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Development needs and knowledge gaps of CESAR1 solvent

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Abstract

The reduction of carbon dioxide (CO2) emissions is a major global challenge in the fight against climate change. Among the various technologies available for post-combustion CO_2 capture, amine-based absorption is currently considered the most advanced and cost-effective[1]. However, the absorption process incurs a significant energy penalty, prompting research efforts to develop new energy-efficient solvents for widespread implementation of CO_2 capture. One such alternative to the commonly used ethanolamine (MEA) is an aqueous blend of 2-amino-2-methyl-1-propanol (AMP) and piperazine (PZ). Research has shown that CESAR1(a blend of 3.0 M AMP and 1.5 M PZ) demonstrates lower energy consumption [2], lower degradation rates [3], [4] and higher loading capacity than MEA [5]. CESAR1 solvent's non-proprietary nature, independence from a specific technology provider, and superior performance compared to MEA make it a compelling choice as an alternative for MEA.

As the technology has not yet undergone full optimization and technology qualification for commercial deployment, it is crucial to assess both the experimental and modelling gaps. A systematic literature review was conducted to identify gaps in the experimental studies within the AURORA project (https://aurora-heu.eu/). The work focused on:

- Physical and transport properties: density, viscosity, surface tension and diffusivity
- Equilibrium properties: vapor-liquid equilibrium, solid-liquid equilibrium and freezing point depression, speciation, and equilibrium reaction constant data
- Kinetics properties
- Solvent degradation data including degradation compounds
- Pilot data, including solvent emissions and aerosol formation
- Available property and simulation models

Selected findings are shown in Figure 1 qualitatively. The figure shows, for example, that even though many properties are available, data on absorption kinetics of CO2 loaded solution is not available and only limited data is available for viscosity of the loaded system even though both of these directly impact the absorption performance.

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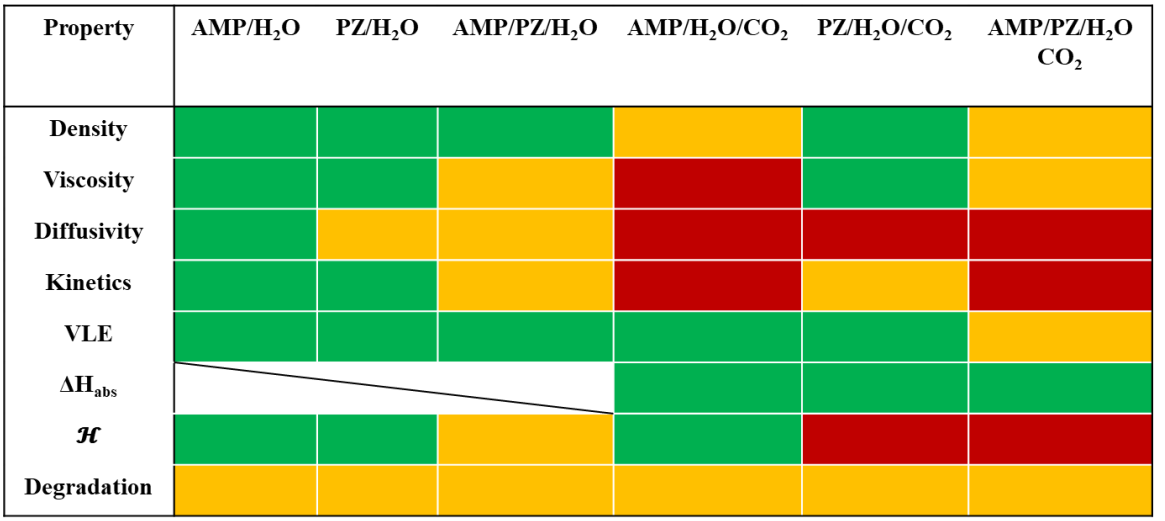

*Figure 1: Qualitative preliminary results of the literature review on selected properties. Legend**: -Data unavailable, -Gaps identified, -Data available.***

In the presentation, we will shortly summarize:

- The identified gaps in experimental data and the available models
- The available pilot data and amine emission data
- Summarize the knowledge on degradation of CESAR1.

The main emphasis will be on the opportunities and challenges related to the CESAR1 solvent and since the aim of the AURORA project is to qualify the CESAR1 solvent for commercial deployment, the presentation will further include the plan for closing the remaining gaps.

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Keywords: post-combustions capture; amine-based absorption; solvent characterization; CESAR1 solvent; literature review.

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