



Commissioning of a lab scale CO₂-Fischer-Tropsch plant for three-phase kinetic studies

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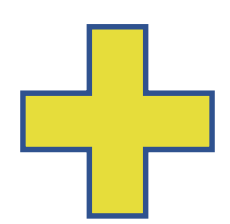
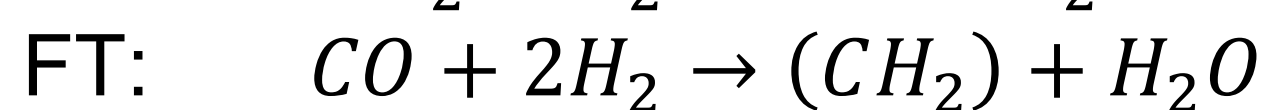
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Motivation

Direct CO₂-Fischer-Tropsch



Three-phase reactor

✓ Dynamic operation

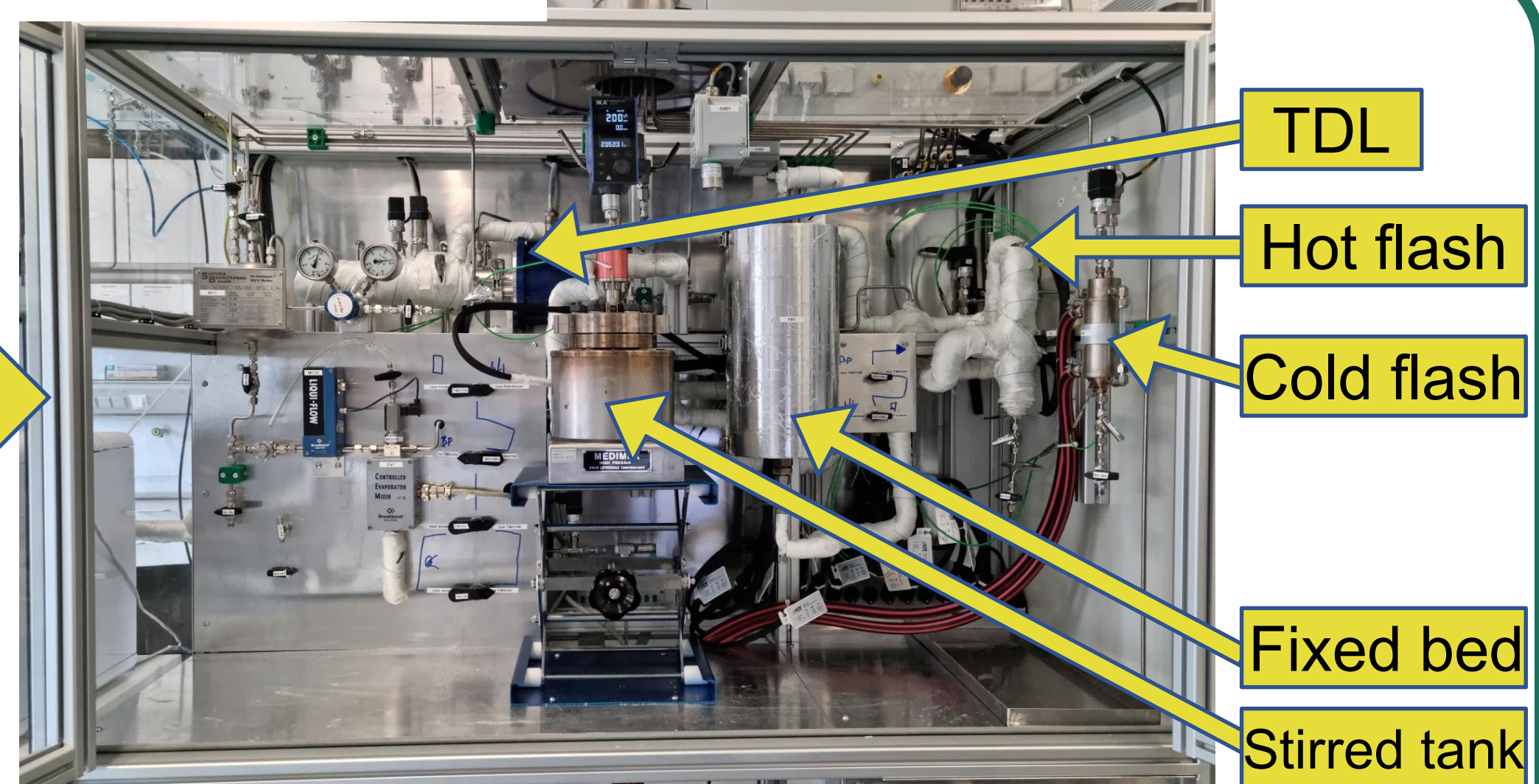
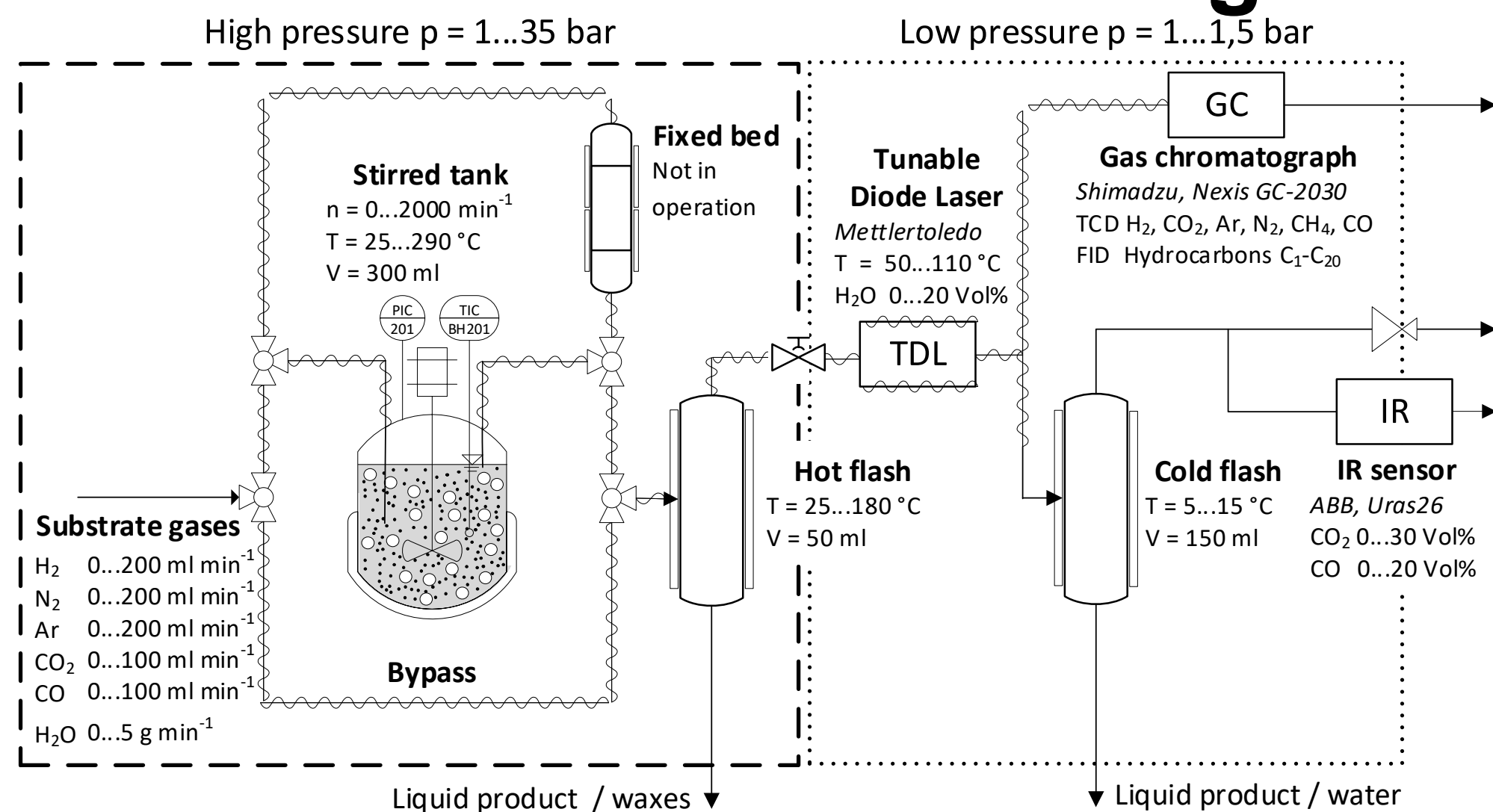
✓ Efficient heat removal

New Power-to-Liquid approach

Challenges

- Focus on small-scale fixed bed^[1,2]
 - Scale-up?
 - Applicability in three-phase system?
- Inhibition & catalyst oxidation by H₂O^[3]
 - Quantification of partial pressure?

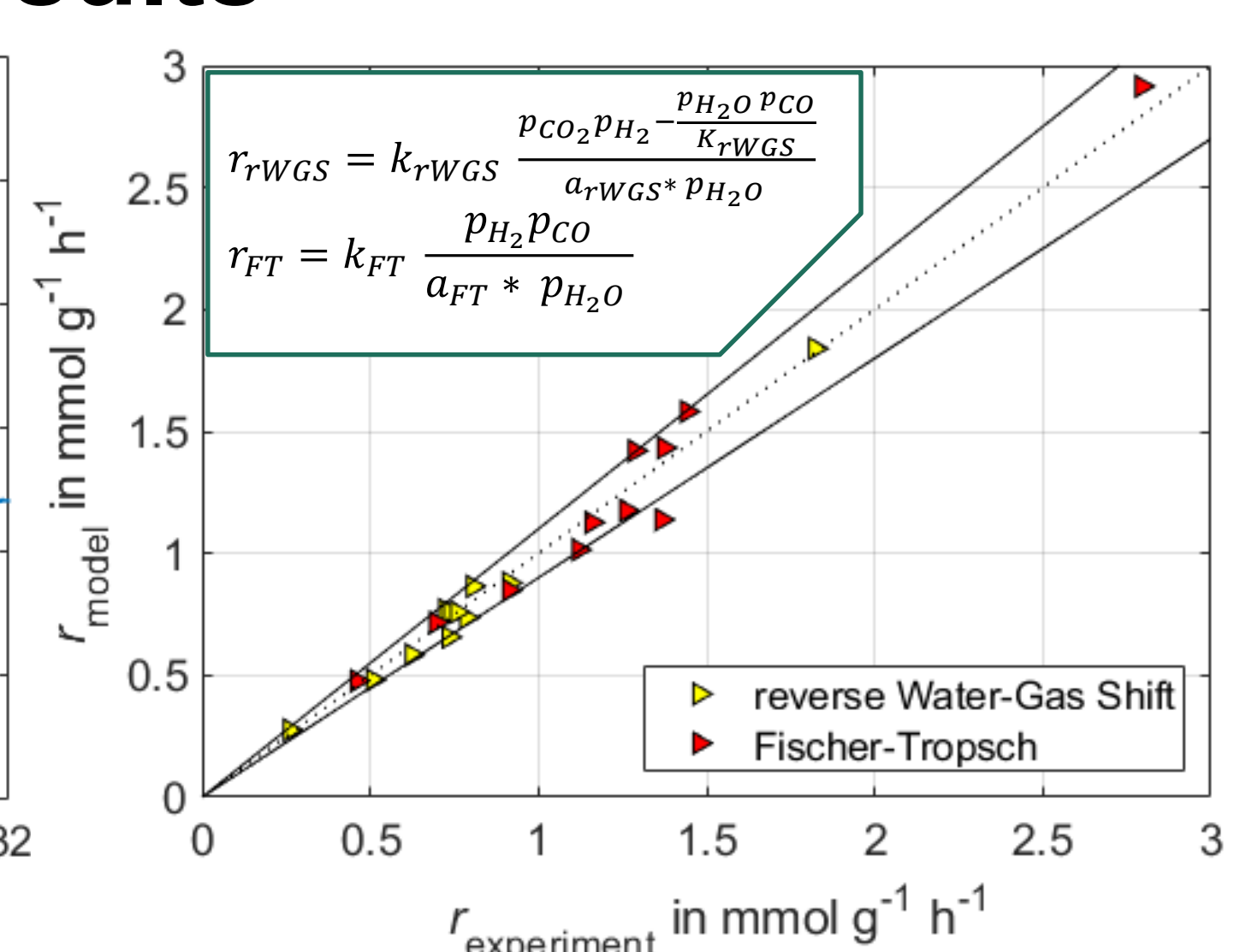
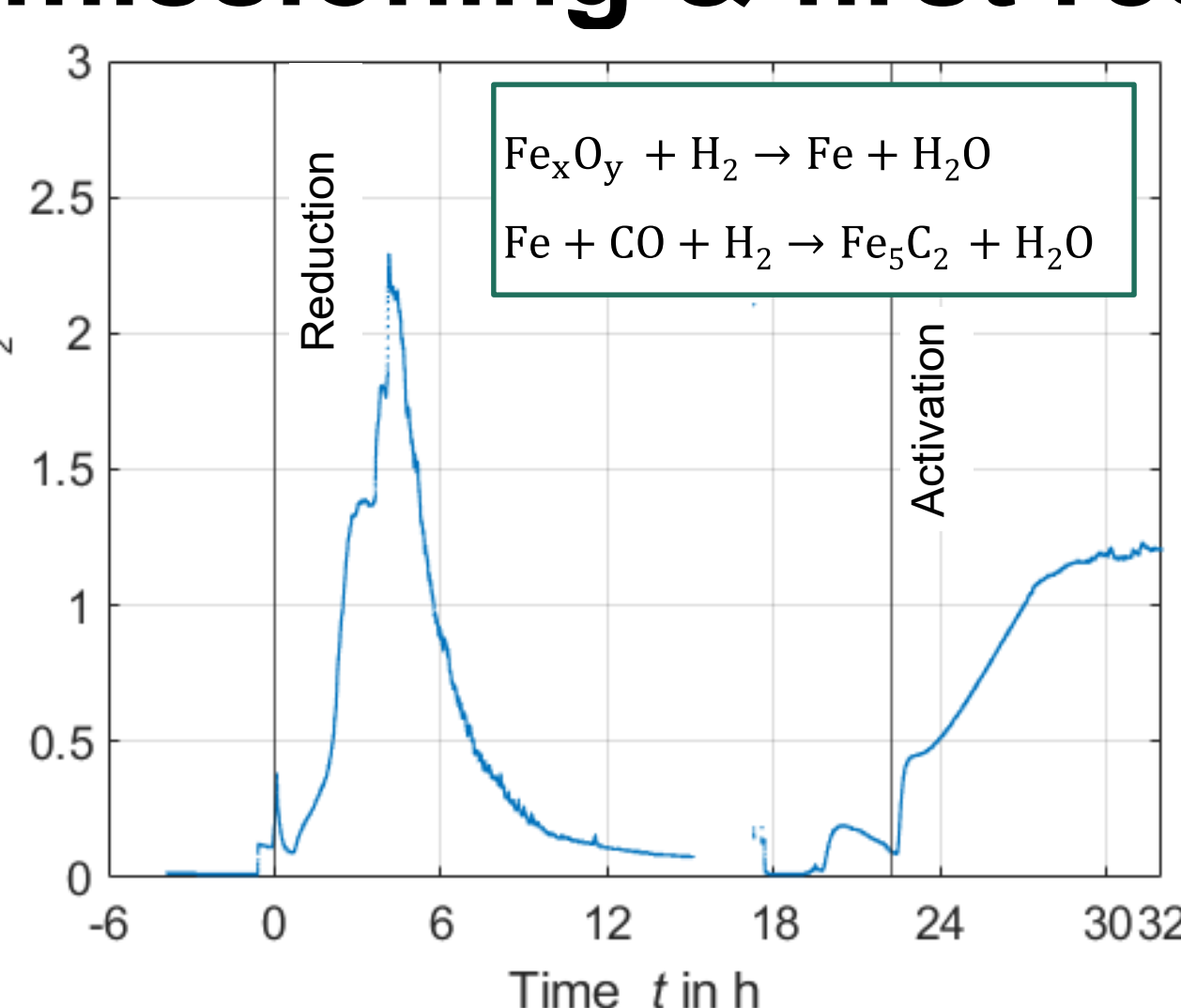
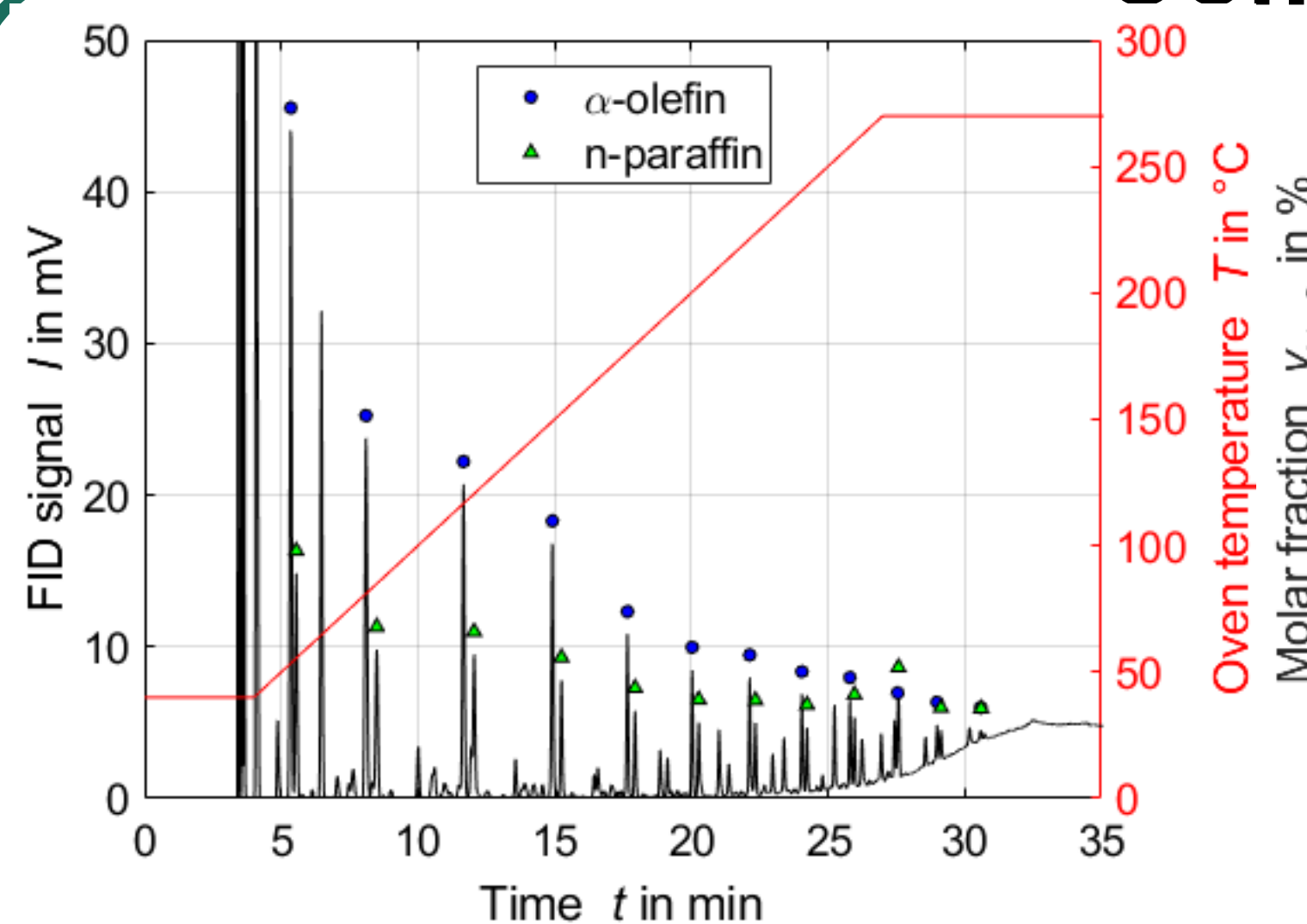
Design and construction



- ✓ in-line H₂O measurement of hot gas stream
- ✓ Online GC sampling of hot gas stream

- ✓ Steady state in < 6 h
- ✓ Up to 20 g of catalyst
- ✓ Full automation via PLC
- ✓ Remote control

Commissioning & first results



✓ Complete product analysis up to C₂₀

✓ Reduction trackable with TDL

✓ Simple model with < 10 % error

Outlook

Experimental

- Extend parameter study
- Examine H₂O effect on deactivation
- Examine in-situ reduction with CO₂

Modelling

- Model product distribution
- Model bubble column reactor

References
 [1] Piriyaasurawong K, et al., Catalysis Today (2020), doi: 10.1016/j.cattod.2020.03.007
 [2] Brübach L, Hodonj D, Pfeifer P. Industrial & Engineering Chemistry Research (2022) doi: 10.1021/acs.iecr.1c04018
 [3] Iglesias M, Schaub G, Int. J. Chem. React. Eng. (2016), doi: 10.1515/ijcre-2014-0135