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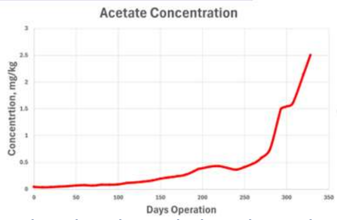
An Experimental Study of Solvent Management and Reclaiming in Amine-based CO_2 Capture.

Mike Ownsworth, Prof. Mathieu Lucquiaud, Prof. Jon Gibbins
mjownsworth1@Sheffield.ac.uk

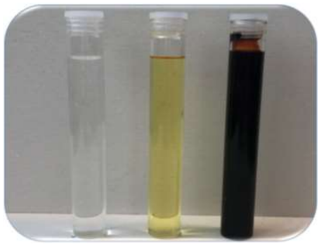
Relevance

Solvent degradation in CO_2 capture applications reduces the effectiveness of the solvent and leads to increased capital and operating costs. Environmental and safety effects only appear after long term operation of a plant.

The SMART test rig, being developed in the lab for later deployment to an industrial site, is intended for long term testing. >10,000 hours.

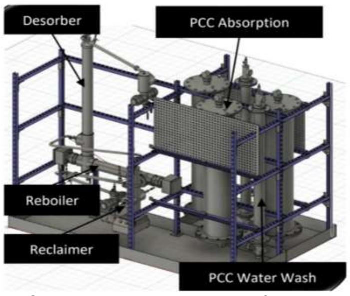


Accelerating degradation shown by acetate concentration (Moser et al., 2020)



Increasing Solvent degradation from left to right (Pokora et al., 2024)

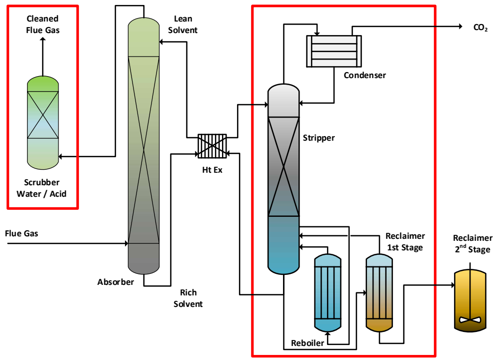
Test Rig Construction



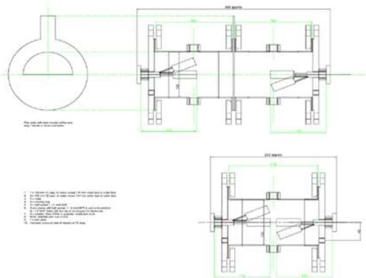
General Arrangement of Lab Test Rig (Joel et al,2024)

SMART test rig under construction in laboratory

SMART is a 6kg/hr CO_2 absorption / desorption plant with an integrated, thermal reclaimer. A wash column is included to investigate environmental emissions.

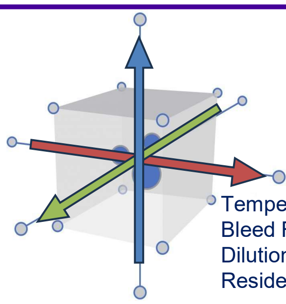


Outline flow sheet of industrial rig installation

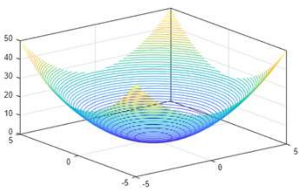


Level control vessels for the reclaimer

Experimental Plans



Temperature, pH, Bleed Rate, Dilution, Residence time

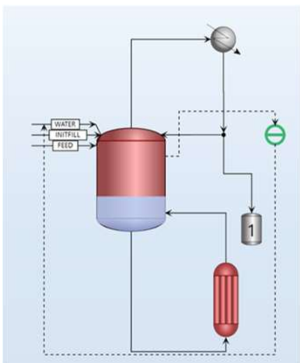


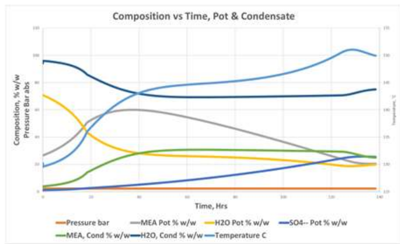
DoE, factors to be considered.

Design Of Experiments reduces screening trials from 512 to 33
$2^9 \rightarrow 2^{(9-5)}$ with central point partial factorial with fold over to eliminate 'aliasing'.

Intention to create a contour plot of the main factors and the desired effects

Aspen modelling of semi continuous reclaimer using BatchSep block to correlate operating conditions with reclaiming effectiveness. Intention to predict scaled up operation.





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References:

1) Joel, L., Pokora, M., Ibrahim, A., Lucquiaud, M., Michailos, S. and Gibbins, J., 2024. SMART-Solvent Management At Reduced Throughput–a prototype demonstration plant. Available at SSRN 5064129.
2) Pokora, M., Joel, L., Ibrahim, A., Lucquiaud, M., Michailos, S. and Gibbins, J. (2024) 'An experimental investigation of optimum conditions for continuous two-stage reclaiming of MEA solvent inventories from commercial plants', *Available at SSRN 5064077.*
3. Moser, P., Wiechers, G., Schmidt, S., Garcia Moretz-Sohn Monteiro, J., Charalambous, C., Garcia, S. and Sanchez Fernandez, E. (2020) 'Results of the 18-month test with MEA at the post-combustion capture pilot plant at Niederaussem – new impetus to solvent management, emissions and dynamic behaviour', *International Journal of Greenhouse Gas Control,* 95.

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