><td>Feeding NaOH After Solvent Feed</td><td>11</td><td>8.8</td><td>19</td></tr>
<tr><td>Feeding NaOH During Solvent Feed</td><td>56</td><td>90</td><td>146</td></tr>
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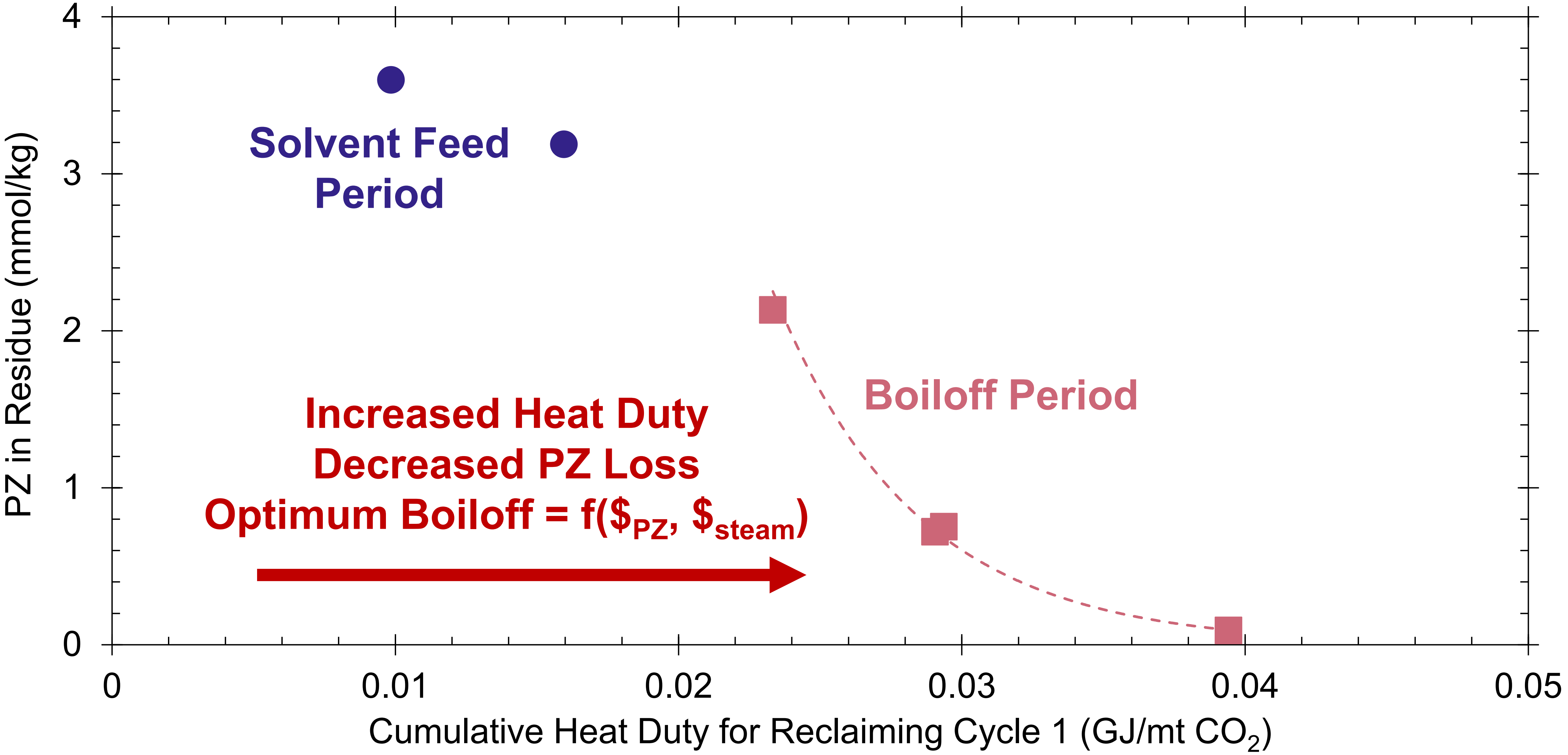
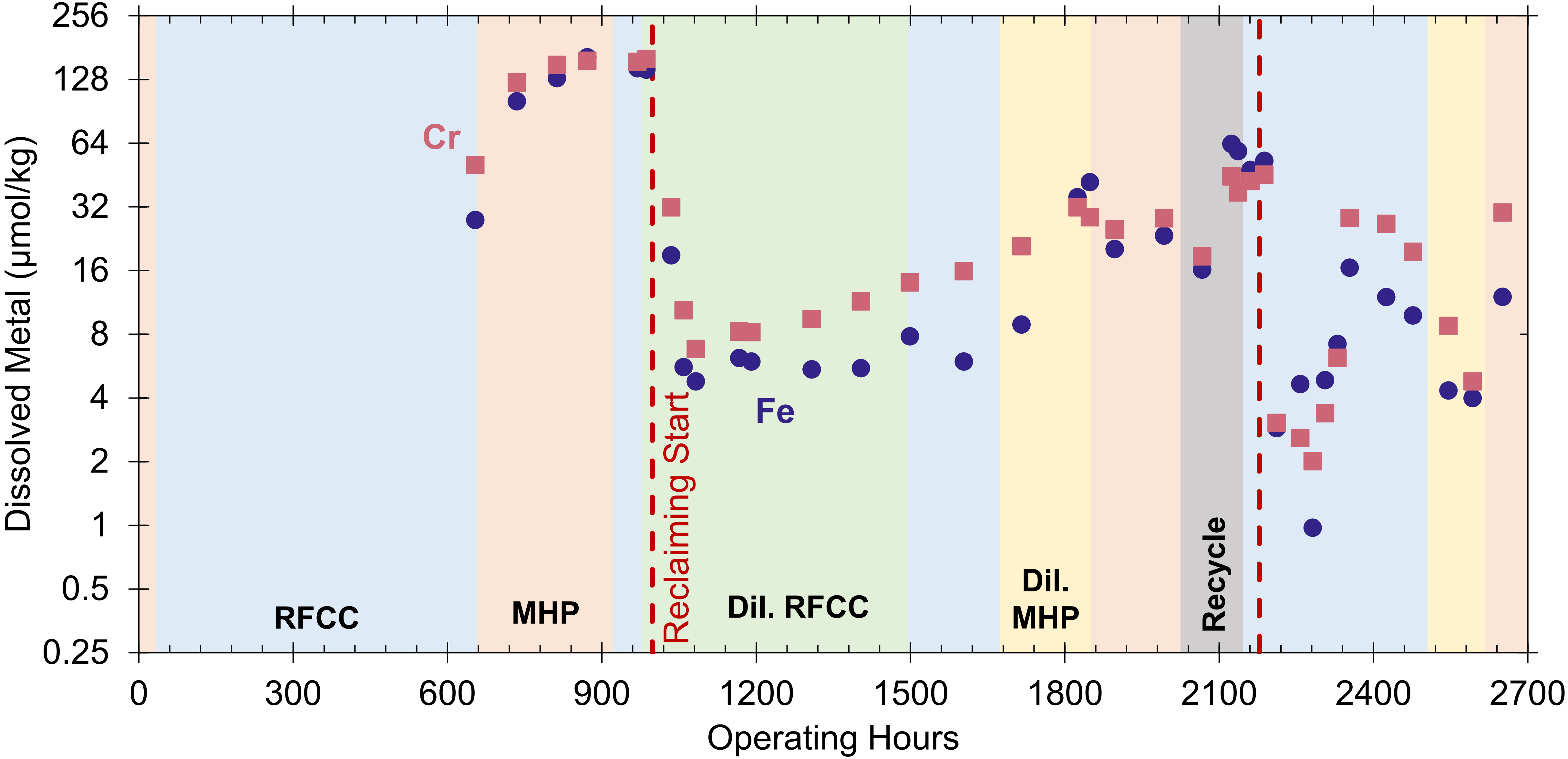
Tradeoff Between Improved PZ Recovery and Increased Heat Duty



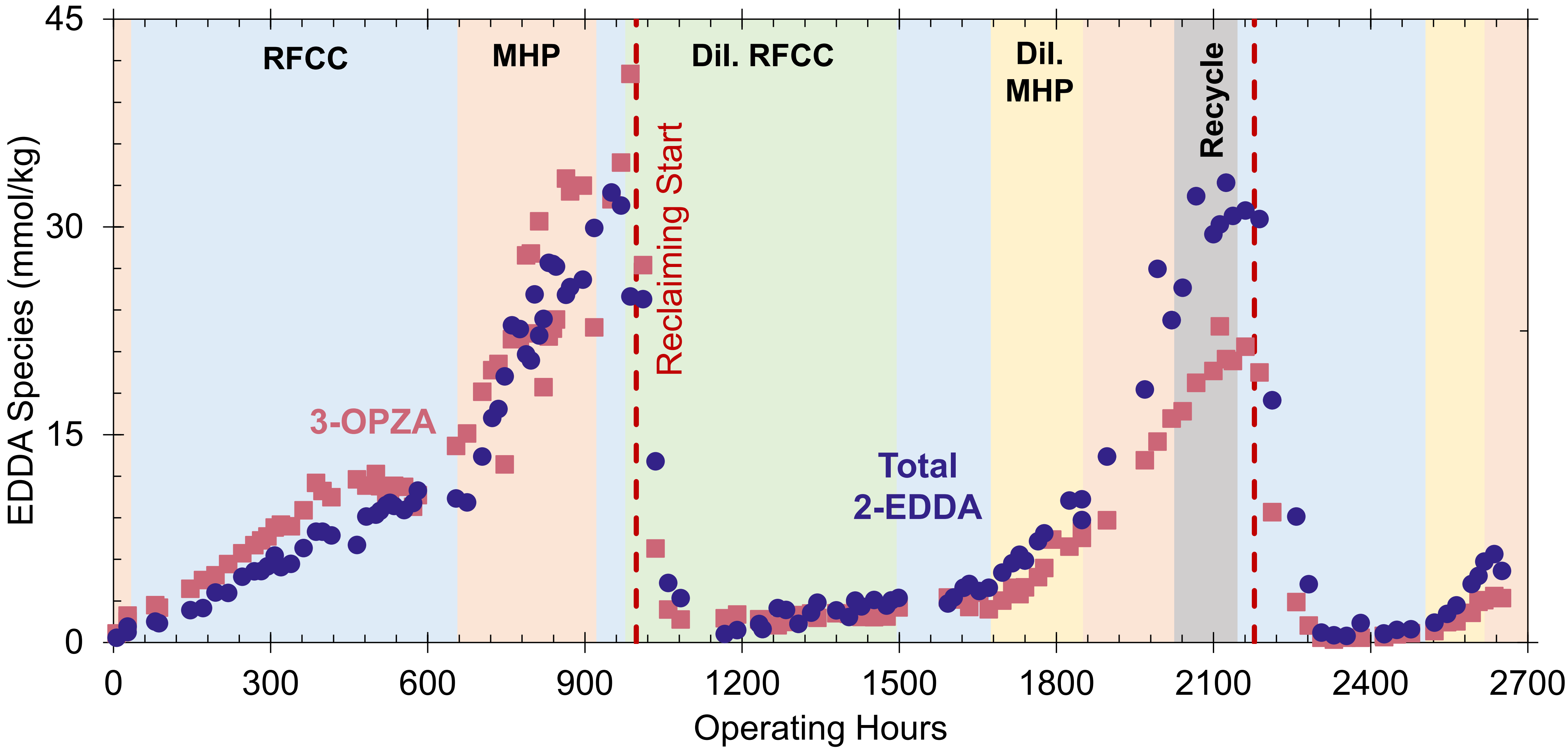
Improved PZ Recovery Due to Boiloff and Caustic Treatment

	NCCC 2023	TCM 2025
PZ Loss to Residue (kg)	180	4.7
Initial PZ Inventory (kg)	2800	16000
Loss as Percent of Inventory	6%	0.03%

Reclaiming Removes 94% of Dissolved Metals at Event 1



Reclaiming Effectively Reduces Suspected Fe-Complexing Agents



Conducted TEA on Optimized Reclaimer Design for 942 MW_{eq} Greenfield NGCC with PZAS*

Solvent Feed
890 h

Boiloff (Water Feed)
670 h

Treat 3 Inventories

Achieves 0.74 wt% PZ in Waste

NH_3 = 9 ppm
Initiate
Reclaiming

Caustic Treatment
24 h
39 m^3 of 50 wt% NaOH per event

Waste Disposal
24 h
180 mt per event

Reclaim 2.8X annually for flue gas w/ 2.5 ppm NO_2
Reclaimer on 50% of Operational Time

*Based on NETL Cost Baseline w/ CANSOLV (Schmitt et al., 2022); Used data from NCCC 2023, TCM 2025, Mustang FEED

Reclaiming Frequency Set by 5 ppm Average NH_3 Emissions Target

NH_3 = 9 ppm
Initiate
Reclaiming

Reclaim 2.8X annually for flue gas w/ 2.5 ppm NO_2
Reclaimer on 50% of Operational Time

*Based on NETL Cost Baseline w/ CANSOLV (Schmitt et al., 2022); Used data from NCCC 2023, TCM 2025, Mustang FEED

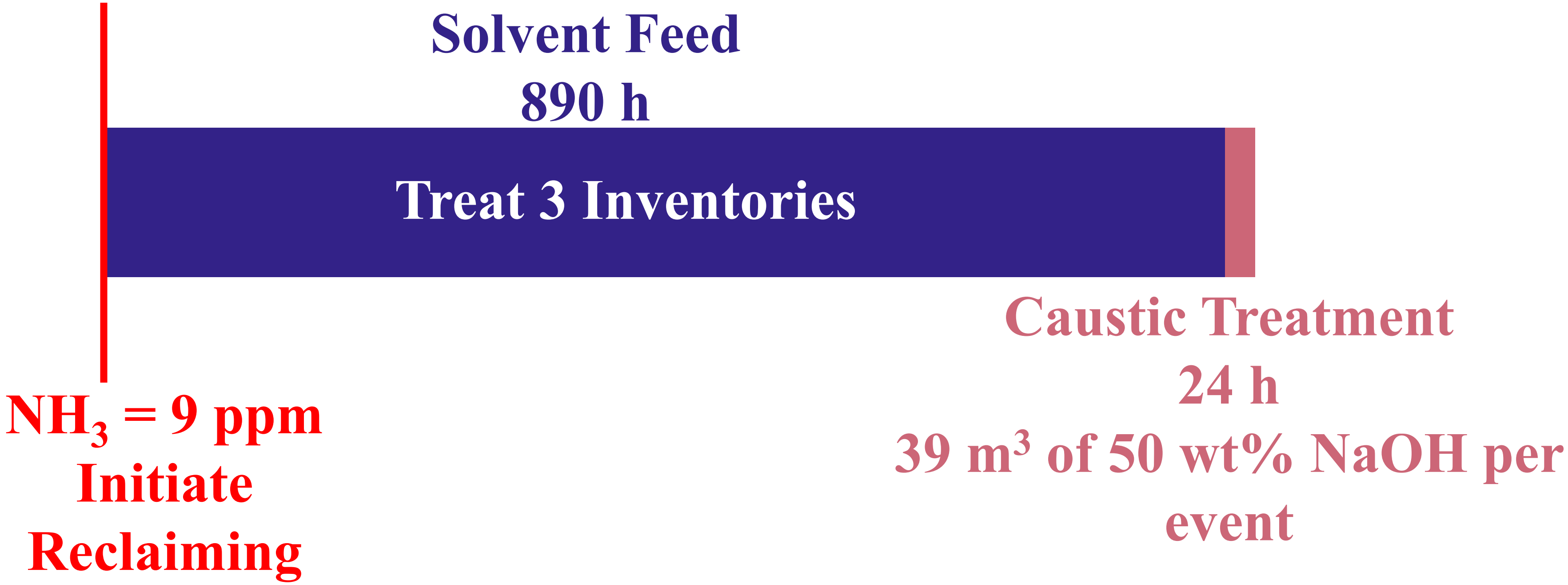
Treat 3 Solvent Inventories Every Event

Reclaim 2.8X annually for flue gas w/ 2.5 ppm NO_2

Reclaimer on 50% of Operational Time

*Based on NETL Cost Baseline w/ CANSOLV (Schmitt et al., 2022); Used data from NCCC 2023, TCM 2025, Mustang FEED

Feed Caustic AFTER Solvent to Recover More PZ and Minimize Caustic Use



Reclaim 2.8X annually
Reclaimer on 50% of Operational Time

*Based on NETL Cost Baseline w/ CANSOLV (Schmitt et al., 2022); Used data from NCCC 2023, TCM 2025, Mustang FEED

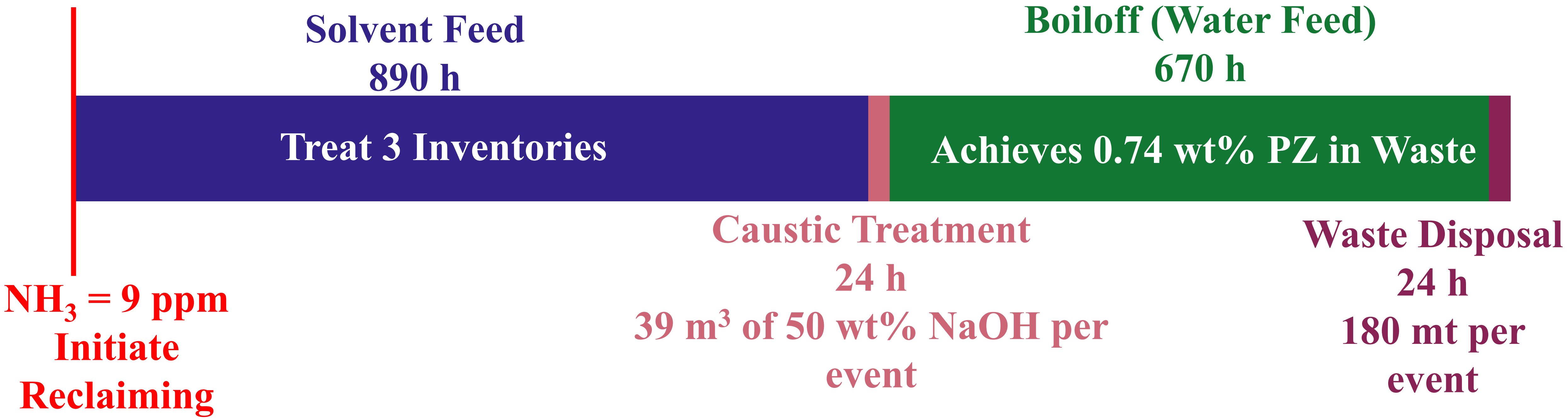
Set Boiloff to Same as TCM 2025; Amount of Boiloff Determines Heat Duty

Reclaim 2.8X annually

Reclaimer on 50% of Operational Time

*Based on NETL Cost Baseline w/ CANSOLV (Schmitt et al., 2022); Used data from NCCC 2023, TCM 2025, Mustang FEED

510 mt Hazardous Waste Annually



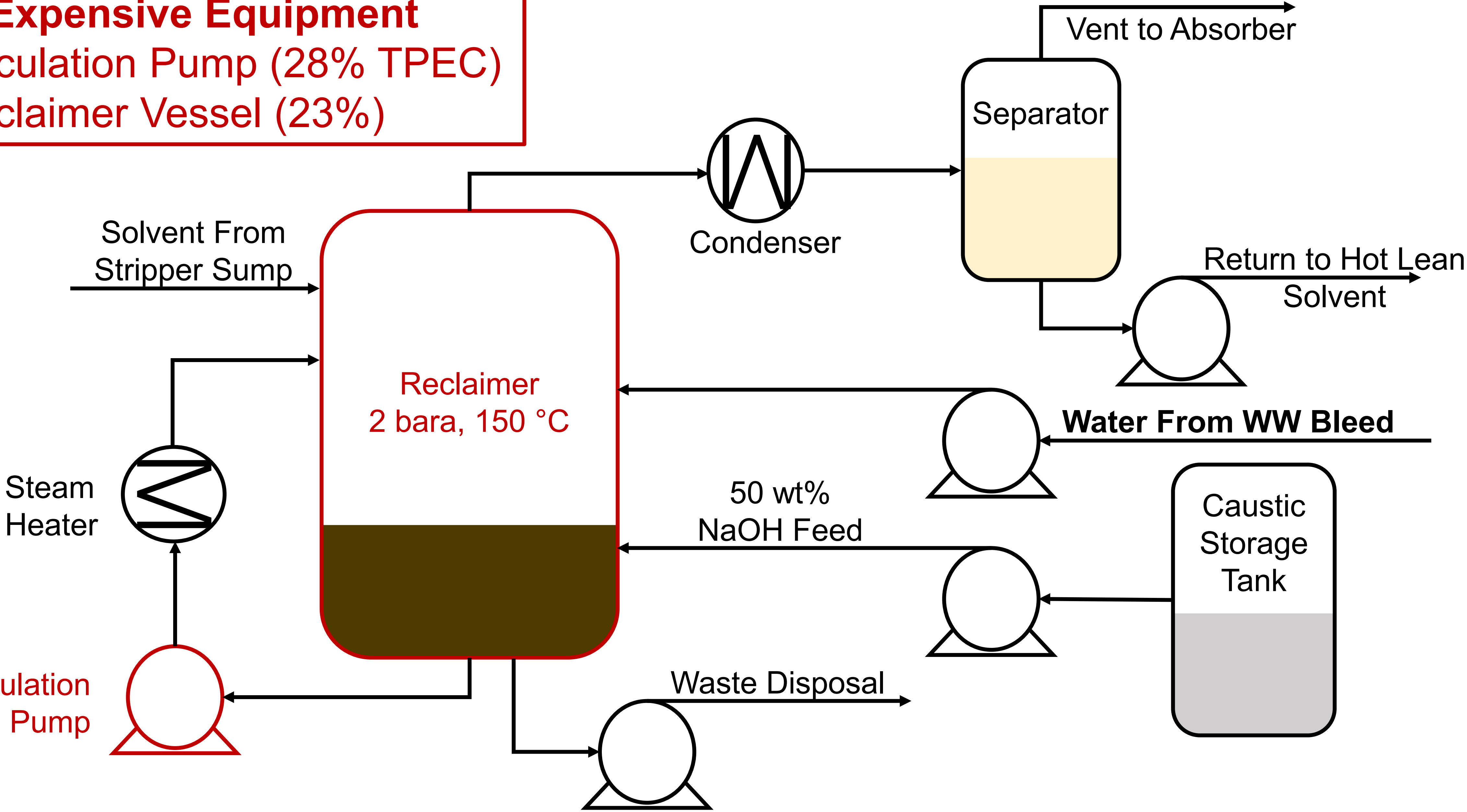
Reclaim 2.8X annually for flue gas w/ 2.5 ppm NO_2
Reclaimer on 50% of Operational Time

*Based on NETL Cost Baseline w/ CANSOLV (Schmitt et al., 2022); Used data from NCCC 2023, TCM 2025, Mustang FEED

Optimized Reclaimer Decouples Reclaimer from Stripper Operation

Most Expensive Equipment

1. Circulation Pump (28% TPEC)
2. Reclaimer Vessel (23%)



Incremental Cost of Reclaiming $0.76/MT CO_2

Cost of Reclaiming (\$/mt CO_2)	0.8
Total Cost of Capture (\$/mt CO_2)	65
Annualized Heat Duty (GJ/mt CO_2)	0.06
PZAS Reboiler Duty (GJ/mt CO_2)	2.5
Total Plant Cost for Reclaiming (\$MM)	5.9
Total Plant Cost for CANSOLV (\$MM)	588

Conclusions

- PZ loss improved from 6% to 0.03% using boiloff and caustic treatment
- Feeding caustic during solvent feed increases NaOH required to neutralize CO_2
- Economic tradeoff between PZ loss to residue and steam requirement
- Reclaiming 3 inventories removes Fe and known chelating agents
- TEA conducted based on 2022 NETL Cost Baseline for 942 MW_{eq} greenfield NGCC using CANSOLV at 95% capture
  - Incremental Cost of Reclaiming = \$0.8/mt CO_2
  - Annualized Reclaimer Heat Duty = 0.06 GJ/mt CO_2

Acknowledgements

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Caustic Feed Overlapped with Solvent Feed