# Breaking the 90 % Barrier: CESAR1 performance in achieving Net-Zero Goals

**Diego Morlando, Hanna K. Knuutila**

Department of Chemical Engineering, NTNU, Trondheim, Norway

*Corresponding author's e-mail address: hanna.knuutila@ntnu.no*

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## ABSTRACT

$CO_2$ capture plays a fundamental role in achieving the climate change goals set by the Paris Agreement 2015. Capturing 90% of the $CO_2$ being emitted from industrial sources is not enough, (Brandl et al., 2021). There is a need to design, optimize and qualify technologies that achieve higher capture rates. The use of chemical solvents, particularly amine-based ones, represents the most advanced technology for Post-Combustion Carbon Capture, (Dutcher et al., 2015).
The CESAR1 solvent, an aqueous blend of 2-amino-2-methyl-1-propanol (AMP) and piperazine (PZ), stands out as an open-source solvent among the others for its low energy consumption and slow degradation rate, (Morlando et al., 2024).

In the pilot tests using the CESAR1 solvent, the most common capture rate aimed for is around 90% and few studies aimed to investigate the energy penalty for a higher $CO_2$ capture rate (98%), (Morlando et al., 2024). Simulation tools can be employed to investigate the effects of different parameters on the amount of $CO_2$ captured and the associated energy costs.

In this work, we developed a rate-based process model for $CO_2$ capture using the CESAR1 solvent in Aspen Plus v14. The thermodynamic package and the process model have been validated using experimental data. For example, the $CO_2$ solubility model predictions have been compared to the data collected by Hartono et al. (2021) and Brúder et al. (2011) as shown in Figure 1. The model accurately predicts the $CO_2$ solubility over the temperature range from 40 to 120 °C.

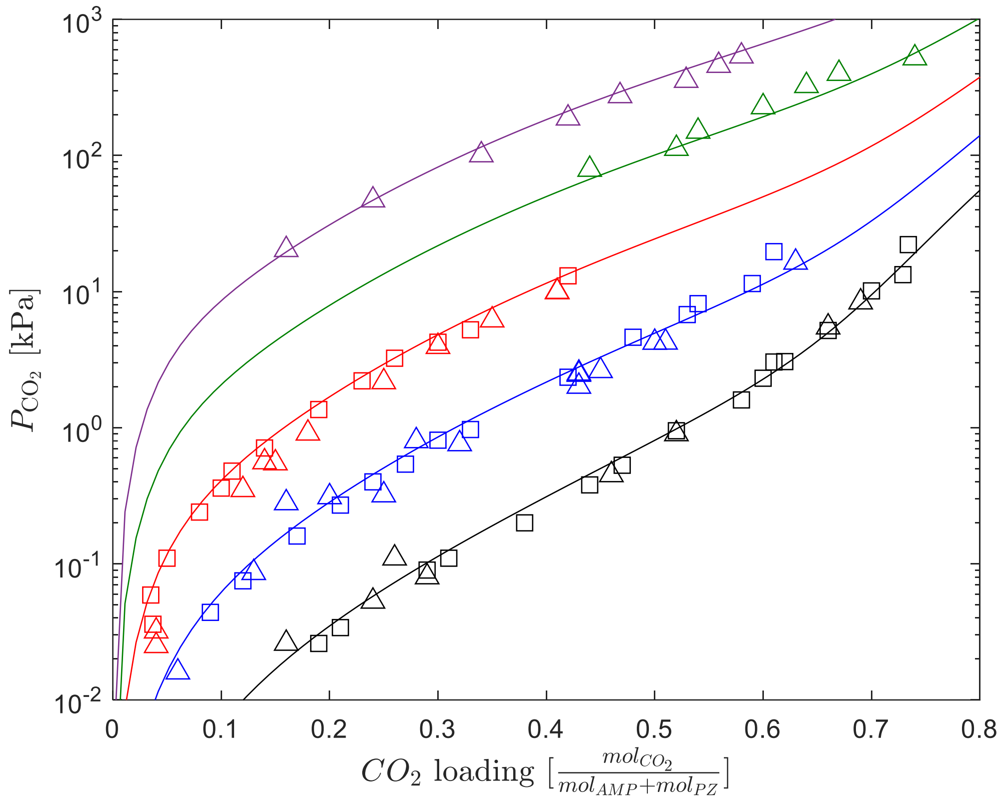


*Figure 1: Model prediction of the $CO_2$ solubility over the CESAR1 solution, (3 M AMP + 1.5 M PZ). (□ Hartono et al. (2021), Δ Brúder et al. (2011)). (Black 40°C, Blue 60 °C, Red 80 °C, Green °100 C, Purple 120°C)*

The model will be used to simulate the $CO_2$ absorption process in a range of $CO_2$ capture from 90 % to higher than >99% and for different $CO_2$ concentrations in the flue gas, from 3 vol% to 18 vol%. This study will provide a broad understanding of the CESAR1 solvent performance at high capture rates for different industrial scenarios.

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