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Comparison of TERC and TNO's LR2 CO<sub>2</sub> capture rigs for normal and accelerated degradation

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## Abstract

Solvent degradation is one of the main obstacles hindering the implementation of CO<sub>2</sub> capture in various industries. This research work aims at establishing a fast-track, cost-effective de-risking mechanism to predict and control degradation of capture solvents, thus accelerating industrial uptake of CO<sub>2</sub> capture. This is done within the LAUNCH project (ACT 2 program no. 299662), where the goal is to accelerate the development and qualification of novel solvents by developing strategies to control degradation, minimizing solvent loss and, therefore, the environmental impacts of CO<sub>2</sub> capture.

The small-scale LAUNCH rig (LR2) located at TNO, Netherlands, and the pilot-scale 1TPD CO<sub>2</sub> capture plant located at Translational Energy Research Centre (TERC), United Kingdom, are used to develop strategies to accelerate degradation in a manner that leads to representative results for industrially relevant conditions. LR2 has a capture capacity of 25 kgCO<sub>2</sub>/day, while the significantly larger TERC plant has a capture capacity of 1000 kgCO<sub>2</sub>/day. The investigation of solvent degradation has been carried out under normal operational conditions and accelerated degradation conditions. This paper presents the results of five test campaigns. For normal operation (Campaign 1) both of the rigs have been operated with cMEA solvent (35 wt%) for approximately 500 hours each using similar operational conditions, so for example absorber L/G ratio and solvent residence times are kept as close as possible. A synthetic flue gas representative of gas turbine flue gas (5% CO<sub>2</sub> in air) has been used for direct comparison between the two rigs. For accelerated degradation, four single accelerated degradation strategies have been studied, i.e. elevated stripper temperature, injection of NO<sub>x</sub>, higher solvent concentration (40 wt% MEA), and intentional rich solvent de-oxygenation by varying oxygen level in the flue gas. Degradation control measures are not included in this publication.

Online and offline analysis were used for solvent and gas monitoring during the tests to determine solvent concentration, CO<sub>2</sub> loadings, emissions to atmosphere and degradation products. Ammonia emissions were observed to be higher at TERC than LR2. However, degradation products were observed to be higher at LR2. HEPO was observed to be the most abundant degradation product at both the rigs. MEA-Urea and HeGly were also observed in significant amounts but not in a specific order. However, the rest of the degradation products did not show any clear trend with respect to the operational conditions or the experimental setups. Therefore, further investigation is required to better understand the phenomenon behind the unexplained trends in the formation of degradation products.

## References

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