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Promotion of CO_2 capture into improved imidazole-based solvents

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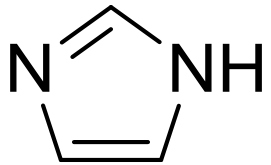
Imidazoles

- Why imidazoles?
  - React as tertiary amines
  - Potentially high loading capacity
  - High thermal stability
  - Low vapor pressure

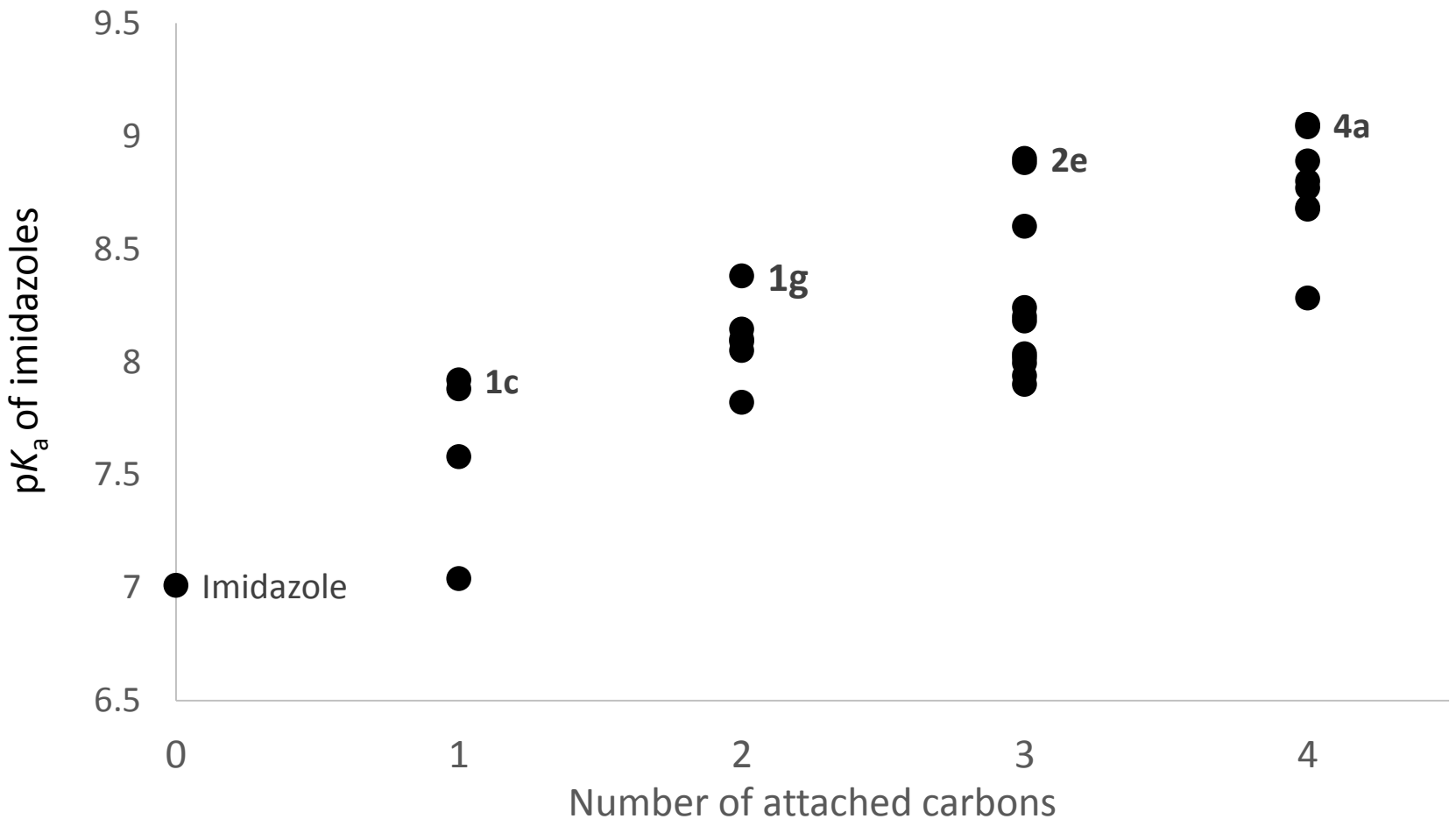


- Challenges
  - pK_a of most imidazoles slightly low → inefficient absorption in mixed amine systems

- Target
  - Imidazoles with enhanced capture properties

Evjen, S.; Fiksdahl, A., Synth. Commun. **2017**, *47*, 1392

pK_a

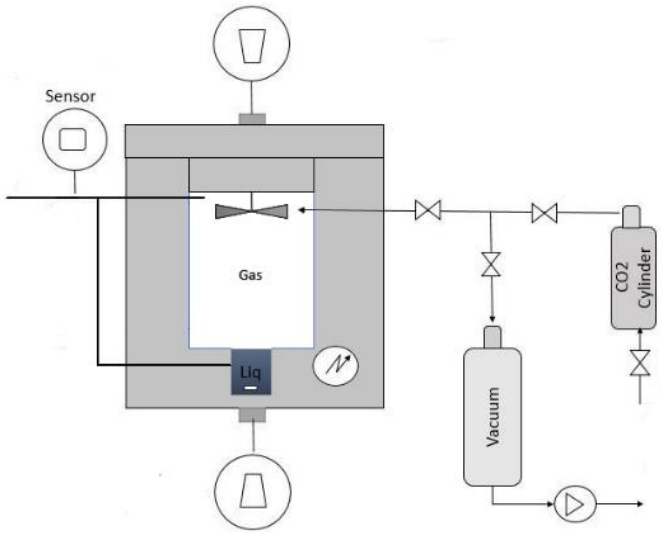

9.5
9
8.5
8
7.5
7
6.5
pKa of imidazoles
0
1
2
3
4
Number of attached carbons
Imidazole
1c
1g
2e
4a

Experimental procedure

- Screening performed at 40 °C by CO_2 injection (2x50 kPa) into vessel containing 1-2 mL aqueous amine solution (30 wt%), with absorption time 2x3 h

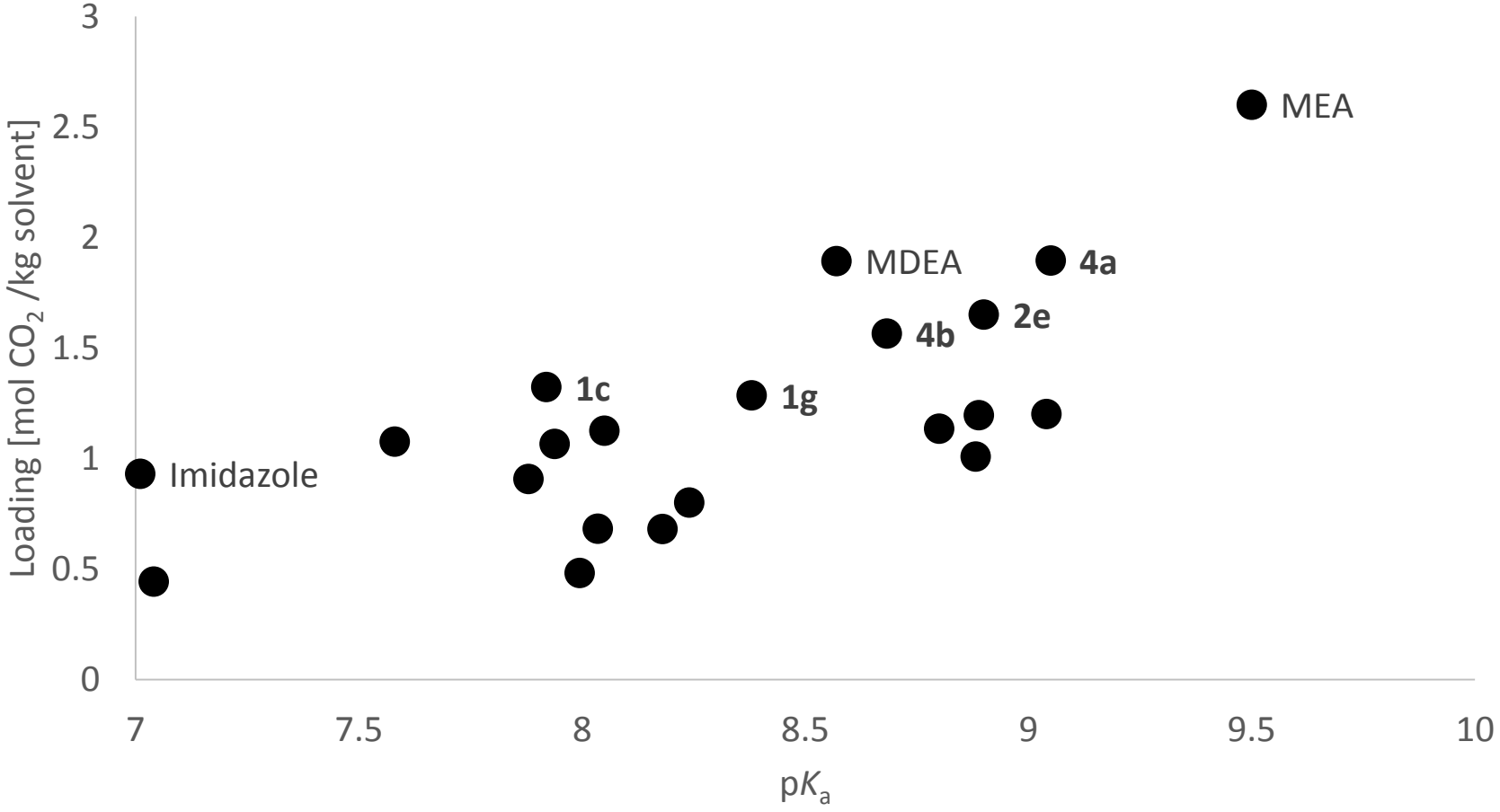
- Absorption monitored by pressure and online FTIR measurements

- Results comparable with other apparatuses



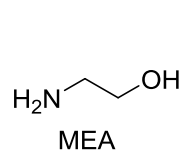
Small scale screening apparatus

Capacity (70-80 kPa CO_2)

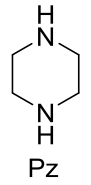


Mixed amine systems

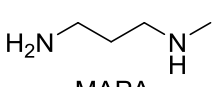
- Absorption rate of imidazoles similar to MDEA
  - Promoters required for efficient CO_2 absorption
- Imidazoles **1c**, **1g, 2e** and **4a** were chosed for further studies in mixed amine systems
- MEA, piperazine, MAPA and DEA were chosen as promoters



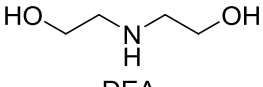
MEA



Pz



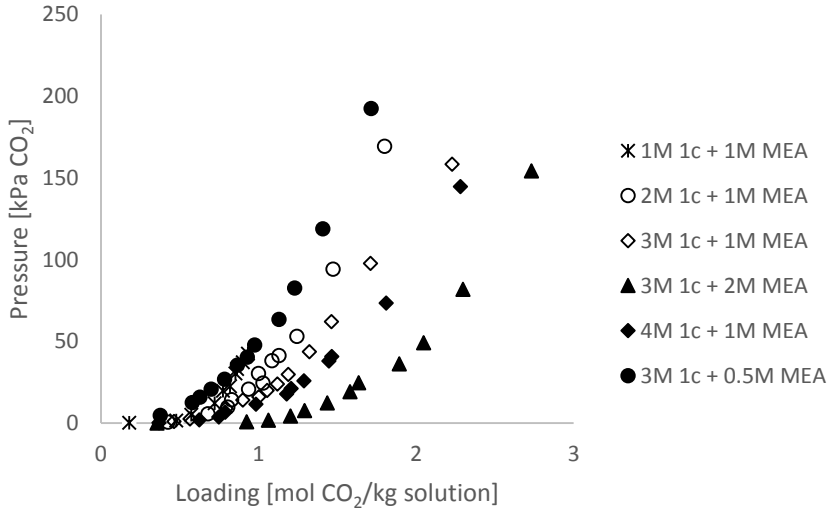
MAPA

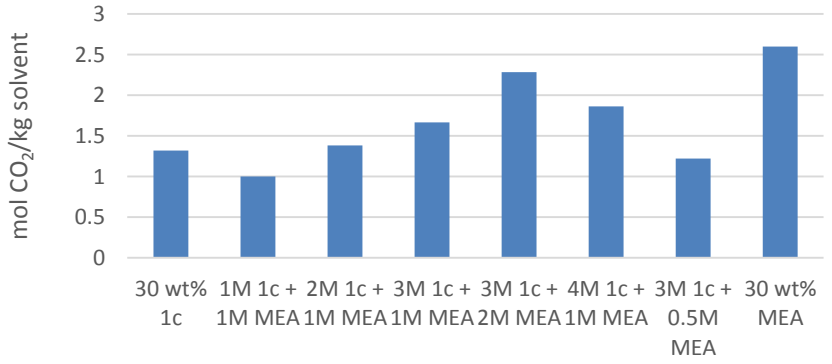


DEA

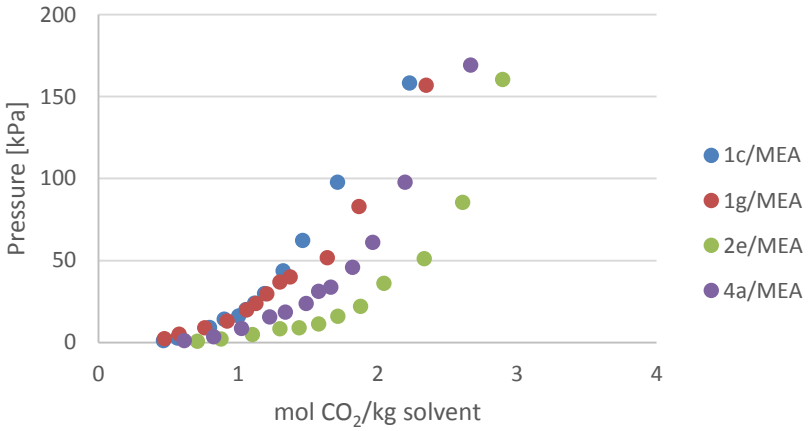
Choosing mixed amine system

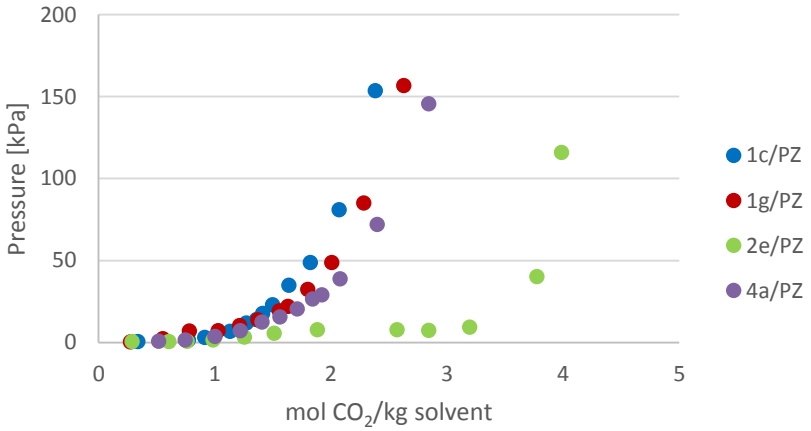
- **1c** and MEA were run in different ratios
- 3M imidazole + 1M promoter was chosed as system
- For mixed experiments: 10-12 injections of CO_2 with 1 h interval
- Experiments at 80 °C were performed with 10 mL solution

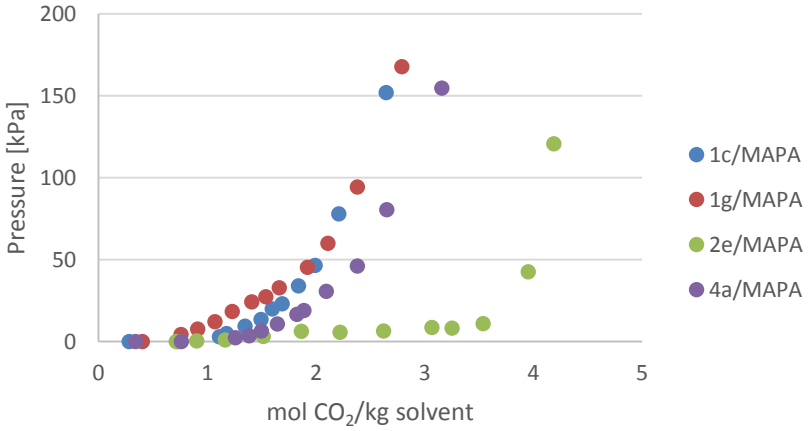


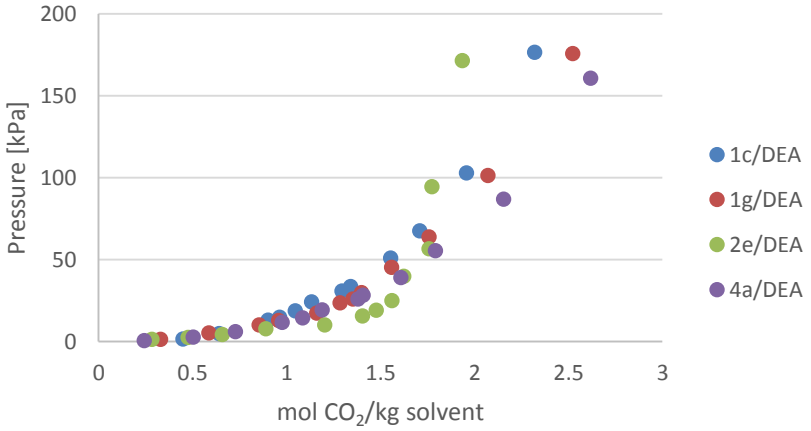


Effect of imidazole 40 °C

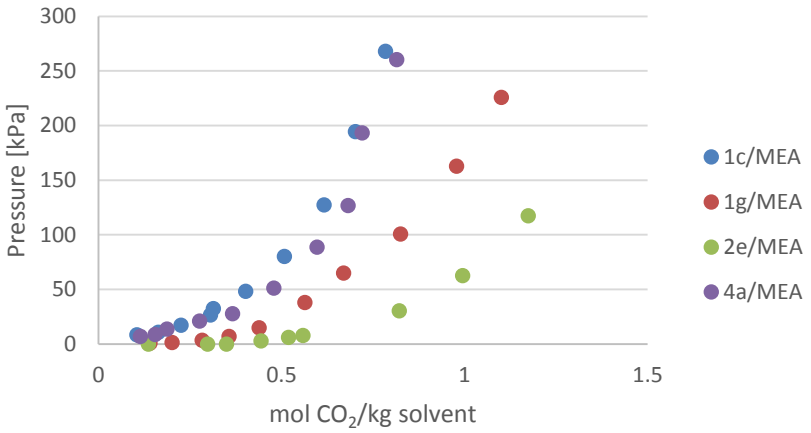


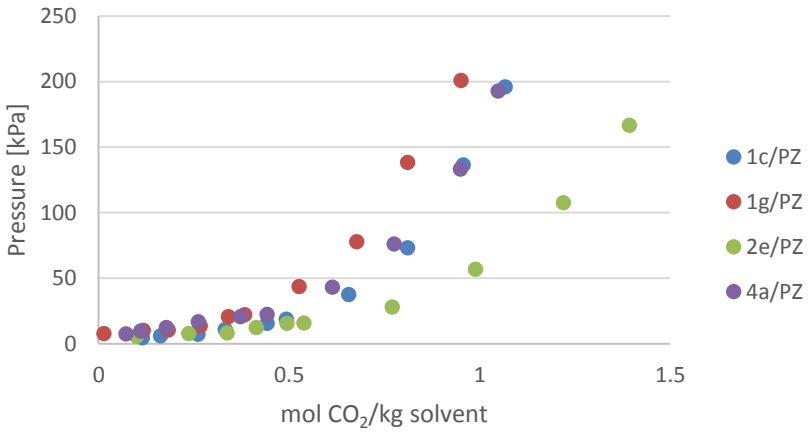


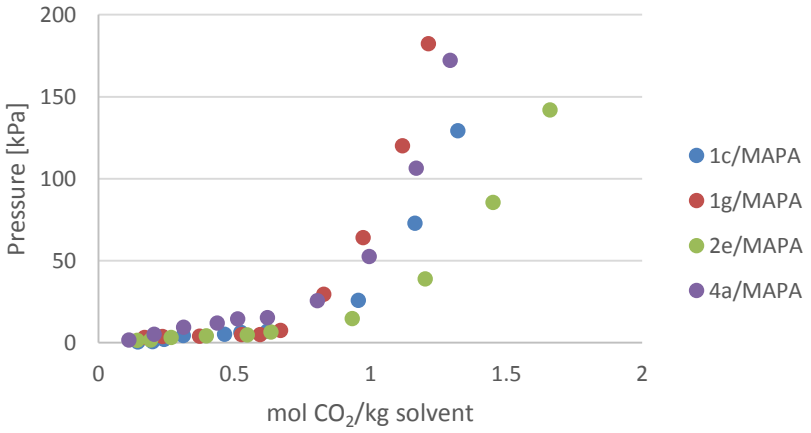


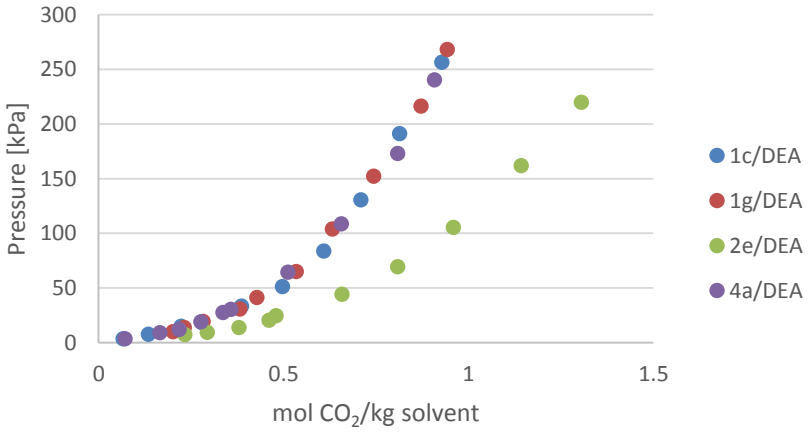


Effect of imidazole 80 °C

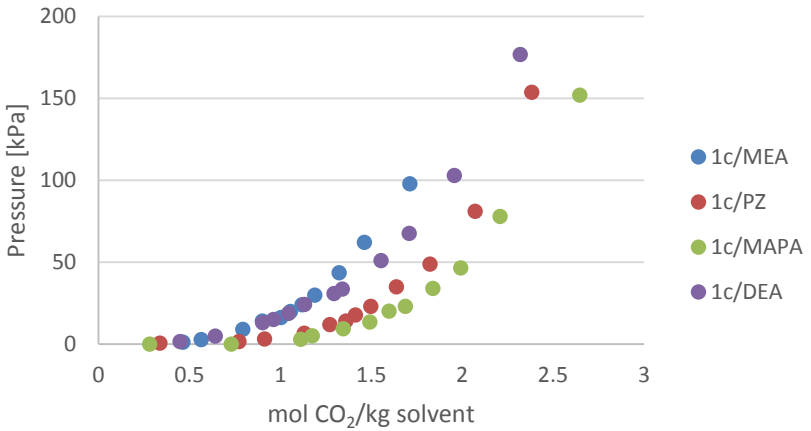


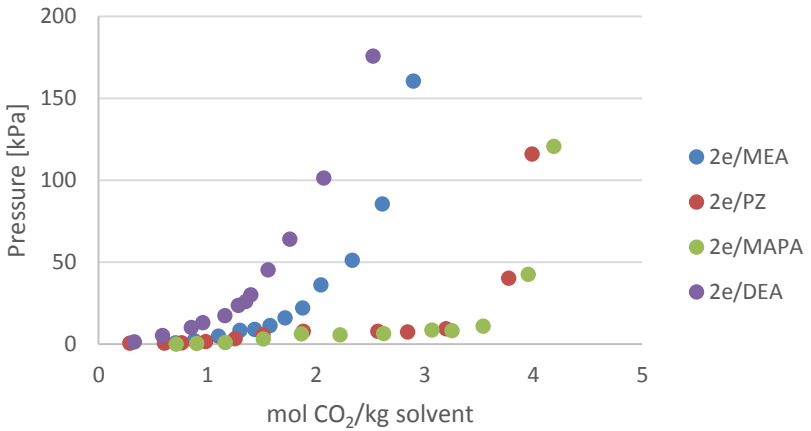


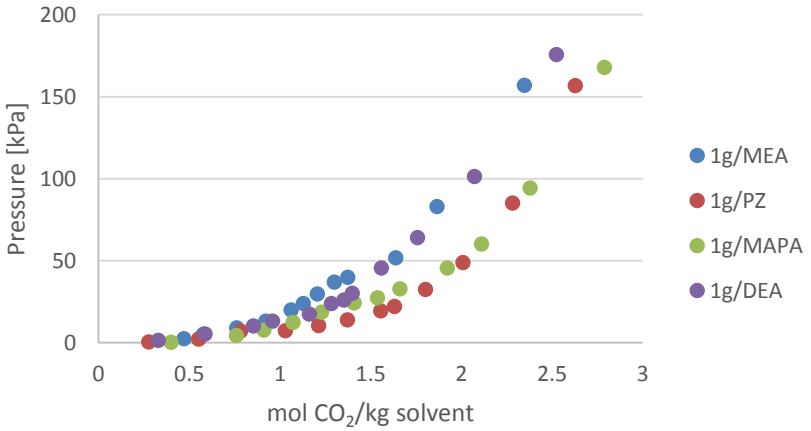


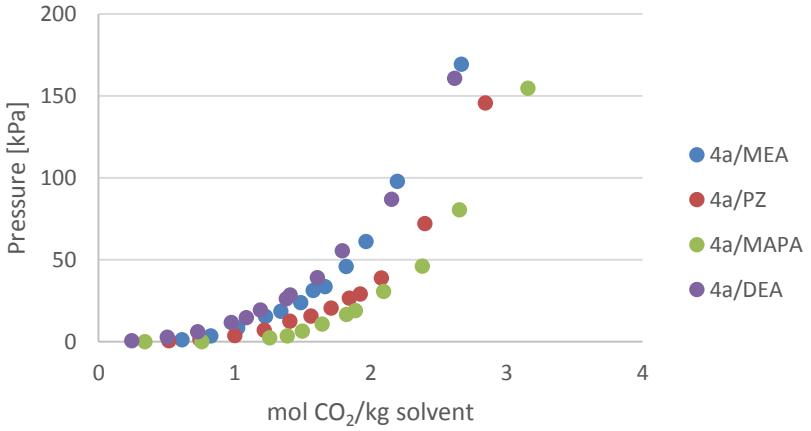


Effect of promoter 40 °C

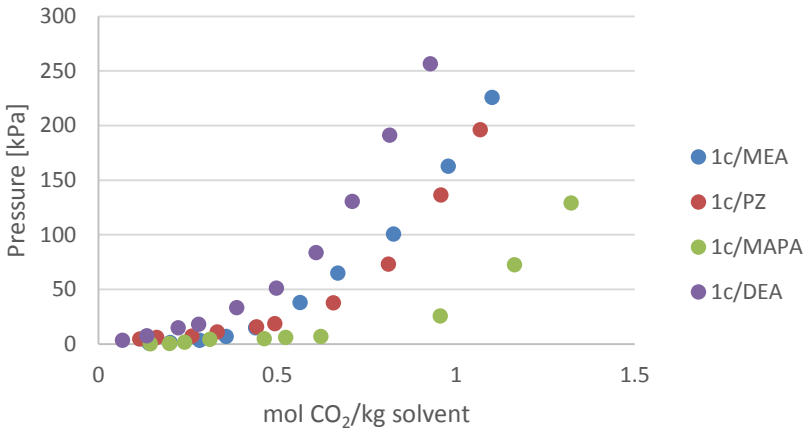


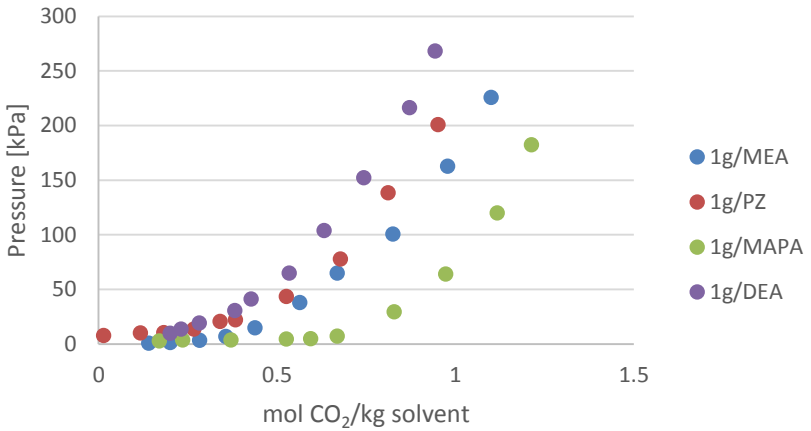


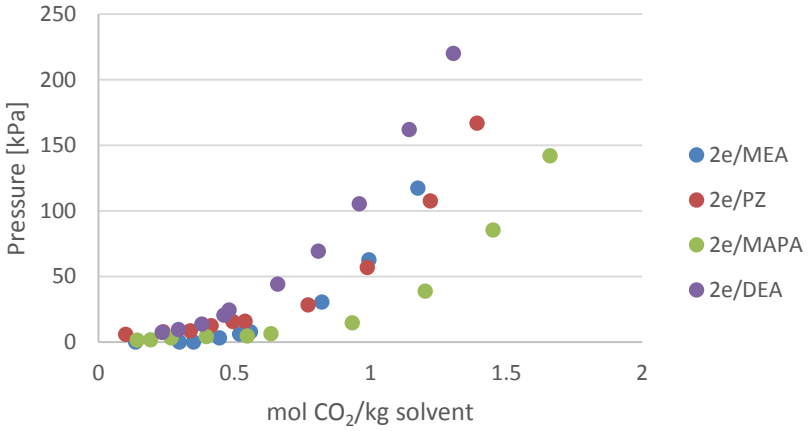


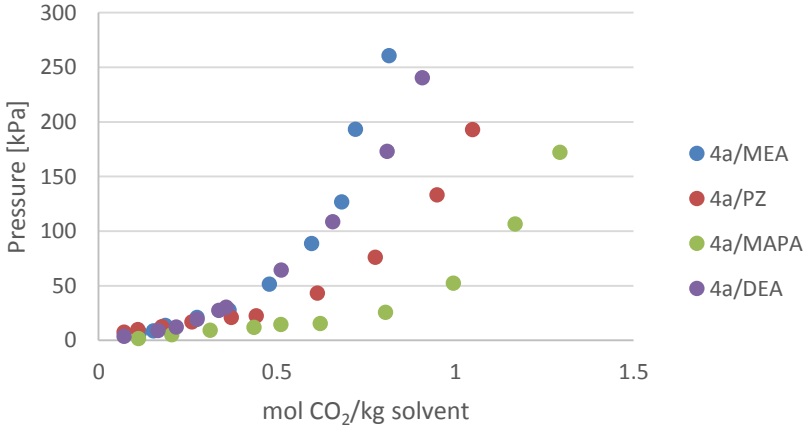


Effect of promoter 80 °C

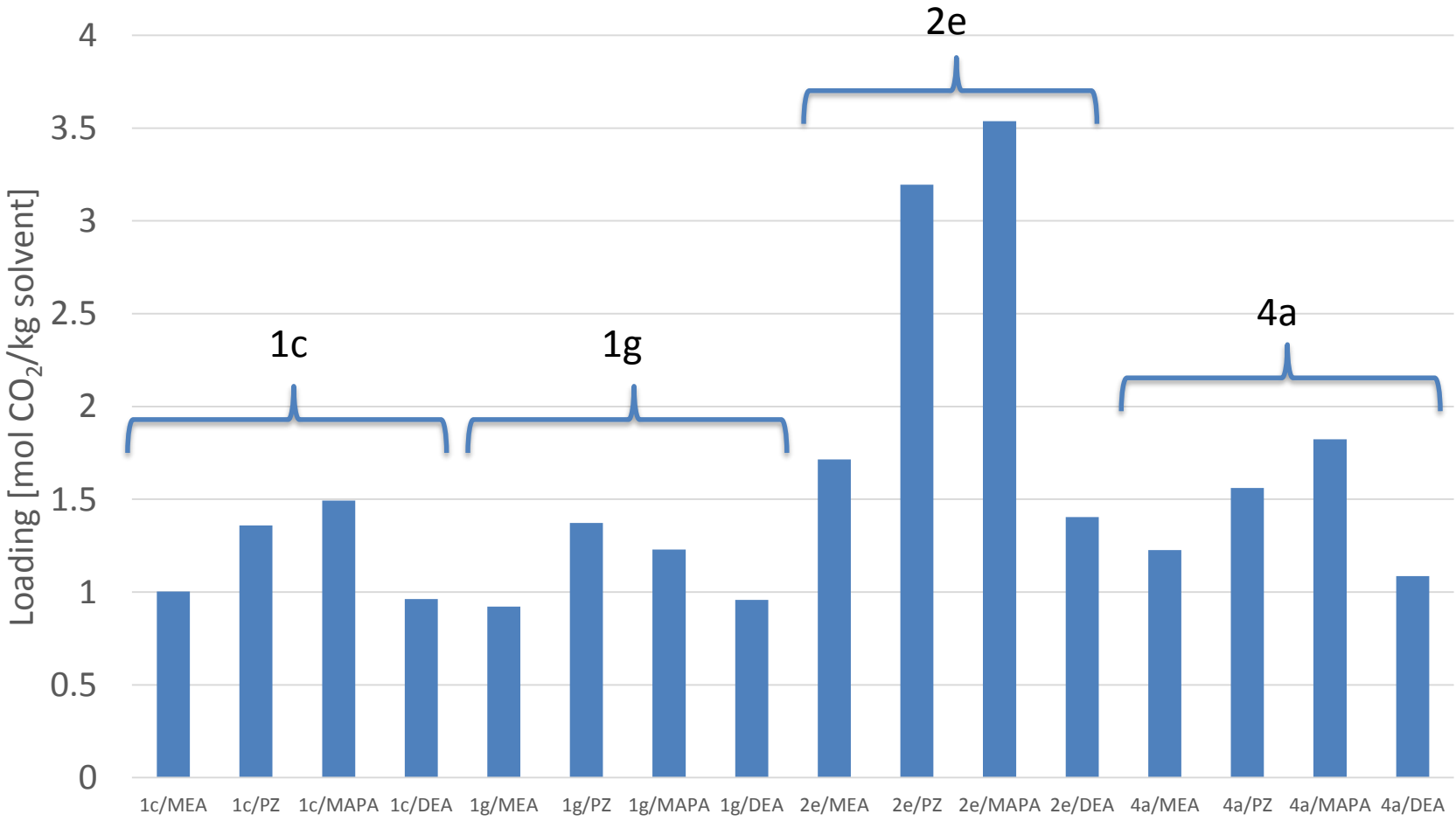




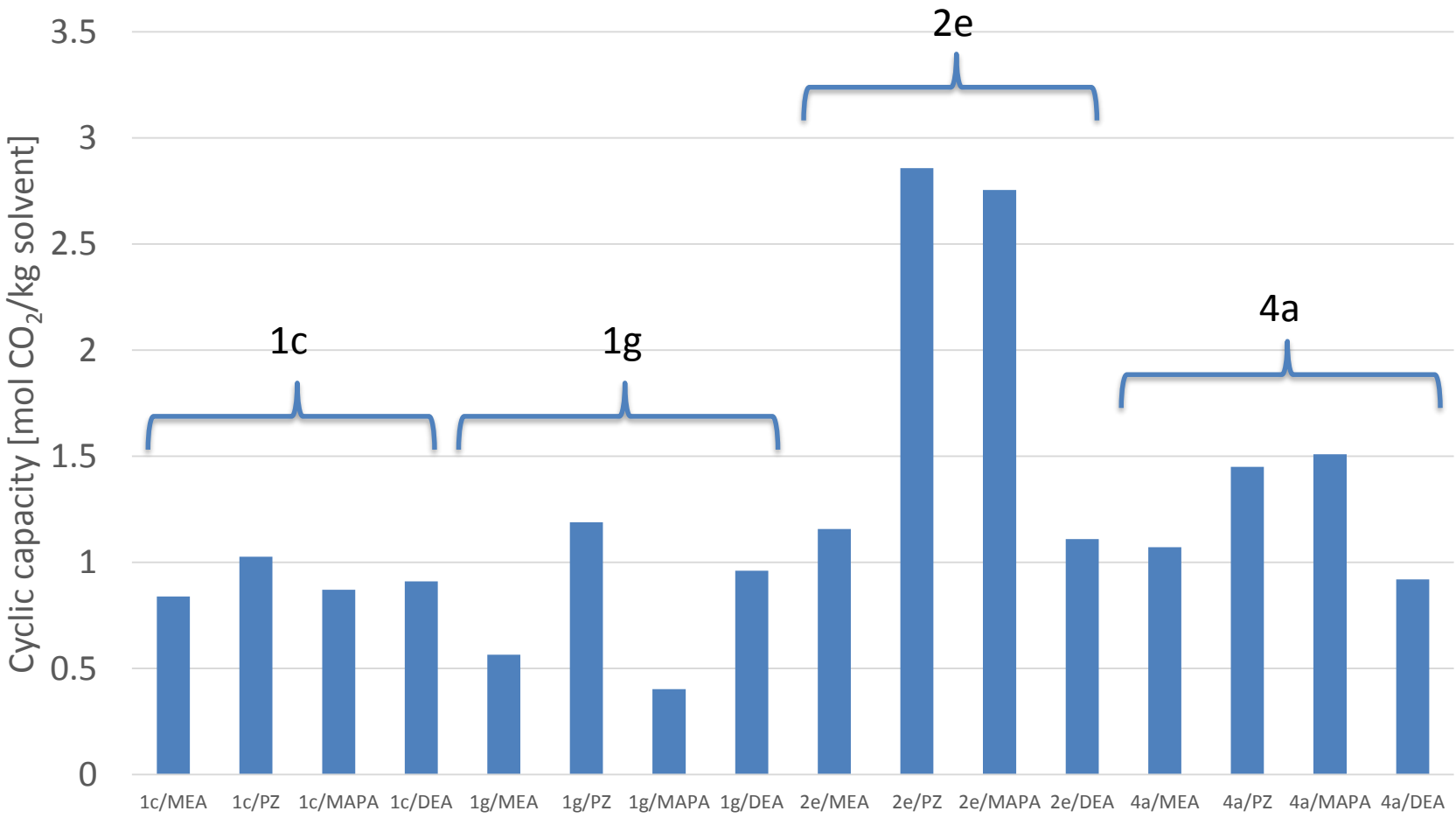




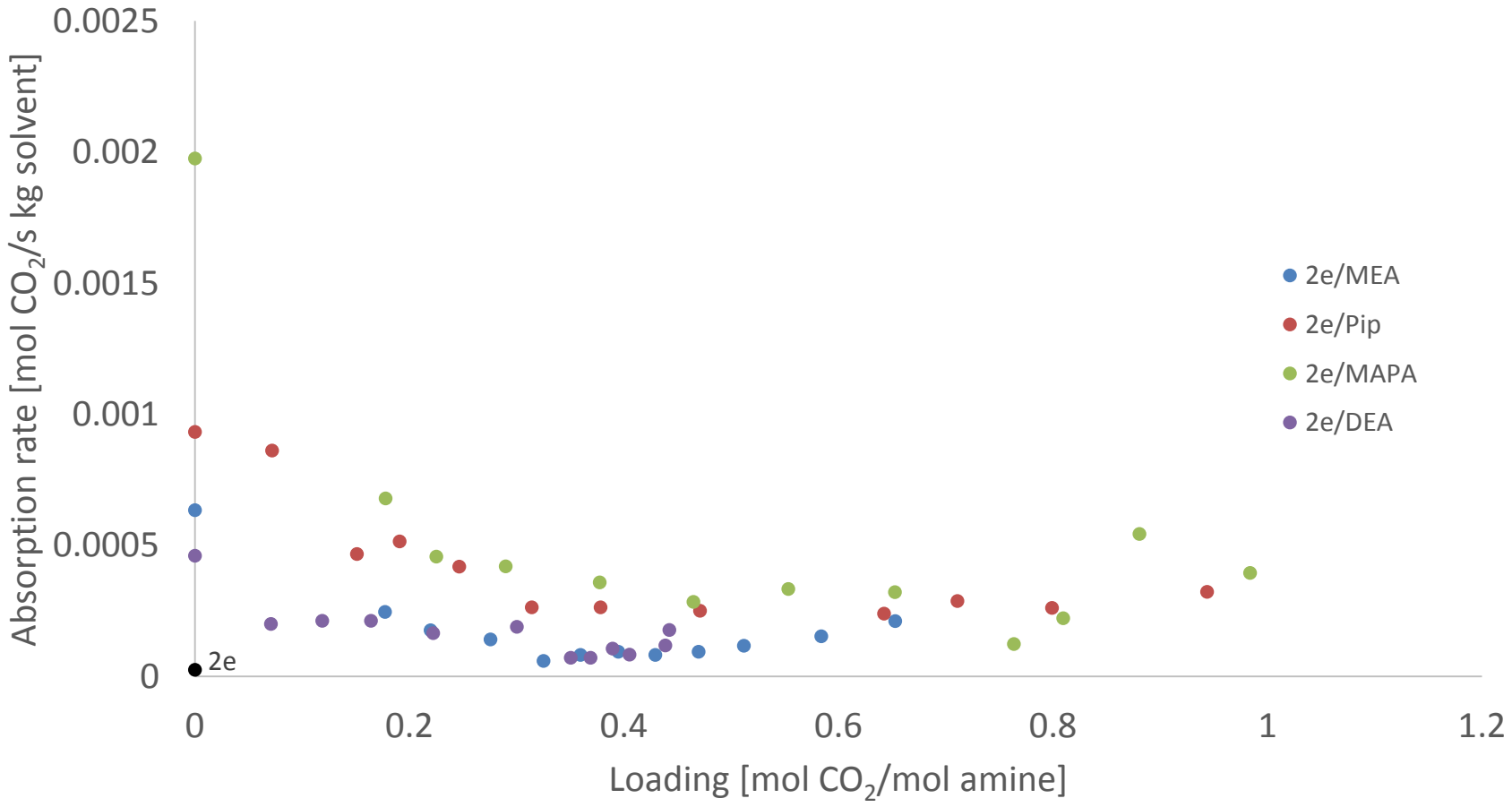
Absorption capacities (10 kPa)



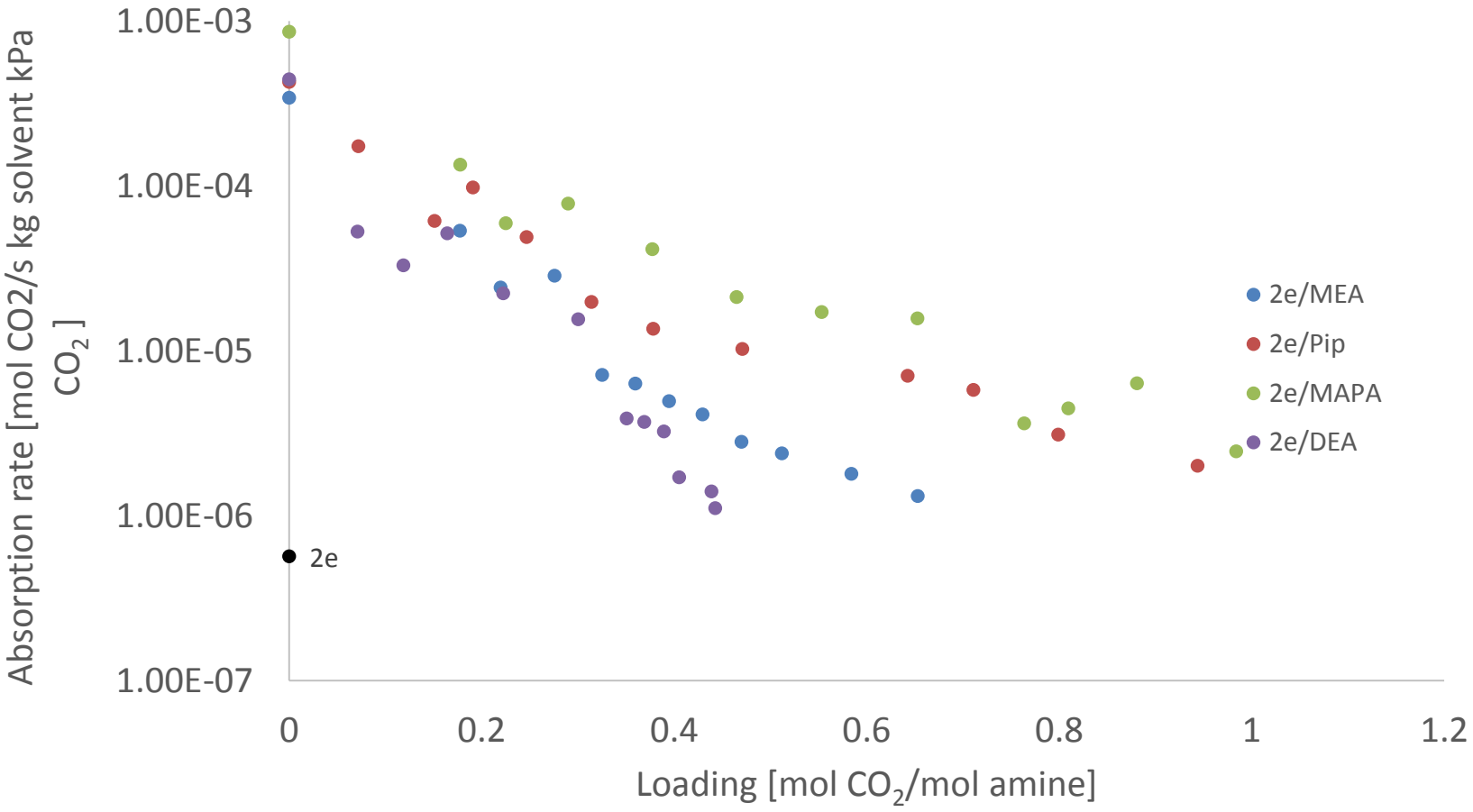
Cyclic capacities (40 °C → 80 °C, 10 kPa)



Absorption rate of 2e



Absorption rate of 2e/p(CO_2)



Conclusion

- A series of imidazole/promotor blends have been studied
- High absorption capacities and cyclic capacities are obtainable for some mixtures of **2e**, also under post combustion conditions
- Most imidazoles are more feasible at higher partial pressures of CO_2
- Promotors greatly enhance absorption rate

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