Large scale CO_2 shipment: development of efficient and reliable operations

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Introduction

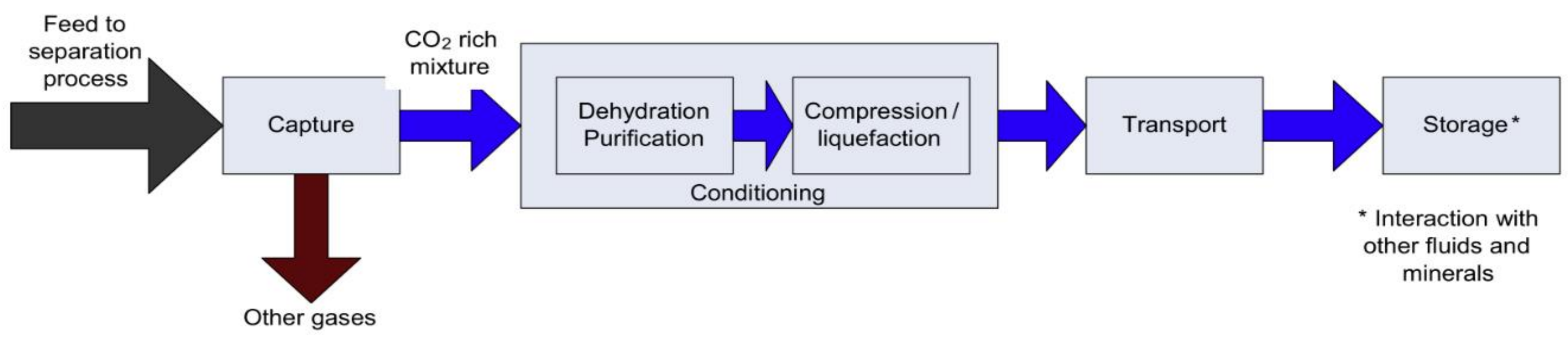


Figure 1: Carbon capture and storage schematic diagram (Pursell, 2012)

- Shipping is optimal for transporting relatively small volumes over long distances thus contributing to decarbonise smaller industries.
- Due to its flexibility it can extend the benefits of CCS to those countries where a pipeline-based transport network is unfeasible such as Korea and Japan.
- There are currently no commercial scale projects transporting CCS-related quantities of liquid CO_2
- Generation and management of boil-off gas in carriers, selection of appropriate elastomers materials as well as development of more efficient liquefaction processes are among of the knowledge gaps that need to be addressed

Project Overview

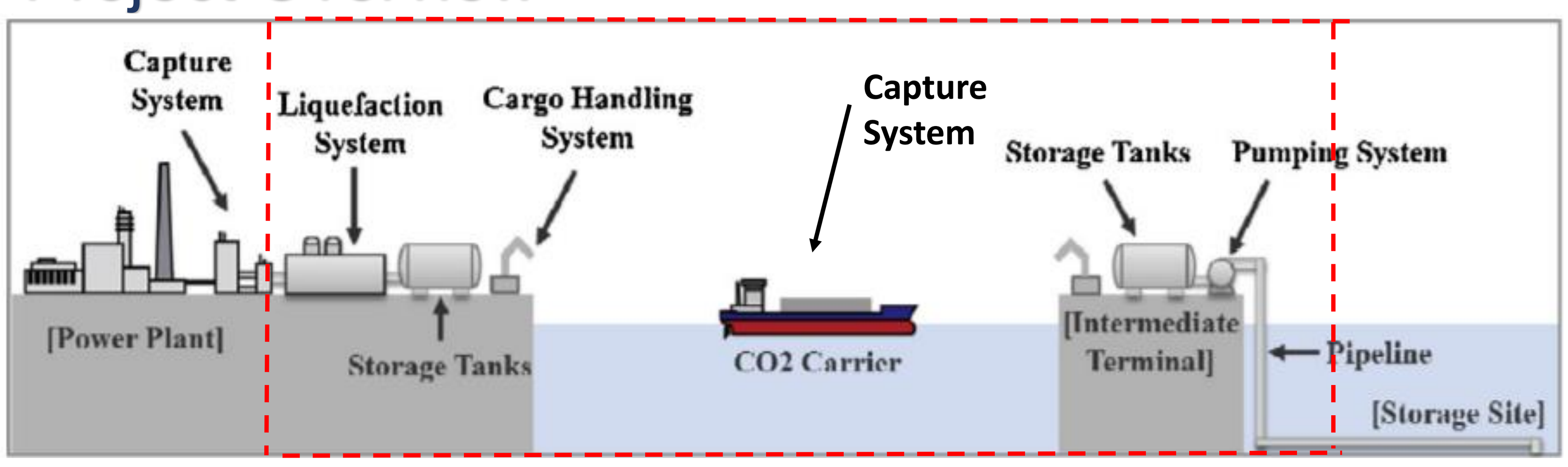


Figure 2: System boundary of the project

Methodology

Aim: To develop an efficient and reliable methods for large scale transportation of CO_2 shipping by addressing some key knowledge gaps

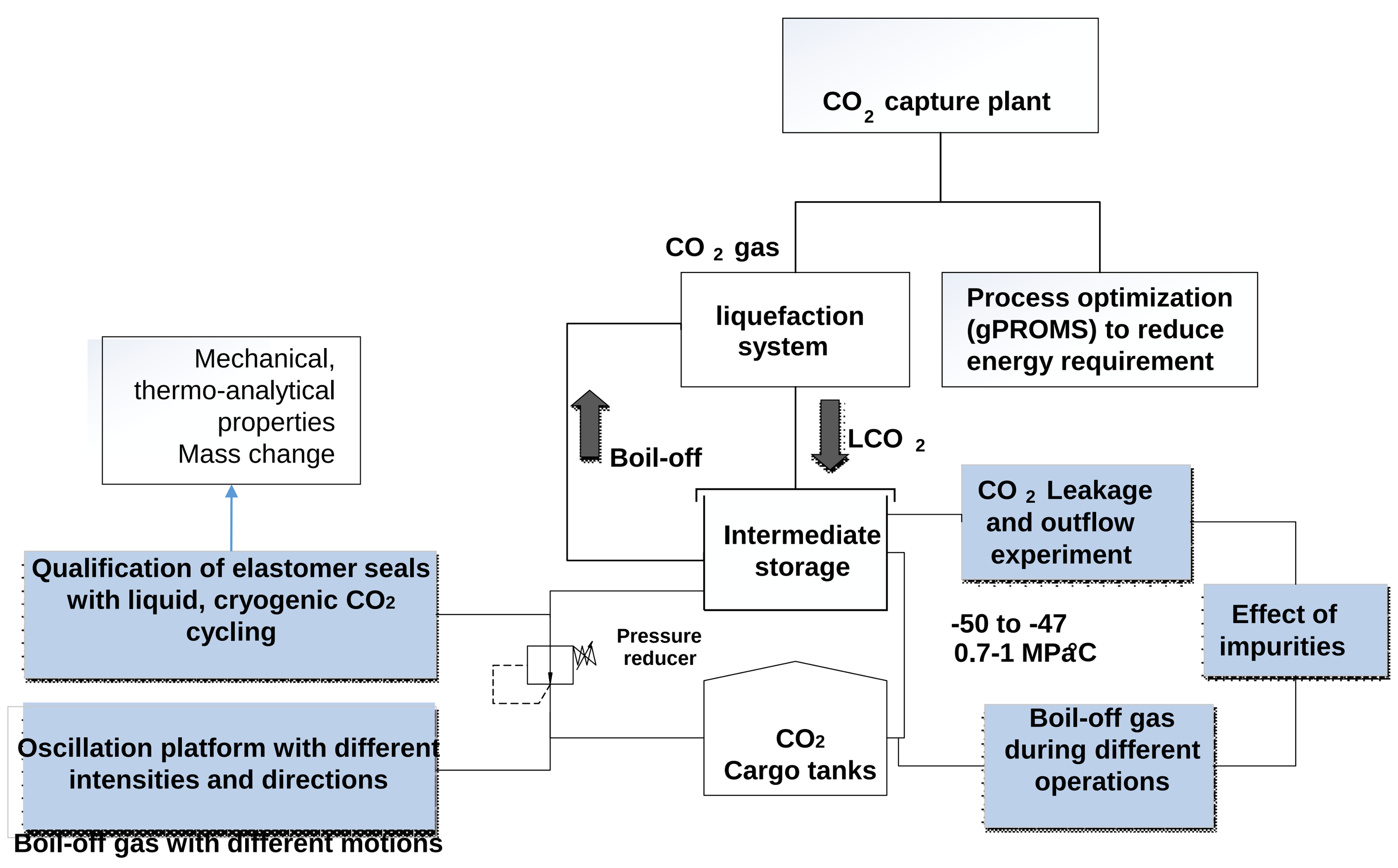


Figure 3: Proposed methodology for the project

Future work

- To perform experimental procedures according to methodology and optimizations and validations of models built using gPROMS.
- To achieve temperatures related to large scale CO_2 shipping using R5 Grant Instruments chiller w/circulator integrated with a Peltier system

Experimental facility

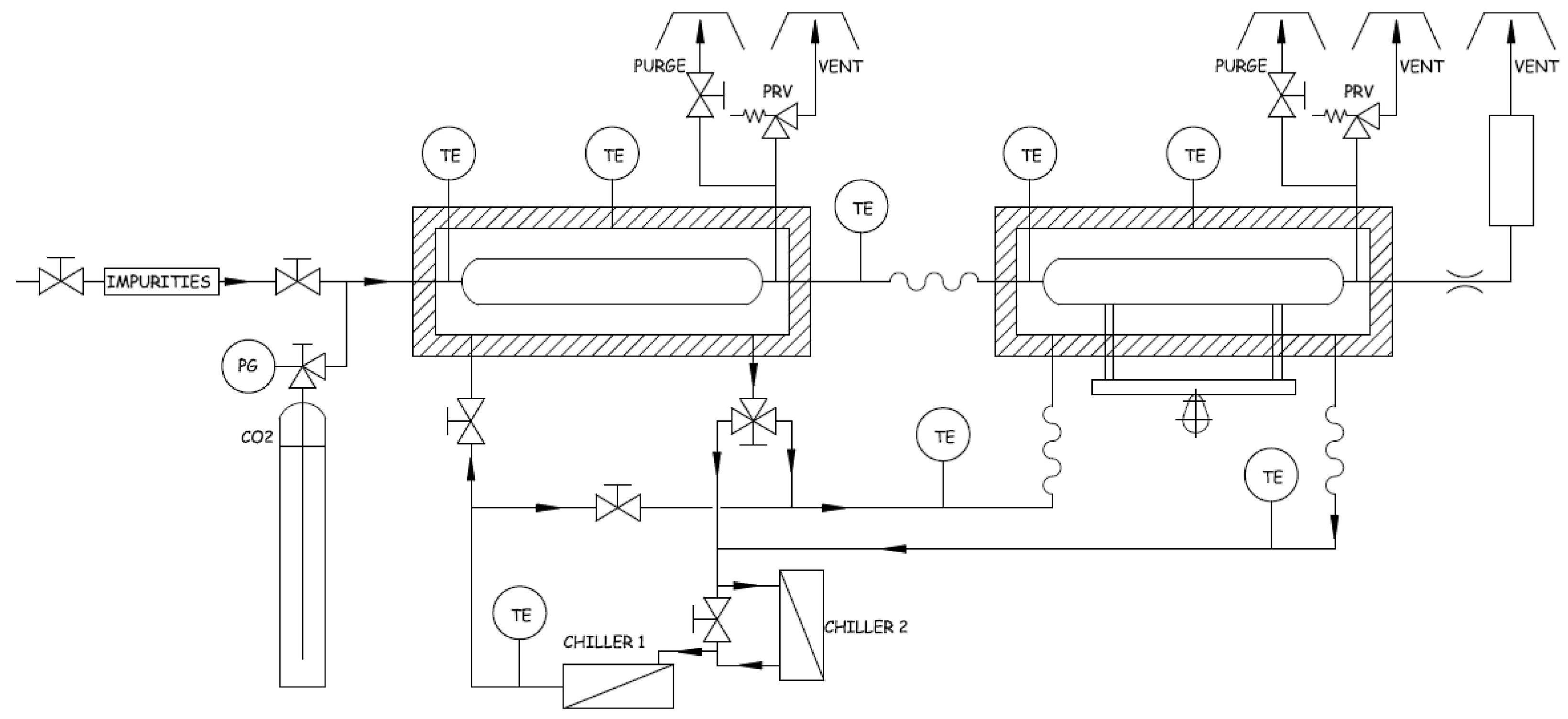
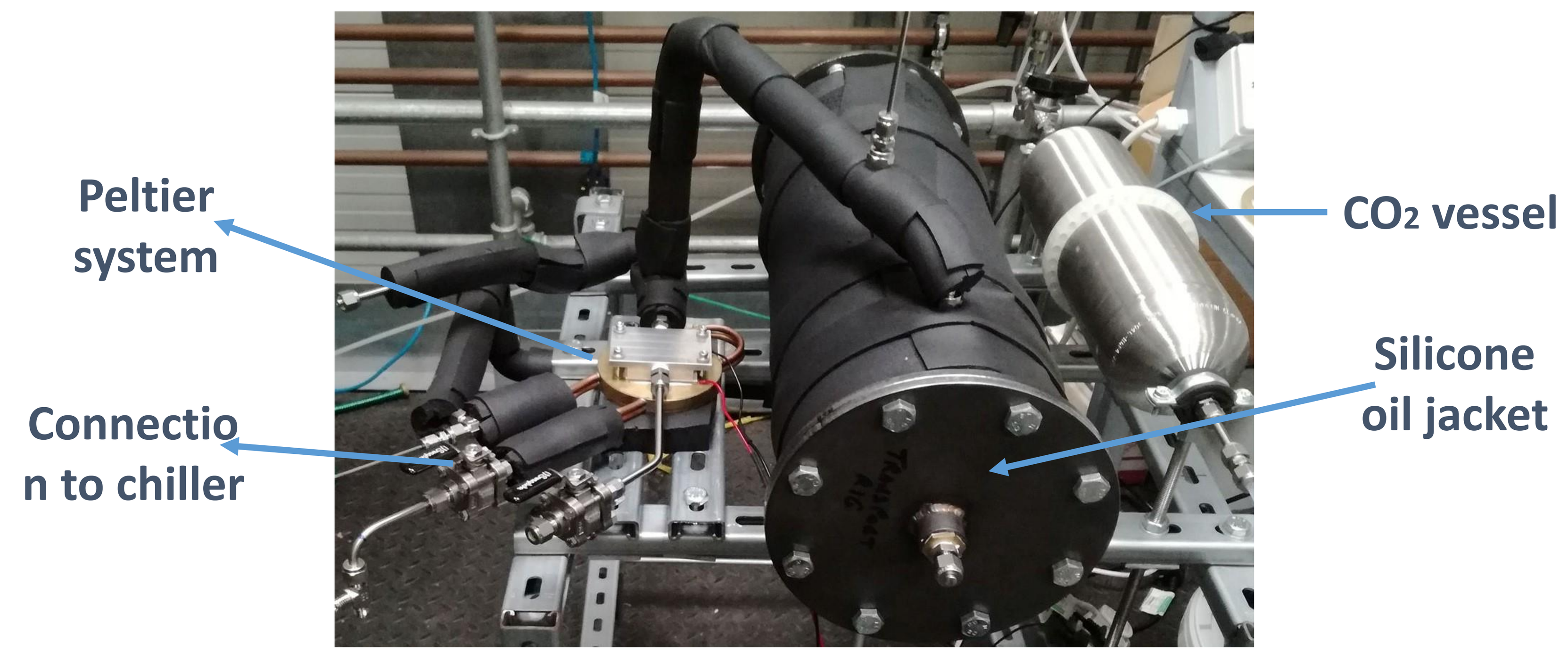


Figure 4: Schematic representation and picture of the CO_2 shipping experimental UKCCSRC Pact facility at Cranfield University

The experimental facility is designed to operate at 0.7-1.0 MPa and -47 °C using a chiller with circulator run on silicone oil



Results

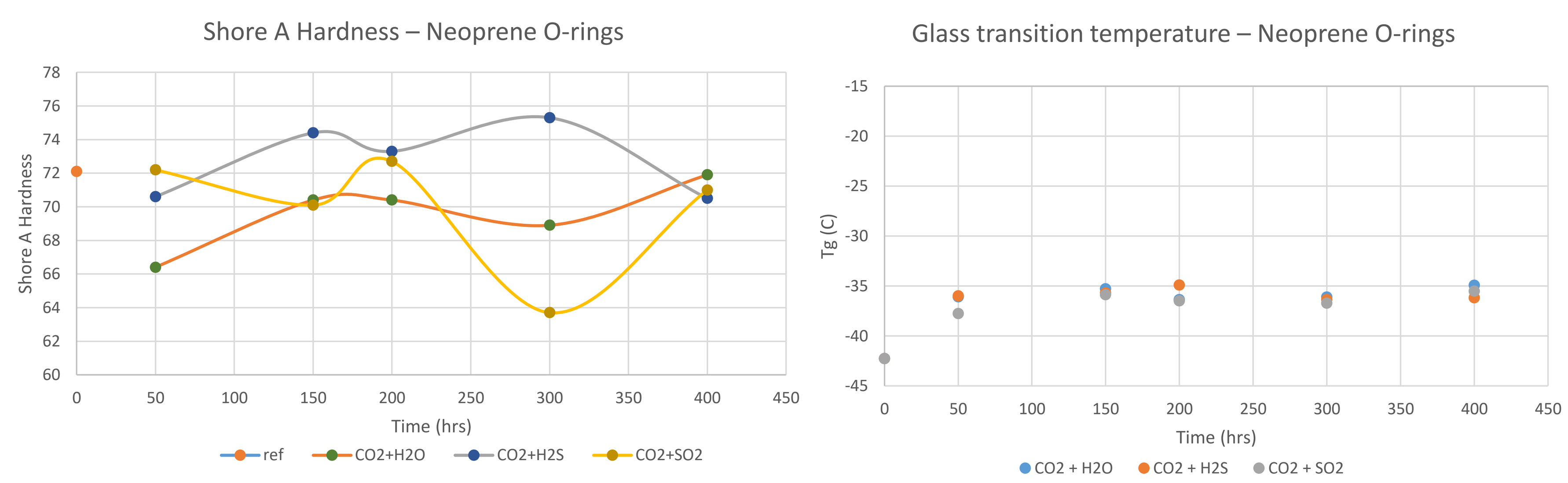


Figure 5: Results on Neoprene seals exposed to 45°C, 95bar CO_2.

Shift in glass transition temperature indicates that the exposure has altered the chemical groups of the material and therefore its properties. Change of Shore A hardness is hereby consistent with previous mass change measurement thus showing that absorption/desorption of fluid directly impact hardness of elastomers.

Conclusions

- Experimental procedures will provide a fundamental understanding of the mechanisms leading to boil-off gas and the effect of impurities
- Characterization of elastomer seals indicates that Neoprene may be unsuitable in both $scCO_2$ and shipping applications.

References

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Pursell, M. (2012) 'Experimental investigation of high pressure liquid CO2 release', (158), pp. 164–171.

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