

Piperazine and nitrosamine degradation in pilot plants

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Commonwealth Scientific and Industrial Research Organisation (CSIRO)

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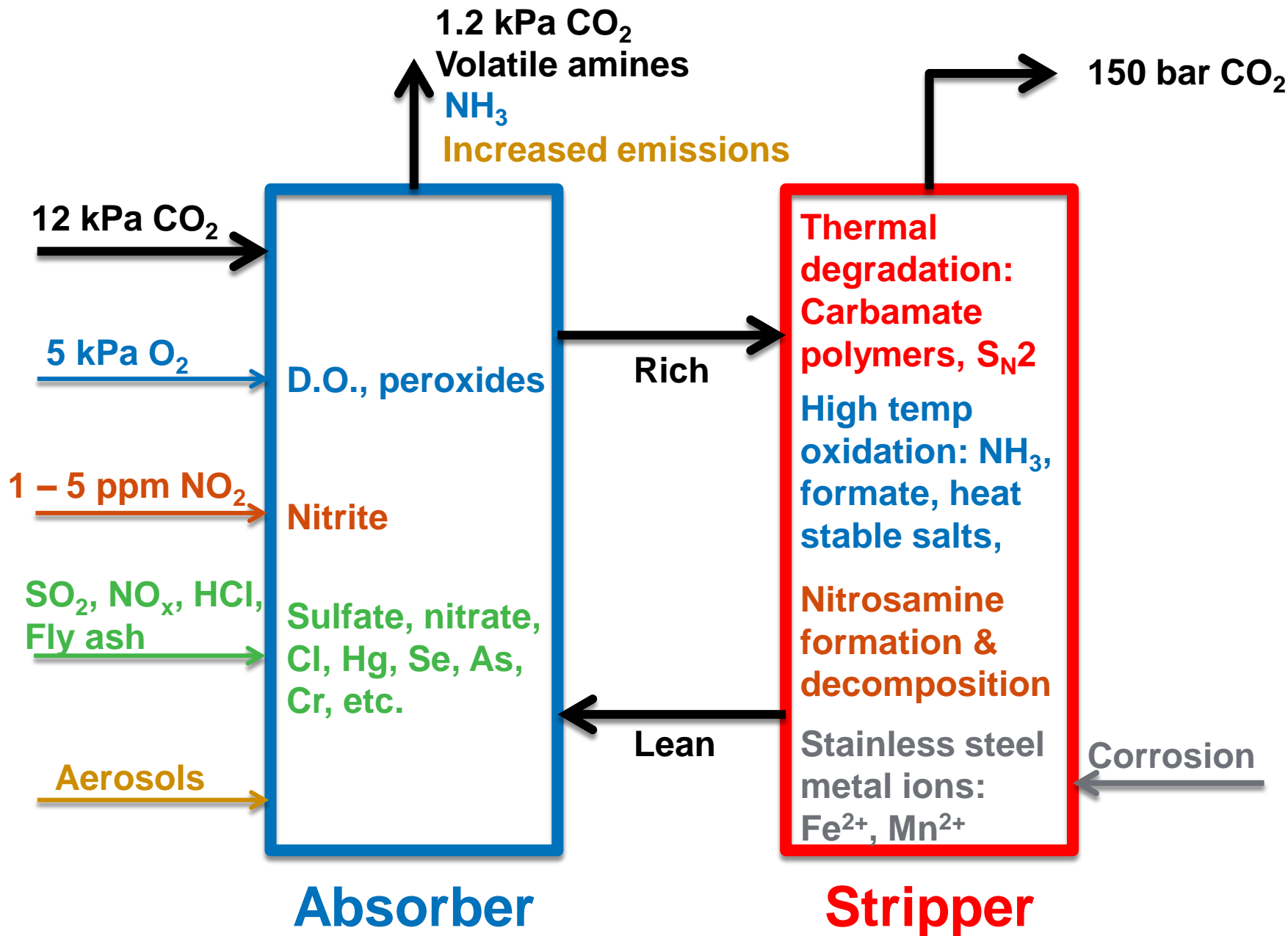
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Outline

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- Introduction
 - ▣ Description of pilot plants and cycling apparatus
 - ▣ Safe shipping of Tarong samples
- Results
 - ▣ Nitrosamine accumulation
 - ▣ Solvent oxidation
 - ▣ Corrosion
 - ▣ Flue gas contaminant accumulation
- Conclusions



8 m PZ as an advanced solvent

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- Benefits:
 - ▣ Faster absorption rate, 2x capacity of MEA
 - ▣ Thermally stable beyond 150 °C: far greater energy performance
 - ▣ More resistant to oxidation than MEA
- Drawbacks:
 - ▣ More viscous than MEA
 - ▣ Limited solubility window
 - ▣ >2x price of MEA per tonne

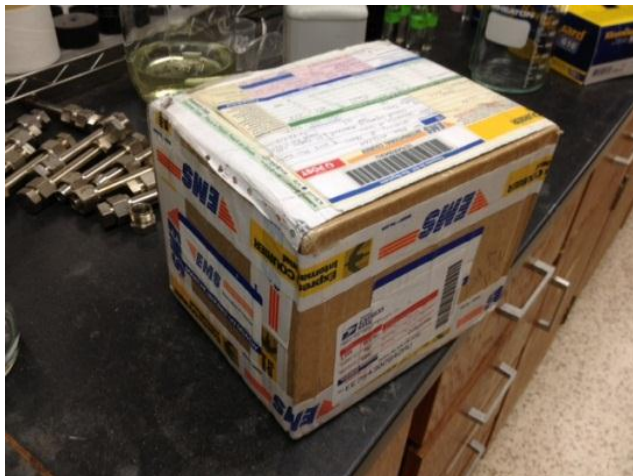
PZ Pilot plants/cycled degradation apparatus

	Tarong	PP2	SRP	HTOR
Flue gas	Coal	Coal	Air + CO ₂	Air + CO ₂
MW _e	0.1	N/A	0.1	Bench scale
O ₂ (kPa)	5	5	18	21
SO ₂ (ppm _v) (avg)	0.6	<0.5	0	0
NO ₂ (ppm _v) (avg)	1.3	1 – 5	0	0
NO _x (ppm _v) (avg)	~200	Controlled	0	0
Materials of construction	SS304	SS	SS304, some CS	SS316, plastic, glass
Stripper T _{op}	120 / 155 C	150 C	135 / 150 C	120 – 160 C
Notes			1 wt% Inh A	Run w/ fresh 8 m PZ and degraded SRP solvent

Safe shipping of Tarong samples

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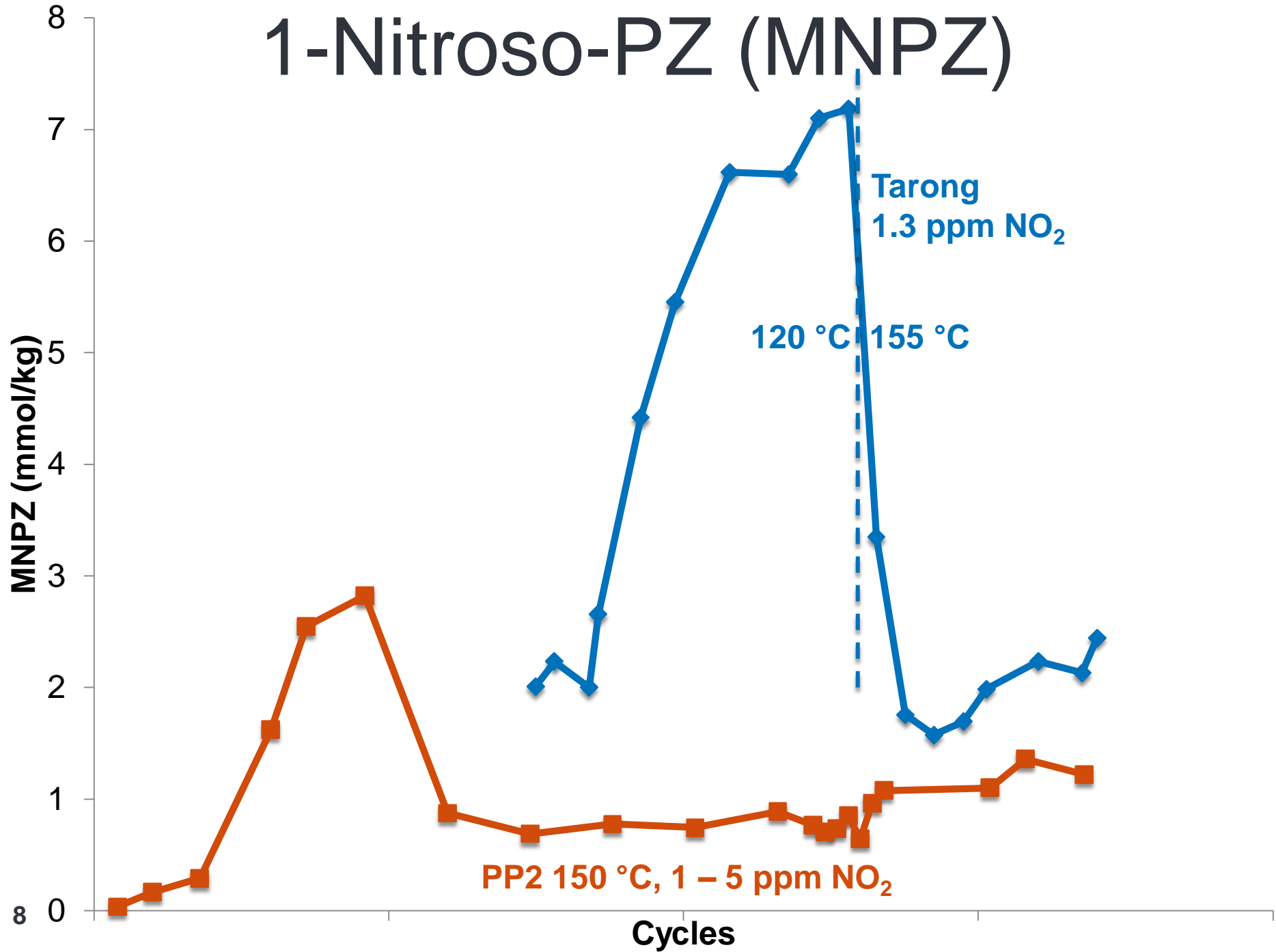
- Sealed in 30 mL vials with tape, then placed in Ziploc bags and surrounded by packing material
- Opened and stored in fume hood at room temperature
- No samples leaked in transit



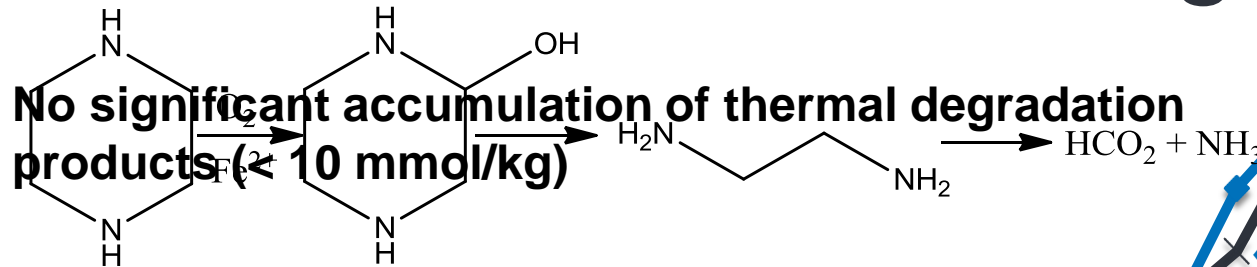
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Results

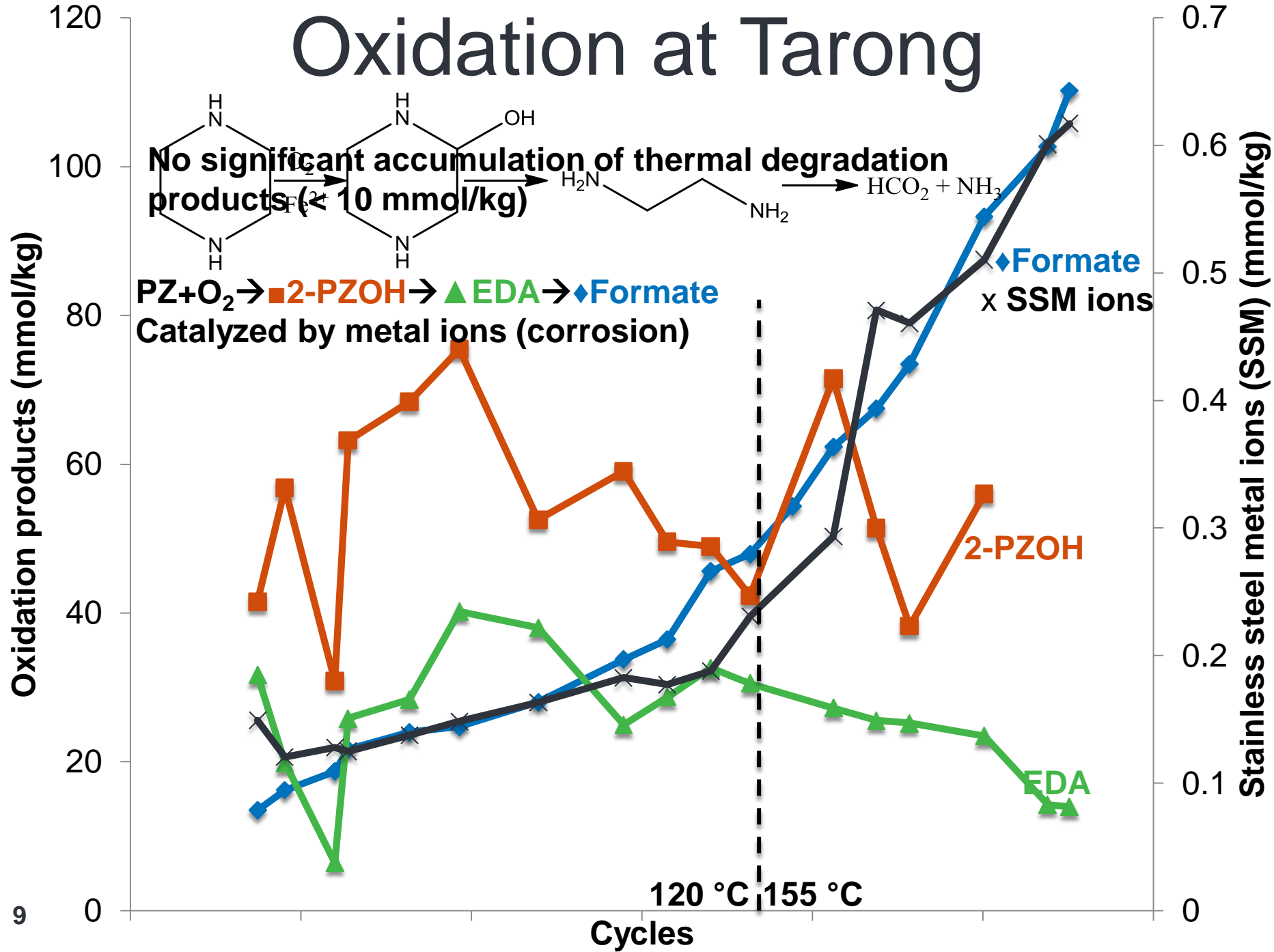
1-Nitroso-PZ (MNPZ)



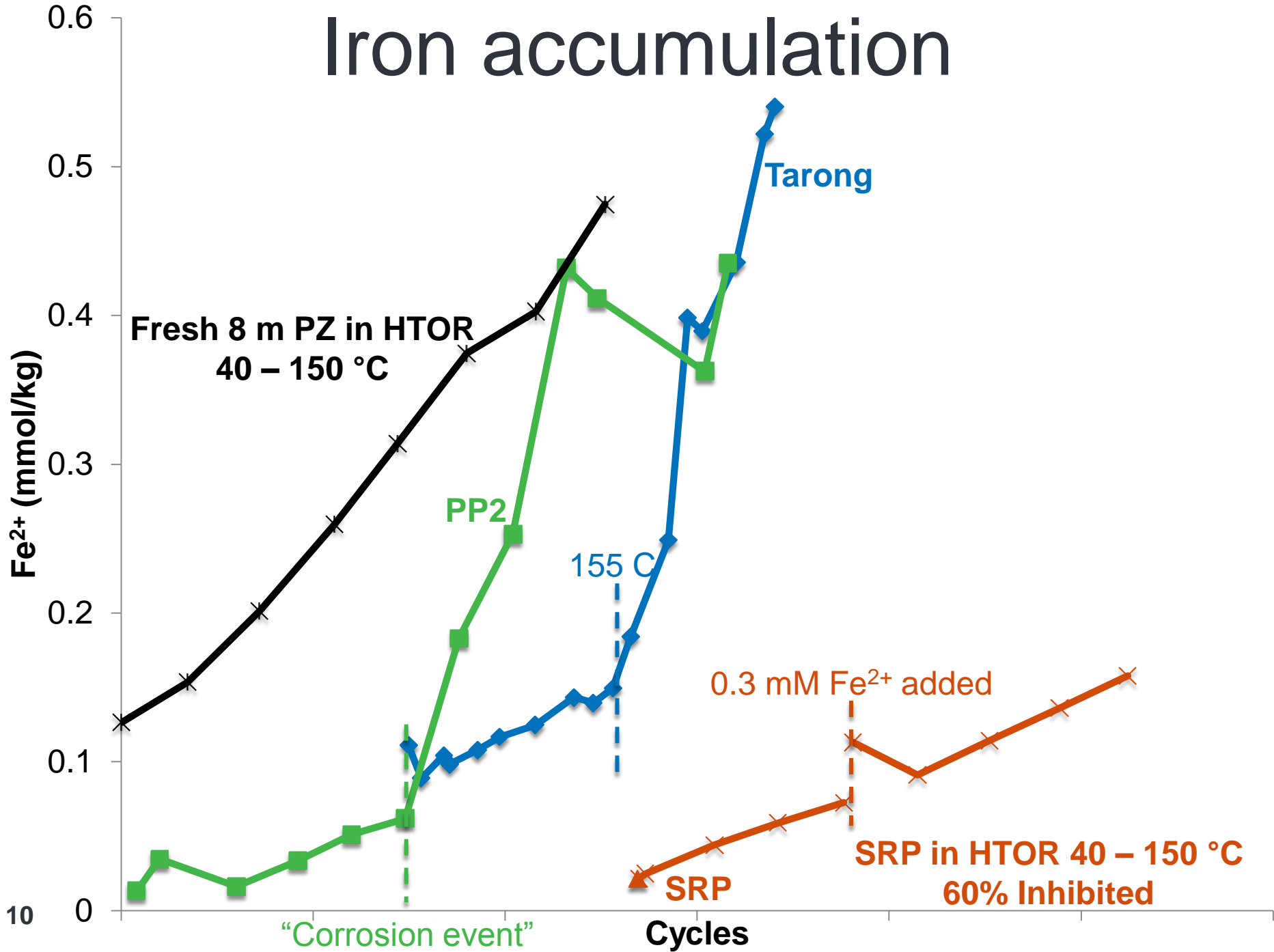
Oxidation at Tarong



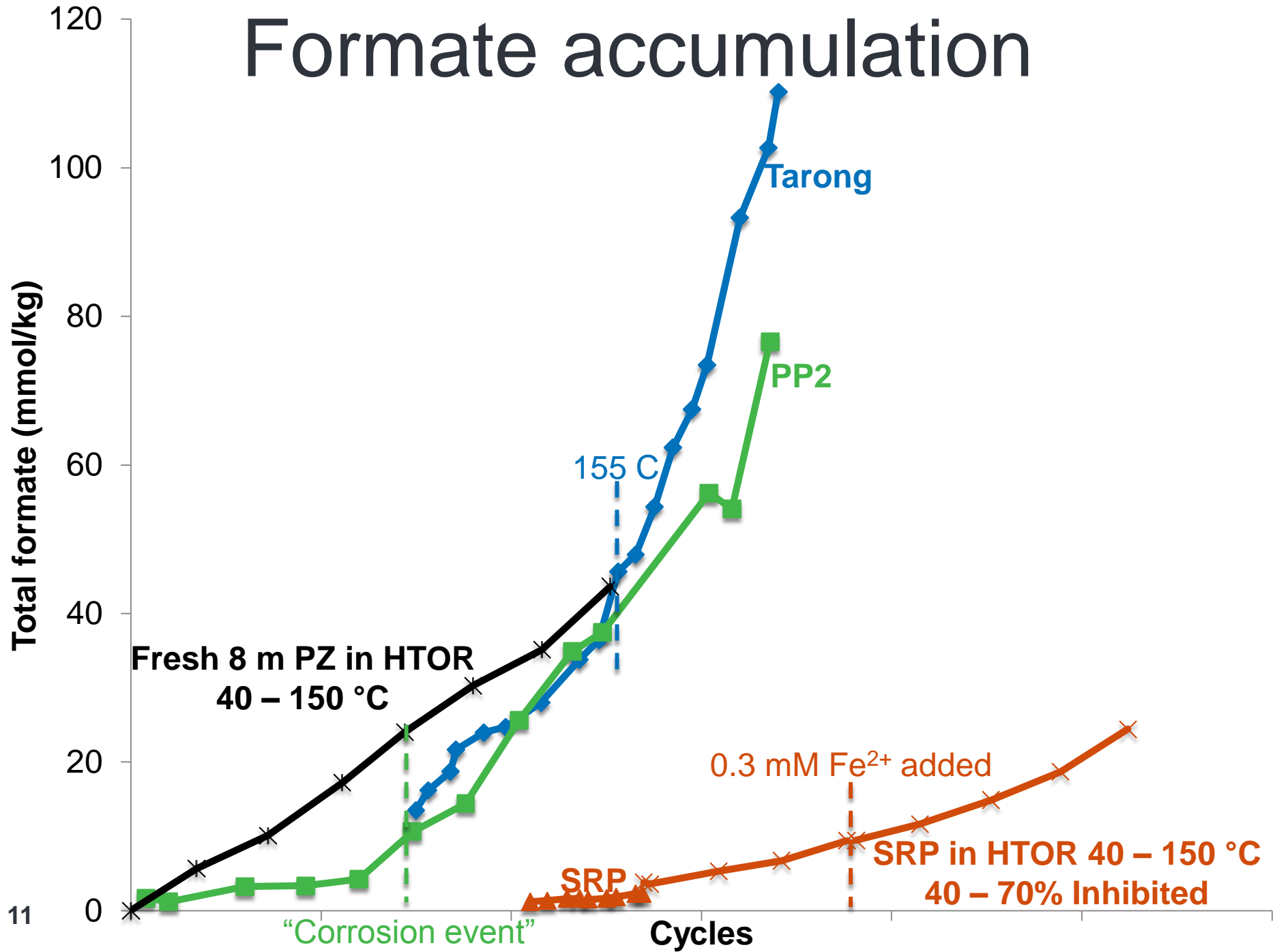
$PZ + O_2 \rightarrow$ ■ **2-PZOH** \rightarrow ▲ **EDA** \rightarrow ◆ **Formate**
 Catalyzed by metal ions (corrosion)



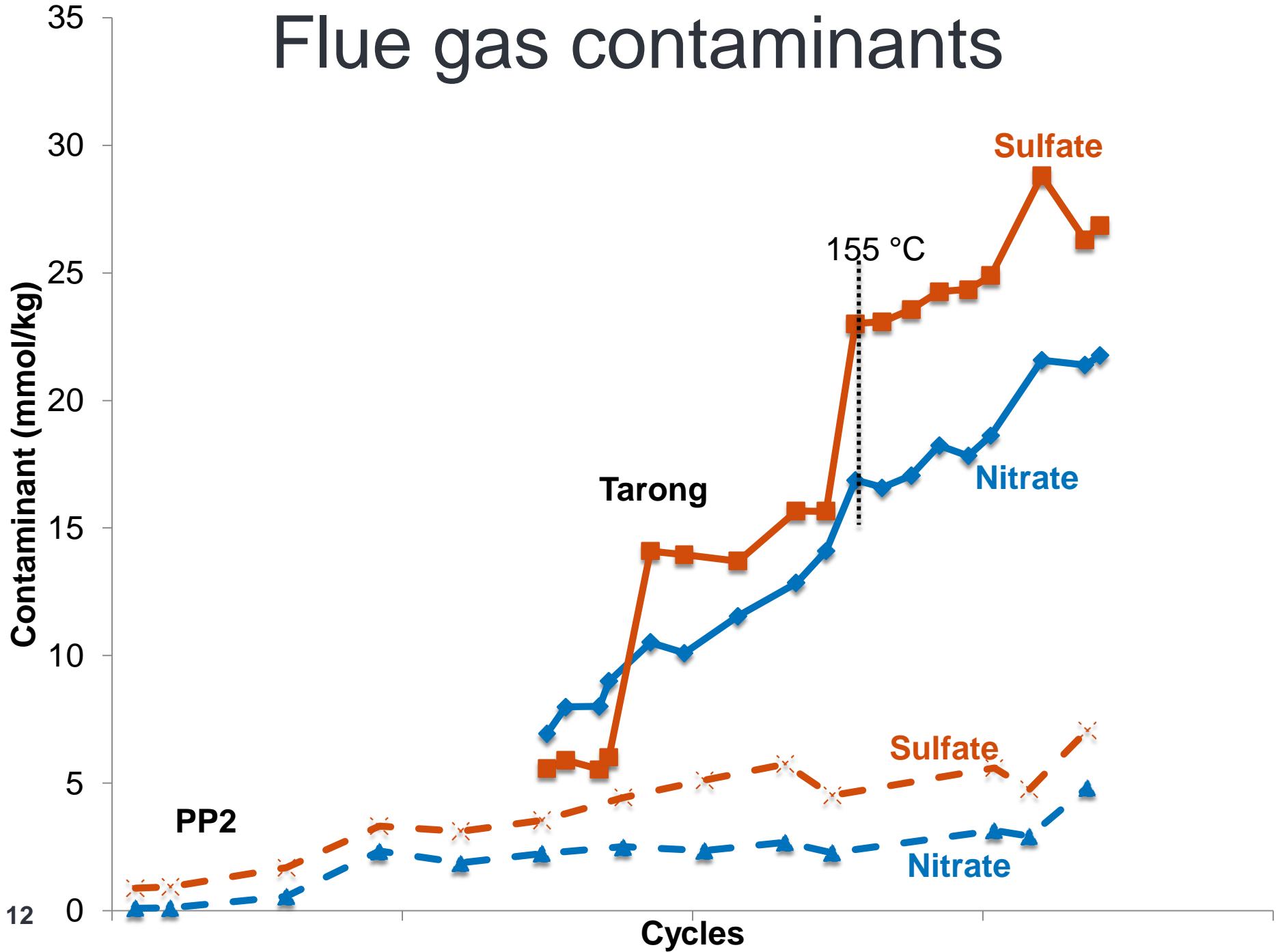
Iron accumulation



Formate accumulation



Flue gas contaminants



Conclusions

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- MNPZ accumulation in PZ pilot plants controlled by thermal degradation to less than 3 mmol/kg at 150 ° C
- Oxidation dominates over thermal degradation as cause of amine loss
 - Ammonia and formate final products
 - Ethylenediamine and 2-PZOH major intermediates
- Rate of formate accumulation linked to accumulation of stainless steel metal ions
- Corrosion and oxidation at SRP inhibited by Inh A

Questions?

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